

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 This section is to be read in conjunction with and covers items common to all sections of Division 23. It is intended to supplement the requirements of Section 01 33 00.

1.2 REFERENCE
STANDARDS

- .1 CSA C22.2 No. 100-14(R2019), Motors and Generators
- .2 CSA C390-10(R2015), Test Methods, Marking Requirements, and Energy Efficiency Levels for Three-Phase Induction Motors.

1.3 GENERAL

- .1 Perform the work included in these specifications and any accompanying drawings, by providing all supervision, labour, materials, supplies, construction tools, equipment and services, hoisting, transportation, receiving, handling, storage, and all other services and expenditures; unless otherwise specified in the scope. Including those not specifically mentioned but which are necessary for a complete installation.

1.4 EQUIPMENT

- .1 Equipment assemblies comprised of electro-mechanical components must be CSA approved where possible and shall bear the appropriate label. If the equipment in question is not CSA approved as an assembly, have the manufacturer arrange and pay for Spot approval and labelling of the equipment prior to installation.

1.5 EQUIPMENT
INSTALLATION

- .1 Provide unions and flanges to permit equipment maintenance and disassembly and to minimize disturbance to piping and duct systems without interfering with other equipment.
- .2 Provide means of access for servicing equipment including permanently lubricated lifetime bearings.
- .3 Pipe equipment drains to floor drains.

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| <u>1.5 EQUIPMENT INSTALLATION (Cont'd)</u> | .4 | Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines. |
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| <u>1.6 PROTECTION OF OPENINGS</u> | .1 | Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system. |
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| <u>1.7 ELECTRICAL</u> | .1 | Electrical work and electrical equipment: .1 Refer to mechanical drawings to determine mechanical/electrical wiring responsibilities. |
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| <u>1.8 MOTORS</u> | .1 | Provide motors for mechanical equipment as specified and as indicated. |
| | .2 | If delivery of specified motor will delay delivery or installation of any equipment, install alternative motor approved by the Departmental Representative for temporary use. Final acceptance of equipment will not occur until specified motor is installed. |
| | .3 | Motor frames must be either of rigid fabricated steel or castings. |
| | .4 | All studs, nuts and bolts subject to periodic removal maintenance purposes must have Unified or American Standard Threads. |
| | .5 | Specific requirements: .1 Specific requirements for motors are given on Equipment Schedules or other sections of this specification. .2 In general, fractional horsepower motors smaller than 560 w (3/4 hp) shall be 115 volts, single phase, 60 Hz. Motors 560 w (3/4 hp) and larger, shall be 575 volts, three phase, 60 Hz or 208 volts, three phase, 60 Hz, as indicated or as specified herein. .3 Motors for variable A/C frequency drives shall be Definite Purpose Inverter Fed Motors in accordance with NEMA MG1, 1993 Rev. 3, Part 31; compatible with the VFD. |
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- 1.8 MOTORS
(Cont'd)
- .5 (Cont'd)
- .4 Provide all 3-phase motor starters supplied by Division 23 complete with phase loss protection.
- .6 Performance requirements:
- .1 Designed for continuous duty at rated output and for full voltage starting, unless another starting method is specified.
- .2 Capable of operation at rated output without exceeding their breakdown torque point during voltage dips to 80 percent of rated voltage for periods of up to 15 seconds during electrical system disturbance.
- .3 As a minimum, the motors must develop torques as specified by NEMA MG1, design B for 3 phase motors and design N or O for single phase motors. The motor code letter shall be between B and H unless specified otherwise.
- .4 Operation within service factor: motors to be sized to operate within the nameplate horsepower rating for all operating conditions. Normal operation should not require operation at a service factor greater than 1.0.
- .5 Motors must be high efficiency. Their quoted efficiency rating at either 75% or 100% of their rated load must be equal to or greater than the efficiency values in the following table when derived using CSA C390 method.

| <u>HP OF MOTOR</u> | <u>ENERGY EFFICIENCY VALUE AT 1760 RPM</u> |
|--------------------|--|
| 1.0 | 82.5 |
| 1.5 | 84.0 |
| 2.0 | 84.0 |
| 3.0 | 87.5 |
| 5.0 | 87.5 |
| 7.5 | 89.5 |
| 10.0 | 89.5 |
| 15.0 | 91.0 |
| 20.0 | 91.0 |
| 25.0 | 92.4 |
| 30.0 | 92.4 |
| 40.0 | 93.0 |
| 50.0 | 93.0 |

- .7 Winding temperature rating:

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1.8 MOTORS
(Cont'd)

.7 (Cont'd)

.1 The motors must be rated for continuous operation without exceeding the following values of temperature rise above an ambient of 40°C.

| <u>ENCLOSURE</u> | <u>MEASUREMENT BY THERMOMETER °C</u> | <u>MEASUREMENT BY RESISTANCE °C</u> |
|-----------------------------------|--|---|
| | CLASS B | CLASS B |
| Drip Proof | 60 | 70 |
| Drip Proof Fully Guarded | 70 | 80 |
| Totally Enclosed Fan Cooled | 75 | 80 |

.2 Drip proof motors specified for 60°C rise continuous rating with Class B insulation must have a service factor of not less than 1.15.

.8 Insulation: use Class B insulation for the motor windings. Provide additional varnish impregnation and bake treatments to the finish wound stator as further protection against severe moisture or dust laden environments.

.9 Bearings:

.1 Motor bearings to preferably be of the grease lubricated type and be constructed and mounted to exclude dirt and moisture and to prevent lubricant from reaching the motor internals.

