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### 3.3 Data Conduit

#### 3.3.1 General

The conduits shall be run in the shortest straight runs wherever possible. Minimum requirements for installed conduit, such as support, end protection, and continuity, are found in the following sections. No section of conduit shall be longer than 30 m (100 ft) or contain more than two 90 bends between pull points or pull boxes (a double offset is equal to one 90 degree bend).

All conduits shall be rigidly installed, adequately supported and properly reamed at both ends. Sections of conduit shall be joined with approved couplings and conduit terminations in outlet boxes, pull boxes, etc., shall be made using approved fittings. All conduits and fittings must be adequately anchored to permit pulling in of cables.

#### 3.3.2 Products

##### 3.3.2.1 Conduit

1. Use EMT conduit unless specified otherwise.
2. Factory bends where 90 degree bends are required for 30 mm and larger conduits.
3. Conduit Sizing

Conduit		Trade Size		Number of cables	Number of drops
Internal diameter				Wire OD	2 cables per drop
mm	in	mm	in	mm 5.2 in 0.205	
20.9	0.82	20	¾	4	2
26.6	1.05	25	1	8	4
35.1	1.38	30	1-1/4	12	6
40.9	1.61	40	1-1/2	16	8
52.5	2.07	50	2	24	12
62.7	2.47	60	2-1/2	38	19
77.9	3.07	75	3	54	27
90.1	3.55	90	3-1/2	TBD	TBD
102.3	4.02	100	4	TBD	TBD

##### 3.3.2.2 Conduit Fittings

1. Steel set screw connectors and couplings for EMT. Die cast connectors and couplings are not acceptable.
2. LB fittings are not allowed.
3. All bushings and connectors shall have have nylon insulated throats.
4. Fittings to be manufactured for use with conduit specified.

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### 3.3.2.3 Conduit Fastenings and Supports

1. One hole steel straps to secure surface conduits smaller than 50 mm. Two hole steel straps for 50 mm conduits.
2. Beam clamps to secure conduits to exposed steel work.
3. Channel type supports for two or more conduits.
4. Six mm dia threaded rods to support suspended channels.
5. Channels will be U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted where required. Galvanized complete with accessories as required.

### 3.3.2.4 Conduit Boxes

1. Outlet Boxes - Outlet boxes shall be no smaller than 50 mm wide, 75 mm high, 64 mm deep (2 in, 3 in, 2-1/2 in). This box will accommodate one or two 3/4 trade size conduit. Where a larger trade size conduit is required the box size shall be increased accordingly. A maximum 1-1/4 trade size conduit will require a 120 x 120 x 64 mm (4-11/16 x 4-11/16 x 2-1/2 in) outlet box. Where a No. 1 trade size conduit is required, a minimum 100 x 100 x 57 mm (4 x 4 x 2-1/4 in) box shall be used.

Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of data outlets on concrete surfaces.

2. Pull Boxes - Where a pull boxes are required, they shall be sized per the following table:

**Pull Box Sizing**

Conduit trade size	Width		Length		Depth		Width increase for each additional conduit	
	mm	in	mm	in	mm	in	mm	in
1	300	12	300	12	100	4	75	3
1-1/4	350	14	350	14	125	5	100	4
1-1/2	400	16	400	18	150	6	100	4
2	450	18	500	20	200	8	100	4
2-1/2	600	24	600	24	200	8	150	6
3	600	24	750	30	250	10	150	6
3-1/2	600	24	900	36	250	10	150	6
4	600	24	1200	48	300	12	200	8

### 3.3.3 Execution

#### 3.3.3.1 Conduit

1. Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

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2. Use EMT conduit except where specified otherwise.
  3. Bends - The inside radius of a bend in conduit shall be at least 6 times the internal diameter. When the conduit size is greater than 50 mm (2 in), the inside radius shall be at least 10 times the internal diameter of the conduit. For fiber optic cable, the inside radius of a bend shall always be at least 10 times the internal diameter of the conduit.  
  
Bend conduit cold. Replace conduit if kinked or flattened more than 10 per cent of it's original diameter.
- Mechanically bend steel conduit over 19mm dia. Conduits 32mm and larger to be bent using a hydraulic bender or use factory bends. Conduits found to be bent using methods other than indicated above will be removed.
4. Install fish cord in empty conduits.
  5. All circuits indicated on these drawings will be run in new conduit.
  6. Minimum size conduit to be used on this project is 19mm, 12mm conduit is unacceptable.
  7. Run parallel or perpendicular to building lines.  
Run conduits in flanged portion of structural steel.
  8. Group conduits wherever possible on surface channels.
  9. Do not pass conduits through structural members except as indicated.
  10. Do not locate conduits less than 75 mm parallel to steam or hot water lines with a minimum of 25 mm at crossovers.
  11. A pull cord shall be installed in all conduit runs. The pull cord shall be 3 mm braided nylon waterproof cord.
  12. Any single conduit run extending from a telecommunications closet shall not serve more than three outlets. Conduit shall be sized per Section 3.3.2.1 and shall be incrementally increased in size from the furthest outlet toward the telecommunications closet.
  13. Conduit shall be reamed to eliminate sharp edges and terminated with an insulated bushing. Conduit protruding through the floor shall be terminated 25-50 mm (1-2 in) above the floor surface.
  14. All conduits shall be left clean, dry and free of debris or other obstructions.
  15. Pull boxes shall be used for the following purposes:
    - 15.1. fishing the conduit run;
    - 15.2. pulling the cable to the box and then looping the cable to be pulled into the next length of conduit
  16. Pull boxes shall be placed in an exposed location, and readily accessible. Where boxes are installed above suspended T-bar ceilings they shall be located immediately above the ceiling and the location of the pull box shall be identified with blue coloured labels attached to the T-bar grid. Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked hinged panel. Pull boxes shall not be placed

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in a metal linear ceiling space, unless immediately above a suitably marked hinged panel.

17. A pull box shall be placed in a conduit run where
  - 17.1.1. the length is over 30 M (100 ft);
  - 17.1.2. there are more than two 90 degree or equivalent bends; or
  - 17.1.3. if there is a reverse bend in the run.
18. Boxes shall be placed in a straight section of conduit, and not used in lieu of a bend. The corresponding ends of the conduit are to be aligned with each other.
19. Conduit fittings shall not be used in place of pull boxes.
20. All conduit shall be clearly labelled at both ends to designate the floor closet by number (eg, CP2.1-1), which shall include the sequential numbering of the conduit originating at that closet (ie, -3). Conduit length shall also be indicated on the label. Pull boxes shall be labelled on the exposed exterior.

### 3.3.3.2 Conduit Fittings

#### 3.3.3.3 Conduit Fastenings and Supports

1. Secure equipment to hollow masonry, tile and plaster surfaces with nylon shields.
2. Secure equipment to poured concrete with expandable inserts.
3. Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
4. Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
5. Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
6. Fasten exposed conduit or cables to building construction or support system using straps.
  - 6.1. One-hole steel straps to secure surface conduits smaller than 50 mm.
  - 6.2. Two-hole steel straps for 50 mm conduits.
  - 6.3. Beam clamps to secure conduit to exposed steel work.
7. Suspended support systems.
  - 7.1. Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - 7.2. Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
8. For surface mounting of two or more conduits use channels at code spacing.
9. Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

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10. Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
11. Do not use wire lashing or perforated strap to support or secure raceways or cables.
12. Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
13. Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturers installation recommendations.

### 3.3.3.4 Conduit Boxes

1. Support boxes independently of connecting conduits.
2. Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.
3. For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
4. Provide correct size of openings in boxes for conduit, reducing washers not allowed.

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### 3.4 Raceway

#### 3.4.1 General

Perimeter pathways serve work stations where telecommunications devices can be reached from walls at convenient levels. Surface metal and surface nonmetal raceways shall be limited to use in dry locations. For other requirements see appropriate building and electrical codes.

#### 3.4.2 Products

1. Single Channel Raceway - A single channel raceway, consisting of a base, cover, couplings, elbows, and similar fittings mounts directly onto wall surfaces at appropriate work levels to provide a continuous perimeter pathway. Telecommunications outlets are located in cover fittings along the raceway and may be moved or added after initial installation.
2. Multichannel Raceway - Multichannel raceway provides perimeter pathways for different systems in combination, such as telecommunications, power, and lighting circuits. The same relative location of each channel is maintained for each system throughout the premises. In multichannel metal raceways, dividers that separate compartments shall be bonded to ground.
3. Raceway must provide 1 inch minimum bend radius control for cables.
4. Standard of Acceptance - Panduit Pan-Way Products, Single Channel Types CD,LD, LDP and Multichannel Type T.

#### 3.4.3 Execution

1. All raceway and fittings must be screwed to wall surface, adhesive mounting is not acceptable.
2. Fill rate not to exceed manufacturers recommendations for Category 5 Data Grade 4 pair UTP cable.

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### 3.5 Cable Tray

#### 3.5.1 General

Cable trays and wireways are rigid structures for the containment of telecommunications cables. These pathways shall be installed in accordance with the applicable electrical code.

#### 3.5.2 Products

Channel cable tray: a prefabricated structure with a one-piece ventilated bottom or solid bottom channel section not exceeding 150 mm (6 in) wide.

Ladder cable tray: a prefabricated structure consisting of two side rails connected by individual transverse members.

Solid bottom cable tray: a prefabricated structure consisting of a solid bottom within longitudinal side rails.

Ventilated or trough cable tray: a prefabricated structure greater than 100 mm (4 in) in width and consisting of a ventilated bottom within two side rails. (See Figure 4.5-1.)

Wireway: a prefabricated structure available in 64 x 64 mm (2-1/2 x 2-1/2 in), 100 x 100 mm (4 x 4 in), and 150 x 150 mm (6 x 6 in). The structure shall consist of a 16 AWG metal trough equipped with a hinged cover. (See Figure 4.5-2.)

Accessories used with cable trays and wireways, include such items as covers, hold-down devices, dropouts, conduit adapters, and dividers.

Cable trays and wireways may be divided by a barrier to allow the placement of both power and telecommunications cables as required by the *Canadian Electrical Code, Part I*.

#### 3.5.3 Execution

1. Trays and wireways may be located below or above the ceiling in either plenum or nonplenum applications.
2. Cable trays are supported by three basic support devices: cantilever brackets, trapeze, and individual rod suspension. Supports are located where practicable so that connections between sections of the tray fall between the support points and the quarter sections of the span. The support centres shall be in accordance with the load and span as specified in the *Canadian Electrical Code, Part I*, for the applicable class. Ideally, a support shall be placed within 610 mm (2 ft) on each side of any connection to a fitting. Wireways shall be supported on 1500 mm (5 ft) centres unless designed for greater lengths.
3. The fittings used include elbows, reducers, crossovers, and tees. These fittings are used to change direction or size of the tray or wireway.
4. The inside of the cable tray or wireway shall be free of burrs, sharp edges, or projections which could damage cable insulation. When a wireway passes through a partition or wall it shall be an unbroken length and if necessary, firestopped. Telecommunications cables shall not exceed 40% of the available cross-sectional area. Metal cable trays and wireways shall

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be bonded to ground. Cable trays and wireways shall not be used as walkways or ladders unless specifically designed and installed for that purpose.

5. A minimum of 300 mm (12 in) access headroom shall be provided and maintained above a cable tray. Care shall be taken to ensure that other building components, eg, air conditioning ducts, do not restrict access to trays or wireways.

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### 3.6 Utility Columns

#### 3.6.1 General

Utility columns provide pathways for the wires and cables from the ceiling to the work station. Utility columns used for both telecommunications and power distribution shall comply with the *Canadian Electrical Code, Part I*.

#### 3.6.2 Products

1. Indoor service poles: extruded aluminum sections to CSA HA Series - M1980 anodized finish of 10 micrometres thickness.
2. Nominal length of poles: 3m in areas with TBar ceilings, 4.3m in areas with exposed ceilings and other miscellaneous heights as required.
3. Service poles approximately 50 mm square with snap-on covers to provide access to wiring without removing unit. Barrier to isolate power from communication system where required.
4. Service poles with fastening accessories at top of pole to secure to inverted T-Bar ceiling using Bet screws to permit relocation. Flange at ceiling to conceal wiring.
5. Metal or PVC sleeve at bottom of pole to conceal vertical adjustment. Reversible grip-tight devices for carpet and tile floors to prevent movement of poles.
6. Service poles with dual knockouts to fit DECO inserts, data wiring supplied and installed by the data contractor.
7. Standard of Acceptance: Wiremold NP600-2-10-6

#### 3.6.3 Execution

1. Utility columns shall be attached to and supported by main ceiling support channels; the utility columns shall not be attached to the transverse or short length channels unless they are also rigidly secured to the main support channel. When utility columns are used, the main ceiling rails shall be rigidly installed and braced to overcome movement, both vertical and horizontal.
2. Install service poles as indicated and as directed on site by Engineer.
3. Install service poles in accordance with manufacturer's recommendations. Secure to ceiling and to finished floor. Adjust length as required.
4. Re-adjust service poles as required after data cabling is installed.

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### 3.7 Copper Cabling

#### 3.7.1 General

#### 3.7.2 Products

Products shall be NordX/CDT Category 5 only. This includes the following items:

- Bulk Cable
- Patch Cables
- Faceplates
- Data Jacks
- Patch Panels
- Interbay Panels

#### 3.7.3 Execution

1. All telecommunications outlet/connectors, patch panels, cross connects, cabinets, plywood backboard, and other components shall be labeled using a mechanically imprinted label or a system as defined by the purchaser. Regardless of the numbering scheme, every cable shall have the same permanent identifier on its termination hardware at both ends.
2. All four pairs of each unshielded twisted pair (UTP) cable shall be terminated on a single port. The splitting of cable pairs between different jacks is not permitted. Terminating resistors required in certain applications shall be placed externally to the telecommunications outlet/connector.
3. Terminating cable pairs (Category 5) shall have a maximum of 13 mm (0.5 in.) of cable untwisted before termination.
4. Each distribution rack shall be connected to the ground bus in the TCs in accordance with the applicable code requirements as per CSA T527.
5. All voice and data equipment shall be properly grounded in the telecommunications closets to meet the manufacturer's requirements.
6. Cable trays shall be provided and utilized in the MC, IC, and TC's to manage cable in an orderly fashion. Cable management should be installed in racks and on walls as per manufacturer's recommendations.
7. Appropriate fire barriers shall be placed around the cables in the sleeves, and unused sleeves shall be properly fire stopped.
8. Installation should be performed in a professional manner using the best practices in the industry. Best practices shall include, but not be limited to, the following points:
9. Backbone cabling utilizing a shield shall be bonded at each sheath opening.
10. All grounding conductors must be rated CMP and must be neatly tied in bundles and fastened to the under-slab or metal structure at intervals not to exceed six feet.
11. All cabling shall be continuous without joins, or splices from the work area to the TCs.

