

PART 1 - GENERAL

1.1 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 product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .2 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .3 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.2 CLOSEOUT
SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental

- Representative before final inspection.
- .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified.
 - .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
 - .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
 - .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

- .3 Use different colour waterproof ink for each service.
- .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows:
- "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 MAINTENANCE
MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.

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 off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and

blemishes.

- .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 HVAC and R Equipment:
 - .1 Refrigerant:
 - .1 HCFC based refrigerant.
 - .2 HFC based refrigerant.

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 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.

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- 3.2 PAINTING REPAIR AND RESTORATION
- .1 Prime and touch up marred finished paintwork to match original.
 - .2 Repair finishes which have been damaged.
 - .3 Painting to be approved by Departmental Representative.
- 3.3 SYSTEM CLEANING
- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.
- 3.4 FIELD QUALITY CONTROL
- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- 3.5 DEMONSTRATION
- .1 Departmental Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
 - .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
 - .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
 - .4 Instruction duration time requirements as specified in appropriate sections.
 - .5 Departmental Representative will record these demonstrations on video tape for future reference.

3.6 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 .
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

PART 1 - GENERAL

1.1 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B139-Series 15, Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .4 National Fire Code of Canada (NFCC 2010)
- .5 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1113-A2007, Architectural Coatings.
 - .2 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

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 QUALITY ASSURANCE

- .1 Sustainability Standards Certification:
 - .1 Low-Emitting Materials: provide listing of sealants, coatings, used in building, comply with VOC and chemical component limits or restriction requirements.

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:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
 - .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials.

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 250 g/L to Standard GS-11 to SCAQMD Rule 1113.
 - .3 Paints: maximum VOC limit 150 g/L to Standard GS-11, to SCAQMD Rule 1113.
- .2 Adhesives: maximum VOC limit to SCAQMD Rule 1168 to GSES GS-36.

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.
- .4 Maintain all minimum clearance required by the NEC.
- .5 Maintain equipment and valves a maximum of 910mm above ceiling.

3.3 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer, CSA B139, as indicated without interrupting operation of other system, equipment, components.

3.4 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain.
 - .1 Discharge to be visible.
- .4 Drain valves: 19MM (NPS 3/4)ball valves unless indicated otherwise, with hose end male thread, cap and chain.

3.6 DIELECTRIC
COUPLINGS

- .1 General: compatible with system, to suit pressure rating of system.
- .2 Locations: where dissimilar metals are joined.

3.7 PIPEWORK
INSTALLATION

- .3 50mm (NPS 2) and under: isolating unions or bronze valves.
- .4 Over 50mm (NPS 2): isolating flanges.
- .1 Screwed fittings jointed with Teflon tape or pipe dope as recommended by manufacturer.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
 - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion.
- .14 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 Install globe valves in bypass around control valves.
- .6 Use gate, ball valves at branch take-offs for isolating purposes except where specified.
- .7 Install plug cocks or ball valves for glycol service.
- .8 Use chain operators on valves 64mm (NPS 2 1/2) and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .15 Install pipe straight and parallel to building lines.

3.8 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.
- .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.

3.9 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.

3.10 PREPARATION
FOR FIRE STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .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.

3.11 FLUSHING OUT
OF PIPING SYSTEMS

- .1 Flush system in accordance with Specifications.
- .2 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 and other relevant sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE
TESTING OF
EQUIPMENT AND
PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Pressure test piping at either city mains pressure, or 1.5 times the normal operating pressure, whichever is greater. Also refer to testing requirements specified in relevant sections of Divisions 21,22,and 23.

- .3 Pipework: test as specified in relevant sections of heating, ventilating and air conditioning work.
- .4 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.
- .5 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .6 Conduct tests in presence of Departmental Representative.
- .7 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .8 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

3.13 EXISTING SYSTEMS

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

3.14 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 in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-2013, 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.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .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.
 - .1 Departmental Representative will make available 1 copy of systems supplier'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.