.2 Anti-friction and generally all bearings must have a minimum rating life of 100,000 hours, for the loading and speed conditions corresponding to the application.

.10 Enclosures:

.1 Provide drip proof motors for all indoor applications.

.2 Motors to have the direction of rotation marked on the stator frame or end brackets.

.3 Provide totally enclosed motors with drain holes fitted with pipe plugs.

.11 Terminal box:

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1.8 MOTORS
(Cont'd)

- .11 (Cont'd)
 - .1 Arrange terminal boxes to permit rotation through 360° in 90° intervals and located at a position which will allow conduit access in any of the four rotation positions.
 - .2 Provide a grounding lug inside the terminal boxes of motors rated 74.6 (100 hp) and smaller.
- .12 Base plate:
 - .1 Provide a common base plate for the driven equipment and motor.
 - .2 Provide adjustable slide bases or rails for all motors where belt drives are used.
- .13 Painting: remove all rust, scale and grease from the stator painting. The internals and externals must be suitably painted to prevent corrosion after cleaning, using the Manufacturer's standard paints.
- .14 Single phase motors: provide single phase motors of the capacitor-start or two-value capacitor type.
- .15 Marking: mark motors according to CSA C22.2.

1.9 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 specified.
- .3 For motors up to 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 Minimum drive rating: 2.0 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .5 Motor slide rail adjustment plates to allow for 150mm minimum centre line adjustment.

1.10 GUARDS

- .1 Provide guards for unprotected drives and/or drive couplings.
- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame.

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- 1.10 GUARDS
(Cont'd)
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- .2 (Cont'd)
 - .2 Nominal 1.214mm (18 ga.) thick sheet metal tops and bottoms.
 - .3 38mm 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, nominal 1.519mm (16 ga.) 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, 19mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.
- 1.11 EQUIPMENT
SUPPORTS
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- .1 Equipment supports supplied by equipment manufacturer: specified elsewhere in Division 23.
 - .2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel.
- 1.12 TESTS
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- .1 Give 24 hour written notice of date for tests.
 - .2 Insulate or conceal work only after testing and approval by the Departmental Representative.
 - .3 Conduct tests in presence of the Departmental Representative.
 - .4 Bear costs including retesting and making good.
 - .5 Equipment: test as specified in relevant sections.
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1.12 TESTS
(Cont'd)

- .6 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.
- .7 Completely fill out commissioning sheet provided in Contract Documents.

1.13 PAINTING

- .1 Finish painting where specified elsewhere in the Mechanical Specifications.
- .2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Prime and touch up marred finished paintwork to match original.
- .4 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.14 SPECIAL TOOLS

- .1 Provide one (1) set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 33 00.
- .2 Furnish one commercial quality grease gun, grease and adaptors to suit the various types of grease and grease fittings.

1.15 ACCESS DOORS

- .1 Supply access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.
- .2 Flush mounted 600mm x 600mm for body entry and 300mm x 300mm for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps. Provide fire-rated access doors where penetrating fire-rated construction. Maintain fire rating integrity of construction. Access hatches are to be keyed locking type for rooms 126, 127.
- .3 Material:

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| 1.15 ACCESS DOORS (Cont'd) | .3 | (Cont'd) .1 Special areas only such as tiled surfaces: use stainless steel with #4 satin finish. .2 Remaining areas: use prime coated steel. .3 Nominal 1.897mm (14 ga.) material. |
| | .4 | Installation: .1 Locate so that concealed items are accessible. .2 Locate so that hand or body entry (as applicable) is achieved. .3 Installation is specified in applicable sections. |
| | .5 | Refer also to Section 23 33 00 for duct access doors. |
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| 1.16 DIELECTRIC COUPLINGS | .1 | General: .1 To be compatible with and to suit pressure and temperature rating of piping system. .2 Where pipes of dissimilar metals are joined. |
| | .2 | Pipes NPS 2 and under: isolating unions. |
| | .3 | Pipes NPS 2-1/2 and over: isolating flanges. |
| | | |
| 1.17 OPERATING AND MAINTENANCE INSTRUCTIONS | .1 | 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. |
| | .2 | Provide demonstrations and instructions in conjunction with the appropriate equipment manufacturers representatives. |
| | .3 | Use operation and maintenance manual, record drawings, audio visual aids, etc. as part of instruction materials. |
| | .4 | Have instructions in maintenance and operating of the following equipment given by factory trained personnel and for the time period specified. The time specified does not include the time for start-up of systems and equipment: |
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- 1.17 OPERATING AND MAINTENANCE INSTRUCTIONS (Cont'd)
- .4 (Cont'd)
- .1 Instruction to be given on the operation and maintenance of all mechanical components including but not limited to pumps, fans, air handling units, boilers and domestic hot water system. The instruction period shall be for a period of not less than three (3) working days. The Contractor and the Instructors will review for an additional two (2) working days, 90 days after the acceptance of the building by the Departmental Representative.
- .2 Where more detailed instructions for some equipment or systems are called for in other sections of the specifications, those sections of the specifications shall take precedence over this section.
- 1.18 OPERATION AND MAINTENANCE MANUAL
- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.
- .2 Operation and maintenance manual to be approved by and final copies deposited with the Departmental Representative before final inspection.
- .3 Operation data to include:
- .1 Description of each system and its controls.
- .2 Description of operation of each system at various loads together with reset schedules and seasonal variances.
- .3 Operation instruction for each system and each component.
- .4 Description of actions to be taken in event of equipment failure.
- .4 Maintenance data to include:
- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
- .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
- .2 Equipment performance verification test results.
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1.18 OPERATION AND
MAINTENANCE MANUAL
(Cont'd)