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12. All cables installed by vendor or subcontractor shall be properly contained in conduit, cable tray, raceway, or duct. Where none of these support media are available, the individual cables shall be formed into cable harnesses, neatly run, properly dressed, supported and secured with appropriate cable ties to the under-slab or metal structure at intervals not to exceed six feet.
13. All exposed cabling is to be installed and routed in a neat and professional manner. Proper manufacturer systems training provides instruction in this area. All exposed cable bundles to be tie-wrapped at a maximum of every 12 in. All cable-ties used shall be hand tightened only to a point where the sheath does not kink.
14. If conduit is used, the maximum number of bends between cable pulling points shall be two ninety degree bends over a maximum of 100 ft.
15. Horizontal fill ratios for conduit, cable trays, raceways and ducts shall conform with standards and manufacturer recommendations and shall not exceed 40%.
16. A pull cord shall be left in all conduit runs after cable installation.
17. Cable management shall be provided in all closets for both bulk cable and patch cables. This will be accomplished with D-rings and interbay panels.
18. All closet terminations shall maintain congruence between A and B patch fields. That is each drop will have the same termination position on both patch panels.
19. All drop terminations shall maintain a logical numbering sequence.
20. All optical fiber and copper cables shall be handled, installed, and supported in accordance with the manufacturer's guidelines. During the laying of the cable, installer shall take care not to overstress the cable. After the cable is installed, installer shall make sure that all parts of the cable are supported properly and shall be stress free at both ends and throughout their length.
21. Appropriate attention shall be given to the handling of Category 5 copper cables to ensure that bending radius conforms to the manufacturer's requirements. At no time shall the cable's static or dynamic bending radius be exceeded.
22. All telecommunications outlet/connectors shall be securely mounted at all work area locations and shall be located so that the cable required to reach the work area equipment will be no longer than three meters.
23. The total optical attenuation through the cross-connect from any terminated fiber to any other terminated fiber shall not exceed 2.0 dB.
24. Optical fiber splices, fusion or mechanical, shall not exceed a maximum optical attenuation of 0.3 dB when measured in accordance with ANSI/TIA/EIA-455 -34.
25. Minimum clearance between cables and power sources are shown below:

### Separation Distances from EMI Sources

<u>Condition</u>	<u>Minimum Separation</u>		
	<2kVA	2-5kVA	>5kVA
Unshielded power lines or electrical equipment	127 mm	305 mm	610 mm

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in proximity to open/nonmetal pathway		5 in.	12 in.	24 in.
Unshielded power lines or equipment in proximity to a grounded metal conduit pathway.		64 mm 2.5 in	152 mm. 6 in.	305 mm 12 in.
Power lines enclosed in shielded or grounded metallic conduit in proximity to a grounded metal conduit pathway		0 mm. 0 in.	76 mm. 3 in.	152 mm. 6 in.
Transformers & electrical motors	1016 mm. 40 in.			
Fluorescent light (coil or electric start)	305 mm. 12 in.			

#### 3.7.3.1 Housekeeping

All closets and terminal facilities must be free of cable clippings, empty reels, cartons or other refuse resulting from the installation.

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### 3.8 Data Closets

All data closets are existing, locations are listed in following table:

Building	Closet Designator	Room Number	Closet Type	
Library	L-1.1	L1004	Entrance	
	L-1.2	L1015A	Riser	
	L-2.1	L2027B	Riser	
	L-3.1	L3017A	Riser	
	L-5.1	L5001A	Riser	
Henrietta Harvey	HH-2.1	HH2034	Entrance	
	HH-3.1	HH3023	Riser	
Chemistry/Physics	C-1.1	C1034	Entrance	
	C-1.2	C1017A	Riser	
	C-2.1	C2043A	Riser	
	C-4.1	C4020A	Riser	
	C-4.2	C4043A	Riser	
	C-C.1	C4063A	Computer Room	
Spencer Hall	SP-0.1	SP002	Entrance	
	SP-1.1	SP1000A	Riser	
	SP-2.1	SP2000C	Riser	
	SP-3.1	SP3021	Riser	
	SP-4.1	SP4011	Riser	
Science	S-1.1	S1029A	Entrance	
	S-1.2	S1079	Riser	
	S-2.1	S2105A	Riser	
	S-2.2	S2026A	Riser	
	S-2.3	S2048A	Riser	
	S-4.1	S4021A	Riser	
	S-4.2	S4079A	Riser	
	TSC	T-2.1	SC2022R	Entrance
		T-2.2	SC2014	Riser
	Hatcher	H9-3.1	9-313A	Entrance
OSC OSC Annex	OS-4.1	OS4000A	Entrance	
	AX-3.1	AX3003	Riser	
St. John's Coll.	J-3.1	J3006	Entrance	
T10	PA-1.1	PA1013B	Entrance	
Biotech	BT-4.1	BT4000C	Entrance	

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<b>Music</b>	MU-1.1	MU1046A	Entrance
	MU-2.1	MU2004A	Riser
<b>Corte Real</b>	BP-2.1	BP2011A	Entrance
<b>CERR</b>	ER-1.1	ER1000D	Entrance
	ER-3.1	ER3021	Riser
	ER-4.1	ER4022A	Riser
	ER-4.2	ER4067	Riser
	ER-6.1	ER6016	Riser
	ER-C.1	ER4057	Riser
<b>Arts &amp; Admin.</b>	A-1.1	A1047	Entrance
	A-2.1	A2066	Riser
	A-3.1	A3097	Riser
	A-3.2	A3045	Riser
	A-4.1	A4072	Riser
<b>Centrifuge</b>	CF-2.1	CF2021	Entrance
<b>C-CORE</b>	K-2.1	K2028	Entrance
<b>Engineering</b>	X-1.1	X1039	Entrance
	X-1.2	X1053	Riser
	X-1.3	En1035F	Riser
	X-3.1	X3034	Riser
	X-C.1	X3029B	Computer Room
<b>Education</b>	E-1.1	E1003A	Entrance
	E-2.1	E2003A	Riser
	E-3.1	E3004A	Riser
	E-4.1	E4011A	Riser
	E-5.1	E5009D	Riser
<b>Bus. Admin</b>	B-1.1	BU1015A	Entrance
	B-3.1	BU3011B	Riser
<b>Feild</b>	GH-2.1	GH2021	Entrance
<b>Phys Ed.</b>	G-1.1	PE1001	Entrance
	G-1.2	PE1015A	Riser
<b>T12</b>	CS-1.1	CS1002	Entrance
<b>6 Clark Place</b>	6CL-2.1	2G-A	Entrance
<b>4 Clark Place</b>	4CL-1.1	4CL-1000A	Entrance
<b>Services</b>	SV-1.1	FM2015A	Entrance

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<b>HSC</b>	HS-1.1	HS1803-C	Riser
	HS-1.2	HS1901-A	Riser
	HS-1.3	HS1602-B	Riser
	HS-1.4	HS1205-D	Riser
	HS-2.1		Riser
	HS-2.2		Riser
	HS-2.3	HS2404-A	Riser
	HS-3.1	HS3301-A	Entrance
	HS-3.2		Riser
	HS-5.1	HS5508-A	Riser
<b>Queen's College</b>	Q-4.1	Q4013	Entrance

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### 3.9 Fiber Optic Cable

#### 3.9.1 General

The supply and installation of fiber optic cable and components is beyond the scope of this document. The following section is included for reference only.

#### 3.9.2 Products

Products shall be as shown below:

- Bulk Cable                      Chromatics Technology
- Patch Cables                  Sumitomo
- Termination Equipment      ADC FL-2000 Series
- Connectors                    Siecor Uni-Cam Series

Products to match existing components.

#### 3.9.3 Execution

1. All telecommunications outlet/connectors, patch panels, cross connects, cabinets, plywood backboard, and other components shall be labeled using a mechanically imprinted label or a system as defined by the purchaser. Regardless of the numbering scheme, every cable shall have the same permanent identifier on its termination hardware at both ends.
2. All multimode fiber termination shall use SC connectors. All singlemode fiber termination shall use SC connectors.
3. Cable trays shall be provided and utilized in the MC, IC, and TC's to manage cable in an orderly fashion. Cable management should be installed in racks and on walls as per manufacturer's recommendations.
4. Appropriate fire barriers shall be placed around the cables in the sleeves, and unused sleeves shall be properly fire stopped.
5. Installation should be performed in a professional manner using the best practices in the industry.
6. All grounding conductors must be rated CMP and must be neatly tied in bundles and fastened to the under-slab or metal structure at intervals not to exceed six feet.
7. All cables installed by vendor or subcontractor shall be properly contained in conduit, cable tray, raceway, or duct. Where none of these support media are available, the individual cables shall be formed into cable harnesses, neatly run, properly dressed, supported and secured with appropriate cable ties to the under-slab or metal structure at intervals not to exceed six feet.
8. All exposed cabling is to be installed and routed in a neat and professional manner. Proper manufacturer systems training provides instruction in this area. All exposed cable bundles to be tie-wrapped at a maximum of every 12 in. All cable-ties used shall be hand tightened only to a point where the sheath does not kink.

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9. If conduit is used, the maximum number of bends between cable pulling points shall be two ninety degree bends over a maximum of 100 ft.
10. Horizontal fill ratios for conduit, cable trays, raceways and ducts shall conform with standards and manufacturer recommendations and shall not exceed 40%.
11. All optical fiber and copper cables shall be handled, installed, and supported in accordance with the manufacturer's guidelines. During the laying of the cable, installer shall take care not to overstress the cable. After the cable is installed, installer shall make sure that all parts of the cable are supported properly and shall be stress free at both ends and throughout their length.
12. Appropriate attention shall be given to the handling of fiber optic cables to ensure that bending radius conforms to the manufacturer's requirements. At no time shall the cable's static or dynamic bending radius be exceeded.
13. The total optical attenuation through the cross-connect from any terminated fiber to any other terminated fiber shall not exceed 2.0 dB.
14. Optical fiber splices, fusion or mechanical, shall not exceed a maximum optical attenuation of 0.3 dB when measured in accordance with ANSI/TIA/EIA-455 -34.

### 3.9.3.1 Housekeeping

All closets and terminal facilities must be free of cable clippings, empty reels, cartons or other refuse resulting from the installation.

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### 3.10 Documentation

#### 3.10.1.1 As-built Drawings

Revisions to the MUNet Data Drawings in CAD format are required. As-built data shall include all electrical, architectural and data work performed. Data drops shall show patch panel termination position information. Data drop location shall be accurate to within 12 inches. Drawings shall be delivered in hardcopy and softcopy format. Softcopy shall be AutoCAD Release 13 (DWG files) on 3-1/2 inch floppy disks in Microsoft Windows compatible format. Hardcopy shall be in D-size format with one copy in reproduceable master and two copies in blueprint form.

#### 3.10.1.2 Test Data

1. Commissioning verification, inspection and certification shall be provided.
2. End-to-end testing for UTP copper shall be conducted for 100% of pairs and shall identify pair reversal, crossed pairs, opens, and shorts. The test results shall be documented, corrections implemented and retesting conducted and documented. In addition documentation shall be presented to show the length of the cable between the data closet and the data drop in the work area.
3. Attenuation testing for optical fiber shall be done after the fiber is installed.
4. Optical time domain reflectometer (OTDR) testing of all optical fiber cables is optional at installation. However, if the optical fiber is suspected by the customer or manufacturer in any network problems, then vendor will provide at reasonable additional cost, OTDR testing during the troubleshooting process. Vendor shall quote optical fiber testing costs as a separate line item along with response to Request For Proposal (RFP).
5. Verify labeling of all wiring at all termination points.
6. Written verification confirming that the testing and inspection has been completed and that all cable runs have passed shall be provided. Document that all defects have been identified, corrected, and retested successfully.
7. Purchaser shall be notified before testing is carried out so that the purchaser can witness all tests.
8. Final testing shall be carried out only after substantial completion.
9. Test data shall be delivered primarily in softcopy format. Individual link tests will be submitted in Comma Separated Value (CSV) format on 3-1/2 floppy disks in Microsoft Windows compatible format, no hardcopy required. Summary data cross referencing data drop to room number shall be delivered in both hardcopy and softcopy format.

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## MUNet Specification

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### 3.11 Labelling

#### 3.11.1 General

All distribution panels, cross-connects, cables and faceplates will be marked with appropriate labels, approval by Computing and Communications, in accordance with the Cable Schedule.

Labels will be installed as follows:

One label at each end of each cable prior to pulling. These labels will not survive stripping back the cable sheath

One label at each end of the cable sheath after stripping.

One label on the inside of each outlet box, plus labelling on the outside of each faceplate in the space provided.

#### 3.11.2 Implementation:

The labelling system used for all drops is a ten character alpha numeric string (10 for buildings with two character identifiers, 9 for buildings with one character identifiers). The label is formatted in the following manner, **L51-5001A**, and contains embedded information to allow easy identification of the following items:

Building	<b>L</b>	this may consist of one or two characters and conforms to the MUNet Building identification plan.
Closet	<b>51</b>	closets are identified by their own floor and sequence number.
Field Separator	<b>-</b>	
Floor	<b>5</b>	floor on which drop is located
Sequence	<b>001</b>	three digit sequence number
Field	<b>A</b>	this may be either A or B and is the termination field identifier in closet. The majority of MUNet faceplates support two drops, each of which is terminated on a separate patch field in the closet

The drop labels consist of a two section white label with black lettering. The first section contains the Building and Closet information. The second section contains the Floor, Sequence and Field information. The total label size is approximately 1/2 x 1-1/2 inches (12 x 38 mm).

The following diagram illustrates the MUNet faceplate types and the typical label locations for each type.

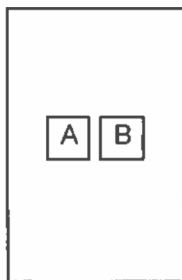
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MUNet Specification

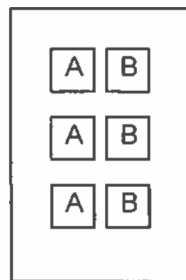
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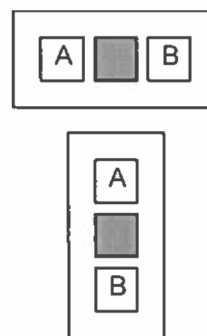
Surface Mount - Dual



Flush Mount - Dual



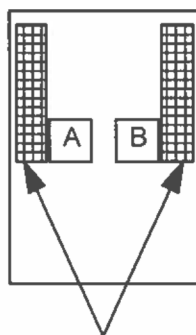
Flush Mount - Six



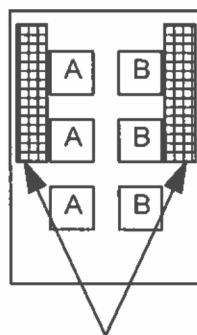
DECO Mount - Dual



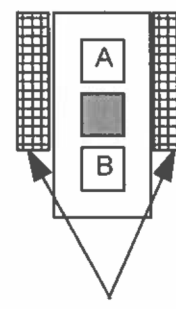
Label to be located on sides.



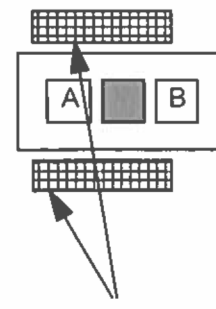
Label locations.



Label locations.



Label to be located on mounting assembly.



Label to be located on mounting assembly.

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## **ADDENDUM A**

January 30, 2008

The attached addendum supersedes the original Information and Specifications regarding the MUNet Specification Revision B dated 18 March 1997, where it adds to, deletes from, clarifies or otherwise modifies them. All other conditions and previous addendums shall remain unchanged.

### **1.1 General**

The overall objective of the original MUNet Specification hasn't changed. It was intended to supply information to various personel involving minor alterations to the existing MUNet Cable Plant where changes are made to existing installed infrastructure.

New infrastructure requirements are still to be considered outside the objective of this publication, but in saying that some updated information will be supplied within this addendum.

### **1.2 Notice**

Some Recommendations should be addressed.

- Never assume, always check
- Follow recommendations outlined in MUNet Specification
- Use BICSI TDMM manual guidelines
- Follow proper cabling standards
- Approval from Computing & Communications Department

### **1.3 Description of Work**

Nordx/CDT IBDN Cabling is still an approved manufacturer to supply products to be used in the MUNet cable plant . Other manufacturers must adhere to the strict manufacturing guidelines followed by top tier suppliers such as Nordx/CDT. These manufacturers must meet approval from the Department of Computing & Communications.

### **1.4.2 Qualification of System**

The certification supplied from the manufacturer must now reflect a Category 6 level that must be capable of Gigabit Transmission over the full design criteria of 100M.

### **2.2.1 Backbone**

The use of Radio links and Wireless Transmission are not accepted as a means to supply backbone support to buildings seeking MUNet services. Where dedicated Fiber optic services are deemed not cost effective other services may be supplied

with the approval of the Department of Computing and Communications.