1.3 QUALITY
ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with applicable regulations.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - 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 in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Motors: high efficiency, in accordance with local Utility company standards and to ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of equipment, install motor approved by

Departmental Representative for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

- .3 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .4 Motors 373 W (1/2 HP) 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, 575 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 (10 HP): 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 (10 HP) 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.
 - .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.

3.3 FIELD QUALITY
CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 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 RELATED
SECTIONS

- .1 Section 01 33 00 Submittal Procedures

1.2 REFERENCES

- .1 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2012, Power Piping, (SI Edition).
 - .2 ANSI/ASME B31.3-2012, Process Piping.
 - .3 ANSI/ASME B31.5-2013, Refrigeration Piping and Heat Transfer Components.
 - .4 ANSI/ASME B31.9-2011, Building Services Piping.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A125-96 (R2007), Specification for Steel Springs, Helical, Heat Treated.
 - .2 ASTM A307-2012, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A563-07a, 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 SP58-2009, Pipe Hangers and Supports Materials, Design and Manufacture.
- .5 Underwriter's Laboratories of Canada (ULC).

1.3 DESIGN
REQUIREMENTS

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 , B31.3, B31.5, B31.9 or MSS SP58.
- .3 Do not allow that supports, guides or anchors to transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being

introduced into pipework or connected equipment.

- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP58.

1.4 PERFORMANCE REQUIREMENTS

- .1 Design supports and hangers to withstand seismic events for location as per the National Building Code.

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.

1.6 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized painted with zincrich paint after manufacture.
 - .2 Use electroplating galvanizing process or hot dipped galvanizing process.
 - .3 Confirm steel hangers in contact with copper piping are copper plated or epoxy coated.
- .2 Upper attachment to concrete:
 - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weld-less forged

steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved where required to MSS SP58.

- .3 Shop and field fabricated assemblies:
.1 Trapeze hanger assemblies: MSS SP58.
.2 Steel brackets: MSS SP58.
.3 Sway braces for seismic restraint systems: to MSS SP58.
- .4 Hanger rods: threaded rod material to MSS SP58.
.1 Ensure that hanger rods are subject to tensile loading only.
.2 Provide linkages where lateral or axial movement of pipework is anticipated.
.3 Do not use 22 mm or 28 mm rod.
- .5 Pipe attachments: material to MSS SP58.
.1 Attachments for steel piping: carbon steel galvanized.
.2 Attachments for copper piping: copper plated black steel.
.3 Use insulation saddles for hot pipework.
.4 Oversize pipe hangers and supports for insulated pipes.
- .6 Adjustable clevis: material to MSS SP58, UL listed FM approved, where required clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
.1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .7 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP58.
- .8 U-bolts: carbon steel to MSS SP58 with two (2) nuts at each end to ASTM A563.
.1 Finishes for steel pipework: galvanized.
.2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated or epoxy coated.
- .9 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP58.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: galvanized black carbon steel to MSS SP58, type 42, UL listed FM approved where required.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.

- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

2.4 INSULATION
PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP58, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded in centre plate for pipe sizes 300 mm and over, carbon steel to comply with MSS SP58.

2.5 EQUIPMENT
SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements. Submit calculations with shop drawings.

2.6 EQUIPMENT ANCHOR
BOLTS AND TEMPLATES

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

2.7 HOUSEKEEPING
PADS

- .1 For basemounted equipment: Concrete, at least 100 mm high, 50 mm larger all around than equipment, and with chamfered edges.
- .2 Concrete: Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for concrete housekeeping pads:
 - .1 Cement: Type GU.
 - .2 Minimum compressive strength at 28 days: 25 MPa.
 - .3 Class of exposure: N.
 - .4 Nominal size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: 75 mm maximum.
 - .6 Chemical admixtures: type as approved and in accordance with ASTM C494.