- .5 (Cont'd)
 - .3 Special performance data as specified elsewhere.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93.
- .6 Approvals:
 - .1 Submit draft copies of Operation and Maintenance Manual to the Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by the Departmental Representative.
 - .2 Make changes as required and re-submit as directed by the Departmental Representative.
- .7 Additional data: Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.19 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Shop drawings and product data to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. (eg. access door swing spaces).
- .3 Accompany shop drawings and product data with:
 - .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 as to current model production.
 - .5 Certification of compliance to applicable codes.
- .4 In addition to transmittal letter referred to in Section 01 33 00, use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.20 CLEANING

- .1 Clean interior and exterior of all systems. Vacuum interior of ductwork, fans and air handling systems.

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| <u>1.20 CLEANING</u> (Cont'd) | .2 | In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition. |
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| <u>1.21 DRAWINGS</u> | .1 | The Departmental Representative's mechanical drawings: .1 Are not intended to show structural details or architectural features. .2 Are not to be scaled. .3 Except where dimensioned, indicate general mechanical layouts only. Because of the small scale of the Mechanical Drawings, it is not possible to show all offsets, fittings and accessories which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves and accessories which are required to meet site conditions. |
| | .2 | Provide field drawings to indicate relative position of various services when required by the Departmental Representative. |
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| <u>1.22 RECORD DRAWINGS</u> | .1 | Refer to Section 01 78 00. |
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| <u>1.23 WARRANTIES</u> | .1 | Make good all defects other than normal wear and tear during the life of the warranty period. Warrant all work and installed equipment to work quietly and satisfactorily and to accomplish the work for which it was installed during the life of the warranty. At any time during this period, make any necessary changes and adjustments, or replacements, to accomplish this at no additional cost to the project. |
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| <u>1.24 PERMITS AND REGULATIONS</u> | .1 | Obtain and pay for any permits required by local codes and regulations and arrange for inspections applicable to the Contractor responsibilities. |
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GC Co-Working Site
Pilot Program at
BIO Facility
1 Challenger Drive
Project No. R.101402.002

COMMON WORK
RESULTS FOR HVAC

Section 23 05 00
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1.24 PERMITS AND
REGULATIONS
(Cont'd)

- .2 Furnish all additional materials or labour required to conform to any of these rules and regulations will be furnished under the Contract with no additional cost to the Contract.

1.25 RELATED WORK

- .1 Caulking:
.1 Perform caulking in compliance with the requirements of Section 07 92 00.
- .2 Welding:
.1 All welding to be performed as specified in Division 23 for all mechanical piping and structural supports and hangers.
.2 All welding shall be performed by certified welders in accordance with the Provincial Labour Requirements and By-Laws of Nova Scotia.

PART 1 - GENERAL

1.1 REFERENCES

- .1 ANSI/ASME B31.1-2018, Power Piping.
- .2 MSS SP-58-2018, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .3 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .4 ASTM A563-15, Standard Specification for Carbon and Alloy Steel Nuts.
- .5 ASTM F3125/F3125M-18, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150ksi (1040 MPa) Minimum Tensile Strength.
- .6 NFPA 13-2019, Installation of Sprinkler Systems.
- .7 NFPA 20-2019, Standard for Installation of Stationary Pumps for Fire Protection.

1.2 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Indicate on manufacturers catalogue literature the following:
 - .1 Upper attachment.
 - .2 Middle attachment.
 - .3 Pipe attachment.
 - .4 Riser clamps.
 - .5 Shields and saddles.
 - .6 Sway braces.

1.3 MAINTENANCE
DATA

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

1.4 DESIGN
REQUIREMENTS

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

1.4 DESIGN
REQUIREMENTS
(Cont'd)

- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
- .3 Confirm supports, guides, anchors do not 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.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and ANSI/MSS SP-58.
- .2 Support only from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

2.2 UPPER
ATTACHMENTS

- .1 Concrete:
 - .1 Inserts for cast-in-place concrete: galvanized steel wedge to MSS SP-58, type 18. ULC listed for pipe NPS 3/4 through NPS 8.
 - .2 Carbon steel plate with clevis, for surface mount: malleable iron socket and expansion case and bolt. Minimum two expansion cases and bolts for each hanger.
- .2 Steel beam (bottom flange):
 - .1 Cold piping NPS 2 and under: malleable iron C clamp to ANSI/MSS SP-58, type 19. ULC listed.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: malleable iron beam clamp to ANSI/MSS SP-58, type 28 or 29. ULC listed.
- .3 Steel beam (top):

2.2 UPPER
ATTACHMENTS
(Cont'd)

- .3 (Cont'd)
 - .1 Cold piping NPS 2 and under: malleable iron "top of beam" C clamp to ANSI/MSS SP-58, type 19. ULC listed.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to ANSI/MSS SP-58, type 25. ULC listed.
- .4 Steel joist:
 - .1 Cold piping NPS 2 and under: steel washer plate with double locking nuts.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.
- .5 Steel channel or angle (bottom):
 - .1 Cold piping NPS 2 and under; malleable iron C clamp to ANSI/MSS SP-58, type 23. ULC listed.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping; universal channel clamp. ULC listed.
- .6 Steel channel or angle (top):
 - .1 Cold piping NPS 2 and under; malleable iron "top of beam" C clamp to ANSI/MSS SP-58, type 19. ULC listed.
 - .2 Cold piping NPS 2-1/2 and larger and all hot piping: steel jaw, hook rod with nut, spring washer and plain washer, to ANSI/MSS SP-58, type 25. ULC listed.