The backbone system will consist of two 24 Singlemode fiber connections supplied in redundant fibers using a redundant path configuration. These backbone cables and routing must be done in coordination the Department of Computing & Communications.

The purpose of this backbone fiber will be considered for sole use of the MUNET cable system, additional service requirements by other interests should be considered in addition to and in coordination with interested parties.

### **2.2.2 Riser**

The riser closets shall be connected to the building entrance closets using a 12 strand Singlemode configuration wired in a physical star arrangement.

### **2.2.3 Horizontal Distribution**

New building or new closet builds should reflect the advancement of cabling technologies. Horizontal cables should consist of at least two four pair Unshielded Twisted Pair (UTP) Category 6 Cables terminated in accordance with CSA T529 and EIA/TIA 568B-2006 using the preferred 568A pinout wiring. These wires will be considered exclusively for MUNet purposes and any extra services (eg Telephone or fax services) must include additional cables.

Patch Panel layout and placement must be approved by the Department of Computing and Communications prior to installation.

### **2.5.2 Design Guidelines**

Fill rates should now reflect the use of Category 6 cabling and its increased diameter.

### **2.8.2 Cabling Design Guidelines**

Design Guidelines should now reflect the use of Category 6 UTP cabling in its criteria.

### **2.8.3 Entrance Facilities**

All entrance facilities and riser closets must be provided with a connection to a UPS system that will be designed and installed in coordination with both the Department of Facilities Management and the Department of Computing and Communications. This system must also be connected to the Emergency power grid or provided some source of emergency power.

### **3.2.2 Products**

Products should reflect the use of Category 6 UTP Cabling.

### **3.4.3 Execution**

Products should reflect the use of Category 6 UTP Cabling.

### **3.7.2 Products**

Products shall be Category 6 specification. This includes the following items:

- Bulk Cable
- Patch Panels
- Faceplates
- Data jacks
- Patch Cables
- Interbay panels

### **3.7.3 Execution**

Products should reflect the use of Category 6 UTP Cabling.

### **3.9.1 General**

Products shall conform to exceed performance of listed products. Variances from the products listed may be granted at the discretion of the department of Computing and Communications.

### **3.10.2 Test Data**

Testing shall be in accordance with the ANSI/TIA/EIA 568-2006 specification. Labeling shall be in accordance to the ANSI/TIA/EIA 606 (A) standard and the MUNet scheme outlined in the MUNet Specification. Testing of Category 6 cabling shall be accomplished using level IIe or higher field testers and measured to be able to Pass Gigabit 1000baseT transmission requirements. Testing of Multimode fiber cabling should be done in accordance with the ANSI/EIA/TIA-526-14A:OFSTP-14A procedure guidelines. Testing of Singlemode fiber cabling should be done in accordance with the ANSI/EIA/TIA-526-7 procedure guidelines.

## **4.0 Conclusion**

### **4.1 Consideration**

Although the premise of this document is to provide a guideline to parties involved in duties which may include providing access to the MUNet Cabling system, it should not be treated as a building design tool. All products and procedures outlined in the preceding document are in reference to a Data network named MUNet and should be considered as just that. Although the provisions for this network can be placed in conjunction with the overall building design procedures, it should be treated as an "entity" upon itself. Overall building network installations should follow the TIA/EIA 568B-2006 standard and those illustrated in the BICSI TDMM (Telecommunications Distribution Methods Manual).

### **4.2 Emerging technologies**

With the advent of new technologies such as VOIP (Voice over internet protocol), POE (Power over Ethernet), IPVideo (Video over Ethernet) and various Wireless Ethernet protocols consideration should be given on a case by case scenario. Each has associated with them various standards and guidelines of their own which may need to be considered when merging with the MUNet Cabling System. The Department of Computing and Communications can assist further if any of these technologies are being considered.

**Important note:**

This document should be treated as a living document and is to be amended as technologies change. Please send your suggestions to:

Derek Greenland RCDD  
Computing and Communications  
[dgreenla@mun.ca](mailto:dgreenla@mun.ca)

- .2 Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and control system.
- .3 Compare design to installed equipment and field installations.
- .4 Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.
- .5 Check filters for cleanliness.
- .6 Check dampers for correct and locked position, and control system for completeness of installation before starting fans.
- .7 Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
- .8 Determine best locations in main and branch ductwork for most accurate duct traverses.
- .9 Place outlet dampers in the full open position.
- .10 Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.
- .11 Lubricate all motors and bearings.
- .12 Check fan belt tension.
- .13 Check fan rotation.

### 3.2 MEASUREMENTS

- .1 Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- .2 Provide instruments meeting the specifications of the referenced standards.
- .3 Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.
- .4 Apply instrument as recommended by the manufacturer.
- .5 Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.
- .6 When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- .7 Take all reading with the eye at the level of the indicated value to prevent parallax.
- .8 Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- .9 Take measurements in the system where best suited to the task.

**3.3 PERFORMING TESTING, ADJUSTING AND BALANCING**

- .1 Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
- .2 Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- .3 Patch insulation, ductwork, and housings, using materials identical to those removed.
- .4 Seal ducts and piping, and test for and repair leaks.
- .5 Seal insulation to re-establish integrity of the vapor barrier.
- .6 Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- .7 Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

**3.4 RECORD AND REPORT DATA**

- .1 Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.
- .2 Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section Includes:
  - .1 Materials and methods for pressure testing all ducts, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.
  - .2 All ductwork installed on this project shall be pressure tested unless it is part of the exclusions outlined in Item 1.8 below.

**1.2**            **RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 01 91 13 – Commissioning (Cx) Requirements.

**1.3**            **REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
  - .1 SMACNA HVAC Air Duct Leakage Test Manual.

**1.4**            **SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
  - .1 Submit proposed report form and test report format to Owner's Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from Owner's Representative.
  - .2 Prepare report of results and submit to Owner's Representative within 24 hours of completion of tests. Include:

- .1 Schematic of entire system.
- .2 Schematic of section under test showing test site.
- .3 Required and achieved static pressures.
- .4 Orifice differential pressure at test sites.
- .5 Permissible and actual leakage flow rate (L/s) for test sites.
- .6 Witnessed certification of results.
- .3 Include test reports in final TAB report.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's field reports specified.

### 1.5 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations.
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's installation instructions and warranty requirements.
  - .2 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### 1.6 TESTING AGENCY

- .1 Certified NEBB/AABC TAB Agency.

### 1.7 TIMING

- .1 Ducts to be tested before installation of insulation or any other form of concealments.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, gaskets, etc.

### 1.8 EXCLUSIONS

- .1 Flexible connections to diffusers.

### 1.9 VERIFICATION

- .1 Owner's Representative to witness tests and to verify reported results.

- .2 Testing results to be certified by the same TAB agency approved by Engineer to undertake TAB on this project.

## **PART 2**      **PRODUCTS**

### **2.1**      **TEST INSTRUMENTS**

- .1 Test apparatus to include:
  - .1 Fan capable of producing required static pressure.
  - .2 Duct section with calibrated orifice plate mounted and accurately located pressure taps.
  - .3 Flow measuring instrument compatible with the orifice plate.
  - .4 Calibration curves for orifice plates used.
  - .5 Flexible duct for connecting to ductwork under test.
  - .6 Smoke bombs for visual inspections.
- .2 Test apparatus: accurate to within +/- 3 % of flow rate and pressure.
- .3 Submit details of test instruments to be used to Owner's Representative at least three months before anticipated start date.
- .4 Test instruments: calibrated and certificate of calibration deposited with Owner's Representative no more than 28 days before start of tests.
- .5 Re-calibrated every six months thereafter.

### **2.2**      **SYSTEM LEAKAGE TOLERANCES**

- .1 As outlined in SMACNA HVAC Air Duct Leakage Test Manual for the applicable duct static pressure class, seal class, and leakage class in each instance. The applicable duct pressure class shall be determined from the external static pressure in the air handling unit and fan schedules. The listed external static pressure is not the duct pressure class. Consult the SMACNA HVAC Air Duct Leakage Test Manual for further clarification in this matter.
- .2 Evaluation of test results to use surface area of duct test section and pressure in duct as basic parameters.
- .3 Engineer shall provide external static pressure to determine duct pressure class if not readily available on drawings.

**PART 3**      **EXECUTION**

**3.1**            **MANUFACTURER'S INSTRUCTIONS**

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

**3.2**            **TEST PROCEDURES**

- .1 Maximum lengths of ducts to be tested consistent with capacity of test equipment.
- .2 Section of duct to be tested to include:
  - .1 Fittings, branch ducts, tap-ins.
- .3 Repeat tests until specified pressures are attained. Bear costs for repairs and repetition to tests.
- .4 Base partial system leakage calculations on SMACNA HVAC Air Duct Leakage Test Manual.
- .5 Seal leaks that can be heard or felt, regardless of their contribution to total leakage.

**3.3**            **CLEANING**

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

**3.4**            **TRIAL TEST**

- .1 Carry out trial leakage test to demonstrate workmanship.
- .2 After acceptance of trial leakage test by Engineer, proceed with installation and testing of remaining ductwork.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3      Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .4      Section 23 05 53.01 - Mechanical Identification.
- .5      Section 23 31 13.01 – Ductwork - Metallic to 2500 Pa.

**1.2**            **REFERENCES**

- .1      American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1      ANSI/ASHRAE/IESNA 90.1, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2      American Society for Testing and Materials International, (ASTM)
  - .1      ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .2      ASTM C518, Standard Test Method for Steady State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - .3      ASTM C553, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .4      ASTM C612, Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .5      ASTM C795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
  - .6      ASTM C921, Standard Practice for Determining Properties of Jacketing Materials for Thermal Insulation.
- .3      Canadian General Standards Board (CGSB)
  - .1      CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4      Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .5      Underwriters Laboratories of Canada (ULC)
  - .1      CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .6      National Energy Code of Canada for Buildings (NECB)

### 1.3 DEFINITIONS

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as defined herein.
  - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
  - .1 CRD: Commercial Round Ductwork.
  - .2 CRF: Commercial Rectangular Finish.

### 1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

### 1.5 MANUFACTURERS' INSTRUCTIONS

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

### 1.6 QUALIFICATIONS

- .1 Installer: certified in performing work of this section, and have at least 5 years successful experience in this size and type of project, qualified to standards of TIAC.

### 1.7 DELIVERY, STORAGE AND HANDLING

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

### 1.8 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 – Construction / Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

- .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility approved by Owner's Representative.
- .5 Divert unused adhesive material from landfill to official hazardous material collections site approved by Owner's Representative.
- .6 Do no dispose of unused adhesive materials into sewer systems, into lakes, streams, onto ground or in other locations where it will pose health or environmental hazard.

## **PART 2**      **PRODUCTS**

### **2.1**      **FIRE AND SMOKE RATING**

- .1 In accordance with CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### **2.2**      **INSULATION**

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity:
  - .1 Rigid mineral fibre board:
    - .1 "K" factor of 0.032 W/m. °C at mean ambient temperature of 24°C when tested in accordance with ASTM C612, Type 1A and 1B, rigid.
  - .2 Mineral fibre blanket:
    - .1 "K" factor of 0.035 W/m.°C at mean ambient temperature of 24°C when tested in accordance with ASTM C518, flexible blanket.
    - .2 Listed "K" factor for mineral fibre blanket is installed value which takes into account a 25% insulation compression factor.
- .3 TIAC Code C-1: Rigid mineral fibre to ASTM C612 with factory applied vapour retarder jacket to CGSB.51-GP-52Ma:
  - .1 Density: 96.11 kg/m<sup>3</sup>.
  - .2 Installed "R" values:
    - .1 25 mm thick: 0.73 m<sup>2</sup>.°C/W.
    - .2 50 mm thick: 1.45 m<sup>2</sup>.°C/W.
  - .3 Sound absorption coefficients when tested in accordance with ASTM C423, Type A mounting, as follows:  

125 Hz   250 Hz   500 Hz   1000 Hz   2000 Hz   4000 Hz

- |  |             |      |      |      |      |      |      |
|--|-------------|------|------|------|------|------|------|
|  | 25 mm thick | 0.10 | 0.35 | 0.85 | 1.04 | 1.05 | 1.03 |
|  | 50 mm thick | 0.38 | 0.93 | 1.10 | 1.07 | 1.07 | 1.07 |
- .1 Noise reduction coefficient: 0.80 for 25 mm thick and 1.05 for 50 mm thick.
- .2 Acceptable Product: Johns-Manville Series 8000 spin-glass, Type 817 with FSK reinforced foil and paper (Foil - Scrim-Kraft), Manson, Owens-Corning, Knauf, or approved equal.
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma.
- .1 Density: 24.1 kg/m<sup>3</sup>.
- .2 Installed "R" Value:
- .1 40 mm thick: 0.83 m<sup>2</sup>.°C/w.
- .2 50 mm thick: 1.11 m<sup>2</sup>.°C/w.
- .3 Operating temperature limits: 40°C to 121°C.
- .4 Acceptable Product: Johns-Manville Micro-Lite XG formaldehyde free, Type 150 with FSK reinforced foil and paper (foil - Scrim-Kraft), Mason, Owens-Corning, Knauf, or approved equal.

### 2.3 JACKETS

- .1 Canvas:
- .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .1 Acceptable Product: S. Fattal Thermocanvas, or approved equal.

### 2.4 ACCESSORIES

- .1 Vapour retarder lap sealer:
- .1 Rubber/Resin solvent based adhesive, flammable wet, fire-resistant dry.
- .2 Acceptable Product: Henry/Bakor 230-06, Foster, Childers or approved equal.
- .2 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .1 Acceptable Product: Duro Dyne, Dyn Air or approved equal.
- .3 Contact adhesive: quick setting:
- .1 Non-flammable, rubberized emulsion based adhesive.
- .2 Acceptable Product: Henry Bakor 200-38, Foster, Childers or approved equal.
- .4 Lagging coating (cement):
- .1 Fire resistive, heavy duty resin emulsion insulation lagging coating.
- .2 Acceptable Product: Henry Bakor 120-09, Foster, Childers or approved equal.
- .5 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

- .1 Acceptable Product: Duro Dyne, Dyn-Air or approved equal.

**PART 3 EXECUTION**

**3.1 PRE-INSTALLATION REQUIREMENTS**

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

**3.2 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports to be outside vapour retarder jacket.
- .4 Supports, Hangers in accordance with Section 23 31 13.01 - Ductwork - Metallic to 2500 Pa:
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .5 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

**3.3 DUCTWORK INSULATION SCHEDULE**

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

	<u>TIAC Code</u>	<u>Vapour Retarder</u>	<u>Thickness</u>
round supply duct (entirety)	C2	Yes	25 mm
rectangular supply duct (entirety)	C1	Yes	25 mm

- .2 The insulation table above represents types and material thicknesses for thermal insulation mounted on the exterior of ductwork.
- .3 Utilize metal corners on all exposed rectangular ducts to be insulated.
- .4 Finishes: conform to following table:

Indoor, concealed	None
Indoor, exposed	Canvas CRF/1 and CRD/1

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1      Section Includes:
  - .1      Thermal insulation for all piping, fittings, valves, flanges and associated piping components installed under this contract, unless specified otherwise in other sections.

**1.2**            **RELATED SECTIONS**

- .1      Section 01 33 00 - Submittal Procedures.
- .2      Section 01 35 29.06 - Health and Safety Requirements.
- .3      Section 01 61 00 - Common Product Requirements.
- .4      Section 01 74 11 - Cleaning
- .5      Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .6      Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
- .7      Section 23 05 53.01 - Mechanical Identification.

