



THE CITY OF WINNIPEG  
**BONIVITAL POOL RENEWAL**  
**1215 ARCHIBALD STREET**

TENDER NO. 750-2023B

# **SPECIFICATIONS**

ISSUED FOR CONSTRUCTION: DECEMBER 22, 2023



LM Comm. No. 2129

**Introductory Information**

00 01 10	Table of Contents	4
00 01 15	List of Drawing Sheets	2
00 31 00	Available Project Information	1
	Basement Floor Plan	1
	Main Floor Plan	1

**SPECIFICATIONS GROUP**

**GENERAL REQUIREMENTS SUBGROUP**

**Division 01 - General Requirements**

01 11 00	Summary of Work	3
01 21 00	Allowances	1
01 31 00	Project Management and Co-ordination	5
01 33 00	Submittal Procedures	4
01 45 00	Quality Control	2
01 50 00	Temporary Facilities and Controls	7
01 61 00	Common Product Requirements	6
01 74 00	Cleaning	2
01 74 19	Waste Management and Disposal	3
01 78 00	Closeout Submittals	7
01 79 00	Demonstration and Training	1
01 91 13	General Commissioning (CX) Requirements	10

**FACILITY CONSTRUCTION SUBGROUP**

**Division 02 - Existing Conditions**

02 41 00.18	Demolition of Minor Works	4
02 81 00	Hazardous Materials – General provisions	18
02 82 10	Asbestos Abatement – Type 1 (Low Risk) Precautions	4
02 82 12	Asbestos Abatement – Glove bag	5
02 82 13	Asbestos Abatement – Type 3 (High Risk) Precautions	12

**Division 03 - Concrete**

03 10 00	Concrete Forming and Accessories	4
03 20 00	Concrete Reinforcing	4
03 30 00	Cast-In-Place Concrete	7
03 48 00	Precast Concrete Specialties	1

**Division 04 - Masonry**

04 22 00	Concrete Unit Masonry	5
----------	-----------------------	---

**Division 05 – Metals**

05 12 23	Structural Steel for Buildings	5
05 31 00	Steel Decking	3
05 50 00	Metal Fabrications	4

**Division 06 - Wood, Plastics, and Composites**

06 10 00	Rough Carpentry for Minor Works	4
06 20 00	Finish Carpentry	5
06 40 00	Architectural Woodwork	9
06 61 16	Solid Surfacing Fabrications	5

**Division 07 - Thermal and Moisture Protection**

07 11 19	Sheet Damproofing	2
----------	-------------------	---

07 21 00	Thermal Insulation	4
07 21 19	Foamed-In-Place Insulation	5
07 26 00	Air/Vapour Barrier Membrane – Self-Adhesive	7
07 26 10	Vapour Retarders	3
07 42 13.20	Acoustic Barrier Panel System	4
07 42 33	Solid Phenolic Wall Panels	5
07 62 00	Sheet Metal Flashing and Trim	2
07 84 00	Firestopping and Smoke Seals	13
07 92 00	Joint Sealants	5

**Division 08 - Openings**

08 06 10	Door Schedule	5
08 11 00	Metal Doors and Frames	6
08 11 16	Aluminum Doors and Frames	8
08 31 16	Access Panels	3
08 71 00	Door Hardware	4
08 71 01	Door Hardware Schedule	4
08 71 13	Automatic Door Operators	4
08 80 00	Glazing	5
08 87 00	Glazing Surface Films	4

**Division 09 - Finishes**

09 06 00.13	Room Finish Schedule	8
09 21 16	Gypsum Board Assemblies	7
09 22 16	Non-Structural Metal Framing	4
09 31 00	Tiling	6
09 51 13	Acoustical Panel Ceilings	5
09 65 00	Resilient Flooring	8
09 81 00	Acoustic Insulation	2
09 84 13	Fixed Sound-Absorptive Panels	4
09 91 13	Exterior Painting	9
09 91 23	Interior Painting	11

**Division 10 – Specialties**

10 21 13	Solid Phenolic Toilet Compartments	4
10 28 00	Toilet and Bath Accessories	7
10 44 00	Fire Protection Specialties	2
10 51 00	Metal Lockers	3

**Division 11 – Equipment**

11 14 00	Pedestrian Control Equipment	3
11 73 13	Ceiling Track Lifts	3

**Division 12 – Furnishings**

12 48 13	Entrance Floor Mats and Frames	3
----------	--------------------------------	---

**FACILITY SERVICES SUBGROUP**

**Division 22 – Plumbing**

22 05 00	Common Work Results for Plumbing	5
22 05 05	Selective Demolition for Plumbing	4
22 05 15	Plumbing Specialties and Accessories	7
22 10 10	Plumbing Pumps	4
22 11 16	Domestic Water Piping	7
22 13 16.13	Sanitary Waste and Vent Piping - Cast Iron and Copper	3
22 13 16.16	Sanitary Waste and Vent Piping – Plastic	2

22 33 00	Electrical Domestic Water Heaters	3
22 42 13	Commercial Water Closets, Urinals	3
22 42 16	Commercial Lavatories and Sinks	2
22 42 19	Commercial Bathtubs and Showers	3
22 47 00	Drinking Fountains and Water Coolers	3
<b>Division 23 – Heating, Ventilating and Air Conditioning (HVAC)</b>		
23 01 05	Operation and Maintenance of HVAC Systems During Construction	2
23 01 31	Air Duct Cleaning for HVAC Systems	7
23 05 00	Common Work Results for HVAC	5
23 05 05	Selective Demolition for Heating, Ventilating, and Air Conditioning (HVAC)	4
23 05 13	Common Motor Requirements for HVAC Equipment	4
23 05 15	Common Installation Requirements for HVAC Pipework	5
23 05 16	Expansion Fittings and Loops for HVAC Piping	4
23 05 17	Pipe Welding	3
23 05 19.13	Thermometers and Pressure Gauges - Piping Systems	4
23 05 23.01	Valves – Bronze	5
23 05 23.02	Valves - Cast Iron	3
23 05 23.03	Valves - Cast Steel	4
23 05 29	Hangers and Supports for HVAC Piping and Equipment	7
23 05 53	Identification for HVAC Piping and Equipment	6
23 05 93	Testing, Adjusting and Balancing for HVAC	5
23 07 13	Duct Insulation	4
23 07 16	HVAC Equipment Insulation	6
23 07 19	HVAC Piping Insulation	8
23 08 13	Performance Verification HVAC Systems	3
23 08 16	Cleaning and Start-Up of HVAC Piping Systems	4
23 11 23	Facility Natural Gas Piping	4
23 21 13.01	Hydronic Systems: Copper	6
23 21 13.02	Hydronic Systems: Steel	5
23 21 16	Hydronic Piping Specialties	4
23 21 23	Hydronic Pumps	4
23 23 00	Refrigerant Piping	5
23 25 00	HVAC Water Treatment	6
23 31 13.01	Metal Ducts - Low Pressure to 500 kPa	5
23 31 13.02	Metal Ducts - High Pressure to 2500 kPa	5
23 33 00	Air Duct Accessories	4
23 33 14	Dampers Balancing	3
23 33 15	Dampers Operating	3
23 33 16	Dampers - Fire and Smoke	4
23 33 53	Duct Liners	4
23 34 00	HVAC Fans	4
23 37 13	Diffusers, Registers and Grilles	3
23 37 20	Louvres, Intakes and Vents	4
23 40 00	HVAC Cleaning Devices	4
23 51 00	Breechings, Chimneys and Stacks	4
23 52 00	Heating Boilers	8
23 57 00	Heat Exchangers for HVAC	4
23 72 00	Air-to-Air Energy Recovery Equipment	3
23 73 00.16	Air Handling Units - Packaged	5
23 74 00	Packaged Outdoor HVAC Equipment	16
23 81 23	Air Conditioning	6
23 82 36	Finned Tube Radiation Heaters	4

23 83 00	Radiant Heating Units	5
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**Division 25 – Integrated Automation**

25 01 11	EMCS: Start-Up, Verification and Commissioning	5
25 01 12	EMCS: Training	3
25 05 01	EMCS: General Requirements	8
25 05 02	EMCS: Submittals and Review Process	4
25 05 03	EMCS: Project Record Documents	3
25 05 54	EMCS: Identification	2
25 05 60	EMCS: Field Installation	9
25 08 20	EMCS: Warranty and Maintenance	4
25 10 01	EMCS: Local Area Network (LAN)	2
25 10 02	EMCS: Operator Work Station (OWS)	12
25 30 01	EMCS: Building Controllers	9
25 30 02	EMCS: Field Control Devices	16
25 90 01	EMCS: Site Requirements, Applications and Systems Sequences of Operation	12

**Division 26 – Electrical**

26 00 10	Basic Electrical Materials & Methods	13
26 00 90	Work in Existing Building	2
26 05 19	Wire & Cable	4
26 05 25	Grounding	3
26 05 29	Fastening & Supports	2
26 05 34	Conduit	4
26 05 35	Outlet Boxes & Fittings	3
26 05 45	Underground Cable & Conduit	2
26 06 21	Mechanical Equipment Connections	3
26 06 22	Miscellaneous Apparatus & Appliances	2
26 10 10	Electrical Service	2
26 12 18	Dry-Type Power Transformers	2
26 24 14	Main Distribution Switchboard	8
26 24 16	Panelboards	3
26 27 16	Cabinets, Splitters, Junction and Pullboxes	2
26 27 26	Wiring Devices	13
26 29 13	Motor Starters	3
26 50 00	Lighting	5
26 53 10	Exit lights	1

**Division 27 – Communications**

27 05 33	Data Cable Raceway System	2
27 13 10.2	Data Systems Copper Cat 6	4
27 51 16	Public Address System	4

**Division 28 - Electronic Safety and Security**

28 31 30	Fire Alarm System	4
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**SITE AND INFRASTRUCTURE SUBGROUP**

**Division 31 – Earthwork**

31 63 23	Bored Concrete Piles	4
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**END OF SECTION**

A0 TITLE PAGE

**ARCHITECTURAL**

A0.1 PARTIAL SITE DEMOLITION PLAN  
A0.2 PARTIAL SITE RENOVATION PLAN  
A1.0 BASEMENT DEMOLITION PLAN  
A1.1 MAIN FLOOR DEMOLITION PLAN  
A1.2 CLERESTORY AND LOW ROOF DEMOLITION PLAN  
A1.3 REFLECTED CEILING DEMOLITION PLAN  
A2.1 BASEMENT RENOVATION PLAN  
A2.2 MAIN FLOOR RENOVATION PLAN  
A2.3 CLERESTORY AND LOW ROOF RENOVATION PLAN  
A3.1 MAIN FLOOR REFLECTED CEILING PLAN  
A3.2 MAIN FLOOR REFLECTED CEILING PLAN - BAFFLES  
A4.1 BUILDING ELEVATIONS, BUILDING SECTION & FRAME TYPES  
A5.1 WALL SECTIONS  
A5.2 WALL SECTIONS  
A5.3 PLAN DETAILS AND SECTION DETAILS  
A6.1 FRONT ENTRANCE CANOPY DETAILS  
A7.1 MAIN FLOOR EAST ENLARGED PLAN  
A7.2 MAIN FLOOR WEST ENLARGED PLAN  
A7.3 MAIN FLOOR EAST FLOOR FINISH PLAN  
A7.4 MAIN FLOOR WEST FLOOR FINISH PLAN  
A8.1 INTERIOR ELEVATIONS  
A8.2 INTERIOR ELEVATIONS  
A8.3 INTERIOR ELEVATIONS  
A8.4 INTERIOR ELEVATIONS  
A8.5 INTERIOR ELEVATIONS  
A8.6 TYPICAL MOUNTING HEIGHTS AND DETAILS  
A9.1 MILLWORK AND VANITY DETAILS  
A9.2 RECEPTION DESK PLAN, ELEVATIONS & DETAILS

**STRUCTURAL**

S1.1 GENERAL NOTES  
S2.1 MAIN FLOOR FRAMING  
S2.2 CANOPY FRAMING PLAN AND SECTIONS  
S4.1 SECTIONS

**MECHANICAL**

M0.0 DRAWING LEGEND, LIST, AND SITE PLAN  
M1.0 BASEMENT - PLUMBING DEMOLITION LAYOUT  
M1.1 MAIN FLOOR - PLUMBING DEMOLITION LAYOUT  
M2.0 BASEMENT - HVAC DEMOLITION LAYOUT  
M2.1 MAIN FLOOR - HVAC DEMOLITION LAYOUT  
M3.0 ROOF - MECHANICAL DEMOLITION LAYOUT  
M4.0 BASEMENT - PLUMBING RENOVATION LAYOUT  
M4.1 MAIN FLOOR - PLUMBING RENOVATION LAYOUT  
M4.2 PLUMBING SPECIFICATIONS  
M5.0 BASEMENT - HVAC RENOVATION LAYOUT  
M5.1 MAIN FLOOR - HVAC RENOVATION PLAN  
M5.2 SECTIONS  
M6.0 BASEMENT - HEATING RENOVATION LAYOUT

M6.1	MAIN FLOOR - HEATING RENOVATION LAYOUT
M7.0	ROOF - MECHANICAL RENOVATION LAYOUT
M8.0	HEATING SCHEMATIC
M8.1	HVAC DETAILS
M9.0	CONTROL SCHEMATICS
M9.1	CONTROL SCHEMATICS

**ELECTRICAL**

E1.0	DRAWING LIST AND ELECTRICAL SYMBOL LEGEND
E1.1	SITE PLAN ELECTRICAL
ED2.0	BASEMENT FLOOR PLAN DEMOLITION ELECTRICAL
EDL2.1	MAIN FLOOR PLAN DEMOLITION LIGHTING
EDP2.1	MAIN FLOOR PLAN DEMOLITION POWER & SYSTEMS
E2.0	BASEMENT FLOOR PLAN ELECTRICAL
EL2.1	MAIN FLOOR PLAN LIGHTING
EP2.1	MAIN FLOOR PLAN POWER & SYSTEMS
E4.0	PANEL SCHEDULES DISTRIBUTION SCHEMATIC
E5.0	ELECTRICAL PANELBOARD SCHEDULES

**MECHANICAL / ELECTRICAL SCHEDULES**

ME1.1	MECHANICAL AND ELECTRICAL SCHEDULES
ME1.2	MECHANICAL AND ELECTRICAL SCHEDULES
ME1.3	MECHANICAL AND ELECTRICAL SCHEDULES
ME1.4	MECHANICAL AND ELECTRICAL SCHEDULES

**END OF SECTION**

## **Part 1 General**

### **1.1 DISCLAIMER**

- .1 Following documents are provided solely for Bidder's convenience and does not relieve Bidder of responsibility to make proper site investigations, or to understand full nature of work, or for determining accuracy of information provided.
- .2 Conditions noted and statements made are applicable only to specific locations, and times, at which investigations were made. Bidder to inquire of firm which prepared document, and may arrange with the City or Contract Administrator to make further explorations, to satisfy them self of particular conditions that they may wish to use in preparing their Bid.
- .3 Data provided and opinions stated in following documents are sole responsibility of firms which prepared documents.
- .4 Neither the City, nor Contract Administrator, assumes any responsibility for content of following documents, nor for conclusions that Bidder may use in preparing their proposal.

### **1.2 EXISTING CONDITIONS**

- .1 Refer to *B3: Site Investigation*, for instructions to examine site and to investigate local conditions and related work.
- .2 Compare bid documents with work in place.
- .3 Compensation will not be made because of failure to make proper site investigations or to understand full nature of work.
- .4 Failure to report discrepancies will not relieve Contractor from performing work as intended, and at no cost to the City.

### **1.3 ASBESTOS CONDITIONS**

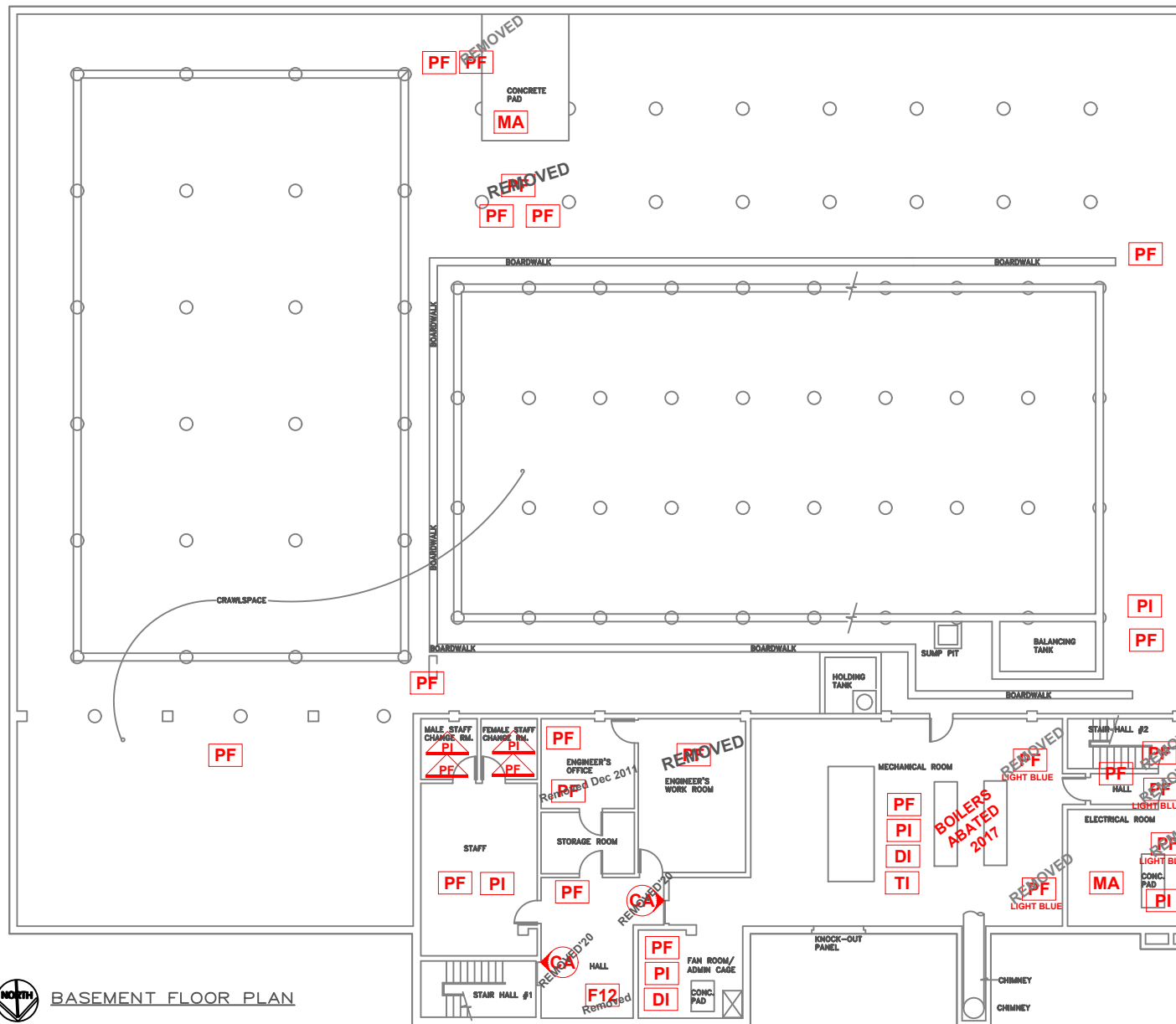
- .1 A copy of the following Basement Floor Plan is attached at the end of this Section.
  - .1 "*Asbestos Locations, PI-02 BoniVital Indoor Pool & Building, 1215 Archibald Street, Winnipeg, Manitoba*" dated August 25, 2021.
- .2 A copy of the following Main Floor Plan is attached at the end of this Section.
  - .1 "*Asbestos Locations, PI-02 BoniVital Indoor Pool & Building, 1215 Archibald Street, Winnipeg, Manitoba*" dated August 25, 2021.

## **Part 2 Products**

## **Part 3 Execution**

**END OF SECTION**





BASEMENT FLOOR PLAN

NOTE: DRYWALL JOINT COMPOUND (DC) THROUGHOUT BUILDING MAY CONTAIN ASBESTOS

**LEGEND**

?? =

AF: ASBESTOS FABRIC  
 BR: BOILER REFRACTORY  
 CA: CAULKING  
 C12: 12X12 CEILING TILE  
 C24: 24X24 CEILING TILE  
 C48: 24X48 CEILING TILE  
 DC: DRYWALL COMPOUND  
 DI: DUCT INSULATION  
 FS: SHEET FLOORING

GENERAL LABELS



F9: 9X9 FLOOR TILE  
 F12: 12X12 FLOOR TILE  
 HB: HARDBOARD  
 MA: MASTIC  
 PF: PIPE FITTING INSULATION  
 PI: PIPE INSULATION  
 PL: PLASTER  
 RD: ROOF DRAIN  
 SC: STIPPLE CEILING

ABOVE CEILING



UNDER FLOORING



WALL DETAIL



SO: SPRAY ON  
 ST: STUCCO/PLASTER  
 TI: TANK INSULATION  
 TP: TRANSITE PIPE  
 VE: VERMICULITE

NOTES:

1. THERE MAY BE ASBESTOS CONTAINING MATERIALS PRESENT THAT WERE NOT LOCATED DURING BUILDING INSPECTIONS
2. REFER TO THE ASBESTOS INVENTORY SURVEY SHEET FOR MORE INFORMATION
3. DO NOT DISTURB ASBESTOS. FOR HANDLING PROCEDURES CALL CENTRAL CONTROL AT 986-2382

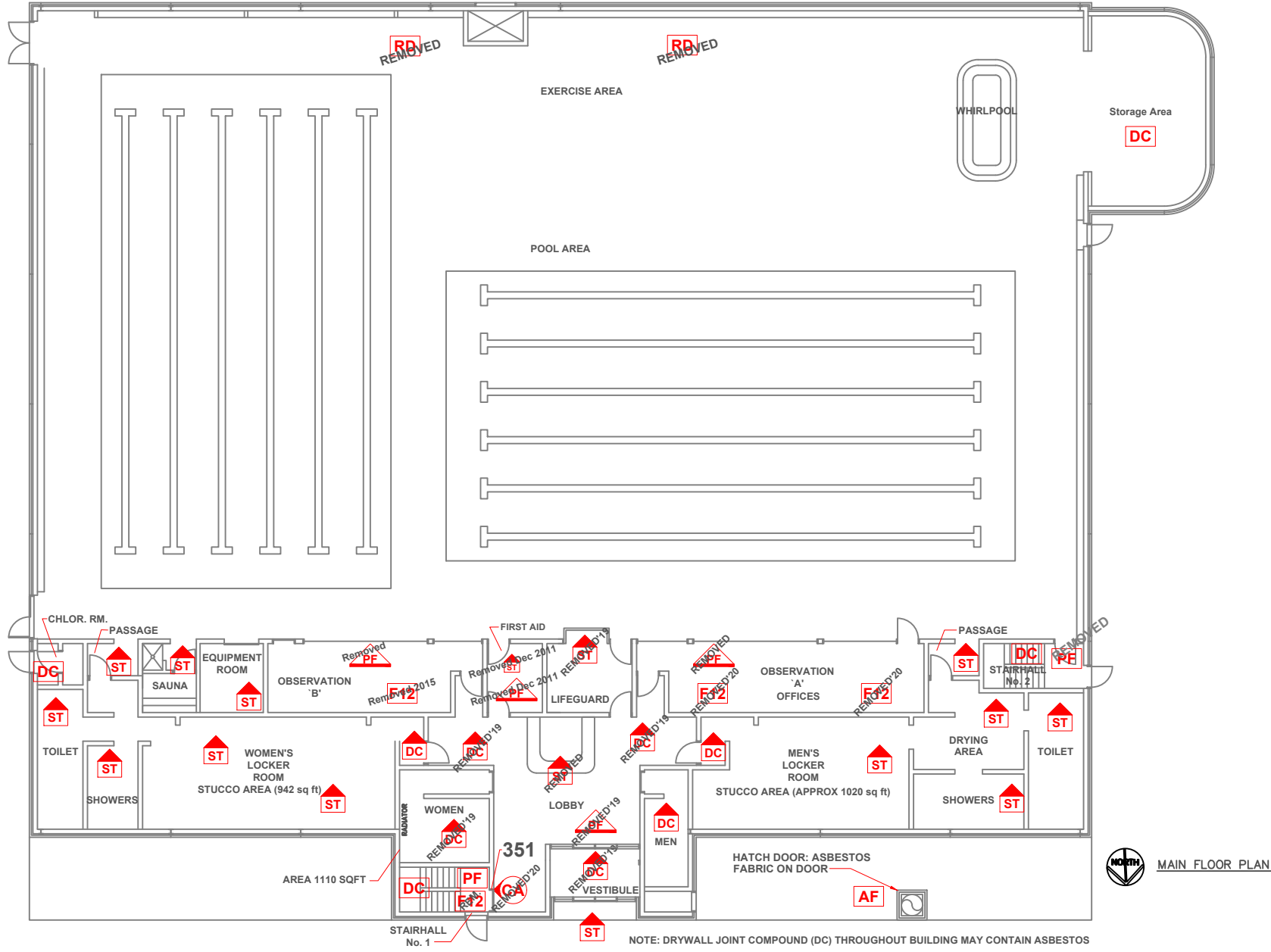
**ASBESTOS LOCATIONS**

BUILDING: PI-02 BoniVital Indoor Pool & Building 1215 Archibald Street Winnipeg, Manitoba		REVISED BY: REM	DATE: AUGUST 25, 2021	SCALE: N.T.S.	SHEET #: 2/2
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*Entrance the Spirit - Vivez le spirit*

**CITY OF WINNIPEG**  
 PLANNING, PROPERTY & DEVELOPMENT  
 DEPARTMENT  
 MUNICIPAL ACCOMMODATIONS DIVISION  
 4th FLOOR - 185 KING STREET  
 WINNIPEG, MANITOBA R3B 1J1  
 PHONE: (204) 986-7266  
 FAX: (204) 986-7311



**MAIN FLOOR PLAN**

NOTE: DRYWALL JOINT COMPOUND (DC) THROUGHOUT BUILDING MAY CONTAIN ASBESTOS

LEGEND			
GENERAL LABELS	ABOVE CEILING	UNDER FLOORING	WALL DETAIL
?? =	??	??	??
AF:ASBESTOS FABRIC	F9: 9X9 FLOOR TILE	SO:SPRAY ON	ST:STUCCO/PLASTER
BR:BOILER REFRACTORY	F12: 12X12 FLOOR TILE	TI:TANK INSULATION	TP:TRANSITE PIPE
CA:CAULKING	HB:HARDBOARD	VE:VERMICULITE	
C12: 12X12 CEILING TILE	MA:MASTIC		
C24: 24X24 CEILING TILE	PF:PIPE FITTING INSULATION		
C48: 24X48 CEILING TILE	PI:PIPE INSULATION		
DC:DRYWALL COMPOUND	PL:PLASTER		
DI:DUCT INSULATION	RD:ROOF DRAIN		
FS:SHEET FLOORING	SC:STIPPLE CEILING		

**NOTES:**  
 1. THERE MAY BE ASBESTOS CONTAINING MATERIALS PRESENT THAT WERE NOT LOCATED DURING BUILDING INSPECTIONS  
 2. REFER TO THE ASBESTOS INVENTORY SURVEY SHEET FOR MORE INFORMATION  
 3. DO NOT DISTURB ASBESTOS. FOR HANDLING PROCEDURES CALL CENTRAL CONTROL AT 986-2382

ASBESTOS LOCATIONS			
BUILDING:		PI-02	
BoniVital Indoor Pool & Building			
1215 Archibald Street			
Winnipeg, Manitoba			
REVISED BY:	DATE:	SCALE:	SHEET #:
REM	AUGUST 25, 2021	N.T.S.	1/2

**CITY OF WINNIPEG**  
 PLANNING, PROPERTY & DEVELOPMENT DEPARTMENT  
 MUNICIPAL ACCOMMODATIONS DIVISION  
 4th FLOOR - 185 KING STREET  
 WINNIPEG, MANITOBA R3B 1J1  
 PHONE: (204) 986-7266  
 FAX: (204) 986-7311

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 78 00 – Closeout Submittals.
- .2 Section 01 79 00 – Demonstration and Training.

### **1.2 REFERENCES**

- .1 National Building Code of Canada (NBCC) 2010, with 2011 Manitoba Amendments.
- .2 National Fire Protection Association (NFPA).