2.3 MIDDLE
ATTACHMENT (ROD)

- .1 Carbon steel threaded rod, cadmium finished.

2.4 PIPE ATTACHMENT

- .1 Cold copper piping; hot copper piping with less than 25mm horizontal movement; hot copper piping with more than 300mm middle attachment rod length: adjustable clevis to ANSI/MSS SP-58, type 1. Copper plated.
- .2 Suspended hot piping, steel and copper, with horizontal movement in excess of 25mm; hot steel piping with middle attachment rod 300mm or less; pipe roller to ANSI/MSS SP-58, type 43.

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| <u>2.4 PIPE ATTACHMENT (Cont'd)</u> | .3 | Bottom supported hot piping, steel and copper: pipe roller stand to ANSI/MSS SP-58, type 45. |
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| <u>2.5 RISER CLAMPS</u> | .1 | Copper pipe: carbon steel copper finished to ANSI/MSS SP-58, type 42. |
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| <u>2.6 SADDLES AND SHIELDS</u> | .1 | Cold piping NPS 1-1/4 and over: protection shield with high density insulation under shield with uninterrupted vapour barrier. |
| | .2 | Hot piping NPS 1-1/4 and over: protective saddle with insulation under saddle. |
| | .3 | Bolts: to ASTM F3125M. |
| | .4 | Nuts: to ASTM A563. |

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| <u>2.7 EQUIPMENT SUPPORTS</u> | .1 | Fabricate equipment supports not provided by equipment manufacturer from structural grade steel. Submit calculations with shop drawings. |
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| <u>2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES</u> | .1 | Provide templates to ensure accurate location of anchor bolts. |
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| <u>2.9 DUCT HANGERS AND SUPPORTS</u> | .1 | Duct hangers and supports to follow the recommendations of SMACNA. |
| | .2 | Provide all hangers required to properly support ductwork. Hangers to be galvanized or primed steel channel or angle sections. To adjust duct height provide cadmium plated threaded steel rods with nuts and washers. All hanger rod installations to be double nutted top and bottom. |
| | .3 | For ducts 500mm and smaller, 25mm strap hangers are acceptable. |
| | .4 | In concrete use self drilling inserts at proper centres securely anchored in concrete. |

- 2.9 DUCT HANGERS .5 Do not break continuity of duct insulation vapour
AND SUPPORTS barrier with hangers or rods.
(Cont'd)

PART 3 - EXECUTION

- 3.1 HANGER SPACING .1 Spacing and middle attachment (rod) diameter as
specified in paragraphs below or as in table below,
whichever is more stringent.
.1 Plumbing piping: most stringent requirements of
Canadian Plumbing Code, Provincial Code, or
authority having jurisdiction.
.2 Copper piping: up to NPS 1/2: every 1524mm
maximum.
.3 Flexible joint roll groove pipe: in accordance
with table below, but not less than one hanger at
joints.
.4 Within 300mm of each horizontal elbow.

| <u>Pipe Size: NPS</u> | <u>Rod Diameter</u> | <u>Spacing Steel</u> | <u>Spacing Copper</u> |
|---------------------------|-------------------------|--------------------------|---------------------------|
| up to 1 1/4 | 9.5mm | 2100mm | 1800mm |
| 1-1/2 | 9.5mm | 2700mm | 2400mm |
| 2 | 9.5mm | 3000mm | 2700mm |
| 2-1/2 | 9.5mm | 3600mm | 3000mm |
| 3 | 9.5mm | 3600mm | 3000mm |
| 4 | 16mm | 4200mm | 3600mm |

- .2 Space hangers for parallel runs of piping such that
the finished, insulated clearance between the pipes,
and between a pipe and a wall, is minimum 50mm.

- 3.2 HANGER .1 Position hanger so that rod is vertical in operating
INSTALLATION (hot) condition.
.2 Adjust hangers to equalize load of piping on
structure.
.3 Clevis pipe hangers shall not penetrate the pipe
insulation. Use oversized hangers complete with
saddles and shields.

3.2 HANGER
INSTALLATION
(Cont'd)

- .4 All hanger rod installations must be double nutted (top and bottom).

3.3 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.

3.4 FINAL
ADJUSTMENT

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

PART 1 - GENERAL

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this Section.
- .3 TAB agency will be present to assist the commissioning authority during the commissioning of HVAC systems. TAB agency will be responsible for measuring entering and leaving air temperature at all coils to calibrate EMCS and for setting the DHW balancing valves.

1.2 QUALIFICATIONS
OF TAB PERSONNEL

- .1 Submit names of personnel certified to AABC or NEBB to perform TAB to the Departmental Representative within 90 days of award of contract.
- .2 TAB contractor must have experience to AABC, NEBB or SMACNA
- .3 Perform TAB in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.
 - .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.
- .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.