**1.3**            **REFERENCES**

- .1      American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1      ASHRAE Standard 90.1, Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings (Including all Addenda).
- .2      American Society for Testing and Materials (ASTM)
  - .1      ASTM C209, Standard Test Methods for Cellulosic Fiber Insulating Board.
  - .2      ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3      ASTM C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - .4      ASTM C534/C534M, Standard Specification for Preformed Cellular Thermal Insulation in Sheet and Tubular Form.
  - .5      ASTM C547, Standard Specification for Mineral Fibre Pipe Insulation.
  - .6      ASTM C1136, Standard Specification for Flexible, Low Permeance Vapour Retarders for Thermal Insulation.
  - .7      ASTM E96/E96M, Standard Test Methods for Water Vapour Transmission of Materials.

- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketting Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards.
- .5 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .6 National Energy Code of Canada for Buildings (NECB).

#### 1.4 DEFINITIONS

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as defined herein.
- .2 TIAC installation standard:
  - .1 CPF: Commercial Piping Finish.

#### 1.5 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.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Instructions: submit manufacturer's installation instructions to Owner's Representative.

## **1.6 QUALITY ASSURANCE**

### **.1 Qualifications:**

.1 Installer: certified in performing work of this Section, and have at least 5 years successful experience in this size and type of project, qualified to standards of TIAC.

### **.2 Health and Safety:**

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

## **1.7 DELIVERY, STORAGE AND HANDLING**

### **.1 Packing, shipping, handling and unloading:**

.1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

### **.2 Storage and Protection:**

.1 Protect from weather, construction traffic.

.2 Protect against damage.

.3 Store at temperatures and conditions required by manufacturer.

### **.3 Waste Management and Disposal:**

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

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

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

.4 Divert unused metal materials from landfill to metal recycling facility approved by Owner's Representative.

.5 Divert unused adhesive materials from landfill to official hazardous material collections site approved by Owner's Representative.

.6 Do not dispose of unused adhesive materials into sewer systems, into lakes, onto ground or in other locations where it will pose health or environmental hazard.

## **PART 2 PRODUCTS**

### **2.1 FIRE AND SMOKE RATING**

#### **.1 In accordance with CAN/ULC-S102.**

.1 Maximum flame spread rating: 25.

- .2 Maximum smoke developed rating: 50.

## 2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) of 0.033 W/m.°C at mean ambient temperature of 24°C values at 24°C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: Rigid moulded mineral fibre with factory applied vapour retarder jacket and AP-T (All Purpose Tape) closure:
  - .1 Mineral fibre: to ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52 Ma and ASTM C1136.
  - .3 Maximum "k" factor: to ASTM C547 and 2.2.2 above .
  - .4 Maximum service temperature: -18°C to 454°C.
  - .5 Acceptable products: Johns-Manville Micro-Lok AP-T Plus with self-sealing lap, Manson, Owens-Corning, Knauf, or approved equal.

## 2.3 INSULATION SECUREMENT

- .1 Longitudinal joints to be made with factory applied self-seal tape for Code A-1 insulation.
- .2 Butt joints for Code A-1 insulation to be made with self-adhesive reinforced butt strips supplied complete with insulation.
- .3 Ends of pipe insulation at valves which are specified as not requiring insulation are to be sealed with vapour retarder lap sealer. Vapour retarder lap sealer shall be a rubber/resin solvent based adhesive, flammable wet, fire resistant dry. Acceptable product: Henry/Bakor 230-06, Foster, Childers or approved equal.

## 2.4 FITTINGS

- .1 All fittings to be insulated to same thickness as adjacent piping insulation.
- .2 Fittings for Code A-1 insulation to be insulated with flexible fibreglass insulation inserts:
  - .1 Acceptable products: Johns Manville Hi-Lo temp insulation inserts complete with Zeston 2000 PVC insulated jacket covers, Mason, Owens-Corning, Knauf, or approved equal.
- .3 All cold piping systems subject to condensation to be insulated with two (2) layers of flexible fiberglass insulation inserts. In addition, an approved vapour retarder mastic compatible with PVC shall be applied between the pipe insulation and the insulation fitting cover and on the PVC fitting cover throat overlap seam.
- .4 All exposed and concealed piping fittings insulated with Code A-1 insulation are to be insulated with flexible fibreglass insulation inserts and PVC insulated fitting covers.

- .5 In addition to pipe fittings such as elbows, tees, reducers, end caps, Y-branches, P-traps, etc., the insulation method for fittings outlined above shall apply to the following, unless other insulation method is specified elsewhere:
  - .1 Grooved pipe couplings and fittings.
  - .2 Flanged connections for pipe-to-pipe and pipe-to-equipment connections.
  - .3 All valves and components in hydronic systems including but not limited to the following:
    - .1 Wye strainers DN 50 and below
    - .2 Control valves DN 50 and below
    - .3 Check valves DN 50 and below
    - .4 Isolation valves including ball, butterfly, gate, globe, etc. DN 50 and below
    - .5 Grooved piping couplings and fittings
    - .6 Flanged connections for pipe to pipe and pipe to equipment connections.

## 2.5 JACKETS

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .2 Colours: white.
  - .3 Minimum service temperatures: -29°C.
  - .4 Maximum service temperature: 66°C.
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Thickness: 20 mil (0.51 mm).
  - .7 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints. Circumferential seams should be a minimum of 25 mm overlap, and longitudinal seams should be 38 mm to 51 mm overlap. This applies to both jackets and fitting covers.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour, 10 mil (0.254 mm).
    - .4 Provide slip joints on continuous long runs of straight piping. Increase circumferential overlap to 203 mm to 254 mm and apply a flexible white caulking in the overlap area to maintain a sealed system.
  - .8 Special requirements:
    - .1 Indoor: flame spread rating 25, smoke developed rating 50.
  - .9 Acceptable Product: Johns Manville Zeston 2000 PVC insulating fitting covers, Proto Corp, Childers, or approved equal.

**PART 3**      **EXECUTION**

**3.1**            **MANUFACTURER'S INSTRUCTIONS**

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

**3.2**            **PRE- INSTALLATION REQUIREMENT**

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

**3.3**            **INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
  - .1 As specified in Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

**3.4**            **PIPING INSULATION SCHEDULES**

- .1 TIAC Code: A-1.
  - .1 Insulation securements: as per Item 2.3.
  - .2 Seals: as per Item 2.3.
  - .3 Installation: TIAC Code: 1501-H and 1501-C.
  - .4 Provide insert between support shield and piping on cold piping 65°C and below, DN 50 or larger. In addition, provide at pipe stanchion saddle supports for cold piping 65°C and below, and hot piping above 65°C regardless of pipe size. Inserts to be fabricated from Johns-Manville Thermo-12 or other high density insulating material suitable for the piping service temperature. Insulation inserts shall be no less than the following lengths:
    - .1 DN 15 to DN 65: 250 mm long.
    - .2 DN 80 to DN 150: 300 mm long.
    - .3 DN 200 to DN 250: 400 mm long.

.2 Thickness of insulation to be as listed in following table.

.1 Do not insulate exposed, chrome plated piping, valves, fittings.

Application	TIAC Code	Pipe sizes (DN) and insulation thickness (mm)				
		to 25	32 to 50	65 to 100	125 to 150	200 & over
Chilled Water Piping	A-1	25	38	38	38	38
Hydronic Heating Piping	A-1	25	25	25	38	38

.3 Finishes:

.1 Exposed indoors: PVC jacket.

.2 Exposed in mechanical rooms, closets and accessible service spaces: PVC jacket.

.3 Concealed, indoors: fibreglass insulation inserts complete with PVC insulated jacket covers on fittings. No further finish. (Code A-1)

.4 Installation:

.1 Exposed indoors: CPF/4

.2 Concealed indoors: CPF/2.

### 3.5 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.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 91 13 – Commissioning Requirements: supplemented as specified herein.
- .2      Section 21 13 13 – Wet Pipe Sprinkler Systems.
- .3      Section 22 11 18 – Domestic Water Piping Copper.
- .4      Section 22 11 18.01 – Domestic Water Piping Plastic.
- .5      Section 22 13 17 – Drainage Waste and Vent Piping – Cast Iron, Copper and Stainless Steel.
- .6      Section 22 13 18 – Drainage Waste and Vent Piping – Plastic.
- .7      Section 22 42 01 – Plumbing Specialities and Accessories.
- .8      Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

**1.2**            **CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS**

- .1      In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.3**            **WET SPRINKLER SYSTEM**

- .1      Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in other Mechanical Divisions.
- .2      Verification of controls, detection devices, alarm devices is specified other Mechanical and Electrical Divisions.
- .3      Verify operation of interlocks between HVAC systems and fire alarm systems.

**1.4**            **REPORTS**

- .1      In accordance with Section 01 91 13 – Commissioning (Cx) Requirements: supplemented as specified herein.

**1.5**            **TRAINING**

- .1      In accordance with Section 01 91 13 – Commissioning (Cx) Requirements: supplemented as specified in relevant specification sections

**PART 2**      **PRODUCTS (NOT APPLICABLE)**

**PART 3**      **EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section Includes:
  - .1 Procedures and cleaning solutions for cleaning new hydronic piping systems.

**1.2**            **RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06 - Health and Safety Requirements.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 11 - Cleaning
- .5 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .6 Section 23 05 93 - Testing, Adjusting and Balancing of HVAC

**1.3**            **REFERENCES**

- .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (MSDS).

**1.4**            **SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
  - .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.
    - .1 Instructions: submit manufacturer's installation instructions.

**1.5**            **QUALITY ASSURANCE**

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

**1.6**            **DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading.

- .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 – Common Product Requirements.
- .2 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      CLEANING SOLUTIONS (TO BE USED FOR STEEL HYDRONIC PIPING ONLY)**

- .1 Chemical cleaner designed to remove mill scale, cutting oil and other particles before start-up.
- .2 Specific gravity: 1.044.
- .3 PH at 100% concentration: 9.5.
- .4 Slightly alkaline liquid compound wetting agents, alkaline additives and corrosion inhibitors.
- .5 Acceptable Manufacturer: Magnus Magsol 20 A, Chem-Aqua, or approved equal.

## **PART 3      EXECUTION**

### **3.1      CLEANING HYDRONIC SYSTEMS**

- .1 This contract shall include the cleaning of the new hydronic systems piping and components installed.
- .2 Timing:
  - .1 Systems to be operational, hydrostatically tested and with devices functional, before cleaning is carried out.
- .3 Cleaning agency:
  - .1 Retain qualified water treatment specialist to perform system cleaning.
- .4 Cleaning procedures:
  - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
    - .1 Cleaning procedures, flow rates, elapsed time.
    - .2 Chemicals and concentrations to be used.

- .3 Inhibitors and concentrations.
- .4 Specific requirements for completion of work.
- .5 Special precautions for protecting piping system materials and components.
- .5 Conditions at time of cleaning of systems
  - .1 Systems to be free from construction debris, dirt and other foreign material.
  - .2 Control valves to be operational, fully open to ensure that coils and terminal units can be cleaned properly.
  - .3 Strainers to be cleaned prior to initial fill.
- .6 Report on Completion of Cleaning
  - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
  - .1 Flush system thoroughly with water, back flush pump, strainers, blow down drain valves and risers to remove all loose debris.
  - .2 For steel piping, then add 2% solution (by volume) of approved pipeline cleaning agent to the system by means of a mechanical non-electric pump to be provided by the cleaning agent supplier. For plastic hydronic piping system use water.
  - .3 Circulate for 48 hours (unheated).
  - .4 During recirculation, back flush strainers, drain valves and risers at their lowest point once every 8 hours.
  - .5 Drain cleaning water completely.
  - .6 Then fill and drain system several times. Circulate 30 minutes every time the system is refilled.
  - .7 Bleed system at several points until water is clear and nonfoaming. Clean strainers.
  - .8 Draw a water sample from the system and send it out to a laboratory for analysis.
  - .9 If the laboratory report is satisfactory, the systems may then be filled with chilled water and hydronic heating water.

### 3.2 START-UP OF HYDRONIC SYSTEMS

- .1 After cleaning is completed, complete the following for each hydronic system:
  - .1 Clean out strainer baskets.
  - .2 Fill system with water.
  - .3 Establish circulation. Ensure air is removed.
  - .4 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
  - .5 Bring system up to design temperature and pressure slowly.

- .6 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .7 Adjust pipe supports, hangers, springs as necessary.
- .8 Monitor pipe movement.
- .9 Retighten bolts, etc. using torque wrench, to compensate for heat caused relaxation. Repeat several times during commissioning.
- .10 Check operation of drain valves.
- .11 Adjust valve stem packings as systems settle down.

**3.3 CLEANING**

- .1 Provide 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.

**3.4 ESTIMATED SYSTEM VOLUME**

- .1 Actual system volume and quantity of cleaning solutions to be determined by Contractor in the field. Contractor shall be responsible to provide all cleaning solutions as required.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section Includes.
  - .1 Materials and installation for steel piping, valves and fittings for hydronic systems.

**1.2**            **RELATED SECTIONS.**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 29.06- Health and Safety Requirements.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 23 05 00 - Common Work Results for HVAC.
- .6 Section 23 05 05 - Installation of Pipework.
- .7 Section 23 05 23.01 - Valves - Bronze.
- .8 Section 23 05 23.05 – Butterfly Valves - Cast Iron and Ductile Iron.
- .9 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .10 Section 23 08 01 - Performance Verification of Mechanical Piping.
- .11 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

**1.3**            **REFERENCES**

- .1 American Society of Mechanical Engineers (ASME).
  - .1 ASME B16.1, Cast Iron Pipe Flanges and Flanges Fittings, Class 25, 125, 250 and 800.
  - .2 ASME B16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300.
  - .3 ASME B16.5, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.
  - .4 ASME B16.9, Factory-Made Wrought Steel Buttwelding Fittings.
  - .5 ASME B18.2.1, Square and Hex Bolts and Screws.
  - .6 ASME B18.2.2, Square and Hex Nuts.
- .2 American Society for Testing and Materials International, (ASTM).

- .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- .3 ASTM A536, Standard Specification for Ductile Iron Castings.
- .4 ASTM B61, Standard Specification for Steam or Valve Bronze Castings.
- .5 ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .6 ASTM E202, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .3 Canadian Standards Association (CSA International).
  - .1 CSA B242, Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CSA B242.2, Grooving Dimensions.
  - .3 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
  - .4 CSA W47.1S1, Supplement No. 1 to W47.1, Certification of Companies for Fusion Welding of Steel Structures.
  - .5 CSA B52 – Boiler Pressure Vessel and Pressure Piping Code
- .4 Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
  - .1 MSS-SP-67, Butterfly Valves.
  - .2 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .5 Provincial Boiler, Pressure Vessel and Compressed Gas Regulations.

#### 1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals, and include the following:
    - .1 Special servicing requirements.
- .3 Grooved joint couplings and fittings to be indicated on product submittals and to be specifically identified with the applicable style or series designation.
- .4 Grooved products manufacturer to supply on site tools and products for installation training.
- .5 All grooved products to be of one manufacturer.

#### 1.5 QUALITY ASSURANCE

- .1 Health and Safety.

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

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal.
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Fold up metal and plastic banding, flatten and place in designated area for recycling.

## **PART 2 PRODUCTS**

### **2.1 CANADIAN REGISTRATION NUMBERS (CRN)**

- .1 All hydronic piping and components DN 25 or larger carrying water at 66°C or higher shall be considered pressure piping and shall be in accordance with the Province of Newfoundland and Labrador Boiler, Pressure Vessel and Compressed Gas Regulations.
- .2 All hydronic pressure piping, pressure fittings, and pressure piping system components shall be required to carry C.R.N. for the Province of Newfoundland and Labrador. Submit shop drawings of pressure piping components clearly showing applicable C.R.N.

### **2.2 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 Up to DN 150, Schedule 40.
  - .2 DN 200 and over, Schedule 30.
  - .3 DN 300 and over, 10 mm wall thickness.

### **2.3 PIPE JOINTS**

- .1 Contractor has option to pick from available acceptable pipe joining methodologies described below for respective pipe sizing ranges.
- .2 DN 50 and under: Schedule 40 screwed fittings with Teflon tape.
  - .1 Pipe thread: taper.
- .3 DN 65 and over: welding fittings and flanges to CSA W47.1 and CSA W47.1S1.
  - .1 Flanges: raised face, weld neck or slip-on.

