

PART 1 - GENERAL

1.1 REFERENCES

- .1 Definitions:
 - .1 HVAC System: complete air duct system from outside air intake/exhaust louvers to farthest air supply/exhaust hood terminal unit and including:
 - .1 Rigid supply and return ductwork;
 - .2 Flexible ductwork;
 - .3 Mixing plenum boxes;
 - .4 Diffusers, registers and terminal units;
 - .5 Dampers and controls;
 - .6 Kitchen exhaust ducting.
 - .2 Reference Standards:
 - .1 National Air Duct Cleaners Association (NADCA)
 - .1 ACR Standard: Assessment, Cleaning and Restoration of HVAC Systems.
 - .2 North American Insulation Manufacturers Association (NAIMA)
 - .1 Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.

1.2 ADMINISTRATIVE
REQUIREMENTS

- .1 Site Evaluation: conduct site visit 2 weeks before start of work to establish specific co-ordinated video survey and cleaning plan to establish specific co-ordinated video survey and cleaning plan determining how areas of facility and HVAC systems will be protected during cleaning operations.
 - .1 Organize and lay out plan for video survey and identify camera and cleaning apparatus insertion points.
 - .2 Ensure plan identifies sequence and schedule of survey and cleaning operations for each individual HVAC system and for complete facility.
 - .1 Take account of elbows, bends, turning vanes, dampers, transitions, take-offs, and other internal features.

- 1.2 ADMINISTRATIVE .1 (Cont'd)
REQUIREMENTS .3 Departmental Representative to review
(Cont'd) video survey and cleaning plan 1 week minimum
prior to start of work.
- .1 Proceed with survey and cleaning work only after receiving written approval from Departmental Representative.
 - .2 Scheduling: Hours of Operation: complete work during non-business hours as follows:
 - .1 Monday to Thursday between 18:00 hours and 07:00 hours.
 - .2 Friday from 18:00hours to Monday at 07:00 hours.
 - .3 Hours of operation are subject to change with 12 hours notice.
 - .3 Project Co-ordination: assign Project Co-ordinator to oversee air duct cleaning processes.
 - .1 Provide Departmental Representative with contact information of Project Co-ordinator including: name, telephone number, cell phone number.
 - .4 Security: Departmental Representative will pay costs and provide security escort at times requested on Contractor's submitted work schedule.
 - .1 Cancellation of security escort requires 72 hours minimum written notice.
 - .2 Failure to cancel security escort requirements 72 hours minimum before scheduled event will result in Contractor paying for security costs.
 - .5 Damaged or broken equipment and components found during initial testing and inspection will be repaired or replaced by Departmental Representative.
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- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit video survey and cleaning plan developed during site evaluation.
 - .1 Ensure plan includes sequence of operation, identification of camera and cleaning apparatus insertion points and schedule for work.
 - .3 Product Data:
 - .1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.
 - .2 Provide two copies of WHMIS and MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements for antimicrobial agents or coatings.
- 1.4 CLOSEOUT SUBMITTALS
- .1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Post Cleaning Inspection Report: submit 4 copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:
 - .1 Name and address of facility;
 - .2 Name and address of HVAC cleaning contractor;
 - .3 Description of HVAC systems with drawings identifying systems cleaned;
 - .4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
 - .5 Identification of points where samples were collected and type of analysis used for each collection;
 - .6 Comments complete with photographs of other observed system features;
 - .7 Identify systems tested, observations, actions taken and recommendations for future maintenance.
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- 2.1 ACCESS DOORS AND PANELS (Cont'd) .2 Ductwork Access Doors:(Cont'd)
.2 Access door size 200mm x 200 mm minimum.
.3 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure 3 screws per side minimum.
- 2.2 SYSTEM FILTERS .1 Supply and install new filters for each HVAC System cleaned.
- 2.3 AIR DUCT CLEANING EQUIPMENT .1 Manually propelled full contact brushes:
.1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.
.1 Ensure brushes are sized to fit various duct sizes in HVAC and kitchen exhaust systems.
.2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.
- 2.4 MULTI-FUNCTIONAL ROBOTIC CLEANING SYSTEM .1 Self-propelled remote controlled, wheeled drive equipped with: camera halogen lights: rotating reciprocating brushes, air supply nozzle, vacuum and spraying system attachment.
.1 Ensure brushes are specifically manufactured and shaped to fit individual ducts equipment and components of HVAC system.
.2 Ensure brushes make scrubbing motion and full contact with HVAC and kitchen exhaust systems interior surfaces.
.3 Replace worn and ineffective brushes when required.
- .2 Camera: fully rotational or pivotal remote control focus and dustproof digital with 480 lines of resolution, capable of storing 4 hours of recorded media.
.1 Camera Light: 2 x 20 watt Halogen with dimmer or equal.
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2.5 HEPA FILTER
EVACUATION FAN .1 Evacuation Fan: includes fan, HEPA filter,
flexible hose and motor capable of maintaining
debris and particulates airborne in airstream
until they reach evacuation fan and
maintaining system under negative pressure.
.1 Ensure HEPA filters are clean and
maintain evacuation fan and HEPA filter to run
efficiently.

2.6 HEPA VACUUM
UNIT .1 Vacuum Unit: includes vacuum fan, integral
HEPA filter, suction hose and vacuum head,
capable of maintaining HVAC System debris and
particulates airborne in air stream until they
reach vacuum unit and maintaining system under
negative pressure.
.1 Ensure HEPA filters are clean and
maintain vacuum unit and HEPA filter to run
efficiently.

PART 3 - EXECUTION

3.1 PREPARATION .1 Close down HVAC system and kitchen exhaust.
.2 Locate and identify externally visible HVAC
system features which may affect cleaning
process including:
.1 Control devices;
.2 Fire and smoke control dampers;
.3 Balancing dampers: indicate and record
positions for resetting;
.4 Air volume control boxes: indicate and
record positions for resetting;
.5 Fire alarm devices;
.6 Monitoring devices and controls;
.3 Cut openings in equipment panels and ductwork
for access to system interior.
.1 Square or rectangular opening sizes: 200
mm minimum each side.
.2 Circular opening sizes: 200 mm minimum
diameter.

3.1 PREPARATION
(Cont'd)

- .4 Installation of Access Doors and Panels:
install access doors and panels for equipment
to facilitate system inspection and cleaning.
 - .1 Install access doors and panels for
inspection and cleaning of equipment as
follows:
 - .1 Fan units;
 - .2 Filters;
 - .3 Dampers;
 - .4 Sensors;
- .5 Installation of Access Doors in Ductwork:
install access doors in ductwork to facilitate
system inspection and cleaning.
 - .1 Access door installation is not
permitted in flexible ductwork.
 - .1 Inspect flexible ductwork only by
disconnecting from main duct and
inspecting from open end.
- .6 When acoustically lined duct is cut for
access, repair cut edges of acoustic lining
using self-adhesive fibre glass tape and water
based duct sealer.
 - .1 Adhere new acoustic lining to match
existing to inside of access panel or door to
ensure continuity of acoustic properties of
system.
- .7 Remove and reinstall ceiling to gain access
to HVAC system as required.
 - .1 Replace ceiling damaged or soiled by air
duct cleaning procedures.

3.2 EXAMINATION /
PRE-CLEANING
INSPECTION

- .1 Verification of Conditions:
 - .1 Make visual inspection of interior of
HVAC and kitchen exhaust systems using remote
controlled robotic camera.
 - .2 Insert camera at pre-established
strategic locations to evaluate condition and
cleanliness of HVAC and kitchen exhaust
systems and components.
- .2 Evaluation and Assessment:
 - .1 Identify location and type of internal
components.