### **1.3 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 The Bonivital Pool Renovation project consists of an interior renovation to improve universal accessibility as much as possible given existing building spatial restrictions. Additional functions are being incorporated to the open pool deck area to include a new barrier-free sauna, and a new multi-purpose room. The interior renovation includes associated mechanical and electrical fit up to suit the new layout.
  - .1 Mechanical scope includes upgrades to the HVAC and domestic water heat system. The antiquated boiler steam system is being replaced with a hybrid system which includes hydronic and electric heating/cooling in the pool deck and front of house area.
  - .2 Electrical scope includes upgrades to the lighting system, fire alarm system, and power distribution to support the upgraded mechanical system.
  - .3 Existing landscape affected by the Work shall be repaired to similar or better condition, based on existing conditions prior to start of construction.
- .2 Exterior work consists of a new air handling unit on concrete pad to the south of the building with an acoustic enclosure. If budget allows, the construction of a new canopy at the entrance with associated modified site work to improve accessibility will be included to the contract.
- .3 Construct project in accordance with contract documents including project manual and project drawings for Architectural, Structural, Mechanical and Electrical disciplines. Contractor and Subcontractors are responsible for co-ordination between trades. Distribution of documents by Contractor to their Subcontractors does not absolve Contractor or their Subcontractors from provisions stated in Division 01 – General Requirements of contract or co-ordination between parties.
- .4 *Part D: Supplemental Conditions, Part C: General Conditions for Construction*, and Division 01 – General Requirements sections apply to technical specification sections found in Project Manual.

### **1.4 CODES AND STANDARDS**

- .1 Work to meet or exceed requirements of applicable standards, building code, fire code and other codes and referenced documents. In event of conflict between any provisions of authorities, most stringent provision applies.
- .2 Safety of Work: perform work in accordance with the National Building Code of Canada, 2020 (NBCC), complete with Manitoba Building Code amendments (MBC), and other applicable regulations and requirements of other authorities having jurisdiction.

- .3 Fire Safety: comply with National Fire Protection Association (NFPA) codes and standards for fire safety.
- .4 Construction Safety:
  - .1 Observe and enforce construction safety measures required by Canadian Construction Safety Code, Provincial Government Worker's Compensation Board, Workplace Safety and Health Act, Municipal Statutes and Authorities having jurisdiction.

## **1.5 SETTING OUT OF WORK**

- .1 Before commencing work, contact utility companies to establish location and extent of existing utility or service lines in area of work. Be absolutely certain of their origin and destination.
  - .1 When breaking into or connecting to existing services or utilities, execute work at times directed by local governing authorities, with minimum of disturbance to work, and/or building.
  - .2 Protect, relocate or maintain existing active services.
  - .3 Cap off services, when indicated, in manner approved by authority having jurisdiction.
  - .4 Where unknown services are encountered, immediately advise Contract Administrator and confirm findings in writing.
  - .5 Record location of services in accordance with Section 01 78 00.
- .2 Assume full responsibility for and execute complete layout of work to locations, lines and elevations indicated.
  - .1 Provide devices needed to lay out and construct work.
  - .2 Supply stakes and other survey markers required for laying out work.

## **1.6 DEMONSTRATION AND TRAINING**

- .1 Be responsible to provide comprehensive demonstration and training program to the City's personnel on operation and maintenance of Contractor supplied and installed equipment and systems in accordance with Section 01 79 00.

## **1.7 PLANNING OF WORK**

- .1 Upon award of contract, immediately commence off-site work (preparation of shop drawings, ordering of materials, preparation of requested documents, etc.). On-site work is expected to commence as soon as possible upon award of contract. Co-operate with the City in scheduling work.
- .2 Plan work to ensure that emergency access and egress required by the City and by the authorities having jurisdiction are maintained, and all life safety and building occupancy requirements of all applicable codes and regulations are in force for construction areas and adjacent floor areas.

## **1.8 ACCESS TO WORK**

- .1 Allow the City, Contract Administrator or both access to work, or other places where work is being fabricated in connection with contract for purposes of inspection and examination of workmanship and materials.
- .2 Maintain safety helmets on job site, ready for use, to be used in compliance with Workplace Safety and Health regulations.

## **1.9 BUILDING PERMIT**

- .1 The City shall pay for the building permit. The Contract Administrator shall apply for the building permit on behalf of the City prior to bid closing. Upon award of Contract, the building permit shall be transferred to and become the responsibility of the Contractor.

- .2 Contract Administrator will apply for foundation permit in advance of full permit.

#### **1.10 NO SMOKING POLICY**

- .1 Fully co-operate, respect and comply with Smoke-Free Workplace policy requirements established by the City throughout its facilities. Smoking is not permitted anywhere within the City's facilities or on the City's property.
- .2 Smoke-free workplace policy applies to everyone who works in workplace and to visitors.
- .3 During full term of contract, ensure that Contractors' employees, Subcontractors and Suppliers, performing work on site on Contractors' behalf, are instructed to comply with Smoke-Free Workplace policy requirements.

#### **1.11 NO ENTERTAINMENT DEVICES**

- .1 Fully co-operate, respect, and comply with the City's request that no entertainment devices (e.g. portable radios, stereos, MP3 players, etc.) will be played on site at any time by Contractor's work force or sub-contractors.

#### **1.12 OCCUPANCY BY THE CITY**

- .1 The City has right to enter and occupy building in whole or in part before substantial performance of work provided that, in opinion of Contract Administrator, such entry and occupancy does not prevent or interfere with Contractor in completion of contract.
- .2 Such occupancy by the City is not considered as acceptance of work and will not relieve Contractor from responsibility to complete contract or as acknowledgement of fulfillment of terms of contract.

### **Part 2 Products**

### **Part 3 Execution**

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Refer to *Form B: Prices* and *E5: Cash Allowance for Additional Work*.

**1.2 CASH ALLOWANCES**

- .1 Total amount of cash allowance will be separated from contract price, by Contract Administrator, with first Change in Work, and retained for sole purpose of paying for scheduled items of extra work when authorized by the City and as directed by Contract Administrator in subsequent Change in Work.
- .2 Contract price to include Contractor's overhead and profit in connection with cash allowances, rather than being included with cash allowance.

**1.3 SCHEDULE OF ALLOWANCES**

.1	Abatement	<i>(excluding GST)</i> \$125,000.00
.2	Cleaning of Pool Deck and Tanks	\$15,000.00
.3	Signage	\$5,500.00
.4	Structural Remediation in Pool Deck Room 1:14	\$10,000.00
.5	Short Circuit and Coordination as described under Section 26 00 10	\$3,500.00
.6	3 <sup>rd</sup> Party Inspection and Review of Friction Piling Operations	\$5,000.00
	<b>Total</b>	<b>\$164,000.00</b>

**Part 2 Products**

**Part 3 Execution**

**END OF SECTION**

## **Part 1 4General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 11 00 – Summary of Work.
- .2 Section 01 33 00 – Submittal Procedures.
- .3 Section 01 78 00 – Closeout Submittals.

### **1.2 CONSTRUCTION SCHEDULE**

- .1 Refer to *D24: Job Meetings, in Supplemental Conditions*.
- .2 Affix copy of construction schedule to wall of construction office during construction period and keep up to date and reviewed at each progress meeting.

### **1.3 START-UP MEETING**

- .1 After award of Contract, but before start of Work, convene a start-up meeting to discuss and resolve administrative procedures and responsibilities.
- .2 Senior representatives of the Contract Administrator, the City, Contractor, major Subcontractors are to attend.
  - .1 Agenda:
    - .1 Appointment of official representatives of participants in the work.
    - .2 Schedules of work, progress scheduling.
    - .3 Schedule of submission of shop drawings, product data, samples, test reports,
    - .4 Schedule for provision of mock-ups and field samples.
    - .5 Requirements for temporary utilities, temporary barriers and controls, construction facilities, site sign and other temporary construction.
    - .6 Record drawings.
    - .7 Maintenance Manuals.
    - .8 Take-over procedures, acceptance, warranties.
    - .9 Monthly progress claims, administrative procedures, holdbacks.
    - .10 Sustainable requirements.
    - .11 Commissioning.
- .3 Establish time and location of meeting and notify all concerned parties within five (5) Working Days of meeting.
- .4 Chair meeting, record minutes, and distribute minutes to all attending parties within four (4) Working Days after meeting.

### **1.4 CONSTRUCTION PROGRESS MEETINGS**

- .1 Schedule and administer project meetings once every week throughout progress of work. Provide physical space for meetings.
- .2 Contractor, Subcontractors involved in work, Contract Administrator and the City are to be in attendance.
- .3 Person attending meetings to be empowered to act on behalf of organizations they represent.
- .4 Prepare agenda and record minutes of meetings and circulate to attending parties and affected parties not in attendance within four (4) days after meeting.
- .5 Meeting agenda to include following:
  - .1 Review, approval of minutes of previous meeting.

- .2 Review of work progress since previous meeting.
- .3 Field observations, problems, conflicts.
- .4 Significant proceedings and decisions. Identify action by parties.
- .5 Problems which impede construction schedule.
- .6 Review of off-site fabrication delivery schedules.
- .7 Corrective measures and procedures to regain projected schedule.
- .8 Revision to construction schedule.
- .9 Progress schedule, during succeeding work period.
- .10 Review submittal schedules: expedite as required.
- .11 Maintenance of quality standards.
- .12 Review proposed changes for effect on construction schedule and on completion date.
- .13 Construction Safety.
- .14 New business.

## **1.5 ON-SITE DOCUMENTS**

- .1 Maintain at job site, one copy of each of following:
  - .1 Contract Drawings.
  - .2 Project Manual
  - .3 Addenda
  - .4 Reviewed shop drawings
  - .5 Proposed change notices
  - .6 Change orders
  - .7 Other modifications to contract
  - .8 Field test reports
  - .9 Copy of approved work schedule
  - .10 Manufacturers' installation and application instructions

## **1.6 JOB LOG**

- .1 Keep permanent, written record on site of progress of work. Make record available for inspection by Contract Administrator and the City. Show dates of commencement and completion of all trades and parts of work, particulars regarding daily weather conditions, changes in work, field instructions, major deliveries, as well as number of employees of various trades involved.

## **1.7 REQUEST FOR INTERPRETATION PROCESS**

- .1 General:
  - .1 Immediately on discovery of the need for interpretation of the Contract Documents, Contractor shall prepare and submit an RFI to the Contract Administrator in the form specified.
  - .2 Contract Administrator will return RFIs submitted to Contract Administrator by other entities controlled by Contractor with no response. The RFI will then be considered closed.
  - .3 Co-ordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
  - .4 For RFIs submitted electronically, include project name and RFI number in subject line of email.
- .2 Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  - .1 Project name (including building number).
  - .2 Project number.
  - .3 Date.



- .4 Name of Contractor.
- .5 Name of Contract Administrator.
- .6 RFI number, numbered sequentially. (eg: RFI-001)
- .7 RFI subject.
- .8 Specification Section number, title and related paragraphs, as appropriate.
- .9 Drawing number and detail references, as appropriate.
- .10 Field dimensions and conditions, as appropriate.
- .11 Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Price, Contractor shall state impact in the RFI.
- .12 Contractor's signature.
- .13 Attachments: Include sketches, descriptions, measurements, photos, product data, shop drawings, co-ordination drawings, and other information necessary to fully describe items needing interpretation.
  - .1 Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- .3 RFI Forms: Contractor generated form including all content indicated in this Section.
  - .1 Form and attachments shall be electronic files in PDF format.
- .4 Contract Administrator's Action: Contract Administrator will review each RFI, determine action required, and respond. Allow ten (10) Working Days for Contract Administrator's response for each RFI. RFIs received by Contract Administrator after 1:00 p.m. will be considered as received the following working day.
  - .1 The following Contractor-generated RFIs will be returned without action:
    - .1 Requests for approval of submittals.
    - .2 Requests for approval of substitutions.
    - .3 Requests for approval of Contractor's means and methods.
    - .4 Requests for approval of corrective actions for deficient work.
    - .5 Requests for co-ordination information already indicated in the Contract Documents.
    - .6 Requests for adjustments in the Contract Time or the Contract Sum.
    - .7 Requests for interpretation of Contract Administrator's actions on submittals.
    - .8 Incomplete RFIs or inaccurately prepared RFIs.
  - .2 Contract Administrator's action may include a request for additional information, in which case Contract Administrator's time for response will date from time of receipt of additional information.
  - .3 If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Contract Administrator in writing within 10 days of receipt of the RFI response. Failure to notify will result in the work being included as part of the contract.
- .5 RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log with progress meeting minutes. Include the following:
  - .1 Project name.
  - .2 Name and address of Contractor.
  - .3 Name and address of Contract Administrator.
  - .4 RFI number including RFIs that were returned without action or withdrawn.
  - .5 RFI description.
  - .6 Date the RFI was submitted.
  - .7 Date Contract Administrator's response was received.
- .6 On receipt of Contract Administrator action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Contract Administrator within ten (10) Working Days if Contractor disagrees with response.

## **1.8 LIFE SAFETY TESTING**

- .1 Refer to the City of Winnipeg Life Safety Tests in Buildings document. Arrange and carry out life safety test with City of Winnipeg in accordance with this document. Provide all necessary management and co-ordination. Arrange all necessary involvement from sub-trades. Prepare test procedures and submit for review six (6) weeks prior to test date.
- .2 Arrange and carry out pre-'dry run' tests and submit written confirmation to Contract Administrator that test has adhered to procedures and that the system is correctly operating.
- .3 Arrange and conduct 'dry run' tests which will mimic the full life safety test. 'Dry run' test shall be conducted in presence of Contractor and Contract Administrator only.
- .4 Create procedures to demonstrate the operation of the life safety system. Procedures shall include, but shall not be limited to:
  - .1 Emergency and exit lighting including measurements where applicable.
  - .2 Operation of emergency power system.
  - .3 Operation of fire alarm including demonstration of all controls and interfaces with other systems including, but not limited to operation of smoke control systems, fire pump and security systems.
- .5 Demonstrate all systems under normal and essential power modes.
- .6 Tests shall not commence until fire alarm system is verified and free of all defects. Submit final verification report to Contract Administrator five (5) working days prior to life safety test for review.
- .7 Provide all fuel, personnel, communications equipment and attendance required.

## **1.9 SUBTRADE AND SUPPLIERS LIST**

- .1 Submit within three (3) Working Days after contract award, all addresses, phone, email, and name of person in charge of subtrades and suppliers used on this project.

## **1.10 CONSTRUCTION PHOTOGRAPHS**

- .1 Maintain and submit to Contract Administrator visual record of construction progress in following formats:
- .2 Use digital camera with capability of producing digital images at minimum 5.0 megapixels, uncompressed, saved in jpeg format.
- .3 Copy each set of images onto a USB drive.
- .4 Identify each USB with name and number of project, date of exposure, set number.
- .5 Pre-Construction Photographs
  - .1 Provide photographs of existing site and general photos prior to start of construction work.
  - .2 Provide photos of all mechanical and electrical panels, devices, prior to demolition. Photos to provide general context of location and a close up for model/brand and condition.
  - .3 Allow for minimum 30 interior and 15 exterior images.
  - .4 Viewpoints:
    - .1 Panoramic view of site from each compass point.
    - .2 Close ups of specific site details and surface features in locations as determined by Contract Administrator.

- .6 Construction Progress Photographs
  - .1 Provide photographs of construction during progress of the work, including site features.
  - .2 Allow for approximately 50 images for each set.
  - .3 Number of sets required (frequency): provide one set monthly with progress statement, plus one set of additional photograph as specified below.
  - .4 In addition to monthly progress images provide additional sets of photographs for:
    - .1 Completion of major elements of the Work such as:
      - .1 Main floor construction.
      - .2 Structural framing.
      - .3 Mechanical and electrical services before concealment.
    - .2 During installation of specific elements of the Work, as determined by Contract Administrator, including but not necessarily limited to:
      - .1 City Furnished Products (CFP).
      - .2 Major elements of interior work.
  - .5 Number of viewpoints: interior and exterior viewpoints including close ups of specific details, in locations as determined by Contract Administrator.
- .7 Photographs of Mock Ups.
  - .1 Number of sets required: one for each mock-up.
  - .2 Allow for approximately 25 images of each set.
  - .3 Number of viewpoints:
    - .1 Each interior elevation, including finishes on walls, floors and ceilings.
    - .2 Mechanical and electrical service outlets (gas, vacuum, switches, etc.)
    - .3 Equipment.
    - .4 Close ups of specific details and features, in locations as determined by Contract Administrator.
- .8 Final Photographs
  - .1 Number of sets required: one.
  - .2 Allow for approximately 100 images for each set.
  - .3 Number of viewpoints:
    - .1 Exterior elevations of each affected side of building.
    - .2 Interior of rooms and finishes as determined by Contract Administrator. Allow for approximately ten (10) photographs of each room.
    - .3 Close ups of specific details as determined by Contract Administrator.
    - .4 Locations of viewpoints as determined by Contract Administrator.

## **Part 2 Products**

## **Part 3 Execution**

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 11 00 – Summary of Work.
- .2 Section 01 31 00 – Project Management and Co-ordination.
- .3 Section 01 78 00 – Closeout Submittals.

### **1.2 ADMINISTRATIVE**

- .1 Submit to Contract Administrator submittals listed for review. Submit with reasonable promptness and in orderly sequence so as not to cause delay in work. Failure to submit in ample time is not considered sufficient reason for an extension of contract time and no claim for extension by reason of such default will be allowed. Work affected by submittals to proceed only after review is complete.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Contract Administrator. Stamp and sign submittals certifying review of submission. This review represents that necessary requirements have been checked and co-ordinated with requirements of work and contract documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of contract documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent work is co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator review of submittals.
- .9 Contractor's responsibility for deviation in submission from requirements of Contract Documents is not relieved by Contract Administrator review.
- .10 Keep one reviewed copy of each submission on site.

### **1.3 REQUEST FOR INTERPRETATION PROCESS**

- .1 Contractor shall prepare and submit an RFI in accordance with Section 01 31 00.

### **1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data provided by Contractor to illustrate details of portion of work.
- .2 Shop drawings that do not include the stamp, date, and signature of the person responsible for reviewing the shop drawings before submittal to the Contract Administrator, will be rejected and returned without being examined.
- .3 Submit shop drawings bearing stamp and signature of qualified professional engineer registered or licensed in Province of Manitoba, Canada where specifically requested in the specifications. Shop drawings not bearing the required Engineer's stamp will be rejected and returned without being examined.

- .4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .5 Submit one (1) electronic copy (e.g. Adobe PDF format) of shop drawings for each requirement requested in specification sections and as the Contract Administrator may reasonably request. A hardcopy and electronic copy of shop drawings are to be included in Operation and Maintenance Manual as specified in Section 01 78 00.
- .6 Submit one (1) electronic copy (e.g. Adobe PDF format) of product data sheets or brochures for requirements requested in specification Sections and as requested by Contract Administrator where shop drawings will not be prepared due to standardized manufacture of product.
- .7 Submit one (1) electronic copy (e.g. Adobe PDF) of test reports for requirements requested in specification Sections and as requested by Contract Administrator.
  - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within three (3) years of date of contract award for project.
- .8 Submit one (1) electronic copy (e.g. Adobe PDF format) of certificates for requirements requested in specification Sections and as requested by Contract Administrator.
  - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract, complete with project name.
- .9 Submit one (1) electronic copy (e.g. Adobe PDF format) of manufacturers' instructions for requirements requested in specification Sections and as requested by Contract Administrator.
  - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .10 Submit one (1) electronic copy (e.g. Adobe PDF format) of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Contract Administrator.
  - .1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .11 Allow minimum of ten (10) Working Days for Contract Administrator's review of each submission or a reasonable longer period of time for large or complex submissions.
- .12 For Contractors' use in preparation of drawings required under contract, Contractors may obtain from Contract Administrator, electronic AutoCAD drawing files subject to following:
  - .1 Removal by Contract Administrator of Contract Administrators' professional seals from electronic drawing file; and
  - .2 Receipt of Licence Agreement prepared by Contract Administrator and signed by Contractor(s) or user(s) of electronic files; and
  - .3 Receipt of payment to Contract Administrator from each separate Contractor requesting an electronic drawing file, an amount of \$250.00 for first electronic file or drawing sheet requested plus an additional \$200.00 for each subsequent electronic file or drawing sheet requested at same time.
- .13 Adjustments made on shop drawings by Contract Administrator are not intended to change contract price. If adjustments affect value of work, state such in writing to Contract Administrator prior to proceeding with work.

- .14 Make changes in shop drawings as Contract Administrator may require, consistent with contract documents. When resubmitting, notify Contract Administrator in writing of any revisions other than those requested.
- .15 Accompany submissions with transmittal letter, containing:
  - .1 Date.
  - .2 Project title and number.
  - .3 Contractor's name and address.
  - .4 Identification and quantity of each shop drawing, product data, and samples.
  - .5 Other pertinent data.
  - .6 Identify on each shop drawing the related specification section (number and title) for which the product/material applies.
- .16 Submissions to include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of Subcontractor, Supplier, Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with contract documents.
  - .5 Details of appropriate portions of work as applicable:
    - .1 Fabrication.
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances, relation to adjacent structure or materials.
    - .3 Setting or erection details.
    - .4 Capacities.
    - .5 Performance characteristics.
    - .6 Standards.
    - .7 Operating weight.
    - .8 Wiring diagrams.
    - .9 Single line and schematic diagrams.
    - .10 Relation to adjacent structure or materials.
- .17 After Contract Administrator's review, distribute copies to subtrades as required.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, copy will be returned and fabrication and installation of work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of work may proceed.
- .21 No extension of Contract Time will be allow for delays in the Work which may be caused for Contract Administrator's rejection of shop drawings.
- .22 Shop drawings which contain deviations from the Contract Documents which are not presented to the Contract Administrator in writing, will rejected and returned without being examined.

## **1.5 SAMPLES**

- .1 Submit samples for review as requested in respective specification sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Contract Administrator's business address.

- .3 Notify Contract Administrator in writing, at time of submission of deviations in samples from requirements of contract documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Contract Administrator are not intended to change contract price. If adjustments affect value of work, state such in writing to Contract Administrator prior to proceeding with work.
- .6 Make changes in samples which Contract Administrator may require, consistent with contract documents.
- .7 Reviewed and accepted samples will become standard of workmanship and materials against which installed work will be verified.

#### **1.6 MOCK-UPS**

- .1 Erect mock-ups in accordance with Section 01 45 00.

#### **1.7 CONSTRUCTION PHOTOGRAPHS**

- .1 Submit construction photographs in accordance with Section 01 31 00.

### **Part 2 Products**

### **Part 3 Execution**

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 11 00 – Summary of Work.
- .2 Section 01 31 00 – Project Management and Co-ordination.
- .3 Section 01 33 00 – Submittal Procedures.

### **1.2 REVIEW AND INSPECTION OF THE WORK**

- .1 *Part C: General Conditions.*

### **1.3 INDEPENDENT INSPECTION AGENCIES**

- .1 Independent Inspection/Testing Agencies will be engaged by Contract Administrator for purpose of inspecting and/or testing portions of work as identified in specification sections, and be paid for by cash allowance.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relieve Contractors of their responsibility to perform work in accordance with contract documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Contractor to correct defect and irregularities as advised by Contract Administrator, at no cost to the City, and pay costs for retesting and re-inspection.

### **1.4 ACCESS TO WORK**

- .1 Allow inspection/testing agencies access to the Work, offsite manufacturing, and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

### **1.5 PROCEDURES**

- .1 Notify appropriate agency in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

### **1.6 REPORTS**

- .1 Submit four (4) copies of inspection and test reports promptly to the Contract Administrator.
- .2 Provide copies to Subcontractor of work being inspected/tested and manufacturer/fabricator of material being inspected/tested.

### **1.7 TESTS AND MIX DESIGNS**

- .1 Furnish test results and mix designs as may be requested.
- .2 The cost of tests and mix designs beyond those called for in the Contract Documents or beyond those required by the Law of the Place of Work shall be appraised by the Contract Administrator and may be authorized as recoverable.



## **1.8 MOCK-UPS AND SAMPLE WORK**

- .1 Prepare mock-ups and sample work specifically requested in specifications.
- .2 Construct mock-ups and sample work at locations acceptable to Contract Administrator.
- .3 Prepare mock-ups and sample work for Contract Administrator's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in work.
- .4 Failure to prepare mock-ups and sample work in ample time is not considered sufficient reason for an extension of contract time and no claim for extension by reason of such default will be allowed.
- .5 Unless noted, approved mock-ups and sample work may remain as part of work.
- .6 When reviewed and approved, mock-ups and sample work become standard of workmanship, appearance, and materials approved for similar areas throughout project.

## **1.9 MILL TESTS**

- .1 Submit mill test certificates as required of the specification Sections and as may be requested.

## **1.10 EQUIPMENT AND SYSTEMS**

- .1 Submit four (4) copies of adjustment and balancing reports for mechanical, electrical building equipment and systems.

## **Part 2 Products**

## **Part 3 Execution**

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 11 00 – Summary of Work.
- .2 Section 01 31 00 – Project Management and Co-ordination.
- .3 Section 01 61 00 – Common Product Requirements.
- .4 Section 01 74 00 – Cleaning.
- .5 Section 01 74 19 – Waste Management and Disposal.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA).
  - .1 CSA O121-08 (R2013), Douglas Fir Plywood.
  - .2 CAN/CSA S269.2-M87 (R2003), Access Scaffolding for Construction Purposes.
  - .3 CAN/CSA Z321-96 (R2006), Signs and Symbols for the Workplace.

### **1.3 TEMPORARY WORK**

- .1 Temporary Electricity and Lighting.
  - .1 Contractor may connect to existing power supply for temporary power during construction for temporary lighting and the operating of power tools, except for purpose of power welding and electric heating. Cost of power reasonably so used will be provided without charge.
  - .2 Electrical power is available from existing feeders to existing panels as approved by the City. Power taken from these panels is not unlimited and must not exceed the capacity of the panels, nor interrupt any existing electrical services in the building.
  - .3 If available existing power is insufficient, provide additional temporary power as construction requirements demand. Contractor shall arrange for connection with appropriate utility company and pay for all costs of installation, maintenance and removal.
  - .4 Do not use existing electrical receptacles without permission from the City. Once permission is granted, use only designated receptacle. Do not exceed 90% of rated circuit capacity.
- .2 Temporary Fire Protection.
  - .1 Provide and maintain temporary fire protection equipment during performance of work required by insurance companies having jurisdiction, and governing codes, regulations and bylaws.
  - .2 Protect existing devices that are remaining for reuse. Damage occurred during construction to existing devices intended for reuse shall be repaired or replaced by the Contractor.
- .3 Temporary Heating and Ventilation.
  - .1 Contractor may make use of existing HVAC system. Cost of HVAC reasonably used will be provided without charge
    - .1 Maintain minimum temperature of 10°C (or higher where specified) during construction.
    - .2 Ventilating.
      - .1 Prevent hazardous accumulations of dust, fumes, mists, vapours or gasses in areas occupied during construction.

- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after completion of work to assure removal of harmful contaminants.
- .3 On work for which permanent heating and ventilation system is used, replace filters and comply with requirements of Mechanical General Provisions as applicable during Work and at time of final acceptance of Work.
- .4 Contractor's temporary use of HVAC equipment shall not contaminate equipment or ducting.
- .2 If existing HVAC system is not available, Contractor to arrange, pay for, operate and maintain temporary heat and ventilation and shelters used during construction, including costs of installation, fuel, operation, maintenance and removal of equipment to keep work that requires protection from cold adequately warm and sheltered from elements.
  - .1 Acceptable temporary heaters to consist of warm forced air type, operated in well ventilated location and vented to exterior.
  - .2 Use of direct-fired heaters discharging waste products into work areas will not be permitted.
  - .3 Provide protection on floors and adjacent surfaces to prevent damage.
  - .4 Temporary heating and ventilation, shelters, fuel and fuel storage: satisfactory to authorities having jurisdiction.
  - .5 Provide temporary heat and ventilation in enclosed areas as required to:
    - .1 Facilitate progress of work.
    - .2 Protect work and products against dampness and cold.
    - .3 Prevent moisture condensation on surfaces.
    - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
    - .5 Provide adequate ventilation to meet health requirements for safe working environment.
  - .6 Maintain minimum temperature of 10°C (or higher where specified) during construction.
  - .7 Ventilating.
    - .1 Prevent hazardous accumulations of dust, fumes, mists, vapours or gasses in areas occupied during construction.
    - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
    - .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
    - .4 Ventilate storage spaces containing hazardous or volatile materials.
    - .5 Ventilate temporary sanitary facilities.
    - .6 Continue operation of ventilation and exhaust system for time after completion of work to assure removal of harmful contaminants.
  - .8 Maintain strict supervision of temporary heating and ventilating equipment to:
    - .1 Conform to applicable codes and standards.
    - .2 Enforce safe practices.
    - .3 Prevent abuse of services.
    - .4 Prevent damage to finishes.
    - .5 Vent direct-fired combustion units to outside.