2.8 OTHER EQUIPMENT
SUPPORTS

- .1 From structural grade steel meeting requirements of CAN/CSA G40,21-04 Grade 300W.
- .2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps and elsewhere as indicated.
- .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 be to industry standards.
 - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
- .4 Clevis plates:
 - .1 Attach to concrete with four (4) minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.2 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code
- .2 Copper piping: up to NPS 1/2: every 1.5 m.
- .3 Hydronic, steam, condensate, rigid, and flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.

Maximum Pipe Size Copper Size: NPS	NPS Maximum Spacing:	Steel Maximum Spacing:
up to 1-1/4	2.2 m	1.8 m
1-1/2	2.1 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.1 m	3.0 m
3	3.1 m	3.0 m
3-1/2	3.1 m	3.3 m

4	4.1 m	3.6 m
5	4.1 m	
6	5.1 m	
8	5.1 m	
10	6.6 m	
12	6.9 m	

.4 Within 300 mm of each elbow.

3.3 HANGER
INSTALLATION

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

3.4 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.

3.5 FINAL
ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Confirm 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.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB1.60-97, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB24.3-92, Identification of Piping Systems.
- 1.2 PRODUCT DATA
- .1 Submit product data in accordance with Section 01 33 00 Submittal Procedures.
 - .2 Product data to include paint colour chips, other products specified in this section.

PART 2 - PRODUCTS

- 2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES
- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
 - .2 Lettering and numbers to be raised or recessed.
 - .3 Information to include, as appropriate:
 - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.
- 2.2 SYSTEM NAMEPLATES
- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
 - .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.

- .3 Sizes:
.1 Conform to following table:

#	mm	Lines	Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

- .2 Use maximum of 25 letters/numbers per line.

- .4 Locations:
.1 Terminal cabinets, control panels: Use size # 5.
.2 Equipment in Mechanical Rooms: Use size # 9.
.3 Use maximum of 25 letters/numbers per line.

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, to Workplace Hazardous Materials Information System (WHMIS) regulations.
.3 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 All other pipes: Pressure sensitive plastic-coated cloth or vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150°C and intermittent temperature of 200°C.

.7 Colours and Legends:

.1 Where not listed, obtain direction from Departmental Representative.

.2 Colours for legends, arrows, to following

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

.3 Background colour marking and legends for piping systems:

Contents

Background colour

Legend

** Add design temperature

++ Add design temperature and pressured

Compressed Air

Green

Comp Air

2.5 DUCTWORK
IDENTIFICATION

.1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.

.2 Colours: Black, or coordinated with base colour to ensure strong contrast.

.3 Identify system : e.g. Weld Exhaust.

2.6 VALVES,
CONTROLLERS

- .1 Brass tags 12 mm diameter with 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. If no EMCS included in project, identification as per this section.
- .2 Inscriptions to include function and (where appropriate) failsafe position, component ID name.

2.8 LANGUAGE

- .1 Identification to be in English.
- .2 Use one nameplate, label, etc. for each language.

PART 3 - EXECUTION

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.

3.3 NAMEPLATES

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- .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 in any way.

3.4 LOCATION OF
IDENTIFICATION ON
PIPING AND DUCTWORK
SYSTEMS

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—
—

- .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.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
- .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES,
CONTROLLERS

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- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with nonferrous chains or closed "S" hooks.
- .2 Install one (1) copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

PWGSC
Weld Lab Exhaust System
PWGSC No. R.065476.617

MECHANICAL
IDENTIFICATION

Section 23 05 53
Page 6

PART 1 - GENERAL

1.1 RELATED

- .1 Materials and installation of high-pressure metallic ductwork, joints and accessories.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 30 - Health and Safety Requirements.
 - .3 Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
 - .4 Section 02 61 33 - Hazardous Materials.
 - .5 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .6 Section 23 05 94 - Pressure Testing of Ducted Air Systems.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 American Society for Testing and Materials (ASTM).
 - .1 ASTM A 653/A 653M-04a, Standard Specification for Steel Sheet, Zinc-Coated Galvanized or Zinc-Iron Alloy Coated Galvannealed by the Hot-Dip Process.
- .3 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .5 Sheet Metal Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 95 (Addendum No. 1, (1997)).
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 1st

Edition 1985.