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- 3.2 EXAMINATION / .2 Evaluation and Assessment: (Cont'd)
PRE-CLEANING .2 Identify extent of potential problems.
INSPECTION .3 If toxic or hazardous materials or
(Cont'd) deposits are suspected after initial
inspection immediately stop work and inform
Departmental Representative.
.1 Do not proceed further with
inspection operations until written
approval from Departmental
Representative.
- 3.3 DUCT CLEANING .1 Do duct cleaning in accordance with NADCA ACR
Standard.
.2 Isolate and clean sections in zones to ensure
that dirt deposits and debris from zone being
cleaned does not pass through another zones
which has already been cleaned.
.1 Isolate zone of duct using closed-cell
polyurethane foam air inflated zone bag before
cleaning.
.3 Ensure vacuum units and evacuation fans are
securely in place before starting cleaning
operation of isolated section of HVAC air duct
system.
.4 Install HEPA filter evacuation fan at one end
of zone section and insert full contact
brushes at other end.
.5 Clean HVAC supply air duct system and
components where particulate sample collected
from surfaces is greater than 75 mg of
particulate per 0.01 square metres.
.6 Clean exhaust, return, transfer ductwork and
plenums, equipment and components where
particulate sample collected from surfaces is
greater than 75 mg of particulate per 0.01
square metres.
.7 Energize brushes to travel from insertion
point to HEPA filter evacuation fan.
.1 Pass brushes through sections as often
as necessary to achieve required cleanliness.
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- 3.3 DUCT CLEANING .7 (Cont'd)
(Cont'd)
- .2 Change brush sizes as required to ensure positive contact with duct and component interiors.
 - .3 Clean corners and pockets where dirt and debris can accumulate.
 - .8 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC and kitchen exhaust air duct system.
 - .9 Clean diffusers, registers, louvers, and other terminal units.
 - .10 Advise Departmental Representative 72 hours minimum before deactivation of fire alarm and smoke detectors duct cleaning operations.
 - .1 Departmental Representative will pay for costs of deactivation of fire alarm and smoke detector system.
- 3.4 ACOUSTICALLY .1 Clean glass fibre acoustically insulated
LINED DUCTWORK
CLEANING
- .1 Use specifically designed robotic apparatus that has been demonstrated not to damage acoustic glass fibre lining.
 - .2 Monitor cleaning process progress by onboard camera.
- 3.5 FIELD QUALITY .1 Post Cleaning Inspection: carry out final
CONTROL/FINAL
INSPECTIONS
- .1 Carry out video survey as directed by Departmental Representative.
 - .2 Include in final survey areas inspected by Departmental Representative prior to cleaning.
 - .3 Identify on HVAC system record drawings access points used for inspection and cleaning.
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3.5 FIELD QUALITY .1 (Cont'd)
CONTROL/FINAL .4 Reset components including dampers and
INSPECTIONS sensors, which have been disturbed during
(Cont'd) cleaning operations.

3.6 SYSTEM STARTUP .1 Install new system filters after cleaning
operations are completed.
.2 Cover each inspection opening with access
door or panel and secure in place after
inspection and cleaning are completed.
.3 Restart each cleaned system.

3.7 CLEANING .1 Clean in accordance with Section 01 74 11 -
Cleaning.
.2 Waste Management: separate waste materials
for reuse and recycling.

PART 1 - GENERAL

- 1.1 REFERENCES .1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.181-Latest Edition,
Ready-Mixed Organic Zinc-Rich Coating.
- .2 National Fire Code of Canada.
- 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.
- 1.3 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in
accordance with Section 01 61 00 - Common
Product Requirements and with manufacturer's
written instructions.
- .2 Delivery and Acceptance Requirements:
.1 Deliver materials to site in original
factory packaging, labelled with
manufacturer's name, address.

PART 2 - PRODUCTS

- 2.1 MATERIAL .1 Paint: zinc-rich to CAN/CGSB-1.181.
.1 Primers Paints Coating: in accordance
with manufacturer's recommendations for
surface conditions.
.2 Primer: maximum VOC limit to Standard
GS-11.
.3 Paints: maximum VOC limit to Standard
GS-11.
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- 2.1 MATERIAL (Cont'd)
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Sealants: maximum VOC limit to SCAQMD Rule 1168 to GSES GS-36.
 - .3 Sealants: maximum VOC limit to GSES GS-36.
 - .4 Adhesives: maximum VOC limit to GSES GS-36.
 - .5 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

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.
- 3.3 CLEARANCES
- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada.
 - .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer and as indicated without

3.6 PIPEWORK
INSTALLATION
(Cont'd)

- .5 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .6 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .7 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .8 Group piping wherever possible and as indicated.
- .9 Ream pipes, remove scale and other foreign material before assembly.
- .10 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .11 Provide for thermal expansion as indicated.
- .12 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 chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.

3.7 SLEEVES

- .1 General: install where pipes pass through masonry, concrete structures, fire rated assemblies, and as indicated.
- .2 Material: schedule 40 black steel pipe.
- .3 Construction: use annular fins continuously welded at mid-point at foundation walls and where sleeves extend above finished floors.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

3.7 SLEEVES
(Cont'd)

- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere:
 - .1 Provide space for firestopping.
 - .2 Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: one piece type with set screws.
 - .1 Chrome or nickel plated brass or type 302 stainless steel..
- .3 Sizes: outside diameter to cover opening or sleeve.
 - .1 Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION
FOR FIRE STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.

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- 3.9 PREPARATION FOR FIRE STOPPING
(Cont'd)
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.
- 3.10 FLUSHING OUT OF PIPING SYSTEMS
- .1 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 11 - Cleaning supplemented as specified in relevant mechanical sections.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.
- 3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK
- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .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.
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3.11 PRESSURE
TESTING OF
EQUIPMENT AND
PIPEWORK
(Cont'd)

- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.12 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.

3.13 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-Latest Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
 - .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
 - .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .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 motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
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1.3 QUALITY ASSURANCE .1 Regulatory Requirements: work to be performed in compliance with applicable Provincial /Territorial regulations.

.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE, AND HANDLING .1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

PART 2 - PRODUCTS

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

2.2 MOTORS .1 Provide motors for mechanical equipment as specified.

.2 Motors under 373 W: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.

.3 Motors 373 W and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 600 V, unless otherwise indicated.

- 2.3 TEMPORARY MOTORS .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.
- 2.4 BELT DRIVES .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.
- 2.5 DRIVE GUARDS .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
.1 Expanded metal screen welded to steel frame.
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- 2.5 DRIVE GUARDS (Cont'd) .2 (Cont'd)
- .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension. -
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.
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- 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.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B31.1-16, Power Piping.
 - .2 ASTM International
 - .1 ASTM A 125, Standard Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563, Standard Specification for Carbon and Alloy Steel Nuts.
 - .3 Factory Mutual (FM)
 - .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 MSS SP 69, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.
 - .5 Underwriter's Laboratories of Canada (ULC)
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
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PART 2 - PRODUCTS

- 2.1 SYSTEM DESCRIPTION .1 Design Requirements:
- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .3 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.
- 2.2 GENERAL .1 Fabricate hangers, supports and sway braces in accordance with MSS SP 58. ANSI B31.1 and
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.
- 2.3 PIPE HANGERS .1 Finishes:
- .1 Pipe hangers and supports: galvanized or painted with zinc-rich paint after manufacture.
 - .2 Ensure steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
- .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 9 mm UL listed.
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2.6 EQUIPMENT SUPPORTS .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES .1 Provide templates to ensure accurate location of anchor bolts.

2.8 HOUSE-KEEPING PADS .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.

2.9 OTHER EQUIPMENT SUPPORTS .1 Fabricate equipment supports from structural grade steel.
.2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

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

3.2 INSTALLATION .1 Install in accordance with:
.1 Manufacturer's instructions and recommendations.
.2 Vibration Control Devices:
.1 Install on piping systems at pumps, boilers, chillers, cooling towers, refrigeration lines, and as indicated.

- 3.2 INSTALLATION (Cont'd) .3 Clamps on riser piping:
- .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

- 3.3 HANGER SPACING .1 Plumbing piping: to Canadian Plumbing Code, 0. Provincial Code authority having jurisdiction.
- .2 Copper piping: up to NPS 1/2: every 1.5 m.
- .3 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .4 Within 300 mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m

- .5 Pipework greater than NPS 12: to MSS SP 69.

- 3.4 HANGER INSTALLATION .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
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- 3.4 HANGER
INSTALLATION
(Cont'd) .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- 3.5 HORIZONTAL
MOVEMENT .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.
- 3.6 FINAL
ADJUSTMENT .1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.
- .2 Adjustable clevis:
- .1 Tighten hanger load nut securely to ensure proper hanger performance.
- .2 Tighten upper nut after adjustment.
- .3 C-clamps:
- .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
- .1 Hammer jaw firmly against underside of beam.
- 3.7 CLEANING .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling.