- .9 Be responsible for damage to work due to failure in providing adequate heat and protection during construction.
- .10 Contractor may make use of existing site gas services to operate temporary heat and ventilation system. Cost of gas reasonably used will be provided without charge.
- .4 Temporary Telephone Service.
  - .1 Arrange, pay for and maintain temporary telephone service (landline or cellular) used during construction in accordance with authorities having jurisdiction. Provide at least one telephone in Contractor's field office available for use by the City, Contractor, Subcontractors and Contract Administrator.
- .5 Temporary Digital Co-ordination.
  - .1 Provide on-site lap top computer with internet access and digital camera to permit emailing of correspondence and photos of construction issues to Contract Administrator for prompt co-ordination and response.
- .6 Temporary Water Supply.
  - .1 Contractor may connect to existing potable water supply for construction use within construction area. Cost of water reasonably so used will be provided without charge.

#### **1.4 CONSTRUCTION FACILITIES**

- .1 Contractor Site Offices
  - .1 Provide office heat, lighted and ventilated, of sufficient size to accommodate site meetings and furnished with drawing lay down table.
  - .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.
  - .3 Subcontractors may provide their own offices as necessary. Direct location of these offices.
  - .4 Offices within building:
    - .1 When usable space is available within the project building and if approved by the the City, the site office may be located within the building, utilizing rooms therein.
    - .2 Such areas may be used contingent upon there being no delay in completion of the work and there being no damages to material or finishes.
  - .5 Personal Protective Equipment:
    - .1 Provide and store within site office personal protective equipment for use of the City's personnel visiting the site.
    - .2 Provide twelve (12) each of the following:
      - .1 Hard hats.
      - .2 Protective eyewear (eyeglass type – not goggles for sanitary reasons).
      - .3 Earmuff hearing protection. Ear plugs are not acceptable for sanitary reasons.
      - .4 Hi-Visibility Safety vests.
      - .5 Safety shoes – either rubber boots with steel toes or strap-on type steel toe guards. Provide in several adult shoe sizes.
- .2 Construction Equipment, Tool, and Material Storage.
  - .1 Refer to Section 01 61 00.
  - .2 Provide and maintain, in clean orderly condition, adequate lockable, weather tight trailers for storage of materials, tools, and equipment which are subject to damage by weather. Co-ordinate location(s) with the City.
  - .3 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

- .4 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.
- .3 First Aid.
  - .1 Provide and maintain clearly marked and fully stocked first-aid case in readily available location.
- .4 Sanitary Facilities.
  - .1 Contractor may make use of existing and new sanitary facilities. When not available, Contractor to provide sufficient sanitary facilities for work force in accordance with authorities having jurisdiction.
  - .2 Keep area and premises in sanitary condition. Service sanitary facilities at least weekly and more frequently if required.
  - .3 Post notices and take such precautions as required by local health authorities.
  - .4 When permanent water and drain connections are completed, provide temporary water closets and urinals complete with temporary enclosures, inside building. Permanent facilities may be used on approval of Contract Administrator.

## **1.5 PROTECTION AND MAINTENANCE OF TRAFFIC**

- .1 Provide and maintain adequate access to project site.
- .2 Build and maintain temporary roads, sidewalk crossings, ramps, and construction runways to maintain access, and snow removal during period of Work.
- .3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.
- .4 Conform to requirements of governing authorities when required and, when necessary, make arrangements with adjacent property owners.
- .5 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect the public.
- .6 Maintain access to property including overhead clearances for use by emergency response vehicles.
- .7 parking permitted on site, limited to the existing parking lot.
- .8 Provide snow removal during period of Work, including to complete parking lot. Snow piling is permitted in the rear (west) parking lot along the western fence. Removal of snow pile is required; pile shall not exceed 10 feet in height and Contractor shall maintain access to existing Sea Cans and storage sheds.

## **1.6 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY**

- .1 Protect adjacent private and public property from damage during the performance of work.
- .2 Be responsible for all damage incurred.

## **1.7 CONSTRUCTION AIDS**

- .1 Construction Hoists and Cranes.
  - .1 Provide, operate and maintain hoists and cranes required for moving of works, materials and equipment. Make financial arrangements with Subcontractors for use thereof.
  - .2 Operate hoists and cranes using qualified personnel.

- .2 Scaffolding and Platforms.
  - .1 Construct and maintain scaffolding, ramps, ladders, swing staging, platforms and temporary stairs in rigid, secure and safe manner in accordance with CAN/CSA S269.2.
  - .2 Erect scaffolding and platforms independent of walls. Remove promptly when no longer required.

## **1.8 TEMPORARY BARRIERS AND ENCLOSURES**

- .1 Site Enclosure.
  - .1 Erect temporary site enclosure to separate construction area from adjacent streets, property, and to protect public, workers, public and private property from injury or damage. At a minimum, provide chain link fence 2.4 m high minimum. Provide lockable gates as require for access to site by workers and vehicles.
  - .2 Provide snow fencing or other similar barriers around trees, natural features, bench marks, utility lines, etc. designated to remain. Protect from damage.
- .2 Weather Enclosures.
  - .1 Provide temporary weather tight enclosures and protection for exterior openings until permanently enclosed.
  - .2 Erect enclosures to allow access for installation of materials and working inside enclosure.
  - .3 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
  - .4 Design enclosures to withstand wind pressure and snow loading.
- .3 Protection of Building Finishes and Equipment.
  - .1 Provide protection for finished and partially finished building finishes and equipment during the performance of work.
  - .2 Provide necessary screens, covers and hoardings.
  - .3 Confirm locations and installation with Contract Administrator at least three (3) days prior to installation.
  - .4 Be responsible for damage incurred due to lack of or improper protection.
- .4 Site Storage and Over Loading.
  - .1 Refer to Section 01 61 00.
  - .2 Confine Work and operations of workforce to limits indicated by Contract Documents. If Work must be performed in another area, notify and obtain permission from the City.
  - .3 Do not unreasonably encumber site with material or equipment.
  - .4 Move stored products or equipment interfering with operations of the City.
  - .5 Do not load or permit to be loaded any part of Work with weight or force that will endanger Work.
  - .6 Obtain and pay for use of additional storage or work areas needed for operations or for delivered equipment or materials not required immediately on site.
  - .7 Repair all existing site conditions damaged by use of site to match pre-construction conditions.
- .5 Guard Rails and Barricades.
  - .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stairwells, open edges of floors and roofs.
  - .2 Construct in accordance with requirements of authorities having jurisdiction.
- .6 Security Measures.
  - .1 In addition to requirement herein, provide hoarding and enclosures of sufficient strength and dimension to prevent unauthorized entry of all persons.

- .2 Maintain at site, at all times, names and telephone numbers of all Contractor's and Subcontractor's representatives, available to hand for use in event of need for immediate response in emergency situations.

## **1.9 TEMPORARY CONTROLS**

- .1 Dewatering.
  - .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water while work is in progress.
  - .2 Dispose of water in accordance with Section 01 74 00 and in manner not detrimental to public and private property, or any portion of work completed or under construction.
- .2 Shoring, Underpinning and Bracing.
  - .1 Conduct condition survey, including photographs of adjacent buildings before commencing excavation and investigate foundations to determine underpinning, etc., required.
  - .2 Take every precaution against any movement or settlement of existing and new construction, utilities, streets, paving, walks, lighting standards, piping, conduit, etc.
  - .3 Engage services of qualified professional engineer with demonstrated competence in work, registered in Province of Manitoba to design and inspect shoring, bracing and underpinning as required for work.
    - .1 Submit design and supporting data at least two (2) weeks prior to commencing work.
    - .2 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered in Province of Manitoba.
  - .4 Provide bracing, shoring, sheeting, sheet piling, underpinning and other retaining structures as required by aforementioned engineer and authorities having jurisdiction to assure horizontal and vertical support of adjacent areas.
  - .5 Assume responsibility for strength, adequacy, safety, and support of retaining structures, utilities, etc. with respect to any movement, settlement, or drainage; liability for injury resulting from inadequate shoring, bracing, and underpinning; responsibility for repair of damage caused.

## **1.10 SITE SIGNS AND NOTICES**

- .1 Site Signs and Notices: signs and notices for safety or instruction to be in English language, or commonly understood graphic symbols to CAN/CSA Z321.
- .2 Maintain approved signs and notices in good condition for duration of project and dispose of off-site on completion of project or earlier if directed by Contract Administrator.
- .3 Maintain sign in clean condition throughout duration of project.
- .4 No other signs or advertisements, other than warning signs, are permitted on site, except by specific written permission by the City.
- .5 Signs and notices for safety and instruction shall be in both official languages Graphic symbols shall conform to CAN3-Z321.
- .6 Maintain approved signs and notices in good condition for duration of project, and dispose of off-site on completion of project or earlier if directed by Contract Administrator.

## **Part 2 Products**

## **Part 3 Execution**

**END OF SECTION**



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 31 00 – Project Management and Co-ordination.
- .2 Section 01 33 00 – Submittal Procedures.
- .3 Section 01 50 00 – Temporary Facilities and Controls.
- .4 Section 01 74 00 – Cleaning.
- .5 Section 01 74 19 – Waste Management and Disposal.

### **1.2 SECTION INCLUDES**

- .1 Product quality, availability, storage, handling, protection, and transportation.
- .2 Procedures for product substitution.
- .3 Manufacturer's instructions.
- .4 Quality of Work, co-ordination and fastenings.
- .5 Co-ordination:
  - .1 Contractor shall co-ordinate the exact location of mechanical and electrical fixtures, outlets, switches, panels, etc. which are located in architectural wall and ceiling finishes with Contract Administrator prior to rough-in and cutting of openings and recesses.
  - .2 Contractor shall be responsible for all costs associated with relocation of mechanical and electrical devices (including replacement of damaged wood veneer paneling, linear wood ceilings and other architectural finishes) resulting from failure to co-ordinate with Contract Administrator prior to rough-in.

### **1.3 LABOUR AND PRODUCTS**

- .1 Products, material and equipment used to contain no asbestos fibre.

### **1.4 REFERENCE STANDARDS**

- .1 *B7: Substitutes, of the Bidding Procedures.*
- .2 Within text of each specifications section, reference may be made to reference standards.
- .3 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .4 If there is question as to whether any product or system is in conformance with applicable standards, Contract Administrator reserves right to have such products or systems tested to prove or disprove conformance.
- .5 Cost for such testing will be born by the City in event of conformance with Contract Documents or by Contractor in event of non-conformance.
- .6 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.

## **1.5 AVAILABILITY**

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays in any items. If delays in supply of products are foreseeable, notify Contract Administrator of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of work.
- .2 In event of failure to notify Contract Administrator at commencement of work and should it subsequently appear that work may be delayed for such reason, Contract Administrator reserves right to substitute more readily available products of similar character, at no increase in contract price or contract time.

## **1.6 QUALITY AND CONFORMANCE**

- .1 When material or equipment is specified by standard or performance specifications, upon request of Contract Administrator, obtain from manufacturer an independent testing laboratory report, stating that material or equipment meets or exceeds specified requirements.
- .2 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .4 Should any dispute arise as to quality or fitness of products, decision rests strictly with Contract Administrator based upon requirements of Contract Documents.
- .5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

## **1.7 STORAGE, HANDLING AND PROTECTION**

- .1 Handle and store products in manner to prevent damage, contamination, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in work.
- .3 Store products subject to damage from weather in weatherproof enclosures as specified in Section 01 50 00.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store construction materials on flat, solid supports and keep clear of ground. Slope to shed moisture.

- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.
- .9 Touch-up damaged factory finished surfaces to Contract Administrator's satisfaction. Use touch-up materials to match original. Do not paint over name plates.
- .10 Cleaning in accordance with Section 01 74 00.
- .11 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.8 TRANSPORTATION**

- .1 Pay costs of transportation of products required in performance of work.
- .2 Transportation costs of products supplied by the City will be paid for by the City, unless specified otherwise. Unload, handle and store such products, unless otherwise specified.

## **1.9 MANUFACTURER'S INSTRUCTIONS**

- .1 Unless otherwise indicated in specification, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Contract Administrator in writing, of conflicts between specifications and manufacturer's instructions, so that Contract Administrator may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements authorizes Contract Administrator to require removal and re-installation at no increase in Contract Price or Contract Time.

## **1.10 QUALITY OF WORK**

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Contract Administrator if required work is such as to make it impractical to produce required results.
- .2 Enforce discipline and good order among workers.
- .3 Do not employ anyone unskilled in their required duties. Contract Administrator reserves right to require dismissal from site, workers deemed incompetent or careless.
- .4 Decisions as to standard or fitness quality of work in cases of dispute rest solely with Contract Administrator, whose decision is final.

## **1.11 CO-ORDINATION**

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Ensure Work of various Subcontractors does not conflict or create interference.
- .3 Be responsible for the proper co-ordination and placement of openings, sleeves, and accessories.
- .4 Supply all items required to be built in as and when required, together with templates, measurements and shop drawings.

- .5 Ensure all workers examine the drawings and specifications covering the Work of others that may affect the performance of their own Work. Examine the Work of others and report to the Contract Administrator, in writing, any defects, or deficiencies that may affect the Work. In the absence of any report, the Contractor shall be held to have waived all claims for damage to or defects in such Work.
- .6 Ensure that components requiring foundations or openings that are required for the installation of Work is co-ordinated. Furnish the necessary information to the Sections concerned in ample time to permit allowance for such items. Failure to comply with this requirement does not relieve the party at fault of the cost of cutting or drilling at a later date and subsequent patching.
- .7 Extras to the Contract where architectural, structural, or mechanical work requires relocation or modifications due to the failure of the Electrical Subcontractor to co-ordination the work and provide interference co-ordination drawings will not be accepted.

#### **1.12 CONCEALMENT**

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform Contract Administrator if there is interference. Install as directed by Contract Administrator.

#### **1.13 REMEDIAL WORK**

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

#### **1.14 LOCATION OF FIXTURES**

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate. Contract Administrator may move these up to 3m from position indicated, at no cost to the City, provided notice is given before related work has commenced.
- .2 Inform Contract Administrator of conflicting installation. Submit field drawings to indicated relative position of various services and equipment when required by Contract Administrator. Install as directed.
- .3 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .4 Contractor shall be responsible for all costs associated with relocation of mechanical and electrical devices (including replacement of damaged stone veneer cladding and wood paneling) resulting from failure to co-ordinate with Contract Administrator prior to rough-in.

#### **1.15 FASTENINGS**

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.

- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically request in affected specification section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

#### **1.16 FASTENINGS - EQUIPMENT**

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

#### **1.17 PROTECTION OF WORK IN PROGRESS**

- .1 Protect Work completed or in progress.
- .2 Prevent overloading of any part of the building. Do not cut, drill, or otherwise sleeve any load bearing structural member unless specifically indicated on drawings or in Specifications without written approval of the Contract Administrator.

### **Part 2 Products**

#### **2.1 PRODUCT OPTIONS**

- .1 Products specified by reference standards or by description only: any product meeting those standards or description is acceptable for use.
- .2 Products specified by naming one or more manufacturers: submit request for substitution for any manufacturer not named.

#### **2.2 SUBSTITUTIONS**

- .1 Refer to Section 01 33 00 and *B8: Substitutes, of Bidding Procedures*.
- .2 The Work is based on the Materials and methods specified in the specifications.
- .3 Should substitutions be required because of unavailability the Contract Administrator will consider proposals to substitute specified products/materials with alternate products/materials.
- .4 Substitutions are not allowed unless application has been made to and prior approval has been granted by the Contract Administrator in writing.
- .5 Each proposal must:
  - .1 Include sufficient information in the form of product data, specifications, drawings, and other manufacturer's data to enable the Contract Administrator to properly evaluate the proposal.

- .2 Identify changes required in the applicable Work which would become necessary to accommodate the substitute.
- .6 The Contract Administrator reserves the right to accept or reject any proposal without prejudice for any reason whatsoever and reserves the right to disclose or not to disclose their reasons for such rejection.
- .7 In submittal of a request for substitution it is hereby understood that the person or entity submitting the request is certifying that the proposed substitute will fully perform the functions called for by the general design, be of equal or superior substance to that specified, is suited to the same use and capable of performing the same function as that specified and can be incorporated into the Work, strictly in accordance with the proposed work schedule.

### **Part 3 Execution**

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 19 – Waste Management and Disposal.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM E1971-05(2011), Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings.
- .2 Canadian Federal Legislation.
  - .1 Canadian Environmental Protection Act (CEPA).
  - .2 Canadian Environmental Assessment Act (CEAA).
  - .3 Transportation of Dangerous Goods Act (TDGA).
  - .4 Motor Vehicle Safety Act (MVSA).
- .3 Refer: *General Conditions*.

### **1.3 PROJECT CLEANLINESS**

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by the City or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building, remove from site.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Provide and use marked separate bins for recycling. Refer to Section 01 74 19 – Waste Management and Disposal.
- .7 Dispose of waste materials and debris off site.
- .8 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

#### **1.4 FINAL CLEANING**

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris including that caused by the City or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of. Do not burn waste materials on site.
- .6 Make arrangements with and obtain permits from Authorities Having Jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds as applicable.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean equipment and fixtures to sanitary condition; replace filters of mechanical equipment.
- .16 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

#### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 – Waste Management and Disposal.

#### **Part 2 Products**

#### **Part 3 Execution**

**END OF SECTION**



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 00 – Cleaning.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM E1971-05(2011), Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings.
- .2 Canadian Federal Legislation.
  - .1 Canadian Environmental Protection Act (CEPA).
  - .2 Canadian Environmental Assessment Act (CEAA).
  - .3 Transportation of Dangerous Goods Act (TDGA).
  - .4 Motor Vehicle Safety Act (MVSA).
- .3 Refer to: *General Conditions*.

### **1.3 DEFINITIONS**

- .1 Definitions:
  - .1 Approved/Authorized recycling facility: waste recycler approved by applicable provincial authority or other users of material for recycling
  - .2 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
  - .3 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
  - .4 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
  - .5 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:
    - .1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
    - .2 Returning reusable items including pallets or unused products to vendors.
  - .6 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.
  - .7 Separate condition: refers to waste sorted into individual types.
  - .8 Source separation: act of keeping different types of waste materials separate beginning from the point they became waste.

### **1.4 QUALITY ASSURANCE**

- .1 Ensure all work is performed in compliance with CEPA, CEAA, TDGA, MVSA, and all applicable federal and provincial regulations.
- .2 Except for items specifically noted, waste or abandoned materials and equipment are Contractor's property and must be promptly removed from site.
- .3 Equipment and re-useable items remain property of the City and must be stored as directed.

### **1.5 USE OF SITE AND FACILITIES**

- .1 Execute Work with minimal interference and disturbance to normal use of premises.

- .2 Maintain security measures established by facility provide temporary security measures approved by the City.

## **1.6 POLLUTION CONTROL**

- .1 Maintain pollution control features installed under this contract.
- .2 Ensure proper disposal procedures as indicated herein are maintained throughout project.
- .3 Control emissions from equipment and plant to local authorities emission requirements.
- .4 Prevent sanding dust and other extraneous materials from contaminating air beyond application area by providing temporary enclosures.

## **1.7 WASTE PROCESSING SITES**

- .1 Contractor is responsible to research and locate waste diversion resources and service providers. Salvaged materials are to be transported off site to approved and/or authorized recycling facilities or to users of material for recycling.

## **1.8 STORAGE, HANDLING AND PROTECTION**

- .1 Store, materials to be reused, recycled and salvaged.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect structural components not removed and salvaged materials from movement or damage.
- .4 Support affected structures. If safety of building is endangered, cease operations and immediately notify Contract Administrator.
- .5 Protect surface drainage, mechanical and electrical from damage and blockage.
- .6 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.
- .7 Separate and store materials produced during project in designated areas.
- .8 Prevent contamination of materials to be salvaged and recycled and handle materials in accordance with requirements for acceptance by designated processing facilities.
  - .1 On-site source separation is recommended.
  - .2 Remove co-mingled materials to offsite processing facility for separation.

## **1.9 DISPOSAL OF NON-HAZARDOUS WASTES**

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste, volatile materials, mineral spirits, oil, or paint thinner into waterways, storm, or sanitary sewers.
- .3 Remove materials on-site as Work progresses.
- .4 Fires and burning of rubbish on site not permitted.

## **1.10 DISPOSAL OF HAZARDOUS WASTE**

- .1 Obtain legislation governing disposal of hazardous and toxic materials, and pay for disposal of these materials in accordance with this legislation and authorities having jurisdiction and requirements of contract documents.
- .2 Do not dispose of water or volatile materials such as: mineral spirits, oil, petroleum based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers.

### **1.11 SCHEDULING**

- .1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

### **Part 2 Products**

### **Part 3 Execution**

### **3.1 APPLICATION**

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

### **3.2 DIVERSION OF MATERIALS**

- .1 From following list, separate materials from general waste stream and stockpile in separate piles or containers, as reviewed by the City and Contract Administrator and consistent with applicable fire regulations.
  - .1 Mark containers or stockpile areas.
  - .2 Provide instruction on disposal practices.
- .2 On-site sale of salvaged, recovered, reusable or recyclable materials is not permitted.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 31 00 – Project Management and Co-ordination.
- .2 Section 01 33 00 – Submittals Procedures.

### **1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Refer to *D30: Warranty, of Supplemental Conditions and General Conditions*.
- .2 Pre-warranty Meeting:
  - .1 Convene meeting one (1) week prior to contract completion with Contractor's representative, the City and Contract Administrator:
    - .1 Verify Project requirements.
    - .2 Review manufacturer's installation instructions and warranty requirements.
  - .2 Contract Administrator to establish communication procedures for:
    - .1 Notifying construction warranty defects.
    - .2 Determine priorities for type of defects.
    - .3 Determine reasonable response time.
  - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
  - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .3 Submit one (1) electronic copy in Adobe PDF format, plus one (1) hard copy to Contract Administrator for their review prior to submitting final copies. One (1) copy will be returned after final review, with Contract Administrator's comments.
- .4 Revise content of documents as required prior to final submittal.
- .5 Submit to Contract Administrator, two (2) weeks prior to Substantial Performance of the Work, final revised copies of Operating and Maintenance manuals, in English, consisting of one (1) electronic copy in PDF format, plus one (1) hard copy.
- .6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .7 If requested, furnish evidence as to type, source and quality of products provided.
- .8 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .9 Pay costs of transportation.

### **1.4 AS-BUILT DOCUMENTS AND SAMPLES**

- .1 Maintain, in addition to requirements in General Conditions, at the site for Contract Administrator one record copy of:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.

- .4 Change Orders and other modifications to the Contract.
- .5 Reviewed shop drawings, product data, and samples.
- .6 Field test records.
- .7 Inspection certificates.
- .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for review by Contract Administrator.

## **1.5 PROJECT RECORD DOCUMENTS**

- .1 Maintain at construction site, three (3) sets of white prints for record drawing purposes. Mark one (1) set "FIELD DRAWINGS" and use to record initial data when field measurements are made. Mark other two sets "RECORD DRAWINGS".
- .2 Store record drawings in field office apart from other documents used for construction. Maintain record drawings in clean, dry and legible condition. Do not use record drawings for construction purposes.
- .3 Record "as-built" information in red ink, accurately and concurrently with construction progress. Do not conceal work until required information is recorded.
- .4 Legibly mark each item to record actual construction, including:
  - .1 Measured depths of elements of foundation in relation to finish first floor datum.
  - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .4 Field changes of dimension and detail.
  - .5 Changes made by Addenda, Change Order and Field Instruction.
  - .6 Details not on original Contract Drawings.
  - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
  - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
  - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.
- .8 At completion of project and prior to final review, neatly transfer "as-built" notations to second and third set of white prints and submit to Contract Administrator along with field drawings. In addition, submit on USB, AutoCAD files of project with all changes included to reflect "as-built" conditions. Drawings must be generated in most current AutoCAD version, and consistent with Bid Documents prepared in AutoCAD 2021.
  - .1 For Contractors' use in preparation of "as-built" drawings required under this contract, Contractors may purchase from Contract Administrator, electronic AutoCAD drawing files in accordance with Section 01 33 00.

## 1.6 MAINTENANCE MATERIALS

- .1 Spare Parts:
  - .1 Provide spare parts, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to site; place and store.
  - .4 Receive and catalogue all items.
    - .1 Submit inventory listing to Contract Administrator.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
  - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
  - .2 Provide items of same manufacture and quality as items in Work.
  - .3 Deliver to site; place and store.
  - .4 Receive and catalogue all items.
    - .1 Submit inventory listing to Contract Administrator.
    - .2 Include approved listings in Maintenance Manual.
  - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
  - .1 Provide special tools, in quantities specified in individual specification section.
  - .2 Provide items with tags identifying their associated function and equipment.
  - .3 Deliver to site; place and store.
  - .4 Receive and catalogue all items.
    - .1 Submit inventory listing to Contract Administrator.
    - .2 Include approved listings in Maintenance Manual.
- .4 Delivery, Storage, And Handling:
  - .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
  - .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
  - .3 Store components subject to damage from weather in weatherproof enclosures.
  - .4 Store paints and freezable materials in a heated and ventilated room.
  - .5 Remove and replace damaged products at own expense and to satisfaction of Contract Administrator.

## 1.7 OPERATION AND MAINTENANCE MANUALS

- .1 Prepare one (1) hardcopy and one (1) electronic copy (PDF) of Operation and Maintenance Manual for the project as indicated above. Electronic (PDF) file to be tabbed and OCR'd.
- .2 Prepare Operation and Maintenance Manuals for each Architectural, Mechanical and Electrical component of project.
- .3 Format:
  - .1 Organize data in form of an instructional manual.
  - .2 Binders for hardcopy: vinyl, hard covered, 3 "D" ring, loose leaf spine and fact pockets.
  - .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
  - .4 Cover: Identify each binder with printed title "Operation and Maintenance Manual"; list title of project and identify subject matter of contents.
  - .5 Arrange content under Section numbers and sequence of Table of Contents.
  - .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
  - .7 Text: Manufacturer's printed data, or typewritten data.

- .8 Hardcopy drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .4 Contents (each volume).
  - .1 Table of Contents: provide title of project; date of submission; names, addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties; schedule of products and systems, indexed to content of volume.
  - .2 For each product of system; list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
  - .3 Product Data; Mark each sheet to clearly identify specific products and component parts and data applicable to installation; delete inapplicable information.
  - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
  - .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
  - .6 A hardcopy and electronic copy of shop drawings as specified in Section 01 33 00.
- .5 Equipment and Systems.
  - .1 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
  - .2 Include installed colour coded wiring diagrams.
  - .3 Operating Procedures: Include complete list of equipment and parts list. Indicate nameplate information such as make, size, capacity, serial number. Provide written explanation of operation of each system with instructions for trouble shooting of operational failures. Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
  - .4 Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
  - .5 Provide servicing and lubrication schedule, and list of lubricants required.
  - .6 Include manufacturer's printed operation and maintenance instructions.
  - .7 Include sequence of operation by controls manufacturer.
  - .8 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
  - .9 Provide installed control diagrams by controls manufacturer.
  - .10 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
  - .11 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
  - .12 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
  - .13 Include test and balancing reports as specified.
  - .14 Additional requirements: including one complete set of final reviewed and stamped shop drawings; cop of hardware and paint schedules; requirements specified in individual specification sections.
- .6 Materials and Finishes.
  - .1 Building Products, Applied Materials and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products as applicable.
  - .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: As specified in individual specifications sections.

## **1.8 EQUIPMENT AND SYSTEMS**

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts.
  - .1 Give function, normal operation characteristics, and limiting conditions.
  - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
  - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
  - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified.
- .15 Additional requirements: As specified in individual specification sections.

## **1.9 CONSTRUCTION PHOTOGRAPHS**

- .1 Submit construction photographs as specified in Section 01 31 00.