.3 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition 1995.

.6 American Conference of Government Industrial Hygenists (ACGIH).

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

.1 Certification of Ratings:

.1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Protect on site stored or installed absorptive material from moisture damage.

.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Construction / Demolotion Waste Management and Disposal Specifications.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Place materials defined as hazardous or toxic in designated containers.

.5 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

.6 Ensure emptied containers are sealed and stored safely.

.7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.6 INDOOR AIR
QUALITY (IAQ)
MANAGEMENT PLAN

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

PART 2 - PRODUCTS

2.1 CLAMP TOGETHER
DUCTWORK FOR WELD
EXHAUST SYSTEM

- .1 Clamp Together Duct:
 - .1 The clamp together duct system manufacturer, to offer a full line of duct and components as part of their regular business. All parts to be of standard sheet metal construction with a rolled lip applied to the each end of the component. An all-stainless steel over-center locking clamp is used to encompass the rolled lips, pull them together and then securely join them. Adapters to enable connection to virtually any machine or existing duct must be available from the same manufacturer as part of their clamp together duct system.
- .2 Duct Clamps:
 - .1 Duct clamps are to be provided by the clamp together duct system manufacturer & have a lifetime guarantee. The lifetime guaranteed clamp is fitted with a 'winged- O-ring' gasket made of ePTFE. The gasket is designed to fully encompass the entirety of the rolled lips including the area formed by the 'v' between the rolled lips.
- .3 Ducting:
 - .1 The clamp together straight duct is to be provided in nominal 1524 mm (5') lengths. Adjustable sleeves and adjustable components must be available as part of the duct system. In addition to the adjustable sleeves, all components such as elbows, tees, reducers, branch take-offs & any part with a collar, must have the ability to also provide adjustability without the use of flanges to enable the installer to quickly make odd lengths and to adjust for a proper fit.

- .4 Ducting Material:
- .1 Duct and Components are to be galvanized steel. Standard gauges for the duct to be 18 ga for 75 mm (3"), 22 ga for 100-150 mm (4-6"), 22 ga for 125-300 mm (7-12") and 20 ga for sizes 330-620 mm (13-24"). Elbows are to be one gauge heavier than standard duct gauge. All components (reducers, branches, etc) are to be 18 ga material. Elbows to have a radius of 2 ½ times the diameter.
- .2 The rolled lip on the duct and fittings are to act as a stiffing ring and therefore allow the product to withstand much higher pressures than normally associated with spiral or other rolled duct. Ducting to be designed to operate at pressure applications up to 1015 mm (40") negative water column pressure. Higher pressure guarantees to be available from manufacturer.

2.2 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping Equipment.
- .1 Band hangers: use on round and oval ducts up to 500 mm diameter, of same material as duct but next sheet metal thickness heavier than duct.
- .2 Trapeze hangers: ducts over 500 mm diameter or longest side, to ASHRAE and SMACNA.
- .3 Hangers: black steel angle with galvanized steel rods to ASHRAE and SMACNA following table:

<u>Duct Size</u> (mm)	<u>Angle Size</u> (mm)	<u>Rod Size</u> (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 steel joist: manufactured joist clamp or steel plate washer.
- .2 For steel beams: manufactured beam clamps:

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do work in accordance with ASHRAE, ACGIH and SMACNA as indicated.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate band hangers 100 mm beyond insulated duct.
 - .2 Ensure diffuser is fully seated.
- .3 Support risers in accordance with ASHRAE and SMACNA and as indicated.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Ensure installation of firestopping does not distort duct.