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1.2 QUALIFICATIONS
OF TAB PERSONNEL
(Cont'd)

- .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 the TAB standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
 - .1 For systems or system components not covered in TAB standard, use TAB procedures developed by TAB Specialist.
 - .2 Where new procedures and requirements are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or SMACNA), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads.
- .2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.4 EXCEPTIONS

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

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|--|----|---|
| <u>1.5 CO-ORDINATION</u> | .1 | Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project. |
| | .2 | Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems. |
| | | |
| <u>1.6 PRE-TAB REVIEW</u> | .1 | Review contract documents before project construction is started and confirm in writing to the 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 the Departmental Representative in writing all proposed procedures which vary from standard. |
| | .3 | During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings. |
| | | |
| <u>1.7 START-UP</u> | .1 | Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise. |
| | .2 | Follow special start-up procedures specified elsewhere in other Divisions. |
| | | |
| <u>1.8 OPERATION OF SYSTEMS DURING TAB</u> | .1 | Operate systems for length of time required for TAB and as required by the Departmental Representative for verification of TAB reports. |
| | | |
| <u>1.9 START OF TAB</u> | .1 | Notify the Departmental Representative seven (7) days prior to start of TAB. |
| | .2 | Start TAB when building is essentially completed, including: .1 Installation of ceilings, doors, windows, other construction affecting TAB. .2 Application of weather-stripping, sealing, caulking. |
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- 1.9 START OF TAB
(Cont'd)
- .2 (Cont'd)
 - .3 Pressure, leakage, other tests specified elsewhere in other Divisions.
 - .4 Provisions for TAB installed and operational.
 - .3 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, 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.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.
- 1.10 APPLICATION TOLERANCES
- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5%, minus 5%.
 - .2 Hydronic systems: plus or minus 10%.
- 1.11 ACCURACY TOLERANCES
- .1 Measured values to be accurate to within plus or minus 2% of actual values.
- 1.12 INSTRUMENTS
- .1 Prior to TAB, submit to the Departmental Representative list of instruments to be used together with serial numbers.
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| <u>1.12 INSTRUMENTS (Cont'd)</u> | .2 | Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system. |
| | .3 | Calibrate within three (3) months of TAB. Provide certificate of calibration to the Departmental Representative. |
| | | |
| <u>1.13 SUBMITTALS</u> | .1 | Submit, prior to commencement of TAB: .1 Proposed methodology and procedures for performing TAB if different from referenced standard. |
| | | |
| <u>1.14 PRELIMINARY TAB REPORT</u> | .1 | Submit for checking and approval of the Departmental Representative prior to submission of formal TAB report, sample of rough TAB sheets. Include: .1 Details of instruments used. .2 Details of TAB procedures employed. .3 Calculations procedures. .4 Summaries. |
| | | |
| <u>1.15 TAB REPORT</u> | .1 | Format to be in accordance with referenced standard. |
| | .2 | TAB report to show results in SI units and to include: .1 Project record drawings. .2 System schematics. |
| | .3 | Submit three (3) copies of TAB Report to the Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs. Submit electronic copy that includes the same information. |
| | | |
| <u>1.16 VERIFICATION</u> | .1 | Reported results subject to verification by the Departmental Representative. |
| | .2 | Provide manpower and instrumentation to verify up to 30% of reported results. |
| | .3 | Number and location of verified results to be at discretion of the Departmental Representative. |
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| <u>1.16 VERIFICATION (Cont'd)</u> | .4 | Bear costs to repeat TAB as required to satisfaction of the Departmental Representative. |
|---------------------------------------|----|--|
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|----------------------|----|--|
| <u>1.17 SETTINGS</u> | .1 | After TAB is completed to satisfaction of the Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings. |
| | .2 | Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way. |
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|-----------------------------------|----|---|
| <u>1.18 COMPLETION OF TAB</u> | .1 | TAB to be considered complete when final TAB Report received and approved by the Departmental Representative. |
|-----------------------------------|----|---|
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|-------------------------|----|--|
| <u>1.19 AIR SYSTEMS</u> | .1 | Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB. |
| | .2 | Do TAB of systems, equipment, components, controls specified in other Divisions. |
| | .3 | Qualifications: personnel performing TAB to be qualified to standards of AABC or NEBB. |
| | .4 | Quality assurance: Perform TAB under direction of supervisor qualified to standards of AABC or NEBB. |
| | .5 | Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration, amperage and volts for each stage of electrical heating coils. |
| | .6 | Locations of equipment measurements to include, but not be limited to, following as appropriate: .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions. .2 At controllers, controlled device. |
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GC Co-Working Site
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1 Challenger Drive
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TESTING, ADJUSTING AND
BALANCING

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1.19 AIR SYSTEMS .7 Locations of systems measurements to include, but
(Cont'd) not be limited to, following as appropriate: Main
ducts, main branch, sub-branch, run-out (or grille,
register or diffuser).

PART 2 PRODUCTS

2.1 NOT USED .1 Not applicable.

PART 3 EXECUTION

3.1 NOT USED .1 Not applicable.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Submittal Procedures: Section 01 33 00

1.2 REFERENCES

- .1 ASTM C411-19, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
- .2 ULC-S102-2018, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 ANSI/NFPA 90A-18, Installation of Air Conditioning and Ventilating Systems.
- .4 ANSI/NFPA 90B-2018, Installation of Warm Air Heating and Air Conditioning Systems.
- .5 ASTM C553-13(R2019), Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .6 CAN/CGSB 51-GP-52MA-89, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit for approval manufacturer's catalogue literature related to installation.

1.4 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in hung ceilings and non-accessible chases and furred spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
-

PART 2 - PRODUCTS

2.1 GENERAL

- .1 All components of insulation system to have maximum flame spread rating of 25 and maximum smoke developed rating of 50 in accordance with CAN/ULC-S102.
- .2 Test materials in accordance with ASTM C411.