## **1.10 WARRANTIES AND BONDS**

- .1 Refer to *D30: Warranty, of Supplemental Conditions and General Conditions*.
- .2 Develop warranty management plan to contain information relevant to Warranties.
- .3 Submit warranty management plan, 30 days before planned pre-warranty conference, to Contract Administrator approval.



- .4 Warranty management plan to include required actions and documents to assure that Contract Administrator receives warranties to which it is entitled.
- .5 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .6 Submit, warranty information made available during construction phase, to Contract Administrator for approval prior to each monthly pay estimate.
- .7 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
  - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) Working Days after completion of applicable item of work.
  - .4 Verify that documents are in proper form, contain full information, and are notarized.
  - .5 Co-execute submittals when required.
  - .6 Retain warranties and bonds until time specified for submittal.
- .8 Include information contained in warranty management plan as follows:
  - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
  - .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and commissioned systems such as fire protection, alarm systems, sprinkler systems, lightning protection systems, .
  - .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
    - .1 Name of item.
    - .2 Model and serial numbers.
    - .3 Location where installed.
    - .4 Name and phone numbers of manufacturers or suppliers.
    - .5 Names, addresses and telephone numbers of sources of spare parts.
    - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
    - .7 Cross-reference to warranty certificates as applicable.
    - .8 Starting point and duration of warranty period.
    - .9 Summary of maintenance procedures required to continue warranty in force.
    - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
    - .11 Organization, names and phone numbers of persons to call for warranty service.
    - .12 Typical response time and repair time expected for various warranted equipment.
  - .4 Contractor's plans for attendance at four (4) and nine (9) month post-construction warranty inspections.
  - .5 Procedure and status of tagging of equipment covered by extended warranties.
  - .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .9 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .10 Written verification to follow oral instructions:
  - .1 Failure to respond will be cause for the Contract Administrator to proceed with action against Contractor.

- .11 Warranty Tags
  - .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Contract Administrator.
  - .2 Attach tags with copper wire and spray with waterproof silicone coating.
  - .3 Leave date of acceptance until project is accepted for occupancy.
  - .4 Indicate following information on tag:
    - .1 Type of product/material.
    - .2 Model number.
    - .3 Serial number.
    - .4 Contract number.
    - .5 Warranty period.
    - .6 Inspector's signature.
    - .7 Construction Contractor.

**Part 2 Products**

**Part 3 Execution**

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 78 00 – Closeout Submittals.

### **1.2 DESCRIPTION**

- .1 Provide comprehensive demonstration and training program to the City's personnel on operation and maintenance of all Contractor supplied and installed equipment and systems. This program to commence two (2) weeks prior to date of Substantial Performance of the Work.
- .2 The City will provide list of personnel to receive demonstration and training, and will co-ordinate their attendance at agreed-upon times.
- .3 Schedule demonstration and training sessions by manufacturer's authorized representative, and provide manufacturer produced training manuals and USB's if available for demonstration purposes.
- .4 In event that manufacturer produced training USB's are not available, video record demonstration and training sessions digitally recorded on USB in following formats: Real Player, Windows Media Player, and Quicktime.

### **1.3 SUBMITTALS**

- .1 Submit proposed schedule of time and date for demonstration and training of each item of equipment and each system prior to designated dates, for the City's approval.
- .2 Submit report within one week after completion of each demonstration and training session, that session has been satisfactorily completed. Identify time and date of each session, including list of the City's personnel present.

### **1.4 CONDITIONS FOR DEMONSTRATION AND TRAINING**

- .1 Equipment and systems have been reviewed by Contract Administrator.
- .2 Testing, adjusting, and balancing has been performed and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals and test reports for use in demonstrations and instructions.

### **1.5 DEMONSTRATION AND TRAINING**

- .1 Demonstration and training to include start-up, operation, control, adjustment, trouble-shooting, servicing and maintenance of each item of equipment at scheduled times, at equipment location.
- .2 Instruct the City's personnel in all aspects of operation and maintenance of equipment and systems referencing manufacturer's operation and maintenance manuals.
- .3 Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instructions.
- .4 Perform demonstration and training program provided under Contract to the City's satisfaction by quality persons knowledgeable in operation and maintenance of installed equipment and systems, and for duration acceptable to the City.

## **Part 2 Products**

## **Part 3 Execution**

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to performance verification of components, equipment, sub-systems, systems, and integrated systems.
- .2 Acronyms:
  - .1 Cx - Commissioning
  - .2 CxA - Commissioning Authority
  - .3 O&M - Operation and Maintenance
  - .4 CVF - Component Verification Form
  - .5 FT – Functional Test
  - .6 TAB - Testing, Adjusting and Balancing

### **1.2 GENERAL**

- .1 Commissioning is a formal, systematic process of ensuring that building systems perform interactively according to the design intent and the City's operational needs.
- .2 Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
  - .1 Applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted standards and that they receive adequate operational checkout by installing contractors.
  - .2 Proper performance of equipment and systems is documented.
  - .3 O&M documentation left on site is complete.
  - .4 The City's operating personnel are adequately trained.
- .3 The Contractor is responsible for demonstrating equipment and systems, troubleshooting and making adjustments as required to the satisfaction of the CxA.
  - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively tested with each other as intended in accordance with Contract Documents and design criteria.
  - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

### **1.3 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS**

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, the Contractor shall correct deficiencies, re-verify equipment and components within the non-functional system, including related systems as deemed required by the CxA and/or related design authority, to ensure effective performance.
- .2 Contractor costs for corrective work, additional tests, and inspections to ensure proper performance of such items to be borne by Contractor.
- .3 Contractor shall pay for CxA labour associated with excessive retesting of systems.

#### **1.4 COORDINATION**

- .1 The following are members of the commissioning team:
  - .1 The City's Representative.
  - .2 Commissioning Authority (CxA).
  - .3 Project Manager.
  - .4 Contract Administrator.
  - .5 General Contractor (Contractor).
  - .6 Mechanical Contractor.
  - .7 Electrical Subcontractor.
  - .8 TAB representative.
  - .9 Controls Contractor.
  - .10 Any other installing subcontractors or suppliers of equipment.

#### **1.5 CONFLICTS (BETWEEN SPECIFICATION SECTIONS)**

- .1 Report conflicts between requirements of this section and other specification sections to the General Contractor before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification (through RFI process) will result in application of the design authority's intent on the issue.

#### **1.6 COMMISSIONING SCHEDULE**

- .1 The Contractor will provide Cx schedule to CxA for review and comment.
- .2 The General Contractor will provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
  - .1 Commissioning site visits
  - .2 Component verification completion
  - .3 Startup and pre-functional activities
  - .4 Functional testing dates
  - .5 The City's training
  - .6 Seasonal or deferred testing.
- .3 All parties are responsible to address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

#### **1.7 SYSTEMS TO BE COMMISSIONED**

- .1 The following systems will be commissioned for this project (if applicable):

**Electrical**

Lighting, Occupancy and Daylighting Control

**Plumbing**

Domestic hot water heaters

Recirculation pumps

Expansion tanks

Sump Pumps

**HVAC**

Air Handling Units

Heat/Energy Recovery Ventilators

Exhaust Fans  
Condensing Units  
Fan Coils  
Force Flow & Unit Heaters  
Reheat coils  
Testing, Adjusting and Balancing Work  
**Direct Digital Controls (DDC)**  
Central Building Automation System

## 1.8 MEETINGS

- .1 Commissioning Kickoff Meeting. The CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance.
- .2 Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA at the discretion of the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Contractors.

## 1.9 SUBMITTALS (SHOP DRAWINGS)

- .1 The CxA requires submittal documentation for facilitating the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team.
- .2 These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review them and provide feedback, where in the opinion of the CxA, correction is required. O&M manuals must be submitted in electronic (pdf) format.

## 1.10 SYSTEM START-UP

- .1 Start-up Plan. The General Contractor will provide a detailed startup plan for all commissioned equipment for review by the CxA.
- .2 The startup plan will include blank startups forms (provided by manufacturer, or otherwise) for commissioned systems.
  - .1 The CxA may attend startups at their discretion to ensure that startup documentation and procedures are being followed as required.
  - .2 The Contractors and vendors shall execute start-up.
  - .3 Provide the CxA with a signed and dated copy of the completed start-up report.
- .3 Start-up documentation to include:
  - .1 Factory and on-site test certificates for specified equipment.
  - .2 Pre-start-up inspection reports.
  - .3 Signed installation/start-up check lists.
  - .4 Start-up reports,
  - .5 Step-by-step description of complete start-up procedures, to permit Contract Administrator to repeat start-up at any time.
- .4 Submit required startup documentation including, but not limited to:
  - .1 Mechanical Systems
    - .1 Major equipment manufacturers startup reports (AHUs, Boilers, Chillers, Heat Pumps, etc.)

- .2 Piping pressure tests
- .3 Sprinkler verification reports
- .4 TAB report
- .2 Electrical Systems
  - .1 Electrical equipment test reports (megger tests, harmonic distortion testing)
  - .2 Low voltage lighting system test report
  - .3 Fire Alarm verification report.
- .3 Controls
  - .1 Control point end-to-end verification report
  - .2 CO/NOx sensor calibration reports

### **1.11 FUNCTIONAL TESTING**

- .1 Refer to Section 1.7 for the list of systems to be commissioned.
- .2 Functional testing demonstrates that each system is operating according to the documented design intent and Contract documents. Each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part and full load). Verifying the sequences of operation is required for all modes. Proper responses to modes and conditions such as power failure, freeze conditions, fire alarm conditions, equipment failure, etc. may also be tested.
- .3 Functional Tests will be developed in an electronic format (pdf) by the CxA and electronic copies will be provided to Contractors.
- .4 The CVFs for a given system's equipment must be completed prior to the functional test.
- .5 The Contractors and/or vendors shall execute the functional tests as a pre-functional test to verify correct system operation and provide the CxA with a signed and dated copy of the completed tests prior to formal functional testing with the CxA present.
- .6 Issues identified during functional testing will be documented by the CxA on the issue tracking log.
  - .1 Contractors shall respond to issues and ensure correction.
- .7 A Sample functional test has been attached (Section 1.14) for bid purposes.

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**1.12 SAMPLE FUNCTIONAL TEST**

**Functional Testing for AHU-1, ERV-1 and Reheat**

Line #	Test	Expectation	First Test Status	Re-Test Status	Completed By	Date
AHU-1.F01	System Off	BMS commands system off during unoccupied mode - unit dampers close to outdoor air, supply fan is off. Verify by operational check.				
AHU-1.F02	Startup	When in occupied mode, BMS commands dampers to full return position, supply fans starts. Verify by operational check and trends.				
AHU-1.F03	Occupancy Schedule	Verify schedule with Owner. <i>Occupied schedule should be same for ERV-1, except for morning warm up periods, tests below.</i>				
AHU-1.F04	Morning Warm Up/Cool Down	AHU will operate in a warm up/cool down mode to bring the space under temperature control prior to occupancy. AHU will operate on full return in this mode, with ERV-1 off.				
AHU-1.F05	Supply Air Temperature Control: Heating	Hydronic Heating coil and modulating valve heat supply air when called to control zone temperature. Verify by operational check and trends.				
AHU-1.F06	Supply Air Temperature Control: Free Cooling	When OAT allows, free cooling mode on the AHU is enabled to maintain supply temperature at setpoint. Outdoor air damper modulates open to control supply air temperature. This sequence is to be staged and integrated with ERV-1 free-cooling. Relief Damper to open during this mode. Verify by operational check and trends.				
AHU-1.F07	Supply Air Temperature Control: Hydronic Cooling	Hydronic Cooling coil and modulating valve cool supply air when called to control zone temperature. Verify by operational check and trends.				
AHU-1.F08	Zone Temperature Control	Verify that AHU adequately controls <i>average</i> zone temperature to setpoint, nominally 72°F (22°C), adjustable.				
AHU-1.F09	Zone Temperature Control: Unoccupied Mode	Verify that AHU adequately controls <i>average</i> zone temperature on fields to setpoint, nominally 78°F (25.5°C), adjustable, in cooling mode. Unoccupied heating mode setpoint to be 60°F (15.5°C), adjustable.				
AHU-1.F10	Graphics & Trends	Verify graphics indicate space temperature and setpoint, AHU enable status, AHU fan status and speed, heating/cooling valve positions, mixed air temperature, OA and return air enthalpy, supply temp SP, and supply air temperature. Trends to be enabled on all points.				



**Functional Testing for AHU-1, ERV-1 and Reheat**

Line #	Test	Expectation	First Test Status	Re-Test Status	Completed By	Date
AHU-1.F11	Alarms	BMS to alarm on: - supply fan failure (x2) - supply air temperature differential from setpoint - high filter differential pressure (nominal 0.7"wc, adjustable) - freeze/estat alarm with shutdown at 40°F (4.4°C), heating valve opens fully, requiring manual restart				
ERV-1.F01	System Off	BMS commands system off during unoccupied mode - unit dampers close to outdoor air, supply and exhaust fans are off. This includes morning warmup periods. Verify by operational check.				
ERV-1.F02	Startup	When in occupied mode, BMS commands dampers open, supply and exhaust fans start (constant speed fans). Verify by operational check and trends.				
ERV-1.F03	Supply Air Temperature Control: Free Cooling	When OAT allows, and in sequence with AHU-1 free cooling, free cooling mode on the ERV is enabled by BMS. Dampers remain fixed during this mode, switching only once every 3 hours.				
ERV-1.F04	Supply Air Temperature Control: Heat Recovery	When OAT allows, and in sequence with AHU-1, heat recovery mode on the ERV is enabled by BMS. Dampers operate routinely during this mode, reversing flow every 2 minutes. Verify by operational check and trends.				
ERV-1.F05	Graphics & Trends	Verify graphics indicate space temperature and humidity, ERV enable status, ERV mode command, supply and exhaust fan status, heating valve positions, supply temp SP, supply temperature, and exhaust air temperature.				
ERV-1.F06	Alarms	BMS to alarm on: - supply fan failure - exhaust fan failure - supply air temperature differential from setpoint - high filter differential pressure (nominal 0.7"wc, adjustable)				

### **1.13 SEVEN (7) DAY INTEGRATED SYSTEM TESTING**

- .1 A 7-Day Integrated Systems Test will be completed to ensure proper building performance and operation. An additional test will be completed during seasonal testing.
- .2 General Acceptance requires that the systems operate as one entity as intended and that documentation is provided indicating such.
- .3 Issues identified during seven day testing will be documented by the CxA on the issue tracking log.
  - .1 Contractors shall respond to issues and ensure correction.

### **1.14 DEFERRED/SEASONAL TESTING**

- .1 Functional tests requiring specific environmental conditions (seasonal tests) will be deferred until after occupancy
- .2 The Contractors and/or vendors shall execute the deferred/seasonal tests as a pre-functional test to verify correct system operation and provide the CxA with a signed and dated copy of the completed tests prior to formal functional testing with the CxA present.
- .3 Issues identified during deferred/seasonal testing will be documented by the CxA on the issue tracking log.
  - .1 Contractors shall respond to issues and ensure correction.

### **1.15 ISSUE TRACKING LOG**

- .1 Contractors shall respond to issues noted on the issue tracking log within 7 days indicating the corrective action taken.
- .2 CxA may request the contractor demonstrate successful resolution of items noted on the tracking log.

### **1.16 STAFF TRAINING**

- .1 The Contractor is responsible for training of O & M staff to ensure they have all information necessary to operate and maintain commissioned features and systems.
- .2 Submit a training plan and schedule to CxA for review.
- .3 Training plan will address the following topics (at a minimum)
  - .1 Design intent
  - .2 Use of Operations and Maintenance (O&M) Manuals
  - .3 Control Drawings and Schematics
  - .4 Startup and Shutdown
  - .5 Unoccupied operations
  - .6 Seasonal changeover
  - .7 Manual operations
  - .8 Alarms
  - .9 System interactions
  - .10 Energy conservation optimizations
  - .11 Health and safety
  - .12 Special maintenance or replacement

- .13 Occupant interaction
- .14 Systems response to operating conditions
- .15 Contractor shall document training exercises with attendance sheets and implementation of training surveys.
- .16 A training evaluation form has been attached (Section 1.19) for bid purposes.

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**1.17 SAMPLE TRAINING EVALUATION FORM**



Commissioning Project Management Services

420 – 70 Arthur St.  
Winnipeg, MB, R3B 1G7  
Tel: 204.669.6818  
Fax: 204.944.1123  
[www.i-designs.ca](http://www.i-designs.ca)

**Sample Project Name**

City, Province

**Training Survey**

**Date:**

**Name:**

**Training Covered:**

---

---

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**1. Was the Instructor familiar with the equipment? Yes  No**

**2. Was the topic covered completely? Yes  No**

**3. Were your questions answered? Yes  No**   
(if No, list questions?)

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---

---

**4. Overall, are you satisfied? Yes  No**

**Comments**

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**1.18 SYSTEMS MANUAL**

- .1 Contractor to provide the following documentation to the CxA for inclusion in the systems manual:
  - .1 As-built architectural drawings (electronic copy)
  - .2 As-built mechanical drawings (electronic copy)
  - .3 As-built electrical drawings (electronic copy)
  - .4 As-built controls drawings and cut sheets (electronic copy)
  - .5 Operations and Maintenance manuals (electronic copy)
  - .6 Occupancy permit.

**1.19 AUTHORITIES HAVING JURISDICTION (I.E. GOVERNMENT AND UTILITY AUTHORITIES)**

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for CxA to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Contract Administrator and CxA within 5 days of test.

**Part 2 Products**

**2.1 Not used.**

**Part 3 Execution**

**3.1 Not used.**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 00 – Cleaning.
- .2 Section 01 74 19 – Waste Management and Disposal.
- .3 Section 02 81 00 – Hazardous Materials – General provisions.
- .4 Section 02 82 10 – Asbestos Abatement – Type 1 (Low Risk) Precautions.
- .5 Section 02 82 12 – Asbestos Abatement – Glove bag.
- .6 Section 02 82 13 – Asbestos Abatement – Type 3 (High Risk) Precautions.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM E1971-19, Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings.
- .2 Canadian Federal Legislation.
  - .1 Canadian Environmental Protection Act (CEPA).
  - .2 Canadian Environmental Assessment Act (CEAA).
  - .3 Transportation of Dangerous Goods Act (TDGA).
  - .4 Motor Vehicle Safety Act (MVSA).
- .3 Canadian Standards Association (CSA).
  - .1 CSA S350-M1980 (R2003), Code of Practice for Safety in Demolition of Structures.
- .4 National Building Code of Canada (NBCC).
  - .1 NBCC Division B Part 8, Safety Measures at Construction and Demolition Sites.

### **1.3 QUALITY ASSURANCE**

- .1 Ensure all work is performed in compliance with CEPA, CEAA, TDGA, MVSA, and all applicable provincial regulations.
- .2 Comply with Workplace Safety and Health Act, Workplace Safety Regulation, Manitoba with regards to health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of work.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit written request in advance of cutting or alteration which affects the following:
  - .1 Structural integrity of any element of project.
  - .2 Integrity of weather-exposed or moisture-resistant elements.
  - .3 Efficiency, maintenance, or safety of any operational element.
  - .4 Visual qualities of sight-exposed elements.
- .2 Include in request the following:
  - .1 Identification of Project.
  - .2 Location and description of affected work.
  - .3 Statement on necessity for cutting or alteration
  - .4 Description of proposed work, and products to be used.
  - .5 Date and time work will be executed.

## **1.5 SITE CONDITIONS**

- .1 Existing Services.
  - .1 Do not, under any circumstances drill, cut or chase openings of any description in any part of existing building structure, without written approval from the City. The City will supervise any work of this type and will require x-ray inspection of structure to be cut prior to drilling at Contractor's expense.
  - .2 No employee of the City is authorized to give approval of Contractor for any drilling unless results of x-ray inspection are provided to the City prior to drilling and approval of the City is communicated to Contractor in writing.
  - .3 Before commencing work, establish location and extent of service lines in area of work. Be absolutely certain of their origin and destination.
  - .4 Where unknown services are encountered, immediately advise Contract Administrator and confirm findings in writing.
  - .5 Record locations of maintained, rerouted and abandoned service lines on project record documents in accordance with section 01 78 00.
- .2 Existing Hazardous Materials.
  - .1 Removal and handling of hazardous materials is to be performed only by persons trained in methods, procedures and industry practices for safe handling and removal of hazardous materials.
  - .2 Asbestos: immediately stop work should any unidentified or unforeseen disturbance of asbestos-containing or contaminated materials be encountered during course of work, and notify Contract Administrator and the City upon discovery of material.
  - .3 Polychlorinated Biphenyls (PCB's): fluorescent light fixtures scheduled for demolition within work area may contain PCB light ballasts. Be familiar with procedures concerning handling and storage of PCB materials, and as outlined in latest edition of "Handbook on PCB's in Electrical Equipment" as prepared by Environment Canada.
  - .4 Mould: immediately stop work should any unidentified or unforeseen mould contaminated materials be encountered during course of work and notify Contract Administrator and the City upon discovery of material

## **1.6 SCHEDULING**

- .1 Co-ordinate demolition and removal of debris to ensure minimal disruption to existing building.
- .2 Execute work with least possible interference, inconvenience or disturbance to occupants, public and normal use or premises. Keep noise and dust to minimum.
- .3 Use only spark proof tools and equipment where explosive fumes may exist either from demolition work, renovation work, or existing operations.

## **Part 2 Products**

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Inspect existing conditions, including elements subject to damage or movement during demolition. Photograph existing conditions in accordance with Section 01 31 00. Conduct a condition survey of building areas to remain before commencing demolition.

- .2 Utilize dustproof hoarding and temporary partitions in accordance with Section 01 50 00 to fully isolate the demolition work from existing building areas to remain to separate dust generating activities from occupied facility. Maintain until such work is complete. Contractor will be responsible for any and all demolition contamination to the City's occupied facilities adjacent to the demolition area.
- .3 Where security of existing building areas to remain has been reduced by work, provide temporary means to maintain security acceptable to Contract Administrator and the City.
- .4 Provide and maintain temporary fire protection equipment during performance of work required by and governing codes, regulations and bylaws.
- .5 Protect building systems, services and equipment as follows:
  - .1 Do not disrupt active or energized utilities designated to remain undisturbed. Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.
  - .2 Provide temporary dust screens, covers, railings, supports and other protection as specified.
  - .3 Provide protection from elements for areas which may be exposed by uncovering work.
- .6 Prior to start of any demolition ensure contaminated or hazardous materials have been removed from site and dispose of at designated disposal facilities in safe manner and in accordance with TDGA.
- .7 Disconnect electrical and telephone service lines entering areas to be demolished. Co-ordinate and schedule disconnects with the City. Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.
- .8 Disconnect and cap mechanical services in accordance with locations and requirements of local authority having jurisdiction and as follows:
  - .1 Sewer and water lines to be removed and capped by qualified tradesmen to prevent leakage in accordance with locations and requirements of authority having jurisdiction.
  - .2 Do not disrupt active or energized utilities designated to remain undisturbed.

### **3.2 DEMOLITION**

- .1 Demolish structures and parts of structures to permit construction of renovations indicated.
- .2 Execute cutting, fitting and patching to complete work in accordance with Section 01 73 29.
- .3 Provide openings in non-structural elements of work for penetrations of mechanical and electrical work.
- .4 Execute work by methods to avoid damage to other work, and which will provide proper surfaces to receive patching and finishing.
- .5 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval of the City.

### **3.3 REPAIR/RESTORATION**

- .1 Where penetrations through existing walls or floors result from removal or relocation of existing equipment, repair to standard of construction of surrounding material.
- .2 Refinish wall, ceiling and floor surfaces to match adjacent finished unless otherwise indicated.
- .3 Fit work to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- .4 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where otherwise indicated.



- .5 Patch holes (abandoned and not required for future services) in existing walls, floor and roofs resulting from demolition and removal of mechanical pipes and or ducts and electrical services.

### **3.4 CLEANING AND WASTE MANAGEMENT**

- .1 Cleaning in accordance with Section 01 74 00.
- .2 Waste Management and Disposal in accordance with Sections 01 74 19.
- .3 Equipment and re-useable items remain property of the City and must be stored as directed.
- .4 Maintain progressive cleaning of work and surrounding areas during renovations. Comply with provincial and local fire and safety laws, ordinances, codes, and regulations.
- .5 Vacuum clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations. Continue vacuum cleaning on an as-needed basis until renovations are ready for occupancy.
- .6 When work is substantially performed, remove remaining waste materials, tools, equipment, machinery and surplus materials not required for performance of remaining work.
- .7 Provide final cleaning in accordance with ASTM E1971 and leave work clean and suitable for occupancy.

### **3.5 PROTECTION**

- .1 Conduct demolition operations to prevent injury to people and damage to adjacent building areas.
  - .1 Ensure safe passage of people around demolition area.
  - .2 Provide temporary dust screens, barriers, warning signs in locations where renovation and alteration work is adjacent to occupied areas.
- .2 At end of each day's work, leave work in safe and stable condition so that no part is in danger of toppling or falling.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 General and Related Work**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Related work specified elsewhere:
  - .3 Section 02 82 10 Asbestos Abatement – Type 1 (Low Risk) Procedures
  - .4 Section 02 82 13 Asbestos Abatement – Type 3 (High Risk) Procedures
  - Section 02 82 12 Asbestos Abatement – Type 2 Glove Bag Method
- .5 Site Conditions identifies all known hazardous building materials within the Project Area. The information provided is for general reference only. Each Contractor must confirm existing conditions on site prior to tender close.
  - .1 The specification fulfils the requirements of Part 36 and 37 of Manitoba Workplace Safety and Health Regulation 217/2006.
- .6 The Outline of Work identifies the location, condition and quantities of hazardous building materials to be removed as part of this project.
  - .1 It is the intent that work prescribed this Section will result in the removal of all hazardous materials as outlined and the decontamination of all surfaces or materials which may have been or become contaminated by hazardous materials either during or prior to work of this Contract.

**1.2 Site Conditions**

- .1 Refer to the City of Winnipeg asbestos inventory, dated May 13, 2021.
- .2 Refer to City of Winnipeg Asbestos Location Drawings for locations of asbestos-containing plaster, pipe insulation, joint compound on drywall, duct insulation and boiler insulation to be removed. Duct mastic is also identified on the drawing but may not require removal.
- .3 Asbestos
  - .1 The following materials have been confirmed to contain asbestos:
    - .1 Parging cement, present on pipe fittings at various locations throughout the building.
    - .2 Plaster ceilings at various locations throughout the Main Floor.
    - .3 Black and red mastic present on ducts.
    - .4 Caulking around doors.
    - .5 Fabric lining the inside of a hatch door located at the exterior of the building

- .6 Parging cement insulation on ducts in the Basement Boiler Room and Fan Room.
- .7 Insulation remaining inside the two boilers in the Boiler Room.
- .8 Joint compound present on drywall walls and ceilings at various locations throughout the Main Floor.
- .2 The following materials are to be treated as asbestos-containing:
  - .1 Original fibreglass insulation of piping that is painted. Locations and quantities of the insulation is to be identified during the site walkthrough.
- .4 General Building Conditions
  - .1 Heat and smoke detectors to remain live throughout work.
  - .2 Sprinklers to remain live throughout work.
- 1.3 Outline of Work**
  - .1 Coordinate the following items with the City’s Project Manager and the Construction Manager, including but not limited to: electrical isolations, GFI connection, water connections, HVAC and exhaust ventilation system isolation, bin placement, schedule, disconnects, etc.
  - .2 Install Hoarding Walls between Abatement Work Areas and Occupied Areas.
  - .3 Using procedures prescribed in the Sections identified in Related Work, remove and dispose of the following:
    - .1 Asbestos-containing joint compound present on ceilings and walls throughout the Main Floor at locations as identified on drawings.
    - .2 Asbestos-containing plaster ceilings throughout the Main Floor at locations identified on drawings.
    - .3 Asbestos-containing parging cement on pipe fittings at locations identified on drawings and at locations where pipe insulation may be concealed above plaster or drywall ceilings that have not been identified.
    - .4 Asbestos-containing duct insulation present in the Basement Boiler Room and Fan Room.:
    - .5 Asbestos-containing insulations from the inside of the two boilers in the Basement Boiler Room.
    - .6 Original fibreglass insulation from straight runs of piping that is painted.
    - .7 Caulking around doors at locations scheduled for demolition.
    - .8 Red and black duct mastic where required to accommodate duct removal.
  - .4 Sample and submit the samples for asbestos analysis for the following materials suspect

to be present:

- .1 Stone lining present inside the hot water holding tank located at the east side in the Boiler Room.
- .5 Refer to Specification Sections identified in the Related Work for specified personnel protective measures for the safe handling, removal or clean-up of hazardous materials in each phase or work area.
- .6 Visit the site prior to tender close to confirm the location and extent of any hazardous building materials or materials contaminated by hazardous materials.
- .7 Protect surfaces, building fabrics and items remaining within the Abatement Work Area.
- .8 Without disturbing hazardous materials, perform removals where required, prior to abatement work.
  - .1 Maximize waste diversion by use of resale of building materials, or recycling.
- .9 Isolate the Abatement Work Area from adjoining Occupied and Non-Occupied Areas whether present at an interior or exterior location.
- .10 Maintain emergency and fire exits from Abatement Work Area, or establish alternative exits satisfactory to Provincial Fire Marshall and local authorities having jurisdiction. Maintain extra routes from occupied areas. Place emergency exit signs at locations to clearly mark exit route. Seal emergency exit doors so as not to impede use of door during emergency evacuation.
- .11 Perform selective demolition of mechanical and electrical equipment, building components, materials and items scheduled for demolition at locations required to facilitate asbestos removal. Refer to all Contract Documents for responsibility of demolition work and disposal.
- .12 Remove and dispose of as appropriate waste, building components, materials and items contaminated by hazardous materials that cannot be effectively cleaned.
- .13 Final clean work area to remove visible signs of asbestos and other hazardous materials, other debris or settled dust.
- .14 Apply lock-down agent to exposed surfaces throughout the work area and to surfaces from which any hazardous materials have been removed.
  - .1 Do not apply lock-down to materials which would be damaged by its application.
- .15 Unless otherwise specified, the handling, removal, clean-up or repair of hazardous materials or surfaces contaminated with hazardous materials is to be performed following wet removal techniques.