3.2 HANGERS

- .1 Band hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with ASHRAE SMACNA and as follows:

<u>Duct Size</u>	<u>Spacing</u>
(mm)	(mm)
to 1500	3000
1501 and over	2500

3.3 LEAKAGE TESTS

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .2 Perform leakage tests in sections.
- .3 Perform trial leakage tests, per specifications and manufacturers recommendations to demonstrate workmanship.

- .4 Do not install additional ductwork until trial tests have been achieved.
- .5 Test section minimum of 30m long with not less than three branch takeoffs and two 90 degrees elbows.
- .6 Complete tests before performing insulation or concealment Work.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS .1 Submittal Procedures: Section 01 33 00
- 1.2 REFERENCES .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards Metal and Flexible.
- 1.3 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00.
.2 Indicate the following:
.1 Flexible connections.
.2 Duct access doors.
.3 Turning vanes.
.4 Instrument test ports.
- 1.4 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.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.
- 2.2 FLEXIBLE CONNECTIONS .1 Frame: galvanized sheet metal frame 0.66 mm thick with fabric clenched by means of double locked seams.
.2 Material:
.1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 400C

to plus 900 degrees C, density of 1.3 kg/m2.

2.3 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 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 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 Allow for slack material in flexible connection.

PART 1 - GENERAL

- 1.1 RELATED SECTIONS .1 Submittal Procedures: Section 01 33 00
- 1.2 REFERENCES .1 Sheet Metal and Air Conditioning National Association (SMACNA)
.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- 1.3 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00.
.2 Indicate the following: dimensions, materials.

PART 2 - PRODUCTS

- 2.1 GENERAL .1 Manufacture to SMACNA standards.
- 2.2 SINGLE BLADE DAMPERS .1 Of same material as duct, 0.8 mm up to 450 mm wide, 1.6 mm maximum up to 1200 mm wide, V-groove stiffened.
.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm.
.3 Locking quadrant with shaft extension to accommodate insulation thickness.
.4 Inside and outside nylon or 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 or selflubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage: 2 % at 500 Pa.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
- .4 Runouts to registers and diffusers: located as close as possible to main ducts.
- .5 All dampers must be vibration free.
- .6 Confirm damper operators are observable and accessible.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Submittal Procedures: Section 01 33 00
- .2 Operations and Maintenance Data: Section 01 78 00
- .3 Duct Accessories: Section 23 33 00

1.2 REFERENCES

- .1 AMCA 99-2007, Standards Handbook.
- .2 ANSI/AMCA 210-2007, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .3 AMCA 300-2008, Reverberant Room Method for Sound Testing of Fans.
- .4 AMCA 301-2006, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .5 ANSI/ASHRAE 51-2007, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.3 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00
- .2 Product data to include fan curves and sound rating data, showing point of operation.
- .3 Indicate the following: motors, wheels, bearings, shafts, drives for all return and exhaust fans, dimensions, weight, sound power levels and service clearances.

1.4 OPERATION AND
MAINTENANCE DATA

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

1.5 MAINTENANCE

- .1 Provide maintenance materials as follows:

ADDENDUM NO 1

MATERIALS

- .1 Spare parts to include:
 - .1 Matched sets of belts.

1.6 MANUFACTURED
ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

PART 2 - PRODUCTS

2.1 FANS GENERAL

- .1 Capacity, static pressure, revolutions per minute, power, model and size as indicated on Drawings.
- .2 Sound ratings: comply with AMCA (Air Moving and Conditioning Association) 301, tested to AMCA 300. Unit shall bear AMCA certified sound rating seal where appropriate.
- .3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300mm diameter.
- .5 Motors: high efficiency; sizes as indicated.
- .6 Factory primed before assembly in colour standard to manufacturer.
- .7 Scroll casing drains: as indicated, complete with plug.
- .8 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.

PART 3 - EXECUTION

3.1 FAN
INSTALLATION

- .1 Install fans as indicated
- .2 Install fan restraining snubbers.

- .3 Provide replacement sheaves and belts if required for final air balance.