2.2 MINERAL FIBRE
BLANKET WITH
VAPOUR BARRIER

- .1 Application: on either cold or variable temperature, round, rectangular (width less than 750 mm) or oval ducting.
 - .1 Minimum 3 m from exterior walls connected to exhaust fans.
- .2 Material:
 - .1 To ASTM C553, rigid mineral fiber blanket, min. density of 0.86 watt/meter.[°]k; CGSB 51-GP-52M for vapour barrier, flexible foil faced (in concealed areas).
- .3 Thickness: 25 mm, unless noted otherwise.

2.3 FASTENINGS

- .1 Tape: self adhesive, 100 mm wide, aluminum, ULC labelled for less than 25 flame spread and less than 50 smoke developed.
- .2 Contact adhesive: quick-setting.
- .3 Lap seal adhesive: quick-setting for joints and lap sealing of vapour barriers.
- .4 For Canvas (All exposed ducting).
 - .1 Washable adhesive for cementing canvas lagging cloth to duct insulation.
- .5 Pins:
 - .1 Weld pins 4 mm diameter, with 32 mm diameter head for installation through the insulation. Length to suit thickness of insulation.
 - .1 Acceptable material: Duro Dyne, Clip-Pin.
 - .2 Weld pins 2 mm diameter, for installation prior to applying insulation. Length to suit thickness of insulation. Nylon retain clips 32 mm square.

- 2.4 JACKETS
- .1 Apply canvas jackets complete with lagging adhesive on all exposed ductwork, ULC listed plain weave, cotton fabric, 227 grams, as follows:
 - .1 Ducting that has air moving at less than 16°C to be complete with vapour barrier.
 - .2 Factory applied foil-scrim-kraft facing consisting of aluminum foil reinforced with fibreglass yarn mesh and laminated to chemically treated fire resistant kraft is acceptable for duct insulation in concealed spaces.

PART 3 - EXECUTION

- 3.1 APPLICATION
- .1 Apply insulation after required tests have been completed and approved. Insulation and surfaces shall be clean and dry when installed and during application of any finish. Apply insulation materials, accessories and finishes to manufacturer's recommendations and as specified.
 - .2 Vapour barriers and insulation to be unbroken over full length of duct or surface, without penetration for standing duct seams and without interruption at sleeves and supports.

- 3.2 INSTALLATION
- .1 General:
 - .1 Install in accordance with ANSI/NFPA 90A and ANSI/NFPA 90B.
 - .2 Adhere and seal vapour barrier using vapour seal adhesives.
 - .3 Stagger longitudinal and horizontal joints, on multilayered insulation.
 - .4 Fill voids or openings between insulation and duct sleeve voids.

- 3.3 FIRE PROTECTION FOR CANVAS JACKETING
- .1 Provide two (2) coats of fire retardant sealer over canvas finish which is not ULC classified to CAN/ULC-S102 prior to painting.
 - .2 Install canvas with ULC classification stamp on the exterior surface.

PART 1 - GENERAL

- | | | |
|--|----|---|
| <u>1.1 SUMMARY</u> | .1 | Section Includes: .1 Materials and installation procedures for electric heating and cooling controls. |
| <u>1.2 RELATED SECTIONS</u> | .1 | Section 01 33 00 - Submittal Procedures. |
| <u>1.3 REFERENCES</u> | .1 | Health Canada/Workplace Hazardous Materials Information System (WHMIS) .1 Safety Data Sheets (SDS). |
| <u>1.4 SUBMITTALS</u> | .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 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures. |
| | .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. |
| <u>1.5 DELIVERY, STORAGE, AND HANDLING</u> | .1 | Packing, shipping, handling and unloading: .1 Deliver, store and handle materials in accordance with manufacturer's written instructions. |

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PART 2 - PRODUCTS

2.1 THERMOSTAT
(LINE
VOLTAGE-HEATING AND
COOLING)

- .1 Line voltage, wall-mounted thermostat, for heating or cooling or heating-cooling as indicated with:
 - .1 Full load rating: 6 A at 120 V.
 - .2 Temperature setting range: 5° C to 30° C.
 - .3 Thermometer range: 5° C to 30° C.
 - .4 Markings in 5 degree increments.
 - .5 Differential temperature fixed at 1.1° C.

2.2 THERMOSTAT
(LINE VOLTAGE,
HEATING)

- .1 Line voltage wall mounted integral electric heating thermostat with:
 - .1 Full load rating: 22 A at 120 V.
 - .2 Temperature setting range: 5° C to 30° C.
 - .3 Single pole.
 - .4 Thermometer range: 5° C to 30° C.
 - .5 Scale markings: Off-5-10-15-20-25° C.

2.3 THERMOSTAT (LOW
VOLTAGE)

- .1 Low voltage wall thermostat:
 - .1 For use on 24 V circuit at 1.5 A capacity.
 - .2 With heat anticipator adjustable 0.1 to 1.2 A.
 - .3 Temperature setting range: 10° C to 25° C.

2.4 ELECTRIC
HEATING RELAYS

- .1 Low voltage solid state electric heating relays installed in ventilated enclosure, recess mounted, complete with power supply. Complete assembly to be CSA approved.
- .2 Heating relays, complete with integral heat sink, over voltage protection and status LED.
- .3 Relay to have veiled conductor connections. No exposed terminals permitted.

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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 control devices. Provide wiring and conduit in accordance with Division 26.
- .2 On outside wall, mount thermostats on bracket or insulated pad 25 mm from exterior wall.
- .3 Install remote sensing device and capillary tube in metallic conduit. Conduit enclosing capillary tube must not touch heater or heating cable.