#### **1.4 Schedule**

- .1 Provide necessary manpower, supervision, equipment and materials to maintain and complete the project on schedule.
- .2 Work Hours:
  - .1 Coordinate all work, scheduling and phasing with the City.
  - .2 NOTE: Duration for which HVAC systems may remain shutdown to accommodate quiet hours work will vary in accordance with outside weather conditions and internal demand. Duration of quiet hours work will have to be scheduled accordingly and in consultation with the Abatement Consultant.
- .3 Provide 48 hours written notice to the Abatement Consultant of any request to work outside normal working hours. Obtain written approval before proceeding.

#### **1.5 Definitions**

- .1 Abatement Consultant: The City's Representative providing inspection and air monitoring.
- .2 Abatement Contractor: Contractor or sub-contractor performing work of this section.
- .3 Abatement Work Area: Area where work takes place which will, or may, disturb hazardous materials.
- .4 Amended Water: Water with wetting agent added for the purpose of reducing surface tension to allow thorough wetting of materials.
- .5 Asbestos: Any of the fibrous silicates defined in Regulation 217/2006 including: actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite.
- .6 Asbestos-Containing Material (ACM): Material identified under Site Conditions including any debris, overspray, fallen material and settled dust.
- .7 Authorized Visitors: The City, Abatement Consultant, or designated representative, and persons representing regulatory agencies.
- .8 Competent Worker: A worker who is qualified because of knowledge, training and experience to perform the work, is familiar with applicable regulations and guidelines, and has knowledge of the potential or actual danger to health and safety in the work.
- .9 Contaminated Waste: Material identified under Site Conditions, including fallen material, settled dust, other debris and materials or equipment deemed to be contaminated by the Abatement Consultant.
- .10 Curtained Doorway: Doorway consisting of two (2) overlapping flaps of rip-proof polyethylene arranged to permit ingress and egress from one room to another while permitting minimal air movement between rooms.

- .11 DOP Test: A testing method used to determine the integrity of the Negative Pressure unit or vacuum using a Dispersed Oil Particulate (DOP) or Poly Alpha Olefin (PAO) HEPA filter leak test. This test is to be conducted on site where units are to be installed. Refer to the Environmental Abatement Council of Ontario (EACO) DOP/PAO Testing Guideline 2013 or ANSI/ASME N510-2007.
- .12 Fitting: Individual segments or pieces of a mechanical service line which may include but is not limited to the hangers, tees, elbows, joints, valves, unions, etc.
- .13 Friable Material: Material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.
- .14 HEPA Filter: High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.
- .15 Milestone Inspection: Inspection of the Abatement Work Area at a defined point in the abatement operation.
- .16 Negative Pressure: A reduced pressure within the Abatement Work Area (> 0.02 inches of water column) established by extracting air directly from Abatement Work Area and discharging it to exterior of building.
- .17 Non-Friable Material: Material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .18 Occupied Area: Any area of the building or adjoining space outside the Abatement Work Area.
- .19 Personnel: All Contractor's employees, sub-contractors employees, supervisors.
- .20 PCM: Phase Contrast Microscopy.
- .21 Remove: Remove means remove and dispose of (as applicable type of waste) unless followed by other instruction (e.g. remove and turn over to The City).
- .22 TEM: Transmission Electron Microscopy.

## **1.6 Regulations and Guidelines**

- .1 Comply with Federal, Provincial, and local requirements, provided that in any case of conflict among those requirements or with these Specifications, the more stringent requirements shall apply. Work shall be performed under regulations in effect at the time work is performed.
- .2 Where regulations are not present, follow accepted industry standards and applicable Guideline documents.
- .3 Regulations and Guidelines include but are not limited to the following:
  - .1 Workplace Safety and Health Act W210.

- .2 Workplace Safety and Health Regulation M.R. 217/2006
- .3 Safe Work Manitoba Guide for Asbestos Management
- .4 The Dangerous Goods Handling and Transportation Act C.C.S.M c. D12.
- .5 Hazardous Waste Regulation, M.R. 195/2015.
- .6 Dangerous Goods Handling and Transportation Regulation, M.R. 55/2003.
- .7 Transportation of Dangerous Goods Regulation (SOR 219/2019-101).

### **1.7 Quality Assurance**

- .1 Removal and handling of hazardous materials is to be performed by persons trained in the methods, procedures and industry practices for Abatement.
- .2 Ensure work proceeds to schedule, meeting all requirements of this Specification.
- .3 Complete work so that at no time airborne dust, visible debris, or water runoff contaminate areas outside the Abatement Work Area.
- .4 Any contamination of surrounding area (indicated by visual inspection or air monitoring) shall necessitate the clean-up of affected area, and in the same manner applicable to an Abatement Work Area at no cost to the City.
- .5 All work of this Section involving electrical, mechanical, carpentry, glazing, etc., shall be performed by licensed persons experienced and qualified for the work required.

### **1.8 Supervision**

- .1 Provide on site, an Overall Superintendent(s), who has authority to oversee all aspects of the work, including but not limited to, estimating and negotiation of changes to the contract, update of submission requirements, scheduling, manpower and equipment requirements, and direct communication and co-ordination with Abatement Consultant and The City's representative.
- .2 Provide on site, in addition to the Overall Superintendent(s), and for each work shift, a Shift Superintendent, who has authority regarding all aspects related to manpower, equipment and production.
- .3 Supervisory personnel must hold a recognized certificate proving attendance at an asbestos removal training course (3 day minimum duration) and have performed supervisory functions on at least five (5) other asbestos abatement projects of similar size and complexity.
- .4 At all times during work, the Overall or Shift Superintendent(s) must be on site. Failure to comply with this requirement will result in a stoppage of all work, at no cost to the City.

- .5 Replace supervisory personnel, with approved replacements, within three (3) working days of a written request from the City. The City reserves the right to request replacement of supervisory personnel without explanation.
- .6 Do not replace supervisory personnel without written approval from the City.

**1.9 Notification**

- .1 Not later than 5 days before commencing asbestos abatement work on this project, notify the local office of the Manitoba Workplace Safety and Health Division..
- .2 Notify Sanitary Landfill site as per local requirements.
- .3 Inform all trades on site of the presence and location of hazardous materials identified in the Contract documents.
- .4 Notify the City or the City's Representative, if suspected asbestos-containing materials not identified in the contract documents are discovered during the course of the work. Stop work in these areas immediately.

**1.10 Submittals**

- .1 Submit prior to starting work:
  - .1 Provincial Workers' Compensation Board Clearance Certificate.
  - .2 Insurance certificates.
  - .3 Copy of Company Health and Safety Policy and applicable programs.
  - .4 Provincial Regulator Notice of Project form.
  - .5 Copy of Certificate of Approval for disposal of hazardous materials waste and location of landfill.
  - .6 Pre-removal damage survey of the Abatement Work Area(s), waste transport routes, and bin storage areas.
- .2 Submit the following information regarding personnel prior to starting work:
  - .1 Resumes of the supervisory personnel.
  - .2 Proof in the form of a certificate that supervisory personnel have attended a training course on asbestos (3 day minimum duration).
  - .3 Written statement that personnel have had instruction on hazards of exposure to hazardous materials identified within this scope, the use of respirator, protective clothing, worker and waste decontamination procedures, and all aspects of work procedures and protective measures.



- .4 Proof of training for the following site specific hazards or conditions identified:
    - .1 Working at Heights
    - .2 Elevated Work Platform.
    - .3 Confined Space.
  - .5 Written statement that personnel have had instruction on hazards of exposure to hazardous materials identified within this scope, the use of respirator, protective clothing, worker and waste decontamination procedures, and all aspects of work procedures and protective measures.
  - .6 WHMIS training certificates for all personnel.
  - .7 Certificate proving that each worker on site has been fit tested for the respirator appropriate for the work being performed.
  - .8 Proof, satisfactory to the Consultant, that all persons involved in the transport and disposal hazardous materials have been trained in accordance with the requirements of Federal and Provincial Transportation of Dangerous Good Acts and Regulations.
- .3 Submit the following information regarding HEPA filtered devices prior to construction of enclosure or asbestos abatement:
- .1 Performance data on HEPA filtered vacuums including DOP tests no more than 3 months old.
  - .2 Performance data on negative air units including DOP tests which must be no more than 3 months old if the unit is vented outdoors or which must be performed on site immediately prior to initial usage and when HEPA filters are changed if the unit is vented indoors.
  - .3 DOP tests to be performed by an independent testing company.
    - .1 DOP testing company is required to submit a detailed technical report of testing protocol, including Introduction, Methodology, Results, Conclusions, and Recommendations, including results of the Air-Aerosol Mixing Uniformity test as per ASME N510-1989 (1995).
    - .2 DOP testing company must also provide calibration certificates from an independent calibration firm or from the manufacturer of the testing equipment for both the aerosol photometer and the pressure gauge on the aerosol generator dated within 1 calendar year from the on-site testing date.
    - .3 DOP testing company must also provide the National Sanitation Foundation (NSF) certification name and number of the on-site technician performing the testing.
  - .4 Proof of calibration of DOP testing equipment.

- .4 Submit the following prior to isolating the work area:
  - .1 Safety Data Sheets for chemicals or material used in the course of the Abatement Project.
- .5 Submit the following upon completion of the work.
  - .1 Manifests, waybills, bills of lading etc. as applicable for each type of waste.

#### **1.11 Insurance**

- .1 The Contractor, and any Sub-Contractors responsible for any Hazardous Materials Abatement work shall obtain, maintain, and evidence with a Certificate of Insurance Pollution Liability insurance for risks arising out of operations by or on behalf of the CONTRACTOR. “Pollution Liability” as used herein includes, but is not limited to Bodily Injury including Health Hazards; Property Damage; or Environmental Damage; resulting from the discharge, dispersal, release or escape of any solid, liquid, gaseous or thermal irritant or contaminant, including smoke, vapours, soot, fumes, acids, alkalis, toxic chemicals, medical waste and waste materials into or upon land, or any structure on land, the atmosphere or any watercourse or body of water, including groundwater provided such conditions are not naturally presenting the environment in the concentration of amounts discovered. Pollution Liability shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period. Without limiting the generality of the foregoing, the policy shall insure the operations of abatement and shall not contain any environmental and/or health hazard exclusions relating to abatement operations.
- .2 Forward all certificates to THE CITY, THE CITY’S Representative(s), and Pinchin Ltd. before work commences, showing THE CITY, THE CITY’S Representative(s), and Pinchin Ltd. as additional insured as their interest may appear.
- .3 THE CITY, THE CITY’S Representative(s), and Pinchin Ltd. may request a certified true copy of any policies.
- .4 The policy shall be endorsed to provide THE CITY, THE CITY’S Representative(s), and Pinchin Ltd. with 30 days written notice of cancellation or material change or alteration to the policy.
- .5 The limits will not be less than:
  - .1 Pollution Policy: \$2,000,000.00 per occurrence and in aggregate

#### **1.12 Inspection**

- .1 From commencement of work until completion of clean-up operations, the Abatement Consultant is empowered by the City to inspect for compliance with the requirements of governing authorities, adherence to specified procedures and materials, and to inspect for final cleanliness and completion.

- .2 The Abatement Consultant is empowered by the City to order a shutdown of work when leakage of asbestos from the controlled work area has occurred or is likely to occur.
- .3 Any deviation from the requirements of the Specifications or governing authorities that is not approved in writing may result in a stoppage of work, at no cost to the City.
- .4 Additional labour or materials expended by the Contractor to rectify unsatisfactory conditions and to provide performance to the level specified shall be at no additional cost to the City.
- .5 Inspection and air monitoring performed as a result of Contractor's failure to perform satisfactorily regarding quality, safety, or schedule, shall be back-charged to the Contractor.
- .6 Facilitate inspection and provide access as necessary. Make good work disturbed by inspection and testing at no cost to the City.
- .7 Refer to the Sections identified in Related Work for specified milestone inspections which are to take place at defined points throughout the abatement operation specific to each phase or work area.
- .8 Provide 24 hours written notice to the Abatement Consultant of any request for scheduling of milestone inspections or transportation of waste through Occupied Areas.
- .9 The following Milestone Inspections may take place, at the City's cost, as outlined in each related specification section:
  - .1 Milestone Inspection - Clean Site Preparation
    - .1 Inspection of preparations and set-up prior to contaminated work in the Abatement Work Area.
  - .2 Milestone Inspection - Contaminated Perimeter Preparation
    - .1 Inspection of Abatement Work Area upon completion of limited demolition or abatement and complete installation of upper seals.
  - .3 Milestone Inspection – Contaminated Demolition Inspection
    - .1 Inspection of required demolition under contaminated conditions, prior to commencement of abatement activities.
  - .4 Milestone Inspection – Bulk Removal Inspection
    - .1 Inspection during asbestos removal, monitoring removal methods, site deficiencies, performing occupied air monitoring, etc.
  - .5 Milestone Inspection - Visual Clearance
    - .1 Inspection of Abatement Work Area after completion of all abatement, but prior to application of lock-down agents or dismantling of enclosure.

- .6 Milestone Inspection – Clearance Sampling
  - .1 Air monitoring performed following removal of asbestos and application of slow drying sealer to ensure fibre levels inside the enclosure(s) are within the acceptable limits.
- .10 Refer to the Sections identified in Related Work for specified milestone inspections which are to take place at defined points throughout the abatement operation specific to each phase or work area.
- .11 Do not proceed with next phase of work until written approval of each milestone is received from the Abatement Consultant.

### **1.13 Air Monitoring - Asbestos**

- .1 Air monitoring will be performed using Phase Contrast Microscopy (PCM) following the National Institute for Occupational Safety and Health Method 7400.
- .2 Co-operate in the collection of air samples, including providing workers to wear sample pumps for up to full-shift periods. Contractor will be responsible for the cost of testing equipment repairs or resampling resulting from the actions of the Contractor's forces.
- .3 Results of PCM samples of 0.03 fibres per cubic centimeter of air (fibre/cc) or greater, outside an Abatement Work Area, from within a Type 1 Work Area after completion of work or from within the Abatement Work Area during or following Glove Bag Work, will indicate asbestos contamination of these areas. Respond as follows:
  - .1 Suspend work within the adjoining Abatement Work Area until written authorization to resume work has been received from the Abatement Consultant.
  - .2 Isolate and clean area in the same manner applicable to the Abatement Work Area.
  - .3 Maintain work area isolation, and repeat clean-up operations until visual inspection and air monitoring results are at a level equal to that specified.
  - .4 At the discretion of the Abatement Consultant provide additional negative air units at locations specified in response to elevated fibre levels being detected in the Clean Change Room or Occupied Areas.
- .4 Results of PCM samples at or greater than 0.01 fibres per cubic centimeter of air (fibre/cc), collected within the Abatement Work Area enclosure after the site has passed a visual inspection, and an acceptable coat of lock-down agent has been applied, will indicate asbestos contamination of these areas. Respond as follows: enclosure after the site has passed a visual inspection, and an acceptable coat of lock-down agent has been applied, will indicate asbestos contamination of these areas. Respond as follows:
  - .1 Maintain work area isolation and re-clean entire work area. Then apply another acceptable coat of lock-down agent to exposed surfaces throughout the work area.

- .2 Repeat above measures until visually inspected and air monitoring results are at a level equal to that specified.
- .5 When results exceed 50% of maximum use concentration for the respirator being used within the work area respond as follows:
  - .1 Immediately stop work within the Abatement Work Area.
  - .2 Instruct workers to exit the Abatement Work Area via the Worker Decontamination Facility while observing specified personnel exiting procedures.
  - .3 Contractor's forces shall not re-enter the Abatement Work Area for a period of 8 hours or until authorized by the Abatement Consultant.
  - .4 Upon re-entry to the Abatement Work Area, mist the air, any fallen debris or exposed surfaces with amended water using an airless sprayer.
- .6 Additional labour or materials expended by the Contractor to rectify unsatisfactory conditions and to provide performance to the level specified shall be at no additional cost to the City.
- .7 Cost of additional inspection and sampling performed as a result of elevated fibre levels in areas outside the Abatement Work Area or from within the work area following completion of work, will be back-charged to the Contractor.

#### **1.14 Worker Protection**

- .1 Instruct workers before allowing entry to the Abatement Work Area. Instruction shall include training in use of respirators, dress, showering, entry and exiting from an Abatement Work Area, and all other aspects of work procedures and protective measures.
- .2 Workers shall not eat, drink, chew gum or tobacco, or smoke in the Abatement Work Area.
- .3 Workers shall be fully protected at all times when possibility of disturbance of hazardous materials exists.
- .4 Provide soap, towels and facilities for washing of hands and face, which shall be used by all personnel when leaving the Abatement Work Area.
- .5 Respiratory Protection
  - .1 Refer to each particular Section of the Specification for specified type of respiratory equipment specific to each phase or work area.
  - .2 Respirators shall be:
    - .1 Certified by the National Institute of Occupational Safety and Health (NIOSH) or other testing agency acceptable to the Provincial regulator.

- .2 Fitted so that there is an effective seal between the respirator and the worker's face. Ensure that no person required to enter an Abatement Work Area has facial hair which affects the seal between respirator and face.
  - .3 Assigned to a worker for their exclusive use.
  - .4 Maintained in accordance with manufacturer's specifications.
  - .5 Cleaned, disinfected and inspected by a competent person after use on each shift, or more often if required.
  - .6 Repaired or have damaged or deteriorated parts replaced.
  - .7 Stored in a clean and sanitary location.
  - .8 Provided with new filters as necessary, according to manufacturer's instructions.
  - .9 Worn by personnel who have been fit checked by qualitative or quantitative fit-testing.
  - .10 Instruction on proper use of respirators must be provided by a competent person as defined by the Occupational Health and Safety Act.
- .3 Provide protective clothing, to all personnel which:
    - .1 Is made of a material that does not readily retain nor permit penetration of asbestos fibres.
    - .2 Consists of head covering and full body covering that fits snugly at the ankles, wrists and neck.
    - .3 Once coveralls are worn, treat and dispose of as contaminated waste.
    - .4 Is replaced or repaired if torn or ripped.
  - .4 Use hard hats, safety footwear and other protective equipment and apparel required by applicable construction safety regulations.

#### **1.15 Visitor Protection**

- .1 Provide clean protective clothing and equipment to Authorized Visitors.
- .2 Instruct Authorized Visitors in the use of protective clothing and Abatement Work Area entry and exit procedures.
- .3 Authorized visitors are required to be fit tested on respirators, prior to entering Abatement Work Area.

#### **1.16 Signage**

- .1 Asbestos Abatement Signs: Post signs at access points to the Abatement Work Area, stating at minimum, the following:
  - .1 There is an asbestos dust hazard.
  - .2 Access to the work area is restricted to persons wearing protective clothing and equipment.

- .2 Bins and Asbestos Waste Containers: Post signs on both sides of every asbestos waste and. Signs must display thereon in large, easily legible letters that contrast in colour with the background the word “CAUTION” in letters not less than ten centimetres in height and the words:
  - .1 CONTAINS ASBESTOS FIBRES;
  - .2 Avoid Creating Dust and Spillage;
  - .3 Asbestos May be Harmful To Your Health; and
  - .4 Wear Approved Protective Equipment.
- .3 Place placards in accordance with Transportation of Dangerous Goods Act.

#### **1.17 Differential Pressure Monitoring**

- .1 Provide and install differential pressure monitors as specified in each section.
- .2 Replace damaged or non-functional equipment at the request of the Abatement Consultant.
- .3 Record at minimum twice daily, and when damage to the enclosure is identified and repaired, the following information:
  - .1 Name of inspector.
  - .2 Date and time.
  - .3 Pressure reading.
  - .4 Repairs completed, if applicable.
- .4 Maintain specified differential pressure.
- .5 Stop contaminated work and take corrective action if pressure differential drops below the specified level. Notify the Abatement Consultant immediately.

#### **1.18 Waste and Material Handling**

- .1 Waste bins must be placed on grade or in receiving.
- .2 All bins for hazardous materials must be covered and locked when waste transfer is not being performed.
- .3 Ensure redundant non-ACM, rubble, debris, etc. removed during contaminated work are treated, packaged, transported and disposed of as appropriate waste.
- .4 Clean, wash and apply Post Removal Sealant to metal waste prior to removal from Abatement Work Area. Recycle metals.
- .5 Clean, wash and apply Post Removal Sealant to non-porous materials prior to disposal as clean waste. Obtain prior written approval from the Abatement Consultant for each individual type of material.

- .6 Clean and wash equipment prior to removal from Abatement Work Area if removed prior to completion.
  - .7 Place all equipment, tools and unused materials that cannot be cleaned in Abatement Waste Containers.
  - .8 As work progresses, and at regular intervals, transport the sealed and labelled waste containers from the Abatement Work Area to waste bin.
  - .9 Place items in bins according to waste classification. Place asbestos waste, metals, non-asbestos waste, etc. in separate bins.
  - .10 Removal of waste containers and decontaminated tools and materials from the Abatement Work Area shall be performed as follows:
    - .1 Remove any visible contamination from the surface of non-porous or cleanable waste being removed from the Abatement Work Area. If the item can be cleaned, remove it from the site as clean waste.
    - .2 Place waste or item in Waste Container and seal closed.
    - .3 Wet wipe outside of Waste Container.
    - .4 Within Decontamination Facility, Transfer Room or at the perimeter of the Abatement Work Area, place in second Waste Container. Seal closed.
    - .5 Remove waste containers and transport to appropriate bin.
  - .11 Transport waste and materials via the predetermined routes and exits. Arrange waste transfer route with The City. Use a closed, covered cart to transport through Occupied Areas.
  - .12 Use Low Risk Procedures while transporting asbestos waste through facility.
  - .13 Provide workers transporting waste with means to access full personal protective equipment and all tools required to properly clean up spilled material in the case of a rupture of a Waste Container.
  - .14 Pick-up and drop off of garbage bin shall be at pre-approved times, and must not interfere with the City's operations.
  - .15 Transport hazardous waste to landfill in accordance with provincial requirements.
  - .16 Cooperate with inspectors from the provincial regulator and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the City.
- 1.19 Re-establishment of Objects and Systems**
- .1 Re-establish objects and items relocated by the Contractor's workforce to facilitate work.



- .2 Re-establish electrical, communication, HVAC and other services previously disconnected or otherwise isolated to accommodate work by this Section.
- .3 Make good at completion of work, all damage not identified in pre-removal survey.

## **PART 2 PRODUCTS AND FACILITIES**

### **2.1 Materials and Equipment**

- .1 Refer to the Sections identified in Related Work for specified materials, equipment or facilities specific to each phase or work area.
- .2 Materials and equipment must be in good condition and free of debris and fibrous materials. Disposable items must be of new materials only.
- .3 Airless Sprayer: AC powered pressure washer that allows wetting agent to mix with water, uses no air or compressed air, and has a nozzle to regulate power and pressure.
- .4 Amended Water: Water with wetting agent added for purpose of reducing surface tension to allow thorough wetting of materials.
- .5 Asbestos Waste Container: A yellow container acceptable to disposal site, and the provincial regulator comprised of the following:
  - .1 Dust tight.
  - .2 Suitable for the type of waste.
  - .3 Impervious to asbestos.
  - .4 Identified as asbestos waste.
- .6 Differential Pressure Monitor: a high precision instrument for measuring and controlling pressure differences in the low range, between the Abatement Work Area and Occupied Area. Calibrate regularly to manufacturer's instructions.
- .7 Discharge Ducting: Polyethylene Tubing. Reinforced with wire. Diameter to equal negative pressure machine discharge. Not to be longer than required, or so long that negative pressure is compromised.
- .8 Ground Fault Panel: Electrical panel as follows:
  - .1 Ground fault circuit interrupters of sufficient capacity to power temporary electrical equipment and lights in Asbestos Work Area.
  - .2 Interrupters to have a 5 mA ground fault protection.
  - .3 Necessary accessories including main switch disconnect, ground fault interrupter lights, test switch to ensure unit is working, and reset switch.

- .4 Openings sealed to prevent moisture or dust penetration.
- .5 Inspected by the Electrical Safety Authority.
- .6 Panel uses CSA approved parts and been constructed, inspected and installed by a licensed electrician.
- .7 Provide one Ground Fault Panel for each 5,000 square feet (500 square metres) of Abatement Work Area.
- .9 HEPA Filtered Negative Pressure Machine: Portable air handling system which extracts air directly from the Abatement Work Area and discharges the air to the exterior of the building. Equipped as follows:
  - .1 Prefilter and HEPA filter. Air must pass HEPA filter before discharge.
  - .2 Pressure differential gauge to monitor filter loading.
  - .3 Auto shut off and warning system for HEPA filter failure.
  - .4 Separate hold down clamps to retain HEPA filter in place during change of prefilter.
- .10 HEPA Vacuum: Vacuum with necessary fittings, tools and attachments. Discharged air must pass through a HEPA filter.
- .11 Hose: Leak-proof, minimum bursting strength of 500 PSI or greater if required, abrasion resistant covering, reinforcing, and machined-brass couplings. Maintained and tested. Hose to be temperature resistant if it is to carry domestic hot water.
- .12 OSB: Oriented Strand Board.
- .13 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.
- .14 Post Removal Sealant (or Lockdown): Sealant that when applied to surfaces serves the function of trapping residual asbestos fibres or other dust. Product must have flame spread and smoke development ratings both less than 50. Product shall leave no stain when dry. Post Removal Sealant shall be compatible with replacement insulation or fireproofing where required and capable of withstanding service temperature of substrate. Apply to manufacturer's instructions.
- .15 Protective Clothing: Disposable coveralls complete with head covering and full body covering that fits snugly at the ankles, wrists and neck.
- .16 Rip-Proof Polyethylene Sheeting: 8 mil (0.20 mm) fabric made up from 5 mil (0.13 mm) weave and two (2) layers of 1.5 mil (0.05 mm) poly laminate or approved equal. In sheet size to minimize on-site seams and overlaps.

- .17 Shower Hose: Water lines for supply of hot & cold water to shower facilities to be rated for use at 200 PSI (1380 kPa) or twice the working pressure whichever is greater. Supply lines to be continuous and free of fittings, joints or couplings.
- .18 Sprayer: Garden type portable manual sprayer or water hose with spray attachment if suitable.
- .19 Tape: Duct tape or tape suitable for sealing polyethylene to surfaces under both dry and wet conditions in the presence of Amended Water.
- .20 Wetting Agent: Non-sudsing surfactant added to water to reduce surface tension and increase wetting ability.

### **PART 3 EXECUTION**

- .1 Refer to the Sections identified in Related Work for specified procedures for work area preparation, maintenance, site dismantlement, application of lock-down agent and all other procedures for the safe handling, removal and clean-up of hazardous materials specific to each phase or work area.