PART 1 - GENERAL

- 1.1 REFERENCES .1 Canadian Gas Association (CGA)
- .2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
.2 CAN/CGSB-24.3, Identification of Piping Systems.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
.2 Samples to include nameplates, labels, tags, lists of proposed legends.
- 1.3 QUALITY ASSURANCE .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- 1.4 DELIVERY, STORAGE, AND HANDLING .1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
-

1.4 DELIVERY, STORAGE, AND HANDLING
(Cont'd)
PART 2 - PRODUCTS

.2 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:
.1 Equipment: manufacturer's name, model, size, serial number, capacity.
.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours: .1 Hazardous: red letters, white background.
.1 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:
.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:
.1 Conform to following table:

Size #	mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1		10 x 50	1	3
2		13 x 75	1	5
3		13 x 75	2	3
4		20 x 100	1	8
5		20 x 100	2	5
6		20 x 200	1	8
7		25 x 125	1	12
8		25 x 125	2	8

2.2 SYSTEM
NAMEPLATES
(Cont'd)

- .3 Sizes:(Cont'd)
 - .1 Conform to following table:(Cont'd)

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.
- .4 Identification for PWGSC Preventive Maintenance Support System (PMSS):
 - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
 - .2 Equipment in Mechanical Room:
 - .1 Main identifier: size #9.
 - .2 Source and Destination identifiers: size #6.
 - .3 Terminal cabinets, control panels: size #5.
 - .3 Equipment elsewhere: sizes as appropriate.

2.3 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
 - .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
-

2.4 IDENTIFICATION .3
OF PIPING SYSTEMS
(Cont'd)

- Legend:
.1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
.3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
.1 To full circumference of pipe or insulation.
.2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
.2 Other pipes: pressure sensitive plastic-coated cloth vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
.1 Where not listed, obtain direction from Departmental Representative.
.2 Colours for legends, arrows: to following table:

<u>Background colour:</u>	<u>Legend, arrows:</u>
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

2.4 IDENTIFICATION OF PIPING SYSTEMS (Cont'd) .7 Colours and Legends: (Cont'd)
.3 (Cont'd)

Contents	Background colour marking	Legend
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS

2.5 IDENTIFICATION DUCTWORK SYSTEMS .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
.2 Colours: back, or co-ordinated with base colour to ensure strong contrast.
.3 Identify System: eg. Supply MUA-1; Exhaust EF-1.

2.6 VALVES, CONTROLLERS .1 Brass tags with 12 mm stamped identification data filled with black paint.
.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROLS COMPONENTS IDENTIFICATION .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 LANGUAGE .1 Identification in English.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PWGSC PMSS.
- 3.3 NAMEPLATES .1 Locations:
- .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
- .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
- .1 Do not paint, insulate or cover.
- 3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
-

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- 3.6 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.

PART 1 - GENERAL

- 1.1 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.
 - .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.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-Latest Edition.
 - .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.
-

- 1.1 QUALIFICATIONS OF TAB PERSONNEL (Cont'd) .8
- (Cont'd) .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.
- 1.2 PURPOSE OF TAB .1
- .2 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.
- 1.3 EXCEPTIONS .1
- TAB of systems and equipment regulated by codes, standards to satisfaction of authority having jurisdiction.
- 1.4 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.
-

- 1.5 PRE-TAB REVIEW .1 Review contract documents before project construction is started and 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.

- 1.6 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.

- 1.7 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, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
-

-
- 1.8 START OF TAB (Cont'd) .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
- .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
- 1.9 APPLICATION TOLERANCES .1 Do TAB to following tolerances of design values:
- .1 HVAC systems: plus 5 %, minus 5 %.
- 1.10 ACCURACY TOLERANCES .1 Measured values accurate to within plus or minus 2% of actual values.
- 1.11 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 3 months of TAB. Provide certificate of calibration to Departmental Representative.
-

- 1.12 ACTION AND INFORMATIONAL SUBMITTAL
- .1 Submit, prior to commencement of TAB:
 - .2 Proposed methodology and procedures for performing TAB if different from referenced standard.
- 1.13 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.
- 1.14 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 3 copies of TAB Report and 1 electronic copy to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.
- 1.15 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.
-

- 1.16 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.
- 1.17 COMPLETION OF TAB .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.
- 1.18 AIR SYSTEMS .1 Standard: TAB to most stringent of this section or TAB standards of NEBB SMACNA.
- .2 Do TAB of systems, equipment, components, controls specified Division 23 following systems, equipment, components, controls:
.1 Rooftop exhaust fan (EF-1).
.2 Makeup Air Unit (MUA-1).
- .3 Qualifications: personnel performing TAB current member in good standing of NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified by 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 Inlet and outlet of dampers, filter, coil, fan, other equipment causing changes in conditions.
.2 At controllers, controlled device.
-

- 1.18 AIR SYSTEMS .7 Locations of systems measurements to include
(Cont'd) as appropriate: main ducts, main branch,
sub-branch, run-out (or grille, register or
diffuser), areas where two unit air streams
combine.
- 1.19 OTHER TAB .1 General requirements applicable to work
REQUIREMENTS specified this paragraph:
.1 Qualifications of TAB personnel: as for
air systems specified this section.
.2 Quality assurance: as for air systems
specified this section.
- .2 Smoke management systems:
.1 Test for proper operation of all smoke
and fire dampers, sensors, detectors, installed
as component parts of air systems specified
Division 23.
- 1.20 POST-OCCUPANCY .1 Measure DBT, WBT (or %RH), air velocity in
TAB occupied zone of following areas: kitchen.

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 REFERENCES .1 Definitions:
- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
 - .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.
- .2 Reference Standards:
- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ASTM International Inc.
 - .1 ASTM B 209M, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C 335, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449/C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 547, Standard Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
-

- 1.1 REFERENCES (Cont'd)
- .2 Reference Standards: (Cont'd)
- .2 (Cont'd)
- .7 ASTM C 612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- .8 ASTM C 921, Standard Practice for Determining the Properties of Jacketing Materials for 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 Green Seal Environmental Standards (GSES)
- .1 Standard GS-36, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State
- .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.
- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .7 Underwriters Laboratories of Canada (ULC)
- .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
- .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
- .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
- .2 Details of operation, servicing and maintenance.
- .3 Recommended spare parts list.
-

PART 2 - PRODUCTS

- 2.1 FIRE AND SMOKE RATING .1 To CAN/ULC-S102:
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.
- 2.2 INSULATION .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
.2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
.3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, will 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 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 C 553.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to ASTM C 553.
- 2.3 JACKETS .1 Canvas:
.1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
.2 Lagging adhesive: compatible with insulation.
.3 Aluminum:
.1 To ASTM B 209 with and without moisture barrier as scheduled in PART 3 of this section.
.2 Thickness: 0.50 mm sheet.
.3 Finish: Smooth.
-

2.3 JACKETS
(Cont'd)

- .3 Aluminum: (Cont'd)
- .4 Jacket banding and mechanical seals: 12
19 mm wide, 0.5 mm thick stainless steel.
 - .1 Stainless steel:
 - .5 Type: 316.
 - .6 Thickness: 0.25 0.50 mm sheet.
 - .7 Finish: Smooth.

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.
- .3 Insulating Cement: hydraulic setting on
mineral wool, to ASTM C 449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated
with dilute fire retardant lagging adhesive to
ASTM C 921 untreated.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic, compatible
with insulation.
 - .2 Reinforcing fabric: Fibrous glass,
untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, reinforced, 50
75 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
 - .1 Maximum VOC limit 50 200 250 g/L to
SCAQMD Rule 1168 GSES GS-36.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless
steel.

- 2.4 ACCESSORIES
(Cont'd)
- .11 Facing: 25 mm stainless or galvanized steel hexagonal wire mesh stitched on one face of insulation.
 - .12 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

PART 3 - EXECUTION

- 3.1 APPLICATION
- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

- 3.2 PRE-
INSTALLATION
REQUIREMENTS
- .1 Pressure test ductwork systems complete, witness and certify.
 - .2 Ensure surfaces are clean, dry, free from
 - .2 Ensure surfaces are clean, dry, free from foreign material.