3.3 CLEANING

- .1 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 Submittal Procedures: Section 01 33 00

1.2 REFERENCES .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2006.
.2 SMACNA HVAC Systems Duct Design, 2006.
.3 ASHRAE Handbook.
.4 ASTM A653/A653M-19A, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.3 SHOP DRAWINGS AND PRODUCT DATA .1 Submit shop drawings and product data in accordance with Section 01 33 00.
.2 Indicate following:
.1 Sealants
.2 Tape
.3 Proprietary Joints

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 SEAL CLASSIFICATION .1 Classification as follows:

| <u>Maximum Pressure (Pa)</u> | <u>SMACNA Seal Class</u> | <u>Location of duct</u> |
|--------------------------------------|----------------------------------|-----------------------------|
| 125 | C | Branch run-outs |

2.1 SEAL
CLASSIFICATION
(Cont'd)

- .2 Seal classification:
 - .1 Class C: transverse joints and connections made air tight with sealant, tape, or combination thereof. Longitudinal seams unsealed.

2.2 SEALANT

- .1 Sealant: oil resistant, polymer type non-toxic flame resistant duct sealant. Temperature range of -30°C to 93°C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fibreglass tape, 50mm.

2.4 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows: R/D = 1.5 at fan discharge, R/D = 1.0 elsewhere.
- .3 Square mitred elbows: with single thickness vanes.
- .4 Main supply duct branches without splitter damper. Provide branch duct balancing dampers.
- .5 Sub branch duct with 45° boot connection and branch duct balancing damper.
- .6 Transitions:
 - .1 Diverging: 45° maximum included angle.
 - .2 Converging: 60° maximum included angle.
- .7 Offsets: short radiused elbows as indicated.
- .8 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles as for transitions.

2.5 GALVANIZED
STEEL

- .1 Lock forming quality: to ASTM A653, Z90 zinc coating.
-

- | | | |
|-------------------------------------|----|---|
| 2.5 GALVANIZED STEEL (Cont'd) | .2 | Thickness: to SMACNA HVAC duct construction standard. |
| | .3 | Fabrication: to SMACNA HVAC duct construction standard. |
| | .4 | Joints: to SMACNA or proprietary manufactured duct joint. Proprietary manufactured flanged duct joint shall be considered to be a class A seal. |

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|-----------------------------|----|--|
| 2.6 HANGERS AND SUPPORTS | .1 | Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hanger: 500mm wide. |
| | .2 | Hanger configuration: to SMACNA, galvanized steel angle with black galvanized steel rods to SMACNA HVAC Duct Construction Standard, Section 4. |
| | .3 | Upper hanger attachments: .1 For steel joist: manufactured joist clamp or steel plate washer. .2 For steel beams: manufactured beam clamps. |

PART 3 - EXECUTION

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|-------------|----|--|
| 3.1 GENERAL | .1 | Do work in accordance with SMACNA HVAC duct construction standards. |
| | .2 | Support risers in accordance with SMACNA. |
| | .3 | Install breakaway joints in ductwork on each side of fire separation. |
| | .4 | Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions. |

- | | | |
|-------------|----|---|
| 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 SMACNA HVAC duct construction standards. |
-

- 3.3 LEAKAGE TESTS
- .1 conduct leakage test in accordance with SMACNA HVAC Duct Leakage Test Manual.
 - .2 Make trial leakage tests as instructed to demonstrate workmanship.
 - .3 Install no additional ductwork until trial test has been approved by the Departmental Representative.
 - .4 Test section minimum of 22.5m long with not less than three (3) branch takeoffs and two 90° elbows.
 - .5 Complete test before insulation or concealment.

- 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 (1) coat of sealant to manufacturer's recommendations.

PART 1 - GENERAL

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

1.2 REFERENCES .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2006.

1.3 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00.
.2 Indicate construction, size and location.

PART 2 - PRODUCTS

2.1 GENERAL .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS .1 Of 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 nylon end bearings.
.5 Channel frame of same material as adjacent duct, complete with angle stop.

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.

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3.1 INSTALLATION
(Cont'd)

- .3 Locate balancing dampers in each branch duct.
- .4 Each grille, register and diffuser connection to have balancing damper located as close as possible to the main ducts.
- .5 Caulk air-tight between duct and damper frame.
- .6 Installation of dampers to be vibration free.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A-2018, Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S112-10(R2016), Fire Test of Fire Damper Assemblies.
 - .2 CAN4 S112.2-07(R2016), Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC S505-2004, Fusible Links for Fire Protection Service.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Smoke dampers.
 - .3 Operators.
 - .4 Fusible links.
 - .5 Design details of breakaway joints.

1.3 CLOSEOUT
SUBMITTALS

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

1.4 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 Provide six(6) fusible links of each type.

1.5 CERTIFICATE OF
RATINGS

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

PART 2 - PRODUCTS

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B or C, blades out of air stream listed and bear label of ULC, meet requirements of provincial fire authority and NFPA 90A. Fire damper assemblies to be fire tested in accordance with CAN/ULC S112. Minimum rating 1.5 hours, dynamically rated.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: offset, round or square; multi-blade hinged or interlocking type; roll door type; or guillotine type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 Retaining angle iron frame, 40 x 40 x 3 mm, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed to prevent disruption of ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.