- .2 Flange gaskets: to suit application.
- .3 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.
- .4 DN 65 and over grooved pipe couplings to CSA B242 designed with angle bolt pads to provide a rigid joint unless otherwise noted.
  - .1 Acceptable product: Victaulic #107 Quick Vic installation ready couplings DN 65 to 200, Victaulic #07 couplings DN 250 to 300, Victaulic AGS W07 DN 350 to 600; Shurjoint; Gruvlok, or approved equal.
  - .2 Coupling gaskets to be Grade "E" EPDM suitable for water and associated corrosion inhibitors at temperature range of approximately -16°C to 83°C. Advise owner's representative during shop drawing submission if gasket material will meet service condition requirements.
  - .3 All grooved products to be of one manufacturer.
- .5 DN 65 and over grooved pipe flange adapter for directly incorporating flanged components with ANSI class 125 or Class 150 bolt hole patterns.
  - .1 Acceptable product: Victaulic Style 741 flange adapter, Star, Shurjoint, Gruvlok, or approved equal.
  - .2 Coupling gaskets to be grade "E" EPDM suitable for water and associated corrosion inhibitors at temperature range of approximately -16°C to 83°C. Advise owner's representative in writing during shop drawing submission if gasket material will meet service condition requirements.
  - .3 All grooved products to be of one manufacturer.

## 2.4 FITTINGS

- .1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.
- .2 Pipe flanges and flanged fittings:
  - .1 Cast iron: to ASME B16.1, Class 125.
  - .2 Steel: to ASME B16.5.
- .3 Butt-welding fittings: steel, to ASME B16.9.
- .4 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.
- .5 Ductile iron grooved end fitting conforming to ASTM A536.
  - .1 Acceptable products: Victaulic, Star, Shurjoint, Gruvlok, or approved equal.

## 2.5 VALVES

- .1 Connections:
  - .1 DN 50 and smaller: screwed ends.
  - .2 DN 65 and larger: flanged ends or grooved ends.
- .2 Ball valves:

- .1 DN 50 or smaller: See specification section 23 05 23.01 - Valves - Bronze.
- .3 Butterfly valves:
  - .1 DN 65 and larger: See specification section 23 05 23.05 – Butterfly Valves – Cast Iron and Ductile Iron.
- .4 Drain valves: DN 20 unless otherwise indicated, bronze, with hose end male thread and complete with cap and chain.
  - .1 Acceptable product: Dahl Figure 50430-0, or approved equal.

### **PART 3**      **EXECUTION**

#### **3.1**            **PIPING INSTALLATION**

- .1 Install pipework in accordance with Section 23 05 05 – Installation of Pipework by certified journeyman and authority having jurisdiction.
- .2 The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the job site and review installation. Contractor shall remove and replace any joints deemed improperly installed.

#### **3.2**            **CLEANING, FLUSHING AND START-UP**

- .1 In accordance with Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.

#### **3.3**            **TESTING**

- .1 Test system in accordance with Section 23 05 05 – Installation of Pipework.

#### **3.4**            **BALANCING**

- .1 Refer to Section 23 05 93 – Testing, Adjusting and Balancing for HVAC, for applicable procedures.

#### **3.5**            **PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 – Performance Verification of Mechanical Systems.
- .2 Provide copies of test reports for Commissioning Manuals.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section includes:
  - .1 The supply and installation of hydronic specialties equipment.

**1.2**            **RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 35 29.06 – Health and Safety Requirements
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal
- .4 Section 01 78 00 – Closeout Submittals.
- .5 Section 23 05 05 – Installation of Pipework.
- .6 Section 23 08 01 – Performance Verification of Mechanical Piping Systems.

**1.3**            **REFERENCES**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ANSI/ASME, Boiler and Pressure Vessel Codes
  - .2 ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .3 ASTM A278M, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 345°C.
  - .4 ASTM A516/A516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate and Lower Temperature Service.
  - .5 ASTM A536, Specification for Ductile Iron Castings.
  - .6 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .3 Air-conditioning, Heating and Refrigeration Institute (AHRI)
  - .1 ARI 410, Forced-circulation Air-cooling and Air-heating Coils.
- .4 Canadian Standard Association (CSA).

- .1 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.
- .5 Province of Newfoundland and Labrador
  - .1 Boiler, Pressure Vessel and Compressed Gas Regulations.
- 1.4 SUBMITTALS**
  - .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Product Data: Submit WHMIS MSDS – Material Safety Data Sheets in accordance with Section 02 62 00.01 – Hazardous Materials.
    - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
    - .2 Indicate on product data expansion tanks, air vents, separators, valves, and strainers.
  - .3 Closeout Submittals:
    - .1 Submit maintenance data in accordance with Section 01 78 00 – Closeout Submittals.
- 1.5 QUALITY ASSURANCE**
  - .1 Health and Safety:
    - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 – Health and Safety Requirements.
- 1.6 DELIVERY STORAGE AND DISPOSAL**
  - .1 Waste Management and Disposal:
    - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
    - .2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- 1.7 PERFORMANCE REQUIREMENTS**
  - .1 Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
    - .2 Hot-Water Heating Piping: 150 psig at 200 deg F.
    - .3 Chilled-Water Piping: 150 psig at 200 deg F.

**PART 2      PRODUCTS**

**2.1            CANADIAN REGISTRATION NUMBERS (CRN)**

- .1 All hydronic piping and components DN 25 or larger carrying water at 66°C or higher shall be considered pressure piping and shall be in accordance with the Province of Newfoundland and Labrador Boiler, Pressure and Compressed Gas Regulations.
- .2 All hydronic pressure piping, pressure fittings and pressure piping system components shall be required to carry C.R.N. for the Province of Newfoundland and Labrador. Submit shop drawings of pressure piping components clearly showing applicable C.R.N.

**2.2            AIR VENT**

- .1 Manual air vent:
  - .1 Chrome brass body.
  - .2 Stainless steel check valve.
  - .3 Automatic or manual operation.
  - .4 Brass disc bearing cover.
  - .5 Copper thermostat assembly.
  - .6 Neoprene O-ring.
  - .7 Heat resistant ABS plastic material handwheel.
  - .8 Cellulose fibre disc.
  - .9 Maximum rated working pressure: 861 kPa.
  - .10 Maximum rated working temperature: 116°C.
  - .11 Two-piece construction.
  - .12 Positive shut-off ball check.
  - .13 Replacement cartridge shall be capable of being installed without shutting or draining down the system.
  - .14 Connection: DN 6 NPT (male).
  - .15 Acceptable products: Watts Regulator Series HAV Model No. 590713, ITT Bell and Gossett, Taco, or approved equal.

**2.3            WYE-PATTERN STRAINERS (DN 6 to DN 80)**

- .1 ASTM A-126 Class B, cast iron body, wye-pattern strainer for liquid service.
- .2 20 mesh strainer screen for DN 6 to DN 50, DN 80 strainer shall utilize a 1 mm perforated screen. All screens shall be 304 stainless steel.
- .3 Female NPT inlet/outlet connections.
- .4 Non-asbestos, gasketed, threaded screen retainer cap.

- .5 Tapped blow-off connection.
- .6 Maximum rated working pressure: 1.72 MPa.
- .7 Maximum operating temperature: 208°C.
- .8 Acceptable products: Watts Regulator Model 77S, Hoffman, Wilkins, or approved equal.

## 2.4 DUCT MOUNTED HEATING COILS

- .1 Furnish and install, where indicated on the drawings, coils as described in the following specifications:
  - .1 Application:
    - .1 Duct mounted hot water reheat coils.
  - .2 Type "HW" and "HWP" Construction:
    - .1 Designation: See schedule on drawings.
    - .2 Tubes shall be 15.8 mm diameter seamless copper, 0.51 mm average wall thickness.
    - .3 Fins shall be continuous plate with full fin collars for dependable fin spacing. Fins shall be star patterned and shall be 0.1905 mm thick in aluminum material.
    - .4 Headers shall be single piece copper, suitable for minimum 1379 kPa coil design pressure, with no separate end disks or caps brazed or welded into header ends. Connections shall be brass (for copper headers) with male pipe threads and shall be welded to header barrels. Coils shall have beveled welded end caps on the header barrels.
    - .5 Both tube-to-return bend and tube-to-header joints shall be high strength brazed. Welding and brazing shall be done by ASME qualified personnel. Tube to header connection nipples shall have an orifice design to enhance turbulence at low fluid flow.
    - .6 Casings shall be minimum 16 ga mill galvanized steel. Top and bottom casing panels to be 38.1 mm double flanged for stacking. End casings shall have smooth, embossed tube holes to provide adequate bearing surface for tubes so as to avoid tube abrasion.
    - .7 Coils shall be suitable for working pressure of 1379 kPa @ 104 C and leak tested at 2068 kPa air under water. Coils must be hydrostatically tested.
  - .3 Performance: See coil schedules on drawings.
  - .4 Coils shall be tested and rated in accordance with Air Conditioning and Refrigeration Institute (ARI) Standard 410 and certified in accordance with the ARI certification program.
  - .5 Acceptable Product: Aerofin Model HW and HWP, Rosemex, Trane, Luvata Heatcraft, Ingenia, or approved equal.

## 2.5 COIL KITS

- .1 Coil kits shall be permitted for substitution of hydronic specialties specified within this section.
- .2 Acceptable Product: Victaulic Coil Kits, or approved substitute.

## 2.6 DIELECTRIC FITTINGS

- .1 Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- .2 Insulating Material: Suitable for system fluid, pressure, and temperature.
- .3 Dielectric Flanges:
  - .1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - .1 Capitol Manufacturing Company.
    - .2 Central Plastics Company.
    - .3 Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - .2 Factory-fabricated companion-flange assembly, for 150 or 300 psig minimum working pressure to suit system pressures.
- .4 Dielectric-Flange Kits:
  - .1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - .1 Advance Products & Systems, Inc.
    - .2 Calpico, Inc.
    - .3 Central Plastics Company.
    - .4 Pipeline Seal and Insulator, Inc.
  - .2 Companion-flange assembly for field assembly. Include flanges, full-face or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - .3 Separate companion flanges and steel bolts and nuts shall have 150 or 300 psig minimum working pressure where required to suit system pressures.
- .5 Dielectric Couplings:
  - .1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - .1 Calpico, Inc.

- .2 Lochinvar Corporation.
- .2 Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300 psig minimum working pressure at 225 deg F.
- .6 Dielectric Nipples:
  - .1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - .1 Perfection Corporation; a subsidiary of American Meter Company.
    - .2 Precision Plumbing Products, Inc.
    - .3 Sioux Chief Manufacturing Company, Inc.
    - .4 Victaulic Company of America.
  - .2 Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300 psig minimum working pressure at 225 deg F.

## 2.7 TEMPERATURE/PRESSURE TEST PORTS

- .1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - .1 Trerice; D3742.
  - .2 Winters.
  - .3 WIKA.
- .2 Construction: brass body.
- .3 Size: ½ NPT.
- .4 Valve plug material: Nordel.
- .5 Rated Operating limits: 275 F and 500 Psig.

## 2.8 FLEXIBLE CONNECTION

- .1 Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - .1 American BOA; Parrap
  - .2 Senior Flexonics.
  - .3 Proco.
  - .4 Mason.
- .2 Material:

- .1 Hose: 321 L stainless steel.
- .2 Braid: 300 series stainless steel.
- .3 Construction: annular butt welded hydro formed closed pitch hose.
- .4 Performance: 50,000 cycle rated and pressure rated per ISO 10380.
- .5 Connections:
  - .1 Threaded up to NPS 2.
  - .2 Flanged NPS 2 – ½ and above.
  - .3 Or to suit equipment end connection.
- .6 Length: minimum of 900 mm.
- .7 Operating conditions:
  - .1 Hydronic Heating and Cooling:
    - .1 Service temperature range to be 40F to 200 F.
    - .2 Maximum required working pressure: 150 Psig.

### **PART 3**      **EXECUTION**

#### **3.1**      **PIPING APPLICATIONS**

- .1 Hot water heating piping, aboveground, NPS 2 and smaller, shall be any of the following:
  - .1 Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; threaded joints; and installation ready grooved coupling.
- .2 Hot water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
  - .1 Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, welded and flanged joints, and installation ready grooved pipe couplings.
- .3 Chilled water piping, aboveground, NPS 2 and smaller, shall be any of the following:
  - .1 Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; threaded joints; and installation ready pipe couplings.
- .4 Chilled water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
  - .1 Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, welded and flanged joints, and installation ready grooved pipe couplings.

### 3.2 VALVE APPLICATIONS

- .1 Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- .2 Install pressure independent control valve in the return pipe of each heating or cooling terminal. Valve and electric actuator shall be supplied by the EMCS contractor and installed by the mechanical contractor.

### 3.3 PIPING INSTALLATIONS

- .1 Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated piping locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- .2 Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- .3 Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- .4 Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- .5 Install piping to permit valve servicing.
- .6 Install piping at indicated slopes.
- .7 Install piping free of sags and bends.
- .8 Install fittings for changes in direction and branch connections.
- .9 Install piping to allow application of insulation.
- .10 Select system components with pressure rating equal to or greater than system operating pressure.
- .11 Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- .12 Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- .13 Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- .14 Install branch connections to mains using tee fittings in main pipe, with the branch connected to the side, top or at any angle above the midpoint of the main pipe. For up-

feed risers, connect the branch to the top of the main pipe. Branch lines in welded piping shall be made with welding tees except that branch lines less than one half diameter of main may be made with Weld O Lets.

- .15 Provide piping wells and fittings required for building control system sensors.
- .16 Install valves according to Division 23.
- .17 Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- .18 Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- .19 Install strainers on inlet side of each control valve, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- .20 Identify piping as specified in Division 23 Section "Mechanical Identification."

### 3.4 HANGERS AND SUPPORTS

- .1 Hanger, support, and anchor devices are specified in Division 23. Comply with the following requirements for maximum spacing of supports.
- .2 Install the following pipe attachments:
  - .1 Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  - .2 Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  - .3 Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - .4 Spring hangers to support vertical runs.
- .3 Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

Nom. Pipe Size (inches)	Max. Span (feet)	Min. Rod Size (inches)	Hanger Type
1¼ and Smaller	5	3/8	Clevis Hanger
1½	8	3/8	Clevis Hanger
2	8	3/8	Clevis Hanger
2½	9	½	Clevis Hanger
3	10	½	Clevis Hanger
4	12	5/8	1 Rod Roll Hanger
5	12	5/8	1 Rod Roll Hanger

Nom. Pipe Size (inches)	Max. Span (feet)	Min. Rod Size (inches)	Hanger Type
6	12	¾	1 Rod Roll Hanger
8 - 12	12	7/8 (two)	2 Rod Roll Hangers
14 - 18	12	1 (two)	2 Rod Roll Hangers
20"	12	1¼ (two)	2 Rod Roll Hangers
24"	12	1½ (two)	2 Rod Roll Hangers

### 3.5 PIPE JOINT CONSTRUCTION

- .1 Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- .2 Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- .3 Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- .4 Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - .1 Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - .2 Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- .5 Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- .6 Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- .7 Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

### 3.6 HYDRONIC SPECIALTIES INSTALLATION

- .1 Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere for system air venting.

### 3.7 TERMINAL EQUIPMENT CONNECTIONS

- .1 Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- .2 Install control valves in accessible locations close to connected equipment.

- .3 Install ports for pressure and temperature reading at coil inlet and outlet connections according to Division 23.

### 3.8 CHEMICAL TREATMENT

- .1 Fill systems with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 48 hours, drain, clean strainer screens, and refill with fresh water.
- .2 Reference Section 23 08 02.