- 3.3 INSTALLATION
- .1 Install in accordance with TIAC National Standards.
 - .2 Apply materials in accordance with manufacturers instructions and as indicated.
 - .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
 - .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Ensure hangers, and supports are outside vapour retarder jacket.
-

- 3.3 INSTALLATION (Cont'd) .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE .1 Insulation types and thicknesses: conform to following table:

Duct Type	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular Cold and Dual Temperature Supply Air Ducts	C-1	Yes	50
Rectangular Warm Air Ducts	C-1	No	25
Supply, Return and Exhaust Ducts Exposed in Space being Served	C-1	Yes	25
Outside Air Ducts to Mixing Plenum	C-1	Yes	25
Mixing Plenums	C-1	Yes	25
Exhaust Duct between Dampers and Louvres	C-1	No	25

3.4 DUCTWORK .1 (Cont'd)
INSULATION SCHEDULE
(Cont'd)

- .2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:
.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.
.1 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

- 3.5 CLEANING .1 Clean in accordance with Section 01 74 11 - Cleaning.
.1 Remove surplus materials, excess materials, rubbish, tools and equipment.
.2 Waste Management: separate waste materials for reuse and recycling.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-Latest Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
 - .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 335-Latest Edition, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C 411-Latest Edition, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .3 ASTM C 449/C 449M-Latest Edition, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C 533-Latest Edition, Calcium Silicate Block and Pipe Thermal Insulation.
 - .5 ASTM C 547-Latest Edition, Mineral Fiber Pipe Insulation.
 - .6 ASTM C 795-Latest Edition, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .7 ASTM C 921-Latest Edition, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-Latest Edition, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-Latest Edition, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
 - .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA).
 - .2 Canadian Environmental Protection Act (CEPA).
-

- 1.1 REFERENCES (Cont'd)
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Latest Edition).
 - .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-Latest Edition, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-Latest Edition, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-Latest Edition, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-Latest Edition, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.
- 1.2 DEFINITIONS
- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
 - .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.
- 1.3 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit one copy of Workplace Hazardous Materials Information System
-

1.3 ACTION AND
INFORMATIONAL
SUBMITTALS
(Cont'd)

- .2 Product Data: (Cont'd)
 - .1 (Cont'd)
 - .1 (Cont'd)
(WHMIS) Material Safety Data Sheets
(MSDS) in accordance with Section
01 33 00 - Submittal Procedures.
 - .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with
Section 01 33 00 - Submittal Procedures.
 - .1 Shop drawings: submit drawings
stamped and signed by professional
engineer registered or licensed in
Province of Newfoundland and Labrador,
Canada.
 - .4 Samples:
 - .1 Submit samples in accordance with
Section 01 33 00 - Submittal Procedures.
 - .2 Submit for approval: complete assembly
of each type of insulation system, insulation,
coating, and adhesive proposed. Mount sample
on 12 mm plywood board. Affix label beneath
sample indicating service.
 - .5 Quality assurance submittals: submit
following in accordance with Section 01 33 00
- Submittal Procedures.
 - .1 Certificates: submit certificates signed
by manufacturer certifying that materials
comply with specified performance
characteristics and physical properties.
 - .2 Instructions: submit manufacturer's
installation instructions.
 - .1 Departmental Representative will
make available 1 copy of systems
supplier's installation instructions.

1.4 QUALITY
ASSURANCE

- .1 Qualifications:
 - .2 Installer: specialist in performing work of
this Section, and have at least 3 years
successful experience in this size and type of
project, qualified to standards or member of
TIAC.
-

1.4 QUALITY ASSURANCE
(Cont'd)

.3 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
.3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Storage and Protection:
.1 Protect from weather, construction traffic.
.2 Protect against damage.
.3 Store at temperatures and conditions required by manufacturer.

.3 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.
.2 Place excess or unused insulation and insulation accessory materials in designated containers.
.3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.

PART 2 - PRODUCTS

- 2.1 FIRE AND SMOKE RATING .1 In accordance with CAN/ULC-S102.
.1 Maximum flame spread rating: 25.
.2 Maximum smoke developed rating: 50.
- 2.2 INSULATION .1 Mineral fibre specified includes glass fibre,
rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to
exceed specified values at 24 degrees C mean
temperature when tested in accordance with
ASTM C 335.
- .3 TIAC Code A-1: rigid moulded mineral fibre
without factory applied vapour retarder
jacket.
.1 Mineral fibre: to CAN/ULC-S702 and
ASTM C 547.
.2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre
with factory applied vapour retarder jacket.
.1 Mineral fibre: to CAN/ULC-S702 and
ASTM C 547.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702 and
ASTM C 547.
- .5 TIAC Code C-2: mineral fibre blanket faced
[with] [without] factory applied vapour
retarder jacket (as scheduled in PART 3 of
this section).
.1 Mineral fibre: to CAN/ULC-S702 and
ASTM C 547.
.2 Jacket: to CGSB 51-GP-52Ma.
.3 Maximum "k" factor: to CAN/ULC-S702 and
ASTM C 547.
- .6 TIAC Code A-6: flexible unicellular tubular
elastomer.
.1 Jacket: to CGSB 51-GP-52Ma.
.2 Maximum "k" factor: CAN/ULC.
-

- 2.2 INSULATION (Cont'd) .6 TIAC Code A-6: (Cont'd)
.3 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
- 2.3 INSULATION SECUREMENT .1 Tape: self-adhesive, aluminum, [plain] [reinforced], 50 mm wide minimum.
.2 Contact adhesive: quick setting.
.3 Canvas adhesive: washable.
.4 Tie wire: 1.5 mm diameter stainless steel.
.5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.
- 2.4 CEMENT .1 Thermal insulating and finishing cement:
.1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449/C 449M.
- 2.5 VAPOUR RETARDER LAP ADHESIVE .1 Water based, fire retardant type, compatible with insulation.
- 2.6 INDOOR VAPOUR RETARDER FINISH .1 Vinyl emulsion type acrylic, compatible with insulation.
- 2.7 OUTDOOR VAPOUR RETARDER FINISH .1 Vinyl emulsion type acrylic, compatible with insulation.
.2 Reinforcing fabric: fibrous glass, untreated 305 g/m².
-

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint by Departmental Representative.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .7 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .2 ABS Plastic:
 - .1 One-piece moulded type and sheet with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint.
 - .3 Minimum service temperatures: -40 degrees C.
 - .4 Maximum service temperature: 82 degrees C.
 - .5 Moisture vapour transmission: 0.012 perm.
 - .6 Thickness: 0.75 mm.
 - .7 Fastenings:
 - .1 Solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Locations:
 - .1 For outdoor use ONLY.
- .3 Canvas:
 - .1 220 and 120 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: compatible with insulation.

- 2.8 JACKETS (Cont'd) .4 Aluminum:
- .1 To ASTM B 209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: smooth.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- .5 Stainless steel:
- .1 Type: 304.
 - .2 Thickness: 0.25 mm.
 - .3 Finish: smooth.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.
- 2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS .1 Caulking to: Section 07 92 00 - Joint Sealants.

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 PRE-INSTALLATION REQUIREMENT .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
-

- 3.1 MANUFACTURER'S INSTRUCTIONS
(Cont'd)
- .1 Surfaces clean, dry, free from foreign material.
- 3.3 INSTALLATION
- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
.1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- 3.4 INSTALLATION OF ELASTOMERIC INSULATION
- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.
- 3.5 PIPING INSULATION SCHEDULES
- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
.1 Securements: [SS [wire] [bands]] [Tape] at 300 mm on centre.
-

- 3.5 PIPING INSULATION SCHEDULES (Cont'd)
- .2 TIAC Code: (Cont'd)
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.

 - .3 TIAC Code: A-3.
 - .1 Securements: [SS [wire] [bands]] [Tape] at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.

 - .4 TIAC Code: A-6.
 - .1 Insulation securements: SS wire bands at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C (Cold) and H (Hot).

 - .5 TIAC Code: C-2 [with] [without] vapour retarder jacket.
 - .1 Insulation securements: [_____].
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.

 - .6 TIAC Code: A-2.
 - .1 Insulation securements: [_____].
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-H.

 - .7 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Applic ation	Temp degrees	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)				
	Run out		to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over

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PART 2 - PRODUCTS

2.1 THERMOSTAT .1 Line voltage, wall-mounted thermostat, for
(LINE heating and cooling control with:
VOLTAGE-HEATING AND .1 Full load rating: 16 A at 120 V.
COOLING) .2 Temperature setting range: 5 degrees C
to 30 degrees C.
.3 Thermometer range: 5 degrees C to 30
degrees C.
.4 Markings in 5 degree increments.
.5 Differential temperature fixed at 1.1
degrees C.