### **END OF SECTION**

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## **GENERAL**

### **1.1 General and Related Work**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
  - .1 Section 02 81 00 Hazardous Materials – General Provisions

### **1.2 Outline of Work**

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 Refer to City of Winnipeg Asbestos Location Drawings.
- .3 Isolate the Abatement Work Area from adjoining spaces through the installation of temporary barriers and partitions as specified herein.
- .4 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of asbestos-containing materials following Type 1 (Low Risk) procedures, and Pinchin and the City specific requirements.

### **1.3 Instruction and Training**

- .1 Provide instruction and training to all workers including the following:
  - .1 Hazards of asbestos.
  - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during abatement work, including:
    - .1 Limitations of equipment.
    - .2 Inspection and maintenance of equipment.
    - .3 Proper fitting of equipment.
    - .4 Disinfecting and cleaning of equipment.
  - .3 Personal hygiene to be observed when performing the work.
  - .4 Measures and procedures prescribed in the regulation and decontamination of the worker.
- .2 Instruction and training must be provided by a competent person.

### **1.4 Personal Protection**

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
  - .1 Provide non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters when requested by personnel.
  - .2 When requested by personnel, provide protective clothing.

### **1.5 Inspections**

- .1 Refer to Part 1.12 Inspections in Section 02 81 00 – General Provisions.
- .2 The following Milestone Inspections are to be scheduled:
  - .1 Milestone Inspection - Visual Clearance
  - .2 Milestone Inspection – Clearance Sampling

**PART 2 PRODUCTS AND FACILITIES**

- .1 Refer to Section 02 81 00.

**PART 3 EXECUTION**

**3.1 Site Preparation**

- .1 Moving of equipment, tools, supplies, and stored materials that can be performed without disturbing ACM will be performed by others.
- .2 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .3 Install one layer of polyethylene sheeting on walls, floors, finishes, millwork, electrical equipment, equipment and furnishings remaining in the Abatement Work Area.
- .4 Install polyethylene drop sheets below areas of work.
- .5 Install signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .6 Shut down HVAC systems serving the Abatement Work Area.
  - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.
  - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
  - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
  - .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .7 Provide power from ground fault interrupt circuits.
- .8 Provide amended water for wetting ACM, and adequate method of wetting (garden sprayers, airless sprayers, etc.).
- .9 Without disturbing asbestos-containing materials, remove and dispose of non-hazardous materials as clean waste prior to asbestos removal work, where possible.
- .10 Do not commence contaminated work until authorized by the Abatement Consultant.

**3.2 Maintenance of Abatement Work Area**

- .1 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .2 Inspect electrical panels and ensure locks and tags are on panels prior to entering the Abatement Work Area.
- .3 Maintain Abatement Work Area in tidy condition.
- .4 Remove any standing water on polyethylene/floor at the end of every shift.

**3.3 Asbestos Removal - General**

- .1 Do not use powered tools or non-hand held tools.
- .2 Do not use compressed air to clean or remove dust or debris.
- .3 Do not break, cut, drill, abrade, grind, sand or vibrate ACM if it cannot be wetted. Type 2 (Moderate Risk) procedures would be required if the material cannot be wetted due to hazard or damage.

- .4 Wet ACM prior to work and keep ACM wet throughout the removal process.
- .5 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.
- .6 Frequently and at regular intervals, place all waste in asbestos waste containers.
- .7 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

### **3.4 Asbestos Removal - Removal of Caulking**

- .1 Wet all material to be disturbed.
- .2 Remove doors and door frames if necessary to remove material.
- .3 Use only non-powered hand-held tools to remove ACM.
- .4 Scrape to remove material adhered to substrate.
- .5 Place removed ACM directly into an asbestos waste container.

### **3.5 Asbestos Removal – Red Duct Mastic**

- .1 Wet all material to be disturbed.
- .2 Undo fasteners if necessary to remove material.
- .3 Where ducting is scheduled for demolition remove sections of duct without cutting through the mastic.
- .4 Wrap removed sections of duct with two layers of rip proof polyethylene for disposal as asbestos waste.

### **3.6 Abatement Work Area Dismantling**

- .1 Do not commence site dismantlement until authorized by the Asbestos Abatement Consultant.
- .2 Wash or HEPA vacuum equipment and tools used in contaminated Abatement Work Area to remove all asbestos contamination, or place in Asbestos Waste Containers prior to being removed from Abatement Work Area.
- .3 Place tools and equipment used in contaminated work site but not cleaned in polyethylene bags prior to removal from Abatement Work Area.
- .4 Clean polyethylene sheeting and drop sheets which with HEPA vacuum or wet cleaning methods at completion of work.
- .5 Wet drop sheets and polyethylene sheeting.
- .6 Carefully roll drop sheets toward the centre. As polyethylene is rolled away, immediately remove visible debris beneath with a HEPA vacuum.
- .7 Remove remaining polyethylene sheeting and tape.
- .8 Place polyethylene sheeting, drop sheets, tape, disposal clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.

**3.7 Waste and Material Handling**

- .1 Refer to Section 02 81 00.

**END OF SECTION**

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## **GENERAL**

### **1.1 General and Related Work**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
  - .1 Section 02 81 00 Hazardous Materials – General Provisions

### **1.2 Outline of Work**

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 Refer to City of Winnipeg Asbestos Location Drawings.
- .3 Isolate the Abatement Work Area from adjoining spaces through the installation of temporary barriers and partitions as specified herein.
- .4 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of asbestos-containing materials following Glove Bag procedures, and Pinchin and the City specific requirements.
- .5 If for reasons of pipe temperature, geometry or access, Glove Bag procedures cannot be used, remove and dispose of asbestos-containing insulations following Type 2 (Moderate Risk) procedures for less than 1 square meter, or Type 3 (High Risk) Procedures for greater than 1 square meter.
- .6 De-activate steam and condensate, and hot water heating pipe systems prior to work.

### **1.3 Instruction and Training**

- .1 Provide instruction and training to all workers including the following:
  - .1 Hazards of asbestos.
  - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during abatement work, including:
    - .1 Limitations of equipment.
    - .2 Inspection and maintenance of equipment.
    - .3 Proper fitting of equipment.
    - .4 Disinfecting and cleaning of equipment.
  - .3 Personal hygiene to be observed when performing the work.
  - .4 The measures and procedures prescribed by this section and decontamination of the worker.
  - .5 Instruction and training must be provided by a competent person.

### **1.4 Personal Protection**

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
- .2 Provide the following minimum respiratory protection to all personnel:
  - .1 Non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters.



- .3 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .4 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

## **1.5 Inspections**

- .1 Refer to Part 1.12 Inspections in Section 02 81 00 – General Provisions.
- .2 The following Milestone Inspections are to be scheduled:
  - .1 Milestone Inspection - Clean Site Preparation
  - .2 Milestone Inspection – Bulk Removal Inspection
  - .3 Milestone Inspection - Visual Clearance
  - .4 Milestone Inspection – Clearance Sampling

## **PART 2 PRODUCTS AND FACILITIES**

### **2.1 Materials and Equipment**

- .1 Refer to Section 02 81 00.
- .2 Glove Bag: Prefabricated bag which provides a completely sealed envelope surrounding a given section of piping to permit the removal of asbestos-containing insulation from within the bag while maintaining the integrity of the bag and preventing the spread of airborne asbestos fibres. The glove bag shall be equipped with,
  - .1 sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period,
  - .2 valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure,
  - .3 a tool pouch with a drain,
  - .4 a seamless bottom and a means of sealing off the lower portion of the bag, and
- .3 Securing Straps: For some types of Glove Bag, reusable nylon straps at least 25mm wide with metal tightening buckle for sealing ends of bags around pipe and/or insulation.

## **PART 3 EXECUTION**

### **3.1 Site Preparation - General**

- .1 Moving of equipment, tools, supplies, and stored materials that can be performed without disturbing ACM will be performed by others.
- .1 Shut down HVAC systems.
  - .1 HVAC systems are to be shut down, locked out and tagged out.
  - .2 Install polyethylene sheeting over openings in ducts and at diffusers and seal.
  - .3 HVAC to remaining areas of building must not be disrupted during work of this section.
  - .4 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
  - .5 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.

- .2 Install caution tape around work area where existing walls are not present.
- .3 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .4 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .5 Cover walls, floors, finishes, millwork, equipment and furnishings below the pipe to be worked on in the Abatement Work Area with polyethylene sheets before disturbing ACM. Drop sheets shall extend a minimum of 1,800 mm from pipe.
- .6 Use existing lighting or install temporary lighting to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .7 Provide Amended Water for wetting ACM, in garden sprayers. Provide one garden sprayer for each worker.
- .8 Do not use compressed air to clean or remove dust or debris when completing work of this section.
- .9 Place HEPA Vacuum in Abatement Work Area for each worker.
- .10 Place required tools to complete the abatement within the Abatement Work Area.
- .11 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .12 Schedule and obtain written approval of Milestone Inspection - Clean Site Preparation before proceeding.

### **3.2 Maintenance of Abatement Work Area**

- .1 Maintain Abatement Work Area in tidy condition.

### **3.3 Glove Bag Removal**

- .1 Do not use Glove Bags on hot pipes that may damage Glove Bag. Refer to manufacturers' limitations.
- .2 Prior to use of Glove Bag on damaged or unjacketed insulation:
  - .1 Spray any areas of damaged insulation jacketing with mist of Amended Water.
  - .2 Tape over damaged insulation to provide temporary repair.
  - .3 Mist areas of insulation with no jacketing and wrap with polyethylene sheeting and seal with tape.
- .3 Place any tools necessary to remove insulation in tool pouch built into Glove Bag.
- .4 Inspect the Glove Bag for damage and defects immediately before it is attached to the pipe or duct.
  - .1 If damage or defects are observed, dispose of Glove Bag.
- .5 Install Glove Bag as per manufacturer's instructions.
- .6 Remove insulation from pipe as per manufacturer's directions.
  - .1 Volume and weight of insulation must not exceed capacity of the Glove Bag or supports.
  - .2 Arrange insulation in the Glove Bag to maximize use of the Glove Bag.

- .7 Only single use glove bags are permitted.
- .8 At regular intervals during its use, if damage or defects are observed during the use of the Glove Bag, which cannot be readily repaired with tape and not affect the integrity or strength of the glove bag.
  - .1 Discontinue use of Glove Bag.
  - .2 Wash inner surface of Glove Bag.
  - .3 Wet insulation.
  - .4 Pull an Asbestos Waste Container over Glove Bag before removing from pipe.
  - .5 Remove Glove Bag and Asbestos Waste Container, seal with tape.
  - .6 Place in a second Asbestos Waste Container and seal with tape.
  - .7 Clean immediate area with a HEPA Vacuum prior to resuming work.
- .9 Glove bags may not be moved along pipe for use on adjacent sections of insulation:
- .10 To remove bag after completion of insulation removal operation:
  - .1 Wash inner surface of Glove Bag.
  - .2 Wash and place all tools in one hand (glove), pull hand out inverted, twist to create a separate pouch, tape inverted hand at two separate locations 25 mm apart so as to seal pouch.
    - .1 Remove inverted hand and tools by cutting between the two tape seals.
    - .2 Place inverted hand pouch and tools into the next clean Glove Bag to be used or into a water bucket, open pouch underwater and clean tools.
  - .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
  - .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
  - .5 Seal valve cover on valve Glove Bags.
  - .6 Seal closure strip if equipped with one. Twist bag at tapered point and secure with tape.
  - .7 Pull an Asbestos Waste Container over Glove Bag before removing from pipe.
    - .1 Cut upper portion of single-use Glove Bag.
    - .2 Seal Asbestos Waste Container with tape.
  - .8 Ensure pipe is clean of all residue after removal of Glove Bag. If necessary, after removal of each section of asbestos, vacuum all surfaces of pipe, using HEPA vacuum or wipe with wet cloth.
- .11 Seal all surfaces of freshly-exposed pipe with Post Removal Sealer.

### **3.4 Clean-Up and Dismantling**

- .1 Remove equipment and tools.
- .2 Remove temporary lighting if used.
- .3 Remove polyethylene seals from HVAC systems.
- .4 Place polyethylene sheeting, drop sheets, seals, tape, clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.

- .5 Clean Abatement Work Area with HEPA vacuums or wet wiping/mopping.
- .6 Seal openings in HEPA vacuums.
- .7 Schedule and obtain written approval of Milestone Inspection – Clearance Sampling before proceeding with the removal of all barricades, etc..
- .8 Remove barricades, fencing, caution tape, signs, etc.

**3.5 Waste and Material Handling**

- .1 Refer to Section 02 81 00.

**3.6 Re-Establishment of Items**

- .1 Upon completion of work:
  - .1 Remove tags and locks from electrical panels and re-energize equipment and items.
  - .2 Enable building air handling systems.
  - .3 Clean and vacuum Abatement Work Area.

**END OF SECTION**

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**PART 1 GENERAL**

**1.1 General and Related Work**

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of Division 1 and the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
  - .1 Section 02 81 00 Hazardous Materials – General Provisions

**1.2 Outline of Work**

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 Refer to City of Winnipeg Asbestos Location Drawings for the locations of asbestos-containing materials.
- .3 Install Hoarding Walls between Abatement Work Area boundaries.
  - .1 Install Type A/B Hoarding Walls between the Abatement Work Area and unoccupied areas.
  - .2 Install Type C Hoarding Walls between the Abatement Work Area and occupied areas.
- .4 Using Type 3 (High Risk) procedures of this section, remove and dispose of the following:
  - .1 Asbestos-containing mechanical insulations.
  - .2 Asbestos-containing plaster.
  - .3 Asbestos-containing joint compound on ceilings and walls.

**1.3 Personal Protection**

- .1 Supervisory personnel and workers shall have training on the recognition and prevention of heat stress and other heat exposure related hazards.
- .2 Protect all personnel at all times when possibility of disturbance of ACM exists.
- .3 Provide the following respiratory protection to all personnel:
  - .1 Full Face Air Purifying Respirators with P100 high efficiency (HEPA) cartridge filters during projects when performing wet abatement asbestos-containing or contaminated materials specified in this section.
  - .2 Non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters for dismantling of Type 3 [High Risk] enclosures, using Type 2 [Moderate Risk] Procedures.
- .4 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .5 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

**1.4 Differential Pressure Monitoring**

- .1 Install differential pressure monitor at a location chosen by the Abatement Consultant.
- .2 Co-operate with the Abatement Consultant in collection of pressure monitoring data.
- .3 Maintain specified differential pressure at monitoring location. Negative air pressure is to be -0.02 inches of water, relative to the area outside the enclosed area.

## **1.5 Inspections**

- .1 Refer to Part 1.12 Inspections in Section 02 81 00 – General Provisions.
- .2 The following Milestone Inspections are to be scheduled:
  - .1 Milestone Inspection - Clean Site Preparation
  - .2 Milestone Inspection - Contaminated Perimeter Preparation
  - .3 Milestone Inspection – Bulk Removal Inspection
  - .4 Milestone Inspection - Visual Clearance
  - .5 Milestone Inspection – Clearance Sampling

## **PART 2 PRODUCTS AND FACILITIES**

### **2.1 Materials and Equipment**

- .1 Refer to Section 02 81 00.

### **2.2 Hoarding Walls**

- .1 Type A Hoarding Wall: 38 mm x 89 mm wood or metal studs at 400 mm o/c with continuous sill and top plate, covered with one layer of rip-proof polyethylene sheeting on each side of wall.
- .2 Type B Hoarding Wall: 38 mm x 89 mm wood or metal studs at 400 mm o/c with continuous sill and top plate, covered with one layer of polyethylene sheeting on each side of wall. Install 13 mm OSB, plywood or gypsum board over polyethylene sheeting on Occupied Area side. Paint Occupied Area side of plywood, OSB, or gypsum board with one coat of primer and one coat of flat white latex.

### **2.3 Decontamination Facilities**

- .1 Workers' Decontamination Facility: A decontamination facility comprised of three linked rooms, Contaminated Change Room, a Shower Room, and a Clean Change Room.
  - .1 Rooms, Occupied Areas and Abatement Work Areas, shall be separated by curtained doorways at each door.
- .2 Contaminated Change Room: Room between Shower Room and Abatement Work Area.
  - .1 Locate on contaminated side of Shower Room.
  - .2 Install asbestos waste container for asbestos contaminated protective clothing.
  - .3 Install storage facilities for any personal protective equipment to be reused in Abatement Work Area including boots, hard hats, etc., but excluding respirators.
  - .4 Install hooks and shelves as required for personal protective equipment.
  - .5 Minimum size of generally 2 m x 2 m. Increase size accordingly to accommodate number of workers.
- .3 Shower Room: Room between Clean Change Room and Contaminated Change Room.
  - .1 Install one walk through shower unit for every six workers.
  - .2 Install constant supply of hot and cold water, controllable at each shower. Water supply must be sufficient to provide water at a minimum temperature of 40 degrees Celsius (maximum 50 degrees) in a volume required for all workers to properly decontaminate.
    - .1 Install individual hot and cold shut-off valves on water supply located on clean side of Shower Room. Connect shower to these valves.

- .2 Install individual controls inside the shower to regulate water flow and temperature.
  - .3 Install rigid piping or Shower Hose with watertight connections for supply and drains.
  - .4 Install a sealed drip pan under and around the showers, 150 mm deep.
  - .5 Install sump pumps, sufficient for volume of waste shower water from showers and drip pan. Direct waste shower water to sanitary drains.
  - .6 Install ground fault protected power switch on clean side of shower for sump pumps, or timed for shut off.
  - .7 Provide adequate quantity of soap, shampoo, clean towels
  - .8 Install an Asbestos Waste Container for disposal of used respirator filters, on the contaminated side of the Shower Room.
- .4 Clean Change Room: A room between the Shower Room and Occupied Areas.
- .1 Install hooks and shelves on clean side of shower in clean Change Room for storage of respirators.
  - .2 Install lockers or hangers for workers' street clothes and personal belongings.
  - .3 Provide ground fault protected power supply to sump pump, battery chargers.
  - .4 Install a fire extinguisher, mount to wall.
  - .5 Minimum size of generally 2m x 2m. Increase size accordingly to accommodate number of workers.
- .5 Waste and Equipment Decontamination Facility: Waste and Equipment Decontamination Facility comprised of three linked rooms: a Container Cleaning Room, a Holding Room and a Transfer Room.
- .1 Purpose of Waste and Equipment Decontamination Facility is to provide a means to decontaminate asbestos waste containers, scaffolding, vacuums, and other tools and equipment and materials required in the Abatement Work Area.
  - .2 Rooms, Occupied Areas and Abatement Work Areas, shall be separated by curtained doorways at each door.
- .6 Container Cleaning Room: Room between Abatement Work Area and Holding Room of sufficient size to allow proper washing of equipment and waste containers or double bagging of asbestos waste. All wash water shall be treated as asbestos contaminated waste.
- .7 Holding Room: Room between Container Cleaning Room and Transfer Room, of sufficient size to accommodate at least two asbestos waste containers and two workers double bagging waste, or for largest item of equipment used.
- .1 Install a fire extinguisher mounted to wall.
- .8 Transfer Room: Room between Holding Room and Occupied Area, acting as an air lock for the transfer of waste.
- .9 Construction of Decontamination Facilities
- .1 Install floor protection as follows:
    - .1 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting beneath entire decontamination facility.
    - .2 Turn 600 mm of polyethylene up the sides of the decontamination facility and overlap with the polyethylene sheeting covering the walls.

- .3 Install plywood with taped and caulked joints between layers of 6 mil polyethylene where required to protect surfaces from water damage (e.g. carpet).
- .2 Install walls as follows:
  - .1 Around all rooms, between all rooms, at entrance to Abatement Work Area and at entrance to Occupied Area.
  - .2 Install 38 x 89 mm wood framing at 610 mm o/c with continuous top and sill plates.
  - .3 Install one layer rip-proof polyethylene sheeting on interior walls of Decontamination Facility.
  - .4 Install 13 mm plywood sheeting over lower 1200 mm of interior polyethylene sheeting in Waste and Equipment Decontamination Facility.
  - .5 Install one layer rip-proof polyethylene sheeting both sides on interior dividing walls of Decontamination Facility.
  - .6 For perimeter walls exposed to the Abatement Work Area, install 13 mm plywood or OSB caulked and sealed at joints, beneath one layer of 6 mil and one layer of rip-proof polyethylene sheeting, on Abatement Work Area side of framing.
  - .7 For perimeter walls exposed to the Occupied Area, install 13 mm plywood or OSB caulked and sealed at joints, over polyethylene sheeting, on Occupied Area side of framing. Paint with 2 coats white latex.
- .3 Install roof as follows:
  - .1 Install joists. Size of joists is to be determined by clear span. Consult Provincial Building Code. For clear spans up to 2850 mm use SPF Select 38 x 140 mm wood joist at 400 mm o/c with continuous 38 x 140 mm wood headers, and install strapping beneath joists.
  - .2 At the Contaminated Change Room and where roof is exposed to the Abatement Work Area, install 19 mm plywood or OSB over joists. Caulk and tape joints and install one layer rip-proof polyethylene sheeting over 2 layers of 6 mil polyethylene sheeting.
  - .3 Where roof is not exposed to the Abatement Work Area, install one layer rip-proof polyethylene sheeting over joists.
  - .4 Turn 600 mm of polyethylene down the sides over polyethylene on the perimeter walls.
  - .5 At underside of joists in all rooms, install one layer of polyethylene sheeting.
  - .6 Minimum interior clear height 2000 mm to underside of joist.
- .10 Curtained Doorways
  - .1 Construct as follows:
    - .1 Install two flap doors, full width and height of door opening at all doors between chambers, facilities and Abatement Work Area.
    - .2 Construct each flap door of two layers of polyethylene sheeting with all edges reinforced with tape. Use wood strapping to securely fasten flap doors to head and alternate jambs.



- .3 Install weights attached to bottom edge of each door flap.
- .4 Provide direction arrows on flaps to indicate opening.

### **PART 3 EXECUTION**

#### **3.1 Clean Site Preparation**

- .1 Moving of equipment, tools, supplies, and stored materials that can be performed without disturbing ACM will be performed by others.
- .2 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping using Type 2 (Moderate Risk) Procedures.
- .3 Install Hoarding Walls between Abatement Work Area and Occupied Area.
- .4 Install Worker and Waste Decontamination facilities.
- .5 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged. Items to remain include but are not limited to:
  - .1 Millwork.
  - .2 Doors.
  - .3 Bulkheads.
  - .4 Toilet Partitions.
  - .5 Plumbing fixtures.
  - .6 Electrical Equipment.
  - .7 Mechanical Equipment.
  - .8 Protect pneumatic control lines located in Abatement Work Area. Notify Abatement Consultant if lines are or become damaged.
- .6 Seal openings (excepting electrical trenches) in floor using tape, caulking, polyethylene, etc. Openings in floor are to be sealed independently prior to installation of polyethylene sheeting on floor. Include floors of duct and service shafts.
- .7 Seal openings in walls below ceiling level using polyethylene, tape, caulking, etc. including but not limited to windows, doors, vents, diffusers, etc.
- .8 Seal openings in ceiling, using polyethylene, tape, caulking, etc. including diffusers, grills, etc.
- .9 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting, on floor surfaces in Abatement Work Area.
  - .1 Install additional layers of rip-proof polyethylene and/or plywood to protect carpeted floor surfaces.
  - .2 Extend floor protection a minimum of 300 mm up all vertical surfaces in the Abatement Work Area.
- .10 On walls within and forming the perimeter of the Abatement Work Area install two layers of 6 mil polyethylene sheeting.
  - .1 At junction of floor and wall surface overlap floor polyethylene with wall polyethylene by a minimum of 300 mm at each layer. One layer of wall polyethylene must always overlap the top layer of floor polyethylene.

- .11 Establish negative pressure in Abatement Work Areas as follows:
  - .1 Discharge HEPA filtered negative pressure machines as follows:
    - .1 To building exterior.
      - .1 Remove existing glazing where necessary and replace with a 19 mm plywood panel.
      - .2 Install panel securely on the exterior side of the window frame and make weather-tight with caulking.
      - .3 For each negative pressure unit, provide a 300 mm diameter, duct opening through panel.
      - .4 Cover duct opening with wire screen and/or chicken wire or extruded metal screen to prevent insect and animal entry.
      - .5 Direct discharge away from building access points or fresh air intakes.
      - .6 Reinstall glazing to match existing upon completion of work.
    - .2 Use metal reinforced polyethylene discharge ducting in locations where the ducting must be protected from damage or collapse.
    - .3 Install and make airtight all negative air discharge ducting.
    - .4 Discharge ducting is not to be longer than required, and to be straight, so that the length of the ducting does not reduce the flow from negative pressure machines.
    - .5 Install in-line booster fans along the length of discharge ducting wherever site conditions require negative air unit discharge to be directed over distances greater than 12 m (40 ft.). Position booster fans so as to avoid any disruption to operations in Occupied areas.
  - .2 Leak test in place using DOP method, negative pressure units which discharge directly into Occupied Areas.
- .12 Provide one specified ground fault electrical panel for each 300 square metres of Asbestos Work Area. All electrical apparatus including temporary heating equipment shall be supplied from a ground fault system. Ensure safe installation of electrical lines and equipment by skilled tradesmen.
- .13 Install temporary lighting in all work areas at levels that will provide for a safe and efficient use of the work area.
- .14 Isolate, at panel, and disconnect existing power supply to Abatement Work Area. Power supply to remaining areas of building must not be disrupted during work of this section.
  - .1 Lock-out/tag-out power at electrical panels.
  - .2 Mark/tag any items within or passing through the Abatement Work Area that are to remain live including but not limited to cable, conduit, wire, fixtures, equipment panels, etc.
- .15 Shut down HVAC systems serving the Abatement Work Area.
- .16 Using Type 2 (Moderate Risk) procedures, construct a polyethylene enclosure, and cut and cap main supply and return ducts where they enter the Abatement Work Area.
  - .1 Perform during Quiet Hours after shutting down HVAC systems affecting the Abatement Work Area.

- .2 Cut and cap ducts as close as possible to perimeter of Abatement Work Area. Cap with metal of gauge equal to sheet metal being capped. Seal seams of cap with duct sealant, tape and polyethylene sheeting. Smoke test seal after system is reactivated. Reseal and retest as required.
- .3 Re-activate HVAC system.
- .17 Perform clean demolition of non-asbestos materials as specified.
- .18 Install signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .19 Notify Abatement consultant Milestone Inspection - Clean Site Preparation. Obtain written approval for this Milestone Inspection before proceeding.

### **3.2 Contaminated Perimeter Preparation**

- .1 Perform the following using Type 3 (High Risk) procedures including using the required personal protective equipment specified.
  - .1 Perform preparation work at perimeter during Quiet Hours after shutting down HVAC systems affecting the Abatement Work Area, or during normal hours if complete HVAC system is isolated.
  - .2 Prior to commencement of, and throughout Contaminated Perimeter Preparation, complete frequent smoke testing to ensure air movement at perimeter of the work area and at service shafts, etc., is flowing inward into the Asbestos Work Area.
  - .3 If smoke testing indicates there is insufficient air movement, stop work and immediately notify the Asbestos Abatement Consultant.
  - .4 Provide additional negative air units as required to ensure proper air flow.
  - .5 Repeatedly mist the air throughout the performance of this work while maintaining surfaces within the Asbestos Work Area in a damp state.
  - .6 Remove ceiling including grids, support and channels, or other obstructions around perimeter of Abatement Work Area. Remove ceilings in sections equal to the work that can be performed in one shift.
  - .7 To complete:
    - .1 Install upper perimeter seal from front of wall to deck above using two layers of rip-proof polyethylene sheeting. Seal completely.
    - .2 Install Type A Hoarding Wall at upper perimeter of Abatement Work Area from top of perimeter wall to deck.
  - .8 Seal any remaining holes in existing perimeter walls, columns, deck, etc. exposed by removal of ceiling at perimeter of Abatement Work Area.
  - .9 Notify Abatement Consultant to the need for Milestone Inspection - Contaminated Perimeter Preparation.

### **3.3 Maintenance Of Contaminated Abatement Work Area**

- .1 Inspect Abatement Work Area perimeter Hoarding Walls and Upper Perimeter Seals at the beginning and end of each working period and once on each day work does not take place. Inspection must be performed by competent person.
- .2 Inspect HEPA filtered negative pressure machines including discharge ducting at the beginning and end of each working period. Inspection must be performed by competent person.