### 3.9 FIELD QUALITY CONTROL

- .1 Prepare hydronic piping according to ASME B31.9 and as follows:
  - .1 Leave joints, uninsulated and exposed for examination during test.
  - .2 Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - .3 Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
- .2 Perform the following tests on hydronic piping:
  - .1 Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  - .2 While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  - .3 Isolate expansion tanks and determine that hydronic system is full of water.
  - .4 Subject piping system to hydrostatic test pressure that is 1.5 times the system's working pressure, not less than 100 psi. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  - .5 After hydrostatic test pressure has been applied for at least 15 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  - .6 Prepare written report of testing.
- .3 Perform the following before operating the system:
  - .1 Open manual valves fully.
  - .2 Inspect air vents at high points of system and bleed air completely (manual type).
  - .3 Set temperature controls so all coils are calling for full flow.

- .4 Verify lubrication of motors and bearings.

### 3.10 INSPECTION SERVICES GROOVED PRODUCTS

#### .1 Product Training:

- .1 The grooved coupling manufacturer's (the "manufacturer") factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. This shall be at the expense of the installing contractor.

#### .2 IACET/Training:

- .1 A factory trained manufacturer's representative (direct employee) shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation in compliance with the following:
  - .1 Manufacturer must be accredited as an Authorized Provider by the International Association for Continuing Education and Training (IACET)
  - .2 Manufacturer must demonstrate that it complies with the ANSI/IACET standard which is recognized as a standard of good practice
- .3 Upon written agreement, the manufacturer shall provide the contractor with a primary point of contact to coordinate jobsite visits, inspections, and required reporting.
- .4 The project kick off installation training is a mandatory requirement and shall be a minimum of one hour training seminar for all purchasing contractor installers on the Project. The training will be conducted by a factory trained representative and will cover the grooving and installation process for the coupling manufacturer's products installed on the Project and must take place prior to initiating the Jobsite Examinations.
- .5 The Engineer / Contractor is solely responsible for making the final selection of the system and its components and assuring that all performance, endurance, maintenance, safety, warning requirements and industry standards of the application are met.
  - .1 Ensure all products are suitable for the intended application, and are in accordance with the manufacturer's latest published product submittals and catalog data.

#### .2 Inspection:

- .1 The factory trained representative's review on any project or jobsite for correct assembly is based solely on an external examination of the visible and accessible manufacturer's couplings after being installed as part of a mechanical pipe joint. The external examination will be limited to the visual assembly requirements of the coupling specified in the coupling manufacturer's published installation instruction handbooks and where required, a confirmation on bolt/nut torque

- using a torque wrench as specified in the coupling manufacturer's installation handbooks.
- .2 Jobsite Examinations covers factory trained representative visits to the project.
  - .1 A visit is defined as eight (8) consecutive hours at the Project over a twenty four (24) hour period totaling an estimated two hundred (200) joints examined and documented.
  - .2 All grooved joints on this project shall require a jobsite examination.
- .3 Confirmation of Visual Examinations:
  - .1 The factory trained representative will document and provide a written report stating compliance or noncompliance of all of the manufacturer's couplings as described in Jobsite Examinations.
  - .2 Locations of limited or no pipe joint accessibility preventing examination will be documented and reported to the owner for disposition.
- .3 Application:
  - .1 Upon completion of the manufacturer's inspection of the installation and any identified corrections, the manufacturer will provide the owner or purchaser with a limited warranty on manufacturer's products (the "Warranted Products").
  - .2 The grooved coupling manufacturer warrants all products to be free from defects in materials and workmanship under normal conditions of use and service as described in the manufacturer's documentation and as consistent with good piping practices.
  - .3 The grooved coupling manufacturer shall not be responsible for any product which has been subject to misuse,
  - .4 The grooved coupling manufacturer shall not be responsible for any product which has been repaired or altered in any manner outside of grooved coupling manufacturer's factory or which has been used in a manner contrary to manufacturer's instructions or recommendations.
  - .5 The grooved coupling manufacturer shall not be responsible for system design errors or any issues that arise as a result of any system design errors.
  - .6 The grooved coupling manufacturer warrants that the Warranted Products have been installed in accordance with the grooved coupling manufacturer's instructions and shall perform in accordance with the applicable grooved coupling manufacturer's published specifications subject to a successful inspection, limitation to inspected products, reasonable access to the jobsite as well as the conditions and limitations contained within the warranty.
    - .1 Core Sciences Building - Memorial University must notify the grooved coupling manufacturer by certified mail, return receipt requested, within thirty (30) days of discovering any alleged failure of the Warranted Products;
    - .2 Core Sciences Building - Memorial University allows the grooved coupling manufacturer's employees or agents reasonable access to the

- Warranted Products and the piping system to conduct an investigation following any notice of alleged failure.
- .3 Upon completion of the investigation, the grooved coupling manufacturer will authorize the repair to the Warranted Products and the piping system if they determine the failure is covered by the manufacturer's warranty; and,
  - .4 At the grooved coupling manufacturer's option, the grooved coupling manufacturer may approve the contractor who makes the repair to the Project and the grooved coupling manufacturer retains the right to inspect following such repairs.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section includes:
  - .1 Materials and installation of low-pressure metallic ductwork, joints and accessories.

**1.2**            **RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 35 29.06 – Health and Safety Requirements.
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .4 Section 01 91 13 – Commissioning Requirements.
- .5 Section 07 84 00 – Firestopping.
- .6 Section 09 91 23 – Interior Painting.
- .7 Section 23 05 94 – Pressure Testing of Ducted Air Systems.

**1.3**            **REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM A480/A480M, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A621/A621M, Specification for Steel Sheet and Strip, Carbon, Hot-Rolled, Drawing Quality.
  - .3 ASTM A653/A653M, Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
  - .4 ASTM A924, Standard Specification for General Requirements for Sheet Steel, Metallic-coated by the Hot-Dip Process.
  - .5 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Agency (NFPA)
  - .1 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
  - .2 SMACNA HVAC Duct Leakage Test Manual.
  - .3 IAQ Guidelines for Occupied Buildings Under Construction.
- .6 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC S110, Fire Tests for Air Ducts.

#### **1.4 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Specification.
- .2 Product Data: submit WHMIS MSDS - Material Safety Data Sheets for the following:
  - .1 Sealants.
  - .2 Tape.
  - .3 Proprietary Joints.

#### **1.5 QUALITY ASSURANCE**

- .1 Certification of Ratings:
  - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
  - .2 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
  - .4 Separate for reuse and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.
  - .5 Place materials defined as hazardous or toxic in designated containers.

- .6 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .7 Fold up metal and plastic banding, flatten and place in designated area for recycling.

**PART 2      PRODUCTS**

**2.1      SEAL CLASSIFICATION**

- .1 Classification as follows:

<u>Maximum Pressure Pa</u>	<u>SMACNA Seal Class</u>
1000 to 2500	A
750	B
500	C
250	C
125	C

- .2 Seal classification:
  - .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
  - .2 Class B: longitudinal seams, transverse joints made airtight with sealant, tape or combination thereof.
  - .3 Class C: transverse joints made air tight with gaskets, sealant, tape or combination thereof. Longitudinal seams unsealed.
- .3 Duct systems seal classification required shall be determined from external static pressure listed in air-handling equipment schedules on drawings. This shall be the seal class used to determine acceptable air leakage when carrying out the duct testing specified in Section 23 05 94 - Pressure Testing of Ducted Air Systems. The engineer shall provide the external static pressure to determine seal class if it is not readily available on the drawings.
- .4 Irrespective of the SMACNA specified sealing methodology for the respective duct static pressure construction class, all rectangular and round duct shall be sealed to a minimum of Class B with all transverse and longitudinal seams sealed.

**2.2      SEALANT**

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of minus 30°C to plus 93°C.
  - .1 Acceptable Product: Dura-Dyne S-2, Foster, Childers, Monsey Bakor, or approved equal.

**2.3      TAPE**

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

- .1 Acceptable Product: Dura-Dyne FT-2, Foster, Childers, Monsey Bakor, or approved equal.

## 2.4 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual and specification Section 23 05 94 - Pressure Testing of Ducted Air System.

## 2.5 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
  - .1 Rectangular: Centreline radius: 1.5 times width of duct.
  - .2 Round: smooth radius or five piece. Centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
  - .1 Over 400 mm: with turning vanes for all sizes.
- .4 Branches:
  - .1 Rectangular main and branch: with 45° entry on branch.
  - .2 Round main and branch: enter main duct at 45° with conical connection.
  - .3 Rectangular main and round branch: choice of either 45° main duct entry with conical connection or spin-on connection.
  - .4 Provide volume control damper in branch duct near connection to main duct.
  - .5 Main duct branches: with volume control damper.
- .5 Transitions:
  - .1 Diverging: 20° maximum included angle.
  - .2 Converging: 30° maximum included angle.
- .6 Offsets:
  - .1 Full short radiused elbows as indicated.
- .7 Obstruction deflectors: maintain full cross-sectional area. Maximum included angles: as for transitions.

## 2.6 FIRESTOPPING

- .1 Retaining angles around duct, on both sides of fire separation.
- .2 Firestopping material and installation must not distort duct. Leave room between fire damper sleeve and wall opening for thermal expansion in the event of a fire as per fire damper listing from manufacturer.

- .3 Material and installation within annular space between ducts, fire damper sleeves and adjacent fire separation to Section 07 84 00 – Firestopping and fire damper manufacturer's recommendations.

## 2.7 GALVANIZED STEEL

- .1 Lock forming quality: Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: metal gauges, transverse joint type and required reinforcement in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005 Version, for the external static pressure listed in the air-handling equipment schedules on the drawings.
- .3 Steel thickness and zinc coating class is to be factory stenciled on the steel.
- .4 All longitudinal joints to be Pittsburgh Lock type unless otherwise indicated. See Item 3.3 this specification section.

## 2.8 STAINLESS STEEL SHEETS

- .1 Comply with ASTM A480 / A480M, type 304L, cold rolled, annealed sheet. Exposed surface finish shall be No. 2 D or No. 4, as specified herein.

## 2.9 SPIRAL DUCT (SINGLE WALL - NON-GASKETED)

- .1 Application:
  - .1 All concealed round duct not specified as "gasketed".
- .2 Galvanized steel with lock formed seams fabricated to SMACNA and ASHRAE Standards.
  - .1 Acceptable Product: Flexmaster Canada Ltd., Atlantic Industries Limited, Peppertree Air Solutions Inc., or approved equal.

## 2.10 HANGERS AND SUPPORTS

- .1 Strap hangers: of same material as duct. See detail on drawings for strap hanger material thickness and strap hanger spacing.
- .2 Extend strap hangers down side and turn under 25 mm fastening securely to side and underside of duct.
- .3 Hanger configuration: to ASHRAE and SMACNA.
- .4 Support vertical ducts with angles screwed to duct and bearing on building structure.
- .5 Hangers: black carbon steel angle (primed) with black carbon steel rods to ASHRAE and SMACNA. See detail on drawings for angle iron size and thickness, rod diameter, and angle spacing.

- .6 Upper hanger attachments:
  - .1 Upper attachment Unistrut: Suspension from Unistrut channel.
    - .1 Channel: cold formed from low-carbon strip steel. Channel shall be pre-galvanized, of 12 ga. Material thickness and 41.3 mm x 41.3 mm dimensions
      - .1 Acceptable Product: Unistrut P1000 or approved equal.
    - .2 Channel nuts: manufactured from mild steel bars and case hardened after machining. Channel nuts shall have electro-galvanized finish, ½" – 13 nut size thread, for use with Unistrut P1000 Series channel.
      - .1 Acceptable Product: Unistrut P1010 or approved equal.
  - .2 Upper attachment structural: suspension from structural steel support channel or angle:
    - .1 All piping: Malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, 12 mm diameter rod.
      - .1 Acceptable Product: Myatt Fig. 586, Hunt, Grinnell, or approved equal.
  - .3 Upper attachment to structural: suspension from OWSJ:
    - .1 Plate washer secured to bottom angle of OWSJ.
      - .1 Acceptable Product: Myatt Figure 545 Plate washer, Hunt, Grinnell, or approved equal.
- .7 Hanger support rod:
  - .1 Horizontal roof and floor applications: continuous threaded rod.
    - .1 Acceptable Product: Myatt Figure 434, Grinnell, Hunt, or approved equal.

### **PART 3**      **EXECUTION**

#### **3.1**      **GENERAL**

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

### **3.2 HANGERS**

- .1 Strap hangers: install in accordance with SMACNA and drawings, whichever is more stringent.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with ASHRAE, SMACNA and drawings, whichever is more stringent.
- .4 All upper hanger attachment assemblies to be of galvanized finish.
- .5 Supply and install steel supports where none exist and are required to accommodate suspension of ductwork.

### **3.3 SEALING AND TAPING**

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

### **3.4 FIELD PAINTING (RESPONSIBILITY OF THE GENERAL CONTRACTOR)**

- .1 Preparation, product and method / application as per Section 09 91 23 – Interior Painting
- .2 Protect all control devices, operable dampers and mechanical equipment prior to application.
- .3 Exposed ductwork in unfinished areas and Mechanical / Electrical spaces shall not require additional painting.

### **3.5 IDENTIFICATION DUCTWORK SYSTEM**

- .1 See specification section 23 05 53.01 – Mechanical Identification.

### **3.6 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**

- .1 On long straight runs in open areas in 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.
- .10 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.

### 3.7 LEAKAGE TESTS/COMMISSIONING

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air System.

### 3.8 DUCT SCHEDULE

- .1 Fabricate ducts with galvanized sheet steel except as otherwise indicated as follows:
  - .1 General exhaust ductwork shall be galvanized construction except as noted below. Wet exhaust between galvanized main and final connections in room shall be 304L welded stainless steel.
  - .2 Fume Hood / Snorkel Exhaust System
    - .1 Welded Type 304L, stainless-steel sheet from fume hood / snorkel to galvanized exhaust main above the ceiling.
    - .2 Stainless steel exposed to View: No. 4 finish.
    - .3 Stainless steel concealed: No. 2D finish.
  - .3 Ducts Exhausting Toilet Rooms and Showers (wet exhaust).
    - .1 Type 304L, stainless-steel sheet.
    - .2 Stainless steel exposed to View: No. 4 finish.
    - .3 Stainless steel concealed: No. 2D finish.

**END OF SECTION**

**Part 1**

**General**

**1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and performance criteria for sound attenuation for mechanical systems.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

**1.3 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM C 423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .3 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials
  - .4 ASTM E 90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
  - .5 ASTM E 477, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS)
- .4 National Building Code (NBCC)
- .5 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .6 American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE)
- .7 Associated Air Balance Council (AABC)
- .8 National Environmental Balancing Bureau (NEBB)

- .9 National Fire Protection Association (NFPA)
  - .1 NFPA 255, Test of Surface Burning Characteristics of Building Materials.
- .10 Underwriters Laboratories (UL)
  - .1 UL 723, Test of Surface Burning Characteristics of Building Materials.

#### 1.4 SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Provide separate shop drawings for each piece of attenuation equipment, system shop drawings complete with product data.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.

#### 1.5 PERFORMANCE REQUIREMENTS

- .1 Rating Data:
  - .1 Provide performance rating data, certified by professional engineer or accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:
    - .1 Silencer: insertion loss, pressure drop at design conditions, generated noise level.
    - .2 Acoustical performance measurements in accordance with ASTM E 477, ASTM E 90 and ASTM C 423, except where specified otherwise.
    - .3 Duct lagging: sound transmission loss.

#### 1.6 QUALITY ASSURANCE

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

**1.7 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 SILENCERS**

- .1 General:
  - .1 Silencers shall be of size, configuration, capacity as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.
  - .2 Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted.
- .2 Materials:
  - .1 Rectangular silencers:
    - .1 All rectangular silencers shall be constructed with an 18 gauge galvanized steel outer casing and 22 gauge galvanized perforated steel inner.
  - .2 Acoustic media:
    - .1 Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to ensure conformance with laboratory test data. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly. Media shall be bacteria and fungus resistant, resilient such that it will not crumble or break, and conforming to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.
  - .3 Media protection:
    - .1 The acoustic media shall be completely wrapped with Tedlar film to help prevent shedding, erosion and impregnation of the glass fiber. The wrapped acoustic media shall be separated from the perforated metal by a factory installed 12 mm thick acoustically transparent spacer. The spacer shall be flame retardant and erosion resistant. A mesh, screen or

corrugated perforated liner will not be acceptable as a substitute for the specified spacer.