2.2 THERMOSTAT .1 Thermostat guards: lockable, clear plastic.
GUARDS Slots for air circulation to thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION .1 Verification of Conditions: verify that
conditions of substrate previously installed
under other Sections or Contracts are
acceptable for electric and electronic control
systems installation in accordance with
manufacturer's written instructions.
.1 Visually inspect substrate in presence
of Departmental Representative.
.2 Inform Departmental Representative of
unacceptable conditions immediately upon
discovery.
.3 Proceed with installation only after
unacceptable conditions have been remedied and
after receipt of written approval to proceed
from Departmental Representative.

3.2 INSTALLATION .1 Install control devices.
.2 Install remote sensing device and capillary
tube in metallic conduit. Conduit enclosing

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.22-Latest Edition, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
 - .2 ASME B16.24-Latest Edition, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-Latest Edition, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-Latest Edition, Refrigeration Piping and Heat Transfer Components.
 - .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 307-Latest Edition, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B 280-Latest Edition, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - .3 Canadian Standards Association (CSA International)
 - .1 CSA B52-Latest Edition, Mechanical Refrigeration Code.
 - .4 Environment Canada (EC)
 - .1 EPS 1/RA/1-Latest Edition, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.
 - .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
-

- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
-
- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Instructions: submit manufacturer's installation instructions.
 - .6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.3 QUALITY ASSURANCE
-
- .1 Pre-Installation Meeting:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
 - .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
-

PART 2 - PRODUCTS

- 2.1 TUBING .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
.1 Hard copper: to ASTM B 280, type ACR.
.2 Annealed copper: to ASTM B 280, with minimum wall thickness as per CSA B52 and ASME B31.5.
- 2.2 FITTINGS .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
.2 Brazed:
.1 Fittings: wrought copper to ASME B16.22.
.2 Joints: silver solder, AWS BCup-3 5% Ag, 6% P, 88% Cu. copper-phosphorous, AWS BCup-2 93% Cu-7% P and non-corrosive flux.
.3 Flared:
.1 Bronze or brass, for refrigeration, to ASME B16.26.
- 2.3 PIPE SLEEVES .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.
- 2.4 VALVES .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
.2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.
-

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 GENERAL .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05 - Installation of Pipework.
- 3.3 BRAZING PROCEDURES .1 Bleed inert gas into pipe during brazing.
.2 Remove valve internal parts, solenoid valve coils, sight glass.
.3 Do not apply heat near expansion valve and bulb.
- 3.4 PIPING INSTALLATION .1 General:
.1 Hard drawn copper tubing: do not bend. Minimize use of fittings.
.2 Hot gas lines:
.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
.2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
.3 Provide inverted deep trap at top of risers.
.4 Provide double risers for compressors having capacity modulation.
.1 Large riser: install traps as specified.
.2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.
-

3.5 PRESSURE AND
LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52 before evacuation to 2MPa and 1MPa on high and low sides respectively.
- .3 Test Procedure: build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.6 FIELD QUALITY
CONTROL

- .1 Site Tests/Inspection:
 - .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14 Pa absolute and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14 kPa.
 - .3 Final to 5 Pa absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.

PART 1 - GENERAL

- 1.1 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-Latest Edition, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A 635M-Latest Edition, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A 653/A 653M-Latest Edition, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
 - .4 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-Latest Edition, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-Latest Edition, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 96-Latest Edition, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual.
 - .3 IAQ Guideline for Occupied Buildings Under Construction.
-

- 1.1 REFERENCES (Cont'd) .6 Transport Canada (TC).
.1 Transportation of Dangerous Goods Act (TDGA).
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- 1.3 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:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
.3 Indoor Air Quality (IAQ) Management Plan.
.1 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.
- 1.4 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.
.2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
-

PART 2 - PRODUCTS

- 2.1 SEAL CLASSIFICATION .1 Classification as follows:
500 C
.2 Seal classification:
.1 Class C: transverse joints and connections made air tight with gaskets sealant tape or combination thereof. Longitudinal seams and joints.
.3 Exhaust ductwork from kitchen to be all welded steel construction to match existing.
- 2.2 SEALANT .1 Tape: polyvinyl treated, open weave fibreglass tape, 50 mm wide.
- 2.3 TAPE .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.
- 2.4 DUCT LEAKAGE .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.
- 2.5 FITTINGS .1 Fabrication: to SMACNA.
.2 Radiused elbows.
.1 Rectangular: Centreline radius: 1.5 times width of duct.
.2 Round: Centreline radius: 1.5 times diameter.
.3 Branches:
.1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45 degrees entry on branch.
.2 Round main and branch: enter main duct at 45 degrees.
-

- 2.5 FITTINGS
(Cont'd)
- .3 Branches: (Cont'd)
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30degrees maximum included angle.
 - .5 Offsets:
 - .1 Short radiused elbows.
 - .6 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.
- 2.6 FIRE STOPPING
- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.
 - .2 Fire stopping material and installation must not distort duct.
- 2.7 GALVANIZED STEEL
- .1 Lock forming quality: to ASTM A 653/A 653M, Z90 zinc coating.
 - .2 Thickness, fabrication and reinforcement: to ASHRAE SMACNA.
 - .3 Joints: to SMACNA.
- 2.8 KITCHEN EXHAUST SYSTEMS
- .1 Construct in accordance with NFPA 96.
 - .2 Material: black steel sheet, all welded.
 - .3 Thickness: not less than 1.37 mm, match existing exhaust duct thickness.
 - .4 Fabrication: as indicated.
-

2.8 KITCHEN EXHAUST SYSTEMS (Cont'd) .5 Reinforcement: in accordance with SMACNA.

2.9 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.

.1 Maximum size duct supported by strap hanger: 500.

.2 Hanger configuration: to SMACNA.

.3 Hangers: black galvanized steel angle with galvanized steel rods to SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp.

.3 For steel beams: manufactured beam clamps:

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do work in accordance with SMACNA 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.
- .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 as follows:

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

3.3 KITCHEN EXHAUST SYSTEMS .1 Install to NFPA 96 and as indicated.

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 LEAKAGE TESTS .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
.2 Do leakage tests in sections.
.3 Make trial leakage tests as instructed to demonstrate workmanship.
.4 Do not install additional ductwork until trial test has been passed.
.5 Complete test before performance insulation or concealment Work.

2.2 FLEXIBLE CONNECTIONS (Cont'd) .2 Material:(Cont'd)
.1 (Cont'd)
rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.3 ACCESS DOORS IN DUCTS .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
.2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
.3 Gaskets: neoprene.
.4 Hardware:
.1 Up to 300 x 300 mm: two sash locks complete with safety chain.
.2 301 to 450 mm: four sash locks complete with safety chain.
.3 451 to 1000 mm: piano hinge and minimum two sash locks.
.4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
.5 Hold open devices.

2.4 TURNING VANES .1 Factory or shop fabricated single thickness with trailing edge, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST .1 1.6 mm thick steel zinc plated after manufacture.
.2 Cam lock handles with neoprene expansion plug and handle chain.
.3 28 mm minimum inside diameter. Length to suit insulation thickness.

2.5 INSTRUMENT TEST .4 Neoprene mounting gasket.
(Cont'd)

2.6 SPIN-IN COLLARS .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
.2 Sheet metal thickness to co-responding round duct standards.

PART 3 - EXECUTION

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

3.2 INSTALLATION .1 Flexible Connections:
.1 Install in following locations:
.1 Inlets and outlets to supply air units and fans.
.2 Inlets and outlets of exhaust and return air fans.
.3 As indicated.
.2 Length of connection: 100mm.
.3 Minimum distance between metal parts when system in operation: 75 mm.
.4 Install in accordance with recommendations of SMACNA.
.5 When fan is running:
.1 Ducting on sides of flexible connection to be in alignment.
.2 Ensure slack material in flexible connection.
.2 Access Doors and Viewing Panels:
.1 Size:
.1 600 x 600 mm for servicing entry.