- .3 Perform Differential Pressure Monitoring on a frequent basis and record pressure at start and end of shift at a minimum.
- .4 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .5 Inspect electrical panels and ensure locks and tags are on panels prior to entering the Abatement Work Area.
- .6 Maintain Abatement Work Area in tidy condition.
- .7 Remove waste and debris frequently.
- .8 Remove standing water on polyethylene/floor at the end of every shift.
- .9 Turn off water supply to hoses and reduce pressure in hose, prior to leaving the Abatement Work Area at end of shift.
- .10 Turn off water supply to showers, at the end of every shift.
- .11 Ensure shower pans are pumped out at the end of every use and shift.

### 3.4 **Wet Removal**

- .1 Do not use compressed air to clean or remove dust or debris.
- .2 Remove and dispose of remaining non-asbestos items before, during or after wet removal.
- .3 Spray asbestos-containing plaster an/or drywall with Amended Water using airless spray equipment prior to removal. Saturate ACM to prevent release of airborne fibres during removal. The use of pressure spraying equipment of any type to remove asbestos-containing materials is not permitted.
- .4 Remove asbestos-containing plaster and/or drywall material specified to be removed, clean substrate.
- .5 Spray asbestos-containing pipe insulations with Amended Water using airless spray equipment.
- .6 Remove pipe insulations specified to be removed and clean substrate. Maintain exposed surfaces of insulation or lagging in a wet condition.
  - .1 Full saturation of insulation will not be required if material is immediately bagged and not allowed to fall to floor.
  - .2 ACM cannot be allowed to fall from one level to the next.
- .7 Spray asbestos-containing duct and mechanical equipment insulations with Amended Water using airless spray equipment.
- .8 Remove duct and mechanical equipment insulations specified to be removed and clean substrate. Maintain exposed surfaces of insulation in a wet condition.
  - .1 Full saturation of insulation will not be required if material is immediately bagged and not allowed to fall to floor.
  - .2 ACM cannot be allowed to fall from one level to the next.
- .9 Remove obstructions as required to remove the ACM.
  - .1 Notify Abatement Consultant if item is not specified to be removed and inhibits removal of ACM.

- .10 All dislodged ACM shall be maintained in wet state until placed in asbestos waste containers for disposal.
- .11 As work progresses, and at regular intervals, place waste in asbestos waste containers and remove from the Abatement Work Area.
- .12 After completion of gross asbestos removal work, perform the following:
  - .1 Wet clean surfaces from which ACM has been removed with stiff bristle brushes, vacuums, wet-sponges etc. to remove all visible residue and asbestos-containing materials.
  - .2 Wet clean surfaces which ACM has fallen on using stiff bristle brushes, vacuums, wet-sponges etc. to remove all visible residue and asbestos-containing materials
  - .3 Wet clean other surfaces in the Abatement Work Area, including the decontamination facilities, scaffolding, equipment, polyethylene sheeting on floor and walls surfaces etc., ducts and similar items not covered with polyethylene sheeting.
  - .4 Remove wash water as contaminated waste.
  - .5 Remove waste.
  - .6 Level of cleanliness must be acceptable to Abatement Consultant.
  - .7 Remove and dispose of the pre-filters from all negative air units as asbestos-contaminated waste.
- .13 Notify Abatement Consultant to the need for Milestone Inspection - Visual Clearance.

### **3.5 Waste and Material Handling**

- .1 Waste bins must be placed on grade or in receiving.
- .2 All bins must be covered and locked when waste transfer is not being performed.
- .3 Ensure redundant non-ACM, rubble, debris, etc. which was not cleaned and which was removed during contaminated work are treated, packaged, transported and disposed of as asbestos waste.
- .4 Clean, wash and apply Post Removal Sealant to metal waste prior to removal from Abatement Work Area.
  - .1 Recycle metals or dispose of metals as clean waste.
- .5 Clean, wash and apply Post Removal Sealant to non-porous materials prior to disposal as clean waste.
  - .1 Obtain prior written approval from the Abatement Consultant for each individual type of material.
- .6 Clean and wash equipment prior to removal from Abatement Work Area if removed prior to completion.
- .7 Place all equipment, tools and unused materials that cannot be cleaned in Asbestos Waste Containers.
- .8 As work progresses, and at regular intervals, transport the sealed and labelled asbestos waste containers from the Abatement Work Area to waste bin.
- .9 Place items in bins according to waste classification. Place asbestos waste, metals, non-asbestos waste, etc. in separate bins.

- .10 Removal of waste containers and decontaminated equipment and materials from the Abatement Work Area shall be performed using the Waste and Equipment Decontamination Facility as follows:
  - .1 Prior to entering the Waste and Equipment Decontamination Facility Container Cleaning Room, the first worker (fully protected inside the Abatement Work Area) shall remove any visible contamination from the surface of the item or waste container being removed from the Abatement Work Area.
  - .2 The first worker then carries the item into the Container Cleaning Room and wet sponges the item prior to passing the item through the curtained doorway to a second worker in the Holding Room. (The second worker shall be fully protected with respirator and disposable clothing and may only leave the decontamination facility via the Abatement Work Area.)
  - .3 The second worker in the Holding Room double bags or wraps and seals the item. Without entering the Transfer Room, the second worker passes the item through the curtained doorway into the Transfer Room.
  - .4 A third worker enters the Transfer Room from the clean area. (The third worker must never enter the Holding Room.) The third worker removes the item from the Transfer Room and transports it to the disposal bin.
- .11 Dispose of plaster debris, lath, hangers and other asbestos-contaminated waste that could tear a 6 mil (0.15 mm) polyethylene bag in sealed rigid Asbestos Waste Container.
- .12 Transport waste and materials via the predetermined routes and exits. Arrange waste transfer route with the City. Use a closed, covered cart to transport through Occupied Areas.
- .13 Limit transportation of waste and materials through Occupied Areas of the building to Quiet Hours.
- .14 Provide workers transporting waste with means to access full personal protective equipment and all tools required to properly clean up spilled ACM in the case of a rupture of an Asbestos Waste Container.
- .15 Bin loading area and waste routes shall be kept clean at all times. Use Type 2 asbestos abatement procedures if appropriate or requested by the City's Representative.
- .16 Pick-up and drop off of garbage bin shall be at pre-approved times, and must not interfere with the City's operations.
- .17 Transport asbestos contaminated waste to landfill licensed by Manitoba Conservation and Climate.
- .18 Co-operate with inspectors from the provincial regulator and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the City.

### **3.6 Application Of Post Removal Sealant**

- .1 Wet Removal
  - .1 Obtain Abatement Consultant's written permission to proceed.

- .2 Apply one coat of Post Removal Sealant with an airless sprayer, in accordance with Manufacturer’s Instructions, to cover all surfaces on all items in the Abatement Work Area, including but not limited to polyethylene, ACM substrate, structural steel, and surfaces scheduled for demolition.
  - .1 Do not apply post removal sealant to materials that will be damaged by its application.
- .3 Notify Abatement Consultant to the need for Milestone Inspection – Clearance Sampling.

### **3.7 Air Clearance Monitoring**

- .1 Site must be dry prior to Air Clearance Monitoring.
- .2 The number of Air Clearance Monitoring samples will be as follows:
  - .1 One sample for every 250 square metres of enclosure volume, minimum of one.
- .3 Restrict access to Abatement Work Area and operate negative air units for a 12 hour period prior to Milestone Inspection – Clearance Sampling.
- .4 The HEPA filtered negative pressure machines shall be in operation during clearance air monitoring.
- .5 PCM samples will be collected as per Air Monitoring Section.

### **3.8 Abatement Work Area Dismantling**

- .1 Maintain hoardings, decontamination facilities and negative air unit(s) fully functional during teardown and removal of asbestos contaminated polyethylene, tape, etc.
- .2 Use Type 2 (Moderate Risk) worker precautions during dismantling.
- .3 Operate negative air units during dismantling.
- .4 Phase the removal of polyethylene, tape, polyurethane foam, caulking and enclosures from the Asbestos Work Area so as to maintain perimeter isolation as long as possible.
- .5 Polyethylene, tape, cleaning material, etc. to be treated as asbestos waste.
- .6 Wash remaining equipment and tools used in contaminated Abatement Work Area to remove all asbestos contamination, or place in Asbestos Waste Containers prior to being removed from Abatement Work Area.
- .7 Clean Abatement Work Area, Equipment and Access area, washing/Showering Room.
- .8 Remove upper seals, and seals over tops of walls, on deck, at columns, etc. within the Abatement Work Area.
- .9 Remove top layer of polyethylene sheeting from surfaces protected by two or more layers of polyethylene sheeting. Remove outer layer as follows:
  - .1 Remove asbestos contaminated Polyethylene by carefully rolling away from walls to centre of Abatement Work Area.
  - .2 Cut the lower layer of polyethylene sheeting to expose the baseboards, window sills, cabinets, shelves and other horizontal surfaces that may be contaminated by fallen ACM.
  - .3 Remove visible fibres or residue found during removal of polyethylene using a HEPA vacuum.

- .4 Remove polyethylene protection and hoarding walls where hoarding walls separate occupied areas from work area. Hoarding walls to remain are identified on asbestos demolition drawings.
- .10 Remove top layer of polyethylene on walls, finishes, and equipment.
- .11 Remove remaining polyethylene sheeting.
- .12 Remove water hoses and shut off at source.
- .13 Remove Signs, Hoarding Walls, Decontamination Facilities.
- .14 Seal vacuum hoses and fittings, flexible ductwork and all tools used in contaminated work site in 6 mil polyethylene bags prior to removal from Work Area.
- .15 Remove temporary lights.
- .16 Remove negative air unit prefilters. Dispose of as asbestos contaminated waste.
- .17 Remove HEPA filtered negative pressure machines and discharge ducting.
- .18 Immediately upon shutting down negative air units, seal air inlet grill and exhaust vent with polyethylene and tape.
- .19 Notify Abatement Consultant to the need for Milestone Inspection - Dismantling Inspection.

### **3.9 Re-Establishment of Items**

- .1 Upon completion of work:
  - .1 Remove and disconnect Ground fault Panel, tags and locks from electrical panels and re-energize equipment and items.
  - .2 Remove negative air discharge panel and reinstall glazing to match existing.
  - .3 Clean, mop and vacuum Abatement Work Area and area beneath Decontamination Facilities.
  - .4 Enable building air handling systems.
- .2 Notify Abatement Consultant to the need for Milestone Inspection – Re-establishment Inspection.

END OF SECTION



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 03 20 00 – Concrete Reinforcing.
- .2 Section 03 30 00 – Cast-in-Place Concrete.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA O121-2008, Douglas Fir Plywood.
  - .3 CSA O151-09, Canadian Softwood Plywood.
  - .4 CSA O153-M1980(R2008), Poplar Plywood.
  - .5 CSA-O325-07, Construction Sheathing.
  - .6 CSA O437 Series-93(R2006), Standards for OSB and Waferboard.
  - .7 CSA-O86-09, Engineering Design in Wood.
  - .8 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
  - .9 CAN/CSA-S269.3-M92(R2008), Concrete Formwork, National Standard of Canada

### **1.3 MEASUREMENT PROCEDURES**

- .1 No measurement will be made under this Section. Include costs in items of work for which concrete formwork and falsework is required.

### **1.4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings for formwork and falsework.
  - .1 Upon request Submit drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .3 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings. Comply with CAN/CSA-S269.3 for formwork drawings.
- .4 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Formwork materials:

- .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, and CSA-O153.
- .2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.
- .2 Form ties:
  - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
  - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
- .3 Form liner:
  - .1 Plywood: high density overlay.
- .4 Form release agent: non-toxic, biodegradable, low VOC.
- .5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene.
- .6 Falsework materials: to CSA-S269.1.

### **Part 3 Execution**

#### **3.1 FABRICATION AND ERECTION**

- .1 Fabricate and erect falsework in accordance with CSA S269.1.
- .2 Refer to drawings for concrete members requiring architectural exposed finishes.
- .3 Do not place shores and mud sills on frozen ground.
- .4 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .5 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .6 Align form joints and make watertight. Keep form joints to minimum.
- .7 Locate horizontal form joints for exposed columns 2400 mm above finished floor elevation.
- .8 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .9 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .10 Construct forms for architectural concrete, and place ties as indicated and as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.

- .11 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .12 Line forms for following surfaces:
  - .1 Surfaces designated as architectural finish.
  - .2 Secure lining taut to formwork to prevent folds.
  - .3 Pull down lining over edges of formwork panels.
  - .4 Ensure lining is new and not reused material.
  - .5 Ensure lining is dry and free of oil when concrete is poured.
  - .6 Application of form release agents on formwork surface is prohibited where drainage lining is used.
  - .7 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.
  - .8 Cost of textile lining is included in price of concrete for corresponding portion of Work.
- .13 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

**3.2 REMOVAL AND RESHORING**

- .1 Notify Engineer 24 hours in advance prior to removing formwork.
- .2 Do not remove forms and bracing until concrete has gained sufficient strength to carry its own weight, construction loads, design loads that are liable to be imposed upon it. Verify strength of concrete by compressive test results.
- .3 Leave formwork in place for following minimum periods of time after placing concrete:

LOCATION	TEMPERATURE IN °C		
	21-35	15-21	10-15
Walls	2 days	3 days	4 days
Grade Beams	2 days	3 days	4 days
Side Forms	2 days	3 days	4 days
Slabs *	7 days	7 days	14 days
Beams *	7 days	7 days	14 days
Structural Shoring *	7 days	7 days	14 days

\* formwork below/supporting these elements shall remain in place for the minimums stated above and then replaced with shoring posts until concrete is 28 days old. Formwork can be removed and replaced with shoring posts earlier, if concrete test cylinders show a strength of 75% of the required 28 day strength.

- .4 Reshore structural members where required due to design requirements or construction conditions and as required to permit progressive construction.
- .5 Remove formwork progressively and in accordance with Building and Safety Code requirements and so that no shock loads or unbalanced loads are imposed on structure.

- .6 Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- .7 Store removed forms, for exposed concrete, so surfaces in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.
- .8 Re-use formwork subject to requirements of CAN/CSA-A23.1.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 03 10 00 – Concrete Forming and Accessories.
- .2 Section 03 30 00 – Cast-in-Place Concrete.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement, A National Standard of Canada.
  - .3 CSA-G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .4 CAN/CSA-G164-M92(R2003)(withdrawn), Hot Dip Galvanizing of Irregularly Shaped Articles, A National Standard of Canada.
  - .5 CSA W186-M1990(R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .2 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A82-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - .2 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
  - .3 ASTM A775/A775M-07b, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- .3 Reinforcing Steel Institute of Canada (RSIC)
  - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

### **1.3 MEASUREMENT PROCEDURES**

- .1 Reinforcing steel will be measured in kilograms of steel incorporated into work, computed from theoretical unit mass specified in CAN/CSA G30.18 for lengths and sizes of bars as indicated.
- .2 No measurement will be made under this Section.
  - .1 Include reinforcement costs in items of concrete work in Section 03 30 00 - Cast-In-Place Concrete.

### **1.4 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.

- .3 Submit shop drawings including placing of reinforcement and indicate:
  - .1 Bar bending details.
  - .2 Lists.
  - .3 Quantities of reinforcement.
  - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Engineer, with identifying code marks to permit correct placement without reference to structural drawings.
  - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
- .4 Detail lap lengths and bar development lengths to CSA-A23.3, unless otherwise indicated.
  - .1 Provide class B tension lap splices unless otherwise indicated.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Substitute different size bars only if permitted in writing by Engineer.
- .2 Reinforcing steel: All reinforcing steel to be CAN/CSA-G30.18M grade 400R deformed bars except column ties and beam stirrups which shall be grade 400W.
- .3 Cold drawn annealed steel wire ties: to ASTM A82.
- .4 Welded steel wire fabric: to ASTM A185/A185M. Provide in flat sheets only.
- .5 Epoxy Coating of non-prestressed reinforcement: to ASTM A775/A775M.
- .6 Galvanizing of non-prestressed reinforcement: to CAN/CSA-G164, minimum zinc coating 610 g/m<sup>2</sup>.
- .7 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .8 Mechanical splices: subject to approval of Engineer.
- .9 Plain round bars: to CSA-G40.20/G40.21.

### **2.2 FABRICATION**

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 All reinforcing is to be detailed in accordance with the latest edition of the Reinforcing Steel Institute of Canada - Manual of Standard Practice, except otherwise noted
- .3 Obtain Engineer's approval for locations of reinforcement splices other than those shown on placing drawings.
- .4 Upon approval of Engineer, weld reinforcement in accordance with CSA W186.

.5 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

.1 Ship epoxy coated bars in accordance with ASTM A775A/A775M.

### **2.3 SOURCE QUALITY CONTROL**

.1 Upon request, provide Engineer with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.

.2 Upon request inform Engineer of proposed source of material to be supplied.

## **Part 3 Execution**

### **3.1 FIELD BENDING**

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Engineer.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

### **3.2 PLACING REINFORCEMENT**

.1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.

.2 Use plain round bars as slip dowels in concrete where noted on the drawings.

.1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.

.2 When paint is dry, apply thick even film of mineral lubricating grease.

.3 Prior to placing concrete, obtain Engineer's approval of reinforcing material and placement.

.4 Ensure cover to reinforcement is maintained during concrete pour.

.5 Protect epoxy coated portions of bars with covering during transportation and handling.

### **3.3 DOWELING PROCEDURES**

.1 For bars that are indicated as being dowelled in, drill in and epoxy grout bars as follows:

.1 10M bars, 200 mm

.2 15M bars, 250 mm

.3 20M bars, 350 mm

.4 25M bars, 400 mm

.2 Use only approved adhesive to manufacturer's instructions. Acceptable product:

.1 Hilti HIT HY-200 by Hilti Canada.

- .3 Clean hole thoroughly prior to application of epoxy. Use injection or caulking gun to ensure that the epoxy fills the bottom of the hole prior to embedment of bar.

### **3.4 FIELD TOUCH-UP**

- .1 Touch up damaged and cut ends of epoxy coated reinforcing steel with compatible finish to provide continuous coating.

**END OF SECTION**



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 03 10 00 – Concrete Forming and Accessories.
- .2 Section 03 20 00 – Concrete Reinforcing.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C260/C250M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
  - .2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .3 ASTM C330/C330M-14, Standard Specification for Lightweight Aggregates for Structural Concrete.
  - .4 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
  - .5 ASTM C1017/C1017M-13, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
  - .6 ASTM D412-06a(2013), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
  - .7 ASTM D624-00(2012), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
  - .8 ASTM D1751-04(2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - .9 ASTM D1752-04a(2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
  - .2 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A283-06(R2011), Qualification Code for Concrete Testing Laboratories.
  - .3 CAN/CSA-A3000-13, Cementitious Materials.
- .4 International Concrete Repair Institute (ICRI)

- .1 ICRI Guideline No. 310.2R-2013, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

### **1.3 SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Certificates:
  - .1 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA-A23.1. Certification letter to be sealed by an engineer registered in the Province of Manitoba.
  - .2 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1. Certification letter to be sealed by an engineer registered in the Province of Manitoba.
- .3 Concrete pours: submit accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .4 Concrete hauling time: submit for review by Engineer deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

### **1.4 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Submit to Engineer , minimum 4 weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
  - .1 When plant does not hold valid certification, provide test data and certification by qualified independent inspection and testing laboratory that materials used in concrete mixture will meet specified requirements.
- .3 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for review by Engineer on following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
  - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.
  - .6 Formwork removal.
  - .7 Joints.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.

- .1 Modifications to maximum time limit must be agreed to Engineer and concrete producer as described in CSA A23.1/A23.2.
- .2 Deviations to be submitted for review by Engineer.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 The concrete constituents shall comply with the following standards:
  - .1 Cement: to CAN/CSA-A3001.
  - .2 Blended hydraulic cement: to CAN/CSA-A3001.
  - .3 Water: to CSA-A23.1.
  - .4 Aggregates: to CAN/CSA-A23.1/A23.2.
  - .5 Admixtures:
    - .1 Air entraining admixture: to ASTM C260.
    - .2 Chemical admixture: to ASTM C494 and ASTM C1017. Engineer to approve accelerating or set retarding admixtures during cold and hot weather placing.

### **2.2 CONCRETE MIX REQUIREMENTS**

- .1 Refer to General Notes on Drawings for concrete mix requirements.

### **2.3 ACCESSORIES**

- .1 Evaporation retardant: Acceptable Product:
  - .1 MasterKure ER 50, formerly (Confilm) by BASF Building Systems at a minimum application rate of 4.9 m<sup>2</sup>/L.
- .2 Cure and sealing compound: to ASTM C309, Type 1. Acceptable product(s):
  - .1 Florseal WB by Sika Canada Inc. at a minimum application rate of 4.9 m<sup>2</sup>/L.
  - .2 MasterKure CC, formerly (Kure-N-Seal) by BASF Building Systems at a minimum application rate of 4.9 m<sup>2</sup>/L.
- .3 Vapour Barrier: 10 mil polyethylene film to CAN/CGSB-51.34 unless otherwise noted on Drawings.
- .4 Grout: Portland Cement based non-shrink, non-metallic composition and shall meet the following requirements:
  - .1 The grout shall not exhibit bleeding or segregation at pumpable consistency.
  - .2 Compressive Strength: 25 MPa @ 1 day.
  - .3 Bond Strength (ASTM C882) 13 MPa @ 28 days.
  - .4 Positive expansion confirmed by ASTM C827.
  - .5 The grout shall not produce a vapour barrier.

- .6 Acceptable products are one of the following only
  - .1 Sika Grout 212 by Sika Canada Inc.
  - .2 Sternson M-Bed Standard by Sternson Construction Products.
- .5 Non premixed dry pack grout: composition of non metallic aggregate Type GU cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 25 MPa at 28 days.

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Obtain Engineer's approval before placing concrete.
  - .1 Provide minimum 48 hours notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 During concreting operations:
  - .1 Development of cold joints not allowed.
  - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .5 Prior to placing of concrete obtain Engineer's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .6 Protect previous Work from staining.
- .7 Clean and remove stains prior to application for concrete finishes.
- .8 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .9 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
  - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with chemical grout to anchor and hold dowels in positions as indicated.
- .10 Do not place load upon new concrete until authorized by Engineer.

#### **3.2 CONSTRUCTION**

- .1 Do cast-in-place concrete work in accordance with CSA-A23.1/A23.2.
- .2 Sleeves and inserts:
  - .1 Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Engineer.

- .2 Where approved by Engineer, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
  - .3 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Engineer.
  - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Engineer before placing of concrete.
  - .5 Check locations and sizes of sleeves and openings shown on drawings.
  - .6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Anchor bolts:
- .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
  - .2 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
  - .3 Set bolts and fill holes with chemical grout.
  - .4 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .4 Drainage holes and weep holes:
- .1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.
  - .2 Install weep hole tubes and drains as indicated.
- .5 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .6 Finishing:
- .1 Finish concrete in accordance with CSA-A23.1/A23.2.
    - .1 Concrete tolerance in accordance with CSA-A23.1/A23.2 straightedge method.
  - .2 Use curing methods compatible with applied finish on concrete surfaces.
- .7 Curing:
- .1 Cure and protect concrete in accordance with requirements CSA A23.1.
  - .2 Unless noted otherwise the curing regime shall be consistent with the Class of Exposure. See General Notes on structural drawing for Class of Exposure.
- .8 Bonded Toppings:
- .1 Refer to General Notes on Drawings for Bonded Topping requirements
- .9 Waterstops:
- .1 Install waterstops to provide continuous water seal.
  - .2 Do not distort or pierce waterstop in way as to hamper performance.
  - .3 Do not displace reinforcement when installing waterstops.
  - .4 Use equipment to manufacturer's requirements to field splice waterstops.

- .5 Tie waterstops rigidly in place.
- .6 Use only straight heat sealed butt joints in field.
- .7 Use factory welded corners and intersections unless otherwise approved by Engineer.
- .10 Joint fillers:
  - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Engineer.
  - .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
  - .3 Locate and form construction joints as indicated.
  - .4 Install joint filler.
  - .5 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

### **3.3 FIELD QUALITY CONTROL**

- .1 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Engineer for review in accordance with CSA-A23.1/A23.2.
  - .1 Ensure testing laboratory is certified in accordance with CSA A283.
- .2 Frequency and Number of Tests:
  - .1 Concrete Tests:
    - .1 Not less than one strength test per 50 cubic metres of concrete placed and not less than one test for each class of concrete placed on any one day.
    - .2 Air measurements will be completed on each of the initial 3 loads of concrete per day of casting to ensure satisfactory control of the air content is established. If adequate control of air content is not established within the first 3 loads of concrete or if a test falls outside the specified limits, the testing frequency shall revert to one test per load until satisfactory control is re-established. Costs for additional testing will be the responsibility of the concrete supplier.
  - .2 Bonded Toppings:
    - .1 Not less than one test per 100 square metres prior to construction submit documentation demonstrating minimum performance requirement will be met.
- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Engineer.
- .4 Engineer may take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .5 Non-Destructive Methods for Testing Concrete: in accordance with CSA-A23.1/A23.2.
- .6 Inspection or testing by Engineer will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

### **3.4 DEFECTIVE CONCRETE**

- .1 Defective concrete: cracking, spalling, scaling and concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
- .2 Repair or replacement of defective concrete will be determined by the Engineer, based on the specifications and the above guidelines.
- .3 Do not patch, fill, touch-up, repair or replace exposed concrete except upon express direction of Engineer for each individual use.
- .4 Modify or replace concrete not conforming to lines, detail and elevations indicated on drawings.
- .5 Repair or replace concrete not properly placed, resulting in excessive honeycombing and other defects in critical areas of stress.
- .6 Notify Engineer of proposed methods of repairing or replacing defective concrete. Methods of repairing or replacing defective concrete shall be acceptable to the Engineer.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCES**

- .1 Canadian Standards and Association (CSA).
  - .1 CSA A23.4-16, Precast Concrete - Materials and Construction.
  - .2 CSA A231.1-19/A231.2-19, Precast Concrete Paving Slabs/Precast Concrete Pavers.

### **1.2 DELIVERY, STORAGE, AND HANDLING**

- .1 Handle all products with appropriate precautions and care as stated in manufacturer's printed instructions.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Precast Concrete Splash Pads.
  - .1 Size: 368 mm wide x 1295 mm long x 127 mm high.
  - .2 Colour: Natural.

### **2.2 FABRICATION**

- .1 Fabricate manufactured units to CSA A23.4 and CSA A231.1/A231.2

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Precast Concrete Splash Pads.
  - .1 Install precast concrete splash pads where indicated on drawings.

**END OF SECTION**



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.
- .2 Section 07 92 00 – Joint Sealants.
- .3 Section 09 21 16 – Gypsum Board Assemblies.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip) Coatings on Iron and Steel Products.
  - .2 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .3 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .4 ASTM A1011/A1011M-18a, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
  - .5 ASTM C119-20, Standard Terminology Relating to Dimension Stone.
  - .6 ASTM C129-17, Standard Specification for Nonloadbearing Concrete Masonry Units.
  - .7 ASTM C568/C568M-15, Standard Specification for Limestone Dimension Stone.
  - .8 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
- .2 Canadian Standards Association (CSA).
  - .1 CSA A23.1-19/A23.2-19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CSA A165 SERIES-14 (R2019), CSA Standards on Concrete Masonry Units.
  - .3 CAN/CSA A179-14 (R2019), Mortar and Grout for Unit Masonry.
  - .4 CSA A370-14 (R2018), Connectors for Masonry.
  - .5 CAN/CSA A371-14 (R2019), Masonry Construction for Buildings.
  - .6 CSA G30.18-09 (R2019), Carbon Steel Bars for Concrete Reinforcement.
  - .7 CSA S304-14 (R2019), Design of Masonry Structures.
- .3 National Building Code of Canada (NBCC).