.4 Combustion ratings:

.1 Silencer materials, including glass fiber, Tedlar film and acoustical spacer shall have maximum combustion ratings as noted below when tested in accordance with ASTM E84, NFPA 255 or UL 723:

- .1 Flamespread classification: 20.
- .2 Smoke development rating: 45.

.3 Construction:

.1 Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. The silencers shall not fail structurally when subjected to a differential air pressure of 1.98 kPa.

.2 Casings shall be lockformed and sealed, to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the Contractor at the jobsite.

.3 All perforated steel shall be adequately stiffened to ensure flatness and form. All spot welds shall be painted.

.4 Acoustic performance:

.1 Silencer dynamic insertion loss shall not be less than that listed in the silencer schedule.

.2 All silencer ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with the ASTM E-477-06a test standard. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption.

.5 Aerodynamic performance:

.1 Silencer pressure drops shall not exceed those listed in the silencer schedule. Silencer pressure drop measurements shall be made in accordance with ASTM E-477 test standard. Tests shall be conducted and reported on the identical units for which acoustical data is presented.

.6 Acceptable Product: Price, Vibro-Acoustics, Vibron, Korfund, VAW Systems, Metlane, or approved equal.

## 2.2 LAGGING

.1 Externally lag fan coil unit with a flexible blanket style acoustic lagging consisting of a loaded vinyl noise barrier with a reinforced fibrous glass scrim reinforced aluminum foil facing on one side and a 25 mm thick quilted fibreglass decoupler on the back.

- .2 The quilt shall decouple the loaded vinyl noise barrier from the noise emitting surface to achieve greater noise reduction.
- .3 Sound transmission loss in decibels (db) shall be as follows:
- | <u>Decoupler</u> | <u>63 Hz</u> | <u>125 Hz</u> | <u>250 Hz</u> | <u>500 Hz</u> | <u>1000 Hz</u> | <u>2000 Hz</u> | <u>4000 Hz</u> | <u>8000 Hz</u> |
|------------------|--------------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|
| 25 mm            | 14           | 18            | 18            | 23            | 30             | 39             | 46             | 37             |
| 50 mm            | 15           | 19            | 20            | 23            | 33             | 44             | 53             | 42             |
- .4 Shall meet smoke and flame spread rating of 50 and 25 respectively.
- .5 Product shall be UL listed.
- .6 Loaded vinyl noise barrier shall be 2 mm thick and have a weight of 4.9 Kg/m<sup>2</sup>.
- .7 Decoupler 25 mm thick shall have a weight of 0.97 Kg/m<sup>2</sup>. Decoupler 50 mm thick shall have a weight of 1.94 Kg/m<sup>2</sup>.
- .8 Overlap blanket joints by 50 mm. Secure lagging material to duct using weld pins and acrylic pressure sensitive tape supplied by the manufacturer of the duct lagging material.
- .9 Acceptable Product: Sound Seal Barricade Noise Control Products Model B-10 LAG/QFA-3 for 25 mm thick decoupler and B-10 LAG/QFA-9 for 50 mm thick decoupler, Vibron, Vibro-Acoustics, Korfund, or approved equal.

### **PART 3**      **EXECUTION**

#### **3.1**      **INSTALLATION**

- .1 Silencers:
- .1 Install in accordance with manufacturer's instructions.
- .2 Instrument test ports: install at inlet and outlet of each in-duct silencer to permit measurement of pressure loss and insertion loss.
- .3 Suspension: to manufacturer's instructions.
- .2 Lagging:
- .1 Install in accordance with manufacturer's instructions.

#### **3.2**      **FIELD QUALITY CONTROL**

- .1 Experienced and competent sound testing agent to take sound measurement after start up and testing, adjusting and balancing of systems to Section 23 05 93 - Testing Adjusting and Balancing (TAB) for HVAC.
- .2 Sound measurements to extend over frequency range of 64 to 8000 Hz and to be taken:
- .1 In duct upstream and downstream of each silencer.

- .2 Ten (10) locations in Level 5 Pavilion A.
- .3 Provide Owner's Representative with notice 24 h in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation, acceptability of noise levels in occupied areas, other conditions affecting acoustics and, where appropriate, recommendation for remedial measures and costs.
- .5 Submit complete report of test results including sound curves, include in Commissioning Manual.
- .6 Manufacturer's Field Services:
  - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
  - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
    - .1 Upon completion of installation.
  - .3 Submit manufacturer's reports to Owner's Representative within 3 days of manufacturer representative's review.

### 3.3 ADJUSTING

- .1 Make adjustments and corrections in accordance with written report.
- .2 Provide Owner's Representative with notice 24 h in advance of visit.

### 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.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars.

**1.2**            **RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 35 29.06 – Health and Safety Requirements.
- .3 Section 01 45 00 – Quality Control.
- .4 Section 01 74 11 – Cleaning.
- .5 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .6 Section 01 78 00 – Closeout Submittals.

**1.3**            **REFERENCES**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA – HVAC Duct Construction Standards – Metal and Flexible.

**1.4**            **SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate the following:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Fire damper access duct sections.
    - .4 Turning vanes.
    - .5 Instrument test ports.
    - .6 Spin-on collars.
    - .7 Open ended duct protection.
    - .8 Remotely operated dampers.

- .9 Flange connections.
- .2 Submit WHMIS MSDS – Material Safety Data Sheets. Indicate VOCs for adhesive and solvents during application and curing.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
  - .1 Certification of ratings: catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .4 Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Specification.

## **1.5 QUALITY ASSURANCE**

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

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
  - .4 Separate for reuse and recycling and place in designated containers steel, metal, and plastic waste in accordance with Waste Management Plan (WMP).
  - .5 Divert unused metal materials from landfill to metal recycling facility as approved by Owner's Representative.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

### **2.2 FLEXIBLE DUCT CONNECTOR (GENERAL INTERIOR DUTY)**

- .1 Application: vibration dampening for fan coil unit.

- .2 Pre-assembled with sheet metal permanently secured to fabric.
- .3 Double-lock gripping fingers of metal to fabric.
- .4 Designed to NFPA 90A and NFPA 90B.
- .5 Airtight and waterproof at 2490 Pa positive to 2490 Pa negative.
- .6 24 gauge galvanized steel to ASTM A-653-94-G60.
- .7 Commercial grade.
- .8 Fabric:
  - .1 Vinyl super duty coated fabric.
  - .2 Black in colour.
  - .3 Low temperature: -30°C.
  - .4 High temperature: 70°C.
  - .5 Woven polyester base fabric.
  - .6 NFPA 701 compliant.
  - .7 Flame retardant coating.
  - .8 Mildew resistant per ASTM G-21.
  - .9 All purpose fabric.
  - .10 Excellent resistance to cuts, tears and abrasions.
- .9 Acceptable Product: Ductmate Proflex Part No. PFC04VSGA, Dura-Dyne, Dyn Air, or approved equal.

### 2.3 ACCESS DOORS IN DUCTS

- .1 Door: two panel design with inner and outer panels pressed from 24 gauge galvanized mild steel for sizes 8 x 5, 12 x 6 and 18 x 10 and 22 gauge galvanized mild steel for sizes 22 x 14 and 26 x 18. Standard thickness shall be nominal 25 mm.
- .2 Insulation: 20 mm thick insulation totally contained between door panels. Insulation shall have a density of 40 Kg per cubic meter.
- .3 Seal: extruded seal with welded seam incorporating an integral flexible hollow tube for low leakage performance fitted between the two door panels for strength and stability.
- .4 Frame: pressed one piece dual flange/frame from 24 gauge galvanized mild steel for all sizes. Frame to be pre-punched for duct mounting.
- .5 Latches: zinc plated steel progressive cam fasteners and fastening clamps, two sets for sizes 8 x 5 and 12 x 6, four sets for size 18 x 10, and six sets for sizes 22 x 14 and 28 x 18. Cam fasteners to be positioned at strategic locations for optimum closure, and low leakage.

- .6 Security chain: retaining safety chain is to be fitted to both door and frame to alleviate damage or injury.
- .7 Suitable for mounting in insulated and non-insulated ducts both internal and external.
- .8 Flat oval shape.
- .9 Provide complete with cut-out templates for duct.
- .10 Doors to be tested to 2 kPa static pressure and shall conform to American and British leakage standards DW 144 Class A and C.
- .11 Acceptable Product: Air Management Inc. (AMI) ACC Series, AST, or approved equal.

#### **2.4 FIRE DAMPER ACCESS DUCT SECTIONS**

- .1 Access doors adjacent to fire dampers shall be at a minimum of 300 mm X 300 mm to permit service and inspection. In locations where it is not possible to install a 300 mm X 300 mm access door due to duct size, the Mechanical Contractor shall install fire damper access duct sections as described below.
- .2 Fire damper access duct sections shall comply with NFPA 80.
- .3 Fire damper access duct sections shall come complete with access sections, removeable Sure Clamps and adapter sections.
- .4 Sure clamps shall come complete with silicon or neoprene gaskets.
- .5 Rectangular fire damper access duct sections shall be fabricated of 26 gauge galvanized sheet metal. Round fire damper access duct sections sizes 100 mm to 300 mm diameter shall be fabricated of 22 gauge galvanized sheet metal, sizes larger than 300 mm diameter shall be fabricated of 20 gauge galvanized sheet metal.
- .6 Fire damper access duct sections shall come with a label that reads "FIRE DAMPER ACCESS".
- .7 Acceptable Product: Sure clamp access - removeable duct section by Langdon Inc., or approved equal.

#### **2.5 TURNING VANES**

- .1 Factory or shop fabricated with trailing edge, to recommendations of SMACNA and as indicated.

#### **2.6 INSTRUMENT TEST PORTS**

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.

- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.
- .5 Acceptable Product: Duro-Dyne IP1 or IP2, Dyn Air, or approved equal.

## 2.7 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to corresponding round duct standards.

## 2.8 OPEN ENDED DUCT PROTECTION

- .1 To be used during construction.
- .2 Co-extruded polyethylene, green in colour, designed to adhere to galvanized steel, 600% elongation, 2.5 mil thickness, 13.1 lbs/in tensile strength.
- .3 Acceptable Product: Ductmate Proguard, or approved equal.

## 2.9 REMOTELY OPERATED DAMPERS

- .1 Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - .1 Young Regulator (Basis of Design)
  - .2 Duradyne
  - .3 Greenheck Fan Corporation
  - .4 Metropolitan Air Technology
- .2 Remotely Operated Dampers:
  - .1 Rectangular Opposed Blade Damper: (Model 830A-CC)
    - .1 Damper(s) to be opposed blade type constructed of .050" minimum heavy duty extruded aluminum frames and blades. All necessary hardware to ensure compatibility with Bowden remote cable control system shall be included. Damper blades to include individual blade bushings for smooth and quiet operation. Damper blades shall rotate between a matched pair of formed and punched 306 stainless steel connecting slide rails which facilitate smooth blade movement and ensure alignment.
  - .2 Round: (Model 5020-CC)
    - .1 Damper(s) to be constructed of heavy duty galvanized steel spiral shell design with rolled-in stiffening beads for superior rigidity. Spiral shell shall have one crimped end and one straight end for ease of installation. Damper to include "V" style 20 gauge galvanized steel blade secured

with 1/2" diameter steel shafts and oil impregnated bronze bearings requiring no lubrication. Damper shall include all necessary hardware to ensure compatibility with Bowden remote cable control system.

.3 Cable Control Systems

.1 Concealed Ceiling Regulator with cup and 3" cover plate: (Model 270-301).

.1 Damper controller and cable shall be concealed above the ceiling. Cable to consist of Bowden cable .054" stainless steel control wire with a tensile strength of 260,000 lbs. that is encapsulated in 1/16" flexible galvanized spiral wire sheath. Control kit shall consist of 2- 5/8" diameter die cast aluminum housing with 3" diameter polished chrome cover, and 14 gauge steel rack and pinion gear drive capable of delivering 35 in. lbs. of push / pull torque that converts rotary motion to push-pull motion. Control shaft shall be D-style flatted 1/4" diameter with 265-degree rotation providing graduations for positive locking and control, and 1-1/2" linear travel capability. Control kit is designed to be imbedded in the ceiling flush with the finished surface. Control kit shall be manually operated.

.2 Ceiling Concealed Regulator with 7/8" threaded cap: (Model 270-896).

.1 Damper controller and cable shall be concealed above the ceiling. Cable to consist of Bowden cable .054" stainless steel control wire with a tensile strength of 260,000 lbs. that is encapsulated in 1/16" flexible galvanized spiral wire sheath. Control kit shall consist of "C" bracket to fasten above the ceiling, 7/8" diameter cold rolled steel zinc plated threaded cap suitable for painting, and 14 gauge steel rack and pinion gear drive capable of delivering 35 in. lbs. of push / pull torque that converts rotary motion to push-pull motion. Control shaft shall be D-style flatted 1/4" diameter with 265-degree rotation providing graduations for positive locking and control, and 1-1/2" linear travel capability. Control kit is designed to be imbedded in the ceiling flush with the finished surface. Control kit shall be manually operated

**2.10 FLANGE CONNECTORS**

.1 Available Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- .1 Ductmate Industries, Inc.
- .2 Nexus PDQ; Division of Shilco Holdings Inc.
- .3 Ward Industries, Inc.; a division of Hart & Cooley, Inc.

.2 Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

.3 Material: Galvanized steel.

.4 Gage and Shape: Match connecting ductwork.

## **PART 3**      **EXECUTION**

### **3.1**      **GENERAL**

- .1 Install duct accessories of materials suited to duct materials. Use galvanized-steel accessories in galvanized-steel duct and stainless-steel accessories in stainless-steel duct.

### **3.2**      **INSTALLATION**

- .1 Flexible connections:
  - .1 Install in following locations:
    - .1 Fan coil unit duct connection.
    - .2 Length of connection: 100 mm (fabric).
    - .3 Minimum distance between metal parts when system in operation: 75 mm.
    - .4 Install in accordance with recommendations of SMACNA.
    - .5 When fan is running:
      - .1 Ducting on sides of flexible connection to be in alignment.
      - .2 Ensure slack material in flexible connection.
  - .2 Access doors and viewing panels:
    - .1 Size:
      - .1 8 x 5 (200 x 1235) one hand or sight.
      - .2 12 x 6 (300 x 150) one hand and sight.
      - .3 18 x 10 (450 x 250) both hands and sight.
      - .4 22 x 14 (550 x 350) full body entry.
      - .5 26 x 18 (650 x 450) full body entry plus ladder.
    - .2 Locations:
      - .1 Fire dampers.
      - .2 Control dampers.
      - .3 Devices requiring maintenance.
      - .4 Required by code.
      - .5 Elsewhere as indicated.
- .3 Fire damper access duct sections:
  - .1 To be installed when the minimum fire damper access door size of 300 mm X 300 mm is not able to be installed due to duct size.
  - .2 If installed within an insulated duct system, insulate fire damper access duct section separately such that the removable duct section can be removed without disturbing adjacent duct insulation.
  - .3 If fire damper access duct section is insulated, provide label on the insulation indicating "FIRE DAMPER ACCESS".