- 3.2 INSTALLATION .2 Access Doors and Viewing Panels: (Cont'd)
- (Cont'd)
- .2 Locations:
- .1 Fire and smoke dampers.
- .2 Control dampers.
- .3 Devices requiring maintenance.
- .4 Required by code.
- .5 Reheat coils.
- .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
- .1 General:
- .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .2 Locate to permit easy manipulation of instruments.
- .3 Install insulation port extensions as required.
- .4 Locations:
- .1 For traverse readings:
- .1 Ducted inlets to roof and wall exhausters.
- .2 Inlets and outlets of other fan systems.
- .3 Main and sub-main ducts.
- .4 And as indicated.
- .2 For temperature readings:
- .1 At outside air intakes.
- .2 In mixed air applications in locations as approved by Departmental Representative.
- .3 At inlet and outlet of coils.
- .4 Downstream of junctions of two converging air streams of different temperatures.
- .5 And as indicated.
- .4 Turning vanes:
- .1 Install in accordance with recommendations of SMACNA and as indicated.
- 3.3 CLEANING .1 Perform cleaning operations as specified in Section and in accordance with manufacturer's recommendations.
-

PART 1 - GENERAL

- 1.1 REFERENCES .1 Sheet Metal and Air Conditioning National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-Latest Edition.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).
- 1.2 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.
- 1.3 QUALITY ASSURANCE .1 Health and Safety Requirements:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- 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.
-

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Manufacture to SMACNA standards.
- 2.2 SINGLE BLADE DAMPERS .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside bronze end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.
- 2.3 MULTI-BLADED DAMPERS .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: pin in bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage : 5% at 300 Pa.
-

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 dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.
- .7 Corrections and adjustments conducted by Engineer.
- 3.3 FIELD QUALITY CONTROL .1 Tests:
.1 Tests to cover period of not less than 3 days and demonstrate that system is functioning as specified.
- 3.4 CLEANING .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus
-

3.4 CLEANING .2 (Cont'd)
(Cont'd) materials, excess materials, rubbish, tools
and equipment.

PART 1 - GENERAL

- 1.1 REFERENCES .1 ASTM International
.1 ASTM A 653/A 653M-Latest Edition,
Standard Specification for Steel Sheet,
Zinc-Coated (Galvanized) or Zinc-Iron
Alloy-Coated (Galvannealed) by Hot-Dip
Process.
- 1.2 ACTION AND
INFORMATIONAL
SUBMITTALS .1 Submit in accordance with Section 01 33 00 -
Submittal Procedures.
.2 Product Data:
.1 Submit manufacturer's instructions,
printed product literature and data sheets for
dampers and include product characteristics,
performance criteria, physical size, finish
and limitations.
- 1.3 CLOSEOUT
SUBMITTALS .1 Submit in accordance with Section 01 78 00 -
Closeout Submittals.
.2 Operation and Maintenance Data: submit
operation and maintenance data for dampers for
incorporation into manual.
- 1.4 DELIVERY,
STORAGE AND
HANDLING .1 Deliver, store and handle materials in
accordance with Section 01 61 00 - Common
Product Requirements and with manufacturer's
written instructions.
.2 Delivery and Acceptance Requirements: deliver
materials to site in original factory
packaging, labelled with manufacturer's name
and address.
.3 Storage and Handling Requirements:
.1 Store materials indoors in dry location
and in accordance with manufacturer's
-

- 1.4 DELIVERY, STORAGE AND HANDLING (Cont'd)
- .3 Storage and Handling Requirements: (Cont'd)
- .1 (Cont'd) recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

- 2.1 MULTI-LEAF DAMPERS
- .1 Opposed and or parallel blade type as indicated.
 - .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, extruded aluminum frame.
 - .3 Pressure fit self-lubricated bronze bearings.
 - .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
 - .5 Operator: electric actuator compatible with damper. Submit shop drawings for approval.
 - .6 Performance:
 - .1 Leakage: in closed position less than 2% of rated air flow.
 - .2 Pressure drop: at full open position less than 15 Pa differential across damper.
 - .7 Insulated aluminum dampers:
 - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.
-

- 2.2 BACK DRAFT .1 Automatic gravity operated, multi leaf,
DAMPERS aluminum construction with nylon bearings,
centre pivoted, spring assisted or
counterweighted, as indicated.

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify that
conditions of substrate previously installed
under other Sections or Contracts are
acceptable for damper installation in
accordance with manufacturer's written
instructions.
 .1 Inform Departmental Representative of
unacceptable conditions immediately upon
discovery.
 .2 Proceed with installation only after
unacceptable conditions have been remedied and
after receipt of written approval to proceed
from Departmental Representative

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

- 3.3 CLEANING .1 Progress Cleaning: clean in accordance with
Section 01 74 11 - Cleaning.
 .1 Leave Work area clean at end of each
day.
 .2 Final Cleaning: upon completion remove
surplus materials, rubbish, tools and
-

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<u>3.3 CLEANING</u>	.2	Final Cleaning:(Cont'd)
<u>(Cont'd)</u>		equipment in accordance with Section 01 74 11
		- Cleaning.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA).
 - .2 Transportation of Dangerous Goods Act.
 - .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
 - .4 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-Latest Edition, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-Latest Edition, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
 - .5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 - .6 Underwriters' Laboratories Inc. (UL).
 - .1 UL 181-Latest Edition, Standard for Factory-Made Air Ducts and Air Connectors.
 - .7 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S110-Latest Edition, Fire Tests for Air Ducts.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Product Data: submit for the following:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.
 - .2 Samples: submit samples with product data of different types of flexible duct being used in
-

1.2 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd) .2 Samples: (Cont'd) accordance with Section 01 33 00 - Submittal Procedures.

1.3 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 29.06 - Health and Safety Requirements.

1.4 DELIVERY, STORAGE AND HANDLING .1 Protect on site stored or installed absorptive material from moisture damage.

PART 2 - PRODUCTS

2.1 GENERAL .1 Factory fabricated to CAN/ULC-S110.
.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC - INSULATED .1 Type 2: spiral wound flexible aluminum with factory applied, 37 mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl jacket, as indicated.

- 2.2 METALLIC - .2 Performance:
INSULATED .1 Factory tested to 2.5 kPa without
(Cont'd) leakage.
 .2 Maximum relative pressure drop
 coefficient: 3.

PART 3 - EXECUTION

- 3.1 DUCT .1 Install in accordance with:
INSTALLATION CAN/ULC-S110SMACNA.
 .2 Limit length of flexible duct to no more than
 1.5 meters.

PART 1 - GENERAL

- 1.1 REFERENCES .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
- .1 ANSI/AMCA Standard 99-Latest Edition, Standards Handbook.
 - .2 ANSI/AMCA Standard 210-Latest Edition/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300-Latest Edition, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301-Latest Edition, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .2 Provide:
 - .1 Fan performance curves showing point of operation, kW and efficiency.
 - .2 Sound rating data at point of operation.
 - .3 Indicate:
 - .1 Motors, sheaves, bearings and shaft details.
 - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.
-

PART 2 - PRODUCTS

- 2.1 SYSTEM DESCRIPTION .1 Performance Requirements:
- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
 - .2 Capacity: flow rate, total static pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
 - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
 - .4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.
 - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal.
- 2.2 FANS GENERAL .1 Motors:
- .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
 - .2 For use with variable speed controllers.
 - .3 Sizes as indicated.
- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet and or outlet safety screens inlet and outlet dampers and vanes.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Finish on fume hood exhaust fans: aluminum.
-

- 2.2 FANS GENERAL .6 Bearing lubrication systems plus extension
(Cont'd) lubrication tubes where bearings are not
easily accessible.
- .7 Vibration isolation: as indicated.
- .8 Flexible connections: to Section 23 33 00 -
Air Duct Accessories.
-
- 2.3 CENTRIFUGAL .1 Fan wheels:
FANS .1 Welded aluminum construction.
 .2 Maximum operating speed of centrifugal
fans not more than 50% of first critical
speed.
 .3 Air foil forward curved and backward
inclined blades, as indicated.
- .2 Bearings: heavy duty split pillow-block
flange mounted grease lubricated ball or
roller self aligning type with oil retaining,
dust excluding seals and a certified minimum
rated life of 100,000 hours.
- .3 Housings:
 .1 Volute with inlet cones: fabricated
steel for wheels 300 mm or greater, aluminum,
for smaller wheels, braced, and with welded
supports.
 .2 For horizontally and vertically split
housings provide flanges on each section for
bolting together, with gaskets of
non-oxidizing non-flammable material.
 .3 Provide bolted or latched airtight
access doors with handles.
- .4 Variable volume control devices:
 .1 The VFD package as specified herein
shall be completely assembled and tested by
the manufacturer in an ISO9001 facility. The
VFD tolerated voltage window shall allow the
VFD to operate \pm nominal voltage as a minimum.
 .1 Environmental operating conditions:
0 to 40°C continuous duty. VFD's that can
operate at 40° C intermittently (during a
24 hour period) are not acceptable and
must be oversized. Altitude 0 to 1000m
-