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2.1 FIRE DAMPERS
(Cont'd)

- .10 Unless otherwise indicated, the installation details given in SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC and in manufacturer's instructions for fire dampers shall be followed.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 Air Duct Accessories.
- .5 Co-ordinate with installer of firestopping.
- .6 Confirm access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

3.2 COMMISSIONING

- .1 Commission in accordance with General Commissioning Requirements. Refer to Section 01 91 13.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Submittal Procedures: Section 01 33 00

1.2 REFERENCES

- .1 CAN/ULC-S110-13(R2018), Fire Tests for Air Ducts.
- .2 ANSI/UL 181-2017, Factory Made Air Ducts and Connectors.
- .3 NFPA 90A-2018, Installation of Air Conditioning and Ventilating Systems.
- .4 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.

1.4 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.

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.

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2.1 GENERAL
(Cont'd)

- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC
INSULATED (SUPPLY
AIR)

- .1 Non-collapsible, coated aluminum foil mylar type mechanically bonded to, and helically supported by, external steel wire with factory applied, 38mm thick flexible glass fibre thermal insulation with vapour barrier and reinforced mylar/neoprene laminate jacket.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 2.

PART 3 - EXECUTION

3.1 DUCT
INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110, UL-181, NFPA 90A, and SMACNA.
- .2 Maximum length of flexible duct: 2.1m.
- .3 Support properly at maximum 1.5m intervals with wide straps to prevent kinks in duct.
- .4 Use rigid sheet metal elbows at diffuser inlet necks. Maximum 15° offset with flexible duct.
- .5 Do not rest flexible ducts on the finished T-bar or GWB ceilings.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Contract Closeout.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASHRAE 51/AMCA 210-2016, Laboratory Methods of Testing Fans for Rating.
 - .2 ANSI/NFPA 90A-2018, Installation of Air Conditioning and Ventilating Systems.
- .2 International Organization of Standardization (ISO)
 - .1 ISO 3741-2010, Acoustics Determination of Sound Power Levels of Noise Sources Using Sound Pressure Precision Methods for Reverberation Rooms.
- .3 Underwriter's Laboratories (UL)
 - .1 UL 181-2013, Factory-Made Air Ducts and Air Connectors.

1.3 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.
 - .5 Dimensions.

1.4 SAMPLES AND
MOCK-UPS

- .1 Submit Samples And Mockups In Accordance With Section 01 33 00 - Submittal Procedures.
- .2 Submit Mockups in accordance with Section 01 45 00 - Quality Control.

-
- 1.5 TEST REPORTS .1 To ANSI/ASHRAE 51/AMCA 210. Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity. Sound power level with minimum inlet pressure of 0.25 kPa in accordance with ISO 3741 for 2nd through 7th octave band, by independent testing agency. Pressure loss through silencer must not exceed 60% of inlet velocity pressure maximum.
- 1.6 CLOSEOUT SUBMITTALS .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.
- 1.7 CERTIFICATION .1 Catalogued or published ratings to be those obtained from tests carried out by manufacturer or those ordered by him from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.
- 1.8 EXTRA MATERIALS .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

PART 2 - PRODUCTS

- 2.1 MANUFACTURED UNITS .1 Terminal units of the same type to be product of one (1) manufacturer.
- 2.2 VAV OR BYPASS BOXES .1 Sizes, capacities, pressure loss, and discharge sound pressure level: as indicated.
- .2 Discharge sound pressure level: to be less than 35 NC.
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- 2.2 VAV OR BYPASS BOXES
(Cont'd)
- .3 Complete with:
 - .1 Minimum air volume stop.
 - .2 Controller and operator as specified under 25 30 02 - EMCS: Field Control Devices.
 - .3 Manual balancing damper.
 - .4 Sound attenuator: as indicated.
 - .4 Casing: constructed of 0.75 mm thick galvanized steel, internally lined with 25 mm, 0.7 kg density fibrous glass, to UL 181 and ANSUNFPA 90A. Mount control components inside protective metal shroud.
 - .5 Damper: galvanized steel with peripheral gasket and self-lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.

PART 3 - EXECUTION

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

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Submittal Procedures: Section 01 33 00
- .2 Closeout Submittals: Section 01 78 00

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate the following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00.

1.4 CERTIFICATIONS

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

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .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.
- .2 Frames:
 - .1 Full perimeter gaskets.

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|---|----|--|
| <u>2.1 GENERAL (Cont'd)</u> | .2 | (Cont'd) |
| | .2 | Plaster frames where set into plaster or gypsum board. |
| | .3 | Concealed fasteners. |
| | .3 | Concealed manual volume control damper operators as indicated. |
| | .4 | Colour: standard or as directed by the Departmental Representative. |
| | | |
| <u>2.2 MANUFACTURED UNITS</u> | .1 | Grilles, registers and diffusers of same generic type, products of one manufacturer. |
| | | |
| <u>2.3 SUPPLY GRILLES AND REGISTERS</u> | .1 | See Schedule. |
| | | |
| <u>2.4 RETURN AND EXHAUST GRILLES AND REGISTERS</u> | .1 | See Schedule. |
| | | |
| <u>2.5 DIFFUSERS</u> | .1 | See Schedule. |
| | | |
| <u>2.6 LINEAR GRILLES</u> | .1 | See Schedule. |
| | | |
| <u>PART 3 - EXECUTION</u> | | |
| | | |
| <u>3.1 INSTALLATION</u> | .1 | Install in accordance with manufacturers' instructions. |
| | .2 | Install with flat head stainless steel or cadmium plated screws in countersunk holes where fastenings are visible. |
| | .3 | Provide concealed safety chain on each grille, register and diffuser where noted on the Project Drawings. |
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