- .4 Instrument test ports.
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
    - .2 Locate to permit easy manipulation of instruments.
    - .3 Install insulation port extensions as required.
    - .4 Locations.
      - .1 For traverse readings:
        - .1 Inlets and outlets of fan systems.
        - .2 Main and sub-main ducts.
        - .3 And as indicated.
      - .2 For temperature readings:
        - .1 At inlet and discharge of reheat coils.
        - .2 And as indicated.
      - .3 For acoustical readings:
        - .1 Upstream and downstream of silencers.
- .5 Turning vanes:
  - .1 Install in accordance with recommendations of SMACNA and as indicated.
- .6 Utilize covering protection over all open end ducts during construction. This includes suspended ducts under construction as well as ductwork temporarily stored on floor on construction site awaiting installation.
- .7 Provide remotely operated volume control dampers above hard ceilings (i.e. gypsum board). Installation of ceiling access doors in hard ceilings to gain access to operators for volume control dampers shall only be allowed at discretion of both the engineer and the architect.

### 3.3 CLEANING

- .1 Perform cleaning operations as specified in Specification and in accordance with Manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section Includes:
  - .1 Balancing dampers for mechanical forced air ventilation and air conditioning systems.

**1.2**            **RELATED SECTIONS:**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 35 29.06 – Health and Safety Requirements.
- .3 Section 01 45 00 – Quality Control.
- .4 Section 01 61 00 - Common Product Requirements.
- .5 Section 01 74 11 - Cleaning
- .6 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .7 Section 01 78 00 – Closeout Submittals.

**1.3**            **REFERENCES**

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.4**            **SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.
    - .2 Indicate the following:
      - .1 Specifications.
  - .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 – Submittal Procedures.

- .1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: Submit manufacturer's installation instructions.

## 1.5 QUALITY ASSURANCE

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

## 1.6 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 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 Manufacture to SMACNA standards.

### 2.2 MANUAL BALANCING DAMPERS

- .1 Rectangular:
  - .1 Frame: for units under 36" wide x 12" high (914 x 305) the frame shall be 22 gauge galvanized steel. For units over 36" wide x 12" high (914 x 305) the frame shall be 18 gauge steel formed into a structural hat channel shape with tabbed corners for reinforcement.
  - .2 Blades: for units under 36" wide x 12" high (914 x 305) the blades shall be single skin, 22 gauge galvanized steel with center 'V' groove for reinforcement. For units over 36" wide x 12" high (914 x 305) the blades shall be single skin 18 gauge galvanized steel with three longitudinal grooves for reinforcement.
  - .3 Bearings: corrosion resistant synthetic sleeve type turning in an extruded hole in the damper frame.
  - .4 Axles: round, screwed into the damper blade.
  - .5 Provide single blade dampers for ducts up to 36" wide x 12" high (914 x 305). Provide multiple blade dampers for ducts larger than 36" wide x 12" high (914 x 305) in either direction.

- .6 Maximum size single section: 48" wide x 48" high (1219 x 1219).
  - .7 Minimum size: 5" wide x 4" high (127 x 102).
  - .8 Dampers are to be supplied approximately 6 mm smaller than given duct dimensions.
  - .9 Acceptable Product: Air Management Inc. (AMI) Model MD2005, Ruskin, or approved equal.
- .2 Round:
- .1 Frame: 20 gauge galvanized steel, 7" (178) long.
  - .2 Blade: single skin 20 gauge galvanized steel.
  - .3 Bearings: corrosion resistant molded synthetic type.
  - .4 Axle: control shaft shall extend beyond the frame through a factory mounted, locking hand quadrant. Axle to be 3/8" (10) square shape.
  - .5 Maximum damper size: 20" diameter (508).
  - .6 Minimum damper size: 4" diameter (102).
  - .7 Dampers are to be supplied approximately 6 mm smaller than given duct dimensions.
  - .8 Maximum temperature: 121°C.
  - .9 Acceptable Product: Air Management Inc (AMI) Model MD200R, Ruskin, or approved equal

### **PART 3**      **EXECUTION**

#### **3.1**      **MANUFACTURER'S INSTRUCTIONS**

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

#### **3.2**      **INSTALLATION**

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 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 to be vibration free.
- .6 Ensure damper operators are observable and accessible.

**3.3**

**CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section Includes:
  - .1 Fire and smoke dampers, and fire stop flaps.

**1.2**            **RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 35 29.06 – Health and Safety Requirements.
- .3 Section 01 61 00 – Common Product Requirements.
- .4 Section 01 74 11 – Cleaning.
- .5 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .6 Section 01 78 00 – Closeout Submittals.
- .7 Section 01 91 13 – Commissioning (Cx) Requirements.
- .8 Section 23 31 13.01 – Ductwork - Metallic to 2500 Pa.

**1.3**            **REFERENCES**

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
  - .1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories of Canada (ULC)
  - .1 CAN4-S112, Fire Test of Fire Damper Assemblies.
  - .2 ULC-S505, Fusible Links for Fire Protection Service.

**1.4**            **SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

- .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
  - .1 Fire dampers.
  - .2 Operators.
  - .3 Fusible links.
  - .4 Design details of break-away joints.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

## 1.5 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .2 Certificates:
  - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

## 1.6 MAINTENANCE

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 – Closeout Submittals.
  - .2 Provide the following:
    - .1 6 fusible links of each type.

## 1.7 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      FIRE DAMPERS (IN WALL OR FLOOR)**

- .1 Furnish and install, at locations shown on plans, fire dampers constructed and tested in accordance with the current edition of UL555 Standard for Fire Dampers. Dampers up to 5.95 m<sup>2</sup> for vertical mount and 2.32 m<sup>2</sup> for horizontal mount shall be classified for dynamic closure to a minimum 12.1 m/s and 996 Pa static pressure for horizontal air flow, air flow up and air flow down. Velocity and pressure ratings shall include both in-duct and no-duct installations. Each fire damper shall be marked with a UL Classified 1½ hour fire protection rating, the maximum velocity/pressure rating for each horizontal and vertical installation and "for use in dynamic systems". Dampers marked "for use in static systems only" are not permitted. In addition, each dynamic fire damper shall include a 74°C fusible link. Each dynamic fire damper shall include an integral roll formed steel sleeve and retaining angles furnished by the damper manufacturer to ensure appropriate installation. Submittal information shall include the fire protection rating, maximum velocity/pressure ratings and the manufacturer's UL installation instructions. Each fire damper shipment shall include the same UL installation instructions. The dampers shall be installed in accordance with these instructions.
- .2 Rectangular fire dampers to be Style 'B' with blades out of airstream for reduced airflow restriction, 80-90% free area.
- .3 Round fire dampers to be style WR, welded, 90-95% free area, round enclosure. The wall sleeve shall be rectangular and the blades shall be out of the airstream for reduced airflow restriction.
- .4 Vertical and horizontal closure spring operation for assured closure under air flow (i.e. fans on) in HVAC systems.
- .5 Shall meet all UL and NFPA criteria for primary fire dampers installed in walls with fire resistive rating of less than 3 hours.
- .6 Provide integral sleeves of sufficient length to full, span wall or floor assembly opening.
- .7 Fire dampers in metal stud walls or supported in wall or floor openings with metal stud framing shall have such framing installed in accordance with the damper manufacturer's recommendations.
- .8 Acceptable Product: Ruskin Model DIBD2 (1½ hr.), Nailor, Controlled Air, Air Management Inc. (AMI), Alumavent, Ventex, Lau, or approved equal.

## 2.2 COMBINATION FIRE AND SMOKE DAMPERS

- .1 Furnish and install at locations shown on plans, combination fire and smoke dampers constructed and tested in accordance with current edition of UL555 and UL555S.
- .2 Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- .3 Closing rating in ducts up to system static pressure rating static pressure class and minimum 3000 fpm velocity.
- .4 Fire Rating: 1-1/2 hours and 3 hours. Reference Architectural drawings for location and duration of fire rated separations.
- .5 Frame: Hat-shaped, 0.094-inch thick, galvanized sheet steel, with welded interlocking, gusseted or mechanically attached corners and mounting flange.
- .6 Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.
- .7 Smoke Detector: By Electrical Contractor.
- .8 Blades: Roll-formed, horizontal, interlocking, 0.063-inch- thick, galvanized sheet steel.
- .9 Leakage: Class I.
- .10 Mounting Sleeve: Factory-installed, 0.05-inch thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- .11 Damper Motors: Two-position, fail closed, fast acting, for fire/smoke control applications.
  - .1 Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - .2 Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 25 and Division 26.
  - .3 Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  - .4 Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 175 in. x lbf and stall maximum torque rating of 425 in. x lbf.
  - .5 Electrical Connection: 115 V, single phase, 60 Hz.
- .13 Accessories:

- .1 Auxiliary switches for signaling or position indication. (open and closed)
- .2 Test and reset switches, damper remote mounted. Provide UL classified heat responsive device to allow dampers to be reopened after initial closure for dynamic smoke control. The device shall include a primary heat sensor and a high limit heat sensor. The device shall allow the damper to be controlled remotely as part of an overall building fire alarm system smoke control sequence.
- .14 Acceptable Product: Ruskin FSD60 Series, Nailor, Controlled Air, Air Management Inc. (AMI), Alumavent, Ventex, Lau, or approved equal.

### **PART 3**      **EXECUTION**

#### **3.1**            **MANUFACTURER'S INSTRUCTIONS**

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

#### **3.2**            **INSTALLATION**

- .1 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .2 Provide duct mounted and wall and/or ceiling mounted access door adjacent to each damper. All ceiling and wall mounted access doors required to gain access to dampers and linkages shall be supplied by the Mechanical Contractor for field installation by the General Contractor. These doors shall be shop primed for field painting by the General Contractor. All duct mounted access doors shall be supplied and installed by the Mechanical Contractor.
- .3 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .4 Install break-away joints of approved design on each side of fire separation.
- .5 Supply dampers with integral sleeve and retaining angles.

#### **3.3**            **CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

#### **3.4**            **COMMISSIONING**

- .1 Commission in accordance with Section 01 91 13 – Commissioning (Cx) Requirements.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation of flexible ductwork, joints and accessories.

**1.2**            **RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 35 29.06 – Health and Safety Requirements.
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .4 Section 01 91 13 – Commissioning (Cx) Requirements.

**1.3**            **REFERENCES**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .4 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible.
  - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .5 Underwriters' Laboratories Inc. (UL)
  - .1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
- .6 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S110, Fire Tests for Air Ducts.

**1.4**            **SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data: submit WHMIS MSDS – Material Safety Data Sheets and information pertaining to the following:

- .1 Thermal properties.
- .2 Friction loss.
- .3 Acoustical loss.
- .4 Leakage.
- .5 Fire rating.

## 1.5 QUALITY ASSURANCE

.1 Certification of Ratings:

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

.2 Health and Safety:

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

## 1.6 DELIVERY, STORAGE AND HANDLING

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

.2 Waste Management and Disposal:

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard 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.

## 1.7 INDOOR AIR QUALITY (IAQ)

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

**PART 2**      **PRODUCTS**

**2.1**            **GENERAL**

- .1      Factory fabricated to CAN/ULC S110.
- .2      Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

**2.2**            **NON-METALLIC - INSULATED**

- .1      Non-collapsible, coated trilaminate aluminum foil/mylar/fiberglass mesh type mechanically bonded to, and helically supported by, external corrosion resistant, galvanized steel wire with factory applied, 37 mm thick flexible glass fibre thermal insulation with flame retardant, non-toxic polyethylene vapour barrier jacket.
- .2      Performance:
  - .1      Rated velocity: 20.3 m/s.
  - .2      Pressure:
    - .1      Positive: 3.0 kPa.
    - .2      Negative: 0.25 kPa
- .3      Classification: ULC-S110 and ULC-181 Class 1 air duct.
- .4      Acceptable Product: Flexmaster Canada Ltd Fabriflex Type FAB-3T, Wiremold, Thermaflex, or approved equal.

**2.3**            **FLEXIBLE DUCT HANGER SUPPORTS**

- .1      Flexible duct hanger supports shall be constructed of durable composite material and shall be 40 mm wide to prevent any restriction of the internal diameter of the ductwork when the weight of the supported section rests on the hanger. The hanger support shall be UL listed for use in return air plenum spaces.
- .2      Acceptable Product: Thermaflex Flextie, Flexmaster, Wiremold, or approved equal.

**2.4**            **FLEXIBLE DUCTWORK ELBOW SUPPORTS**

- .1      Flexible duct elbow supports shall be constructed of durable composite material and shall be fully adjustable to support flexible duct diameters from 150 mm to 400 mm diameter. Flexible duct elbow supports shall be UL listed for use in return air plenum spaces.
- .2      Acceptable Product: Thermaflex FlexFlow Elbow, Flexmaster, Wiremold, or approved equal.

**2.5**            **FLEXIBLE DUCT FASTENING CLAMP**

- .1      Stainless steel band with cadmium plated hexbolt for attaching flexible ductwork to metal duct fittings. Clamps to be suitable for sizes 150 mm, 200 mm and 300 mm diameter.

- .2 Acceptable Product: Thermaflex Snaplock Clamp, Flexmaster, Wiremold, or approved equal

**PART 3**      **EXECUTION**

**3.1**      **DUCT INSTALLATION**

- .1 Install in accordance with: NFPA 90A and NFPA 90B SMACNA.
- .2 Maximum length of flexible duct: 3 m.
- .3 Flexible duct supports to be installed at a maximum spacing of 1.0 m. Maximum allowable sags between supports to be 12 mm per 300 mm.
- .4 Provide a flexible duct elbow at each flexible duct diffuser connection.
- .5 Utilize flexible duct fastening clamps to secure flexible duct to metal duct fittings. For duct sizes other than those sizes listed, utilize plastic draw bands UL listed for air plenum applications.
- .6 Provide flexible ductwork only in locations as indicated on drawings.

**END OF SECTION**

**PART 1**      **GENERAL**

**1.1**            **RELATED SECTIONS**

- .1      Section 01 33 00 – Submittal Procedures.
- .2      Section 01 45 00 – Quality Control.
- .3      Section 01 74 21 – Construction/Demolition Waste Submittal and Disposal.
- .4      Section 01 78 00 – Closeout Submittals.
- .5      Section 23 32 48 – Acoustical Air Plenums.
- .6      Section 25 30 02 – EMCS: Field Control Devices
- .7      Section 25 90 01 – EMCS: Site Requirements, Applications and Systems Sequences of Operation

**1.2**            **REFERENCES**

- .1      American National Standards Institute (ANSI)
  - .1      ANSI/AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .2      ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2      American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1      AHSRAE 130, Methods of Testing for Rating Ducted Air Terminal Units.
- .3      Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1      Material Safety Data Sheets (MSDS).
- .4      International Organization of Standardization (ISO)
  - .1      ISO 3741, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .5      Underwriter's Laboratories (UL)
  - .1      UL 181, Factory-Made Air Ducts and Air Connectors.
  - .2      UL 1995, Heating and Cooling Equipment.
- .6      Air-conditioning Refrigeration Institute (ARI)
  - .1      ARI 880, Air Terminals.
- .7      National Fire Protection Association (NFPA)

- .1 NFPA 90A, Installation of Air-conditioning and Ventilation Systems.
- .8 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame construction and Manufactured Housing.
  - .2 ASTM D4300, Standard Test Methods for Ability of Adhesive Films to Support or Resist the Growth of Fungi.
- .9 Air Diffusion Council (ADC).
- .10 Canadian Standards Association (CSA).

### 1.3 SYSTEM DESCRIPTION

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

### 1.4 SUBMITTALS

- .1 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 – Submittal Procedures.
  - .2 Test data: to ANSI/AMCA 210.
    - .1 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.
    - .2 Sound power level with minimum inlet pressure of 0.25, 0.5, 1, and 1.5 kPa in accordance with ISO 3741 for 2<sup>nd</sup> through 7<sup>th</sup> octave band, also made by independent testing agency.
    - .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.
- .2 Shop Drawings:
  - .1 Submit shop drawing in accordance with Specification.
  - .2 Indicate the following:
    - .1 Capacity.
    - .2 Pressure drop.
    - .3 Noise rating.