2.3 CENTRIFUGAL
FANS
(Cont'd)

- .4 Variable volume control devices:(Cont'd)
- .1 (Cont'd)
 - .1 (Cont'd)
above sea level, less than 95% humidity,
non-condensing.
 - .2 Enclosure shall be type NEMA 1 and
shall be UL listed as a plenum rated VFD.
VFD's without these ratings are not
acceptable.
 - .2 All VFD's shall have the following
standard features:
 - .1 All VFD's shall have the same
customer interface, including digital
display, and keypad, regardless of
horsepower rating.
 - .2 The keypad shall include
Hand-Off-Auto selections and manual speed
control. The drive shall incorporate
"bumpless transfer" of speed reference
when switching between "Hand" and "Auto"
modes. There shall be fault reset and
"Help" buttons on the keypad. The Help
button shall include "on-line" assistance
for programming and troubleshooting.
 - .3 There shall be a built-in time
clock in the VFD keypad. The clock shall
be used to date and time stamp faults and
record operating parameters at the time
of fault. The clock shall also be
programmable to control start/stop
functions, constant speeds, PID parameter
sets and output relays.
 - .4 Plug-in modules to expand number of
relays.
 - .5 1P20 and 1P66 protection.
 - .6 W/F control and voltage boost.
 - .7 The VFD shall allow the EMCS to
control the drive's digital and analog
outputs via the serial interface. This
control shall be independent of any VFD
function.
 - .3 RFI filters. All VFD's shall include RFI
filters.
 - .4 FEATURES - Features to be furnished and
mounted by the drive manufacturer. All
features shall be UL Listed by the drive

- 2.3 CENTRIFUGAL FANS
(Cont'd)
- .4 Variable volume control devices:(Cont'd)
.4 (Cont'd)
manufacturer as a complete assembly and carry a UL508 label.
- .1 Door interlocked, padlockable circuit breaker that will disconnect all input power from the drive and all internally mounted options.
 - .2 Fast acting fuses exclusive to the VFD - fast acting fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection.
 - .3 The drive shall provide single-phase motor protection in the VFD.
 - .4 Indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.
 - .5 Mounting Arrangements:
 - .6 VFD units shall be mounted within close proximity to the motor it is controlling. Contractor is fully responsible for coordinating the exact location of the VFD unit with the Air Handling Unit. Avoid interference with all access doors, filter and drain locations and maintain appropriate clearances. Mounting support to be composed of unistrut.

PART 3 - EXECUTION

- 3.1 EXAMINATION
- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC fans installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and

- 3.1 EXAMINATION .1 (Cont'd)
(Cont'd) .3 (Cont'd)
after receipt of written approval to proceed
from Departmental Representative.
- 3.2 FAN .1 Install fans as indicated, complete with
INSTALLATION resilient mountings and flexible electrical
leads and flexible connections.
- .2 Provide sheaves and belts required for final
air balance.
- .3 Bearings and extension tubes to be easily
accessible.
- .4 Access doors and access panels to be easily
accessible.
- 3.3 VFD INSTALLATION.1 Installation shall be the responsibility of
the EMCS contractor. The contractor shall
install the drive in accordance with the
recommendations of the VFD manufacturer as
outlined in the installation manual.
- .2 Power wiring shall be completed by the
electrical contractor. Three copper conductors
and a ground wire are required. Separate the
input power wiring from the output power
wiring in individual metallic conduit. Do not
combine. Provide a separate metallic conduit
for control wiring. The contractor shall
complete all wiring in accordance with the
recommendations of the VFD manufacturer as
outlined in the installation manual.
- 3.4 CLEANING .1 Progress Cleaning: clean in accordance with
Section 01 74 11 - Cleaning.
 .1 Leave Work area clean at end of each
day.
- .2 Final Cleaning: upon completion remove
surplus materials, rubbish, tools and
-

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<u>3.4 CLEANING</u>	.2	Final Cleaning:(Cont'd)
<u>(Cont'd)</u>		equipment in accordance with Section 01 74 11
		- Cleaning.

END

PART 1 - GENERAL

- 1.1 REFERENCES .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
- .1 ANSI/AMCA Standard 99-Latest Edition, Standards Handbook.
 - .2 ANSI/AMCA Standard 210-Latest Edition/(ANSI/ASHRAE 51-Latest Edition), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - .3 ANSI/AMCA Standard 300-Latest Edition, Reverberant Room Method for Sound Testing of Fans.
 - .4 ANSI/AMCA Standard 301-Latest Edition, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for roof exhausters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .2 Include:
 - .1 Fan performance curves showing specified point of operation.
 - .2 Sound rating data.
- 1.3 MAINTENANCE MATERIAL SUBMITTALS .1 Extra Materials:
- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
-

- 2.1 SYSTEM DESCRIPTION (Cont'd)
- .1 (Cont'd)
 - .2 Capacity: flow rate, total static pressure Pa, r/min, W, model and size and sound ratings as indicated on schedule.
 - .2 Statically and dynamically balanced. Constructed to ANSI/AMCA Standard 99.
 - .3 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210, unit to bear AMCA certified rating seal.
 - .4 Bearings: sealed lifetime ball or roller bearings of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 100,000 hours.
- 2.2 ROOF EXHAUSTERS
- .1 Centrifugal V belt driven.
 - .1 Housings: spun aluminum complete with resilient mounted motor and fan.
 - .2 Impeller: aluminum non-overloading.
 - .3 Adjustable motor sheave.
 - .4 12 mm mesh 2.0 mm diameter aluminum birdscreen.
 - .5 Automatic gasketed aluminum backdraft dampers.
 - .6 Disconnect switch within fan housing.
 - .7 Curb cap with prepunched mounting holes.
 - .8 Motor and drives isolated on shock mounted.
 - .9 Drain through.
 - .10 Static resistant belts.
 - .11 Corrosion resistant fasteners.
 - .12 Internal lifting lugs.
 - .13 Grease trap.
 - .14 Junction box mounted and wired.
 - .15 CSA approved motor.
-

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roof and wall exhausters installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Install in accordance with manufacturer's instructions.
- 3.3 ANCHOR BOLTS AND TEMPLATES .1 Size anchor bolts to withstand seismic acceleration and velocity forces.
- 3.4 CLEANING .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .3 Waste Management: separate waste materials for reuse and recycling.

PART 1 - GENERAL

- 1.1 SYSTEM DESCRIPTION .1 Performance Requirements:
.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.
- 1.2 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 Indicate following:
.1 Capacity.
.2 Throw and terminal velocity.
.3 Noise criteria.
.4 Pressure drop.
.5 Neck velocity.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
.2 Instructions: submit manufacturer's installation instructions.
- 1.3 QUALITY ASSURANCE .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
-

- 1.4 DELIVERY,
STORAGE, AND
HANDLING
- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.
- 1.5 MAINTENANCE
- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

PART 2 - PRODUCTS

- 2.1 GENERAL
- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
 - .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board.
 - .3 Concealed fasteners.
 - .3 Concealed manual volume control damper operators.
 - .4 Colour: standard as directed by Departmental Representative.
 - .5 See Diffuser/Grille schedules on Drawings.
-

- 2.2 MANUFACTURED UNITS .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.
- 2.3 RETURN AND EXHAUST GRILLES AND REGISTERS .1 General: with opposed blade dampers.
- 2.4 DIFFUSERS .1 General: volume control dampers with flow straightening devices and blank-off quadrants and gaskets.
- .2 See schedules as indicated.

PART 3 - EXECUTION

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head oval head stainless steel screws in countersunk holes where fastenings are visible.
- 3.3 CLEANING .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 52.2-Latest Edition, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10-Latest Edition, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.14-Latest Edition, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .3 CAN/CGSB-115.15-Latest Edition, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .4 CAN/CGSB-115.18-Latest Edition, Filter, Air, Extended Area Panel Type, Medium Efficiency.
 - .5 CAN/CGSB-115.20-Latest Edition, Polarized Media Air Filter.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 96-Latest Edition, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .4 Underwriters' Laboratories of Canada (ULC)
 - .1 ULC-S646-Latest Edition, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC filters and include product characteristics, performance criteria, physical size, finish and limitations.
 - .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- 1.3 MAINTENANCE MATERIAL SUBMITTALS
- .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 such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 2 complete sets of filters for each.
- 1.4 DELIVERY, STORAGE AND HANDLING
- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original factory
-

- 2.3 FIBROUS GLASS .2 Holding frame: 1.2 mm minimum thick
PANEL FILTERS galvanized steel with 3 mm diameter hinged
(Cont'd) wire mesh screen.
- .3 Performance: minimum average synthetic dust
weight arrestance 70% to ANSI/ASHRAE 52.2.
- .4 Fire rated: to ULC -S111.
- .5 Nominal thickness: 50 mm.
- 2.4 COTTON PANEL .1 Disposable pleated reinforced cotton dry
FILTERS media: to CAN/CGSB 115.18.
- .2 Holding frame: galvanized steel, or slide in
channel for side access.
- .3 Performance:
.1 Average atmospheric dust spot efficiency
30% to ANSI/ASHRAE 52.2.
.2 Average synthetic dust weight arrestance
90% to ANSI/ASHRAE 52.2.
- .4 Fire Rated: to ULC -S111.
- .5 Nominal thickness: 50 mm.
- 2.5 FILTER GAUGES .1 Diaphragm actuated, direct reading.
- DIAL TYPE
- .2 Range: 0 to 250 Pa.
-

PART 3 - EXECUTION

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for filter installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- 3.2 INSTALLATION .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.
GENERAL
- 3.3 REPLACEMENT .1 Replace media with new upon acceptance.
MEDIA .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.
- 3.4 FILTER GAUGES .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
.2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.
-

PART 1 - GENERAL

- 1.1 REFERENCES .1 Definitions:
- .1 Catalogued or published ratings: ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.
- .2 Reference Standards:
- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
 - .1 ANSI/ASHRAE 52.2-Latest Edition, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - .2 ANSI/ASHRAE/IES 90.1-Latest Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #18.
 - .3 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-Latest Edition, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant, insulation, filters, and paints and include product characteristics, performance criteria, physical size, finish and limitations.
-

- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
(Cont'd)
- .3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.
.2 Indicate on drawings:
.1 Fan performance curves for supply air, with system operating conditions indicated, as tested in an AMCA Certified Chamber.
.2 Sound performance data for supply air, as tested in an AMCA Certified chamber.
.3 Motor ratings, electrical characteristics and motor and fan accessories.
.4 Dimensioned drawings showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
.5 Heating coil details including capacity, electrical requirements, etc.
.6 Cooling coil details including capacity, dimensions, etc.
.7 Outdoor condenser details including construction, capacity, etc.
.8 Estimated gross weight of each installed unit.
.9 Installation, Operating and Maintenance Manual (IOM) for each model.
- 1.3 CLOSEOUT SUBMITTALS
- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
.2 Operation and Maintenance Data: submit operation and maintenance data for make-up air system for incorporation into manual.
- 1.4 MAINTENANCE MATERIAL SUBMITTALS
- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of
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- 1.4 MAINTENANCE MATERIAL SUBMITTALS (Cont'd) .2 (Cont'd)
suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- 1.5 DELIVERY, STORAGE AND HANDLING .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect make-up air system from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Field and Factory assembled components to form units supplying air at design conditions as indicated.
- 2.2 FANS .1 In accordance with Section 23 34 00 - HVAC Fans.
- 2.3 CASING .1 Materials: formed, single wall metal cabinet, fabricated to permit access to internal components for maintenance.
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2.3 CASING
(Cont'd)

- .1 Materials:(Cont'd)
 - .1 Outside casing: 18 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Pre-painted components as supplied by the factory shall have polyester urethane paint on 18 gauge G60 galvanized steel. Base rail is 12 gauge, galvanized (G90) steel.
 - .2 Internal assemblies: 24 gauge, galvanized (G90) steel except for motor supports which shall be a minimum 14 gauge galvanized (G90) steel.
- .2 Cabinet Insulation: comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.
 - .1 Materials: fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.
 - .1 Thickness: 1 inch (25 mm).
 - .2 Fire Hazard Classification: maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C411.
 - .3 Location and application: floor of each unit shall be insulated with fiberglass insulation.
- .3 Access panels: unit shall be equipped with removable access panels to provide easy access to all major components. Access panels shall be fabricated of 18 gauge galvanized G90 steel. Removable access panels shall incorporate a formed drip edge.
- .4 Supply air blower and assembly options:
forward curve blower: blower assembly consists of an electric motor and a belt driven, double width, and double inlet forward curve blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on spring isolation devices.
- .5 Control centre/connections:
 - .1 Unit shall have an electrical control centre where all high and low voltage connections are made. Control centre shall be

- 2.3 CASING .5 Control centre/connections: (Cont'd)
(Cont'd) .1 (Cont'd)
constructed to permit single-point high
voltage power supply connections.
- 2.4 COILS AND .1 General:
OUTDOOR CONDENSER .1 Electric heating coil: capacity as
indicated on drawings. Electric Heating Coil
is to be UL listed with open coil elements.
Heater control cabinet is to be installed
within the units heating section. Electric
heater is to be provided with SCR controls.
Electric heater is to be controlled off of
SCR. Units with electric heat are to be
provided with a centre that shall be
constructed to permit single-point high
voltage power supply connections.
- .2 Cooling coil: capacity as indicated on
drawings.
.1 Serpentine type, arranged to
prevent trapping of oil.
.1 Liquid distributors to ensure
even distribution of liquid
refrigerant to circuits.
.2 Silver solder or braze joints
in refrigerant tubing.
.3 Evacuate and charge coil with
nitrogen and seal before sending to
site.
.2 Tubes: copper.
.3 Fins: copper or aluminum plate or
spiral wound.
.4 Headers: copper.
.5 Pressure tests: to Canadian
Refrigeration Code. Dehydrated. Sealed
with nitrogen charge.
.3 Outdoor condenser: capacity as indicated
on drawings.
.1 Refrigerant R410A.
.2 16 mm liquid line.
.3 29 mm suction line.
.4 Single compressor.
.5 Two stage cooling.
.6 Voltage: 575/3/60.
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- 2.4 COILS AND OUTDOOR CONDENSER (Cont'd) .1 General: (Cont'd)
.3 Outdoor condenser: (Cont'd)
.7 Casing: suitable for salt-laden air and all components corrosion resistant materials.
- 2.5 FILTERS .1 Units shall have 50 mm thick MERV 8 disposable pleated filters following the outdoor air intake in a V-bank arrangement and shall be accessible from the exterior of the unit.
- 2.6 BLOWER - FC .1 Blower section construction, Supply Air: belt drive motor and blower shall be assembled onto a minimum 14 gauge galvanized steel platform and must have helical coil spring vibration devices.
.2 Blower assemblies: shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
.3 Centrifugal blower housing: formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
.4 Forward curved blower (fan) wheels: galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.
.5 Fan to be equipped with a variable speed drive (VSD) to operate at a reduced speed when EF-1 is not running.
- 2.7 MOTORS .1 General: Blower motors greater than 3/4 horsepower shall be "NEMA Premium" unless otherwise indicated. Compliance with EPA's minimum energy=efficiency standards for single speed ODP and TE enclosures is not acceptable.
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- 3.6 CLEANING .2 Final Cleaning: upon completion remove
(Cont'd) surplus materials, rubbish, tools and
equipment in accordance with Section 01 74 11
- Cleaning.
- .3 Waste Management: separate waste materials
for reuse and recycling.
- 3.7 FIELD QUALITY .1 Manufacturer's Field Service: Engage a
CONTROL factory authorized service representative to
inspect field assembled components and
equipment installation, to include electrical
and piping connections. Report results to A/E
in writing. Inspection must include a complete
startup checklist to include (as a minimum)
the following: Completed Start-Up Checklists
as found in manufacturer's IOM.
- 3.8 START-UP SERVICE.1 Engage a factory authorized service
representative to perform startup service.
Clean entire unit, comb coil fins as
necessary, and install clean filters. Verify
water source for compliance with
manufacturer's requirements for flow and
temperature. Measure and record electrical
values for voltage and amperage. Refer to
Division 23 "Testing, Adjusting and Balancing"
and comply with provisions therein.
- 3.9 DEMONSTRATION .1 Engage a factory authorized service
AND TRAINING representative to train Owner's maintenance
personnel to adjust, operate and maintain the
entire Make-Up Air unit.