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete masonry units and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.4 QUALITY ASSURANCE**

- .1 Qualifications.
  - .1 The following qualifications are mandatory for Masonry Contractors:
    - .1 Member in good standing with Manitoba Masonry Contractors Association (MMCA), and Manitoba Masonry Institute (MMI).
    - .2 All associated trade certification is mandatory including Red Seal Certification.
    - .3 Minimum five (5) years' experience on projects of similar size and complexity.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver and store masonry units on pallets and cover with tarpaulins adequately secured. Keep units protected from materials which could stain them.
- .2 Store bagged products, such as lime, cement and metal accessories in dry, waterproof sheds.
- .3 Keep masonry materials completely free from ice and frost.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Interior Standard Light Weight CMU: to CSA A165 for interior non-load bearing walls.
  - .1 Classification: H/10/C/M (hollow light weight).
  - .2 Size: imperial modular as indicated.
  - .3 Special shapes: provide square and bull nose corner units for exposed corners as indicated. Provide purpose-made shapes for lintels and bond beams. Provide additional special shapes as indicated.
  - .4 Radius block (bull nose corner units): with excessive ridging will not be acceptable. Grind to smooth finish to satisfaction of Contract Administrator.
  - .5 Mortar: Type “N”-5 Mpa.
- .2 Joint Sealants: in accordance with Section 07 92 00.

### **2.2 MORTAR AND MASONRY GROUT**

- .1 Mortar and Masonry Grout.
  - .1 Use same brands of materials and source of aggregate for entire project.
  - .2 Mortar and grout to CAN/CSA A179.
  - .3 Do grouting of masonry work with concrete using white non-staining cement where mortar has white non-staining cement and standard gray Portland cement where mortar has standard gray Portland cement.
- .2 Mixing: prepare and mix mortar materials and pigment under strict supervision, and in small batches for immediate use only. Use and mix proprietary mortar, and use and store ready mixed mortars, in strict accordance with CAN/CSA A179. Do not use re-tempered mortars except for ready mixed mortar; re-tempered in accordance with manufacturer’s instruction.
- .3 For Bedding Steel Bearing Plates, Lintels, for Laying Bearing Courses under Concentrated Loads and for Laying Masonry as indicated on Structural Drawings: use Type “M” cement mortar as per CAN/CSA A179, unless otherwise indicated on structural drawings.
- .4 For Masonry Work as indicated on Structural Drawings: use Type “S” cement mortar as per CAN/CSA A179, unless otherwise indicated on structural drawings.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 General.
  - .1 Install masonry connectors and reinforcement in accordance with CSA A370, CAN/CSA A371, CSA A23.1/A23.2 and CSA S304.1 unless indicated otherwise.

- .2 Prior to placing concrete, mortar and grout, obtain Contract Administrator's approval of placement of reinforcement and connectors.
  - .3 Tie masonry veneer to backing in accordance with CAN/CSA A371, CSA S304.1, NBCC, and as indicated.
  - .4 Grout masonry in accordance with CSA S304.1 and as indicated.
  - .5 Do lateral support and anchorage in accordance with CSA S304.1 and as indicated.
  - .6 Build masonry plumb, level and true to line, with vertical joints in alignment.
  - .7 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
  - .8 Buttering corners of units, throwing mortar droppings into joints, deep or excessive furrowing of bed joints will not be permitted. Do not shift or tap units after mortar has taken initial set. Where adjustment must be made after mortar has started to set, remove mortar and replace with fresh supply.
  - .9 Do not field bend reinforcement or connectors except where indicated or authorized by Contract Administrator. Replace bars and connectors which develop cracks or splits.
- .2 Exposed Masonry.
- .1 Keep exposed faces free from stains, chips and cracks. Remove chipped, cracked, and otherwise damaged units in exposed masonry and replace with undamaged units.
  - .2 Keep masonry walls clean and free of mortar and stains during laying. Allow mortar drippings which adhere to wall to dry but not set. Remove mortar from exposed masonry surfaces with wood paddles and scrapers. Use a natural fiber brush to remove all remaining traces.
- .3 Jointing.
- .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, and uniformly concave joints.
  - .2 Strike flush all joints concealed in walls and joints in walls to receive insulation or other applied material except paint or similar thin finish coating.
  - .3 Use sufficient force to press mortar tight against masonry units on both sides of joints.
  - .4 Remove excess material or burrs left after jointing. Use trowel or rub with burlap bag.
  - .5 Lay all joints approximately 10 mm thick unless otherwise specified or otherwise shown on drawings. All joints full of mortar except where specifically designated to be left open.
- .4 Cutting.
- .1 Cut out for recessed or built-in objects. Make cuts straight, clean, and free from uneven edges.
- .5 Built-ins.
- .1 Build-in items occurring in masonry provided by other Sections including door and window frames, anchor bolts, sleeves, inserts, loose steel lintels, shelf angles, manufactured fireplace, and any other items indicated. Build-in items to present neat, rigid, true and plumb installation. Brace door jambs to maintain plumb. Leave wall openings required for ducts, grilles, pipes and other items.
  - .2 Fill voids between masonry and metal frames with masonry mortar or insulation as indicated.
  - .3 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
- .6 Control and Expansion Joints.
- .1 Provide control and expansion joints in exterior walls at max. 7315 mm (24'-0") o.c. or as shown on drawings.
  - .2 Terminate reinforcement 25 mm short of each side of control and expansion joints unless otherwise indicated.

- .3 Leave space between top of non-load bearing walls and partitions and structural elements as shown on structural drawings. Do not use wedges.
- .4 Build masonry to tie-in with stabilizers, with provision for vertical movement.
- .5 Leave minimum 6 mm space below shelf angles.
- .7 Masonry Lintels (CMU).
  - .1 Masonry lintels for all openings to be 190 mm high U-block with standard 190 mm high coursing above. Installation of 390 mm high vertical U-block is not acceptable above openings. Refer to structural drawings for reinforcing.

### 3.2 STANDARD CONCRETE MASONRY UNITS

- .1 Lay concrete masonry units in running  $\frac{1}{2}$  bond coursing as indicated in full bed of mortar. Lay-up walls plumb and true with courses level, accurately spaced and coordinated with other work.
- .2 Jointing: concave where exposed, or where paint or other finish coating is specified, and flush where air/vapor barrier membrane is indicated.
- .3 Minimize cutting block. Cut exposed block with power driven abrasive cutting disc or diamond cutting wheel where cutting is required and for flush mounted electrical outlets, grilles, pipes, conduit, leaving 3 mm maximum clearance.
- .4 Do not wet concrete masonry before or during laying.
- .5 Use full bed of mortar for first course. For remaining courses bed face shells and cross and end webs and vertical end joints fully in mortar. Compress end joint mortar.
- .6 Stagger end joints in every course. Align joints plumb over each other in every other course.
- .7 Bond intersecting concrete masonry walls in alternate courses. Where block work abuts concrete, bond each block course with dovetail anchors. Locate corners accurately.
- .8 Install reinforced concrete unit masonry lintels over openings where indicated and as specified.
  - .1 End bearing: not be less than 200 mm.
  - .2 Place and grout reinforcement in accordance with CSA S304.
- .9 Install welded ladder reinforcing at vertical spacing of 400 mm in all block walls. Provide ladder reinforcing in first mortar joint above and below all openings extending minimum 400 mm beyond edge of opening.

### 3.3 CONSTRUCTION TOLERANCES

- .1 Lay masonry units plumb, level and true to line within tolerances as per MSJC requirements and as follows:
  - .1 Maximum variation from plumb.
    - .1 In 3 m - 6 mm.
    - .2 In 6 m - 10 mm.
    - .3 In 12 m or more - 13 mm.
  - .2 Maximum variation from level.
    - .1 In any bay or up to 6 m - 6 mm.
    - .2 In 12 m or more - 13 mm.
  - .3 Maximum variation from linear building lines.
    - .1 In any bay or up to 6 m - 13 mm.
    - .2 In 12 m or more - 19 mm.
  - .4 Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown.
    - .1 Minus 6 mm.
    - .2 Plus 13 mm.

- .5 Maximum variation in prepared opening dimensions.
  - .1 Accurate to minus 0 mm.
  - .2 Plus 6 mm.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
  - .2 Standard Concrete Unit Masonry:
    - .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.

### **3.5 PROTECTION**

- .1 Protect laid CMU from damage by weather. At end of each day or shutdown period, cover exposed tops of masonry with canvas or strong waterproof membrane securely clamped down and overhanging on each side of wall at least 600 mm.
- .2 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.
- .3 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 05 31 00 – Steel Decking.

### **1.2 REFERENCES**

- .1 ASTM International Inc.
  - .1 ASTM A36/A36M-08, Standard Specification for Carbon Structural Steel.
  - .2 ASTM A193/A193M-08, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications.
  - .3 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .4 ASTM A325-07a, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - .5 ASTM A325M-08, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).
  - .6 ASTM A490M-04ae, Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-85.10-99, Protective Coatings for Metals.
- .3 Canadian Institute of Steel Construction (CISC)/Canadian Paint Manufacturer's Association (CPMA)
  - .1 CISC/CPMA 2-75, Quick-Drying, Primer for Use on Structural Steel.
  - .2 CISC/CPMA 1-73a, Quick-Drying, One-Coat Paint for Use on Structural Steel.
- .4 Canadian Standards Association (CSA International)
  - .1 CSA G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .3 CAN/CSA-S16-01(R2007), Limit States Design of Steel Structures.
  - .4 CAN/CSA-S136-07, North American Specifications for the Design of Cold Formed Steel Structural Members.
  - .5 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
  - .6 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .7 CSA W55.3-1965(R2003), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
  - .8 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .5 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International
  - .1 SSPC SP-2, SP-7.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Manitoba, Canada.
- .3 Erection drawings:
  - .1 Submit erection drawings indicating details and information necessary for assembly and erection purposes including:
    - .1 Description of methods.
    - .2 Sequence of erection.
    - .3 Type of equipment used in erection.
    - .4 Temporary bracings.
- .4 Fabrication drawings:
  - .1 Submit fabrication drawings showing designed assemblies, components and connections are stamped and signed by qualified professional engineer licensed in the Province of Manitoba, Canada.
- .5 Samples :
  - .1 Upon request, prepare sample of typical exposed structural connections in accordance with AISC Specifications of Architecturally exposed structural steel for approval of Engineer. Samples to be judged upon alignment of surfaces, uniform contact between surfaces, smoothness and uniformity of finished welds. When approved, sample units will serve as a standard for workmanship, appearance and material acceptable for entire project.
- .6 Source Quality Control Submittals:
  - .1 Submit 2 copies of mill test reports 4 weeks prior to fabrication of structural steel.
    - .1 Mill test reports to show chemical and physical properties and other details of steel to be incorporated in project.
    - .2 Provide mill test reports certified by metallurgists qualified to practice in Province of Manitoba, Canada.
- .7 Fabricator Reports:
  - .1 Upon request, provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials in manufacturer's original, undamaged containers with identification labels intact.

## **Part 2 Products**

### **2.1 DESIGN REQUIREMENTS**

- .1 Design details and connections in accordance with requirements of CAN/CSA-S16 and CAN/CSA-S136 with CSA-S136.1 to resist forces, moments, shears and allow for movements indicated.
- .2 Shear connections:
  - .1 Select framed beam shear connections from an industry accepted publication such as "Handbook of the Canadian Institute of Steel Construction" when connection for shear only (standard connection) is required.
  - .2 Select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, provided no point loads act on beam, when shears are not indicated.
- .3 For composite construction select or design minimum end connection to resist reaction resulting from factored movement resistance as tabulated in the "Handbook of the Canadian Institute of Steel Construction" assuming 100% shear connection with depth of steel deck and/or slab shown on drawings.
- .4 Upon request, Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Manitoba, Canada for non standard connections.

### **2.2 MATERIALS**

- .1 Structural steel: All rolled or steel structural sections shall be G40.21-350W. All Hollow structural sections to be G40.21-350W class C. All angles, channels and plates shall be G40.21-300W.
- .2 Anchor bolts: to CSA-G40.20/G40.21, Grade 300W.
- .3 Bolts, nuts and washers: to ASTM A307, ASTM A325M, and ASTM A490/A490M as required.
- .4 Welding materials: to CSA W59 and certified by Canadian Welding Bureau.
- .5 Shop paint primer:
  - .1 Steel not receiving finish painting: one coat of CISC/CPMA 1-73A quick drying shop primer
  - .2 Steel receiving finish painting: one coat of CISC/CPMA 2-75 quick drying shop primer.
- .6 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m<sup>2</sup>.
- .7 Shear studs: to CSA W59, Appendix H.

### **2.3 FABRICATION**

- .1 Fabricate structural steel in accordance with CAN/CSA-S16, CAN/CSA-S136, and in accordance with reviewed shop drawings.



- .2 Install shear studs in accordance with CSA W59.
- .3 Continuously seal members by continuous welds where indicated. Grind smooth.

## **2.4 SHOP PAINTING**

- .1 Clean, prepare surfaces and shop prime structural steel as follows:
  - .1 Steel not receiving finish painting: One coat of CISC / CPMA 1-73a quick drying shop primer. Steel to be cleaned in conformance with SSPC-SP2.
  - .2 Steel receiving finish painting: One coat of CISC / CPMA 2-75 quick drying shop primer. Steel to be cleaned in conformance with SSPC-SP7.
  - .3 Exterior structural steel: All exterior structural steel shall be hot-dipped galvanized unless noted.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter.
- .3 Apply one coat of primer in shop to steel surfaces, except:
  - .1 Surfaces to be encased in concrete.
  - .2 Surfaces to receive field installed stud shear connections.
  - .3 Surfaces and edges to be field welded.
  - .4 Faying surfaces of slip-critical connections.
  - .5 Below grade surfaces in contact with soil.
- .4 Apply paint under cover, on dry surfaces when surface and air temperatures are above 5 degrees C.
- .5 Maintain dry condition and 5 degrees C minimum temperature until paint is thoroughly dry.
- .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 GENERAL**

- .1 Structural steel work: in accordance with CAN/CSA-S16, CAN/CSA-S136.
- .2 Welding: in accordance with CSA W59.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel structures and/or CSA W55.3 for resistance welding of structural components.

### **3.3 CONNECTION TO EXISTING WORK**

- .1 Verify dimensions and condition of existing work, report discrepancies and potential problem areas to Engineer for direction before commencing fabrication.

### **3.4 MARKING**

- .1 Mark materials in accordance with CSA G40.20/G40.21. Do not use die stamping. When steel is to be left in unpainted condition, place marking at locations not visible from exterior after erection.
- .2 Match marking: shop mark bearing assemblies and splices for fit and match.

### **3.5 ERECTION**

- .1 Erect structural steel, as indicated and in accordance with CAN/CSA-S16, CAN/CSA-S136, and in accordance with reviewed erection drawings.
- .2 Field cutting or altering structural members: to approval of Engineer.
- .3 Clean with mechanical brush and touch up shop primer to bolts, rivets, welds and burned or scratched surfaces at completion of erection.
- .4 Continuously seal members by continuous welds where indicated. Grind smooth.

### **3.6 FIELD QUALITY CONTROL**

- .1 Inspection and testing of materials and workmanship will be carried out by testing laboratory designated by Engineer.
- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by Engineer.
- .3 Submit test reports to Engineer within 2 weeks of completion of inspection.
- .4 City will pay costs of tests as specified in Section 01 21 00 – Allowances.
- .5 Test shear studs in accordance with CSA W59.

### **3.7 FIELD PAINTING**

- .1 Paint in accordance with Section 09 91 00 - Painting.
  - .1 Touch up damaged surfaces and surfaces without shop coat with primer to SSPC-SP7 except as specified otherwise. Apply in accordance: MPI Architectural Painting Specification Manual.

### **3.8 CLEANING**

- .1 Clean in accordance with Section 01 74 00 – Project Clean-Up.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 05 12 23 – Structural Steel For Buildings.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM A653/A653M-01a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A792/A792M-01a, Specification for Steel Sheet, 55%Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.79-1978(R1999), Cellular Metal and Cellular Concrete Floor Raceways and Fittings.
  - .2 CAN/CSA-S16.1-94(R2000), Limit States Design of Steel Structures.
  - .3 CSA-S136-94(R2001), Cold Formed Steel Structural Members.
  - .4 CSA W47.1-92(R2001), Certification of Companies for Fusion Welding of Steel Structures.
  - .5 CSA W55.3-1965(R1998), Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.
  - .6 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Sheet Steel Building Institute (CSSBI)
  - .1 CSSBI 10M-96, Standard for Steel Roof Deck.
  - .2 CSSBI 12M-96, Standard for Composite Steel Deck.

### **1.3 DESIGN REQUIREMENTS**

- .1 Design steel deck using limit states design in accordance with CSA S136.
- .2 Steel deck and connections to steel framing to carry dead, live and other loads including lateral loads, diaphragm action, composite deck action, and uplift as indicated.
- .3 Deflection under specified live load not to exceed 1/360 of span.

### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings erection and shoring drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit drawings stamped and signed by qualified professional engineer registered or licensed in Province of Manitoba, Canada.
- .3 Submit design calculations if requested by Engineer.

- .4 Indicate deck plan, profile, dimensions, base steel thickness, metallic coating designation, connections to supports and spacings, projections, openings, reinforcement details and accessories.
- .5 Indicate details of temporary shoring of steel deck, such as location, time and duration of placement and removal of shoring for concrete fill decks.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Zinc-iron Alloy (ZF) coated steel sheet: to ASTM A653/A653M structural quality Grade 230, with ZF75 coating, for interior surfaces not exposed to weather, unpainted finish, thickness as indicated on structural drawings.
- .2 Decks to be painted: zinc-iron alloy coated decks suitable for finish painting.
- .3 Zinc (Z) coated steel sheet: to ASTM A653/A653M structural quality Grade 230, with ZF75, coating, for exterior surfaces exposed to weather, thickness as indicated on structural drawings.
- .4 Acoustic insulation: fibrous glass 17.5 kg/m<sup>3</sup> density profiled to suit deck flutes.
- .5 Closures: as indicated in accordance with manufacturer's recommendations.
- .6 Cover plates, cell closures and flashings: steel sheet with minimum base steel thickness of 0.76 mm. Metallic coating same as deck material.
- .7 Primer: zinc rich, ready mix to CAN/CGSB-1.181.
- .8 Shear studs: to CSA W59.

### **2.2 TYPES OF DECKING**

- .1 Steel roof deck: thickness and profile as per structural drawings, interlocking side laps.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 Structural steel work: in accordance with CAN/CSA-S136.
- .2 Welding: in accordance with CSA W59, except where specified otherwise.
- .3 Companies to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding.

### **3.2 ERECTION**

- .1 Erect steel deck as indicated and in accordance with CSA S136, and in accordance with reviewed erection drawings.

- .2 Butt ends: to 1.5 to 3 mm gap. Install steel cover plates over gaps wider than 3 mm.
- .3 Lap ends: to 50 mm minimum.
- .4 Weld and test stud shear connectors through steel deck to steel joists/beams below in accordance with CSA W59.
- .5 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.
- .6 Temporary shoring, if required, to be designed to support construction loads, wet concrete and other construction equipment. Do not remove temporary shoring until concrete attains 75% of its specified 28 day compression strength.

### **3.3 CLOSURES**

- .1 Install closures in accordance with approved details.

### **3.4 OPENINGS AND AREAS OF CONCENTRATED LOADS**

- .1 No reinforcement required for openings cut in deck which are smaller than 150 mm square.
- .2 Frame deck openings with any one dimension between 150 to 300 mm as with minimum L64x64x6.4 each side of opening perpendicular to flutes. Angle shall be welded to at least two flutes on each side of opening.
- .3 Deck supplier shall reinforce openings over 300mm to 450mm across the flutes with suitable reinforcement based on a structural analysis of the loads involved.
- .4 For deck openings with any one dimension greater than 450 mm and for areas of concentrated load, reinforce in accordance with structural framing details, except as otherwise indicated.

### **3.5 CONNECTIONS**

- .1 Install connections in accordance with CSSBI recommendations as indicated.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.
- .2 Section 06 20 00 – Finish Carpentry.
- .3 Section 09 21 16 – Gypsum Board Assemblies.
- .4 Section 09 84 13 – Fixed Sound-Absorptive Panels.
- .5 Section 09 91 23 – Interior Painting.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A53/A53M-18, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - .2 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
  - .3 ASTM A325M-14, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength [Metric].
  - .4 ASTM A480/A480M-16, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .5 ASTM A500/A500M-13, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - .6 ASTM A780/A780M-09(2015), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - .7 ASTM A786/A786M-15, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
- .2 Canadian Standards Association (CSA).
  - .1 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Steel/Structural Quality Steels.
  - .2 CSA S16-14, Design of Steel Structures.
  - .3 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.
  - .4 CSA W55-08 (2013) - Certification of Companies for Resistance Welding of Steel and Aluminum.
  - .5 CSA W59-18, Welded Steel Construction.
- .3 The Society of Protective Coatings (SSPC).
  - .1 SSPC Painting Manual, Volume 2, 2011 Edition, SSPC SP-3 Power Tool Cleaning Surface Preparation Standard.

### **1.3 DESIGN CRITERIA**

- .1 Details and specifications are intended to indicate the general character and extent of metal fabrications and do not attempt to indicate all methods of construction.
- .2 Fabricate and install metal fabrications to withstand all stresses encountered in normal use. Unless specified or noted otherwise, all imposed live loads shall be in accordance with NBC.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

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

- .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .3 All fabricator designed assemblies, components and connections, and drawings to be stamped and signed by qualified Professional Engineer licensed in Province of Manitoba.

## **1.5 QUALITY ASSURANCE**

- .1 **Manufacturer Qualifications:** Company specializing in manufacturing the Products specified in this section with minimum three (3) years' documented experience. Submit proof of experience upon Contract Administrator's request.
- .2 **Welders' Certificates:** Submit, certifying welders employed on the Work, verifying qualification within the previous 12 months to CSA-W55.3.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 **Steel Sections:** to CSA G40.20/G40.21, Grade 300 W.
- .2 **Steel Plate:** to CSA G40.20/G40.21, Grade 300W.
- .3 **Steel Pipe:** to ASTM A53/A53M standard weight, schedule 40, seamless black and galvanized finish as indicated.
- .4 **Structural Hollow Sections:** to CSA G40.20/G40.21, Grade 350, ASTM 500.
- .5 **Steel Tubing:** to CSA G40.20/G40.21, Grade 317W, sizes and dimensions as indicated; large diameter tube to ASTM A500.
- .6 **Bolts and Anchor bolts:** to ASTM A307.
- .7 **Stainless Steel Sheets:** to ASTM A269.

### **2.2 ACCESSORIES**

- .1 **Welding Materials:** to CSA W59.
- .2 **Welding Electrodes:** to CSA W48 Series.
- .3 **Shop Paint Primer:** fast dry alkyd metal shop coat primer (grey) to CISC/CPMA Standard 1-73a.
- .4 **Grout:** non-shrink, non-metallic, flowable, 24h, 15 MPa, pull-out strength 7.9 MPa.

### **2.3 FABRICATION**

- .1 Review Contract Documents and provide all metal fabrications indicated.
- .2 Notify Contract Administrator of any proposed member substitutions and changed connection details.
- .3 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .4 Verify all dimensions prior to fabrication.
- .5 Use self-tapping shake-proof countersunk flat headed screws on items requiring assembly by screws or as indicated.
- .6 Where possible, fit and shop assemble work, ready for erection.
- .7 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

- .8 Provide bolt holes where required for fastenings.
- .9 Provide holes by drilling, not burning; free of burrs and rough edges. Provide countersunk holes for field installation of fabricated items to accept flat-head fasteners. All welds min. 6 mm all around fillet welds unless otherwise noted on drawings.
- .10 Welding.
  - .1 Perform to CSA W59. All seams continuously welded and free from any slag or splatter.
  - .2 Grind welds smooth and flush with adjacent surface prior to hot-dip galvanizing, except hidden welds.

## **2.4 FINISHES**

- .1 Shop Priming.
  - .1 Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CSA S16 and SSPC SP-2.
  - .2 Clean all members of loose mill scale, rust, oil, dirt, slag, flux deposits, and other foreign matter by scraping, wire brushing, or other effective approved methods.
  - .3 Apply one coat of grey primer in shop to all steel surfaces to achieve minimum dry film thickness of not less than 1 mil, except:
    - .1 Galvanized steel.
    - .2 Surfaces to be encased in concrete.
    - .3 Surfaces and edges to be field welded.
  - .4 Apply primer under cover, on dry surfaces when surface and air temperatures are above 5°C.
  - .5 Maintain dry condition and 5°C minimum temperature until primer is thoroughly dry.
  - .6 Strip paint from bolts, nuts, sharp edges and corners before prime coat is dry.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Erect metal work square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .2 Provide suitable means of anchorage acceptable to Contract Administrator, such as dowels, anchor clips, bar anchors, expansion bolts and shields, toggles.
- .3 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .4 Provide components for building by other sections in accordance with shop drawings and schedule.
- .5 Make field connections with bolts to CAN/CSA S16.1, or weld.
- .6 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .7 Touch-up field welds, bolts and burnt or scratched surfaces after completion of erection with suitable primer.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.



- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.3 SCHEDULES**

- .1 Interior Casework, Vanity, Grooming Counter Support.
  - .1 Fabricate from HSS, steel plate and steel angles and as indicated.
  - .2 Finish: factory prime coat finish, with on-site paint finish to exposed components in accordance with Section 09 91 23, colour: Black.
- .2 Wood Bench.
  - .1 Fabricate from steel angles and as indicated.
  - .2 Solid hardwood (WD1) slats by Section 06 20 00.
  - .3 Finish: factory prime coat finish, with on-site paint finish to exposed components in accordance with Section 09 91 23, colour: Black.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 20 00 – Finish Carpentry.
- .2 Section 06 40 00 – Architectural Woodwork.
- .3 Section 08 11 00 – Metal Doors and Frames.
- .4 Section 08 11 16 – Aluminum Doors and Frames.
- .5 Section 09 21 16 – Gypsum Board Assemblies.
- .6 Section 09 22 16 – Non-Structural Metal Framing.
- .7 Section 10 21 13 – Solid Phenolic Toilet Compartments.
- .8 Section 10 28 00 – Toilet and Bath Accessories.

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - .2 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3 ASTM D5456-121e1, Standard Specification for Evaluation of Structural Composite Lumber Products.
- .2 American Wood Protection Association (AWPA).
  - .1 AWPA Book of Standards, 2013.
  - .2 AWPA M2-11, Standard for Inspection of Treated Wood Products.
- .3 Canadian Standards Association (CSA).
  - .1 CAN/CSA O80 SERIES-21, Wood Preservation.
  - .2 CSA O86-19, Engineering Design in Wood.
  - .3 CSA O121-17, Douglas Fir Plywood.
  - .4 CSA O141-05(R2019), Softwood Lumber.
  - .5 CSA O151-17, Canadian Softwood Plywood.
  - .6 CSA O153-19, Poplar Plywood.
  - .7 CSA O325-21, Construction Sheathing.
- .4 National Building Code of Canada (NBCC).
- .5 National Lumber Grades Authority (NLGA)
  - .1 NLGA SPS 1 Special Products Standard for Fingerjoined Structural Lumber, 2017.
  - .2 NLGA Standard Grading Rules for Canadian Lumber, 2017.
- .6 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC S102-18-Rev1, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.2 QUALITY ASSURANCE**

- .1 Lumber identification: by grade stamp of agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.

### **1.3 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 LUMBER MATERIAL**

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with CSA O141 and NLGA Standard Grading Rules for Canadian Lumber.
- .2 Machine stress-rated lumber: acceptable for all purposes.
- .3 Glued end-jointed (finger-jointed) lumber is not acceptable.
- .4 Structural Composite Lumber (SCL) in accordance with ASTM D5456.
- .5 Framing and board lumber: in accordance with NBCC.
- .6 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, panel and soffit backing:
  - .1 Use S2S or S4S material.
  - .2 Board sizes: "Standard" or better grade.
  - .3 Dimension sizes: "Standard" light framing or better grade.
  - .4 Post and timber sizes: "Standard" or better grade.
- .7 Pressure Treated Dimension Lumber: vacuum pressure impregnated Alkaline Copper Quaternary (ACQ) treated lumber to CSA O80. Minimum moisture content at treatment in accordance with CAN/CSA O80. Minimum retention for above ground use 4.0 kg/m<sup>3</sup> and for ground contact 6.4 kg/m<sup>3</sup>. All wood to be free of defects. Any warped, checked or bent materials will be rejected.

### **2.2 PANEL MATERIAL**

- .1 Construction Sheathing: to CSA O325.
- .2 Plywood Standards: type, grade and thickness as indicated and in accordance with following standards:
  - .1 Douglas fir plywood (DFP): to CSA O121, standard construction.
  - .2 Canadian softwood plywood (CSP): to CSA O151, standard construction.
  - .3 Poplar plywood (PP): to CSA O153, standard construction.
- .3 Fire Retardant Treated Plywood: type, grade and thickness as indicated and in accordance with following standards:
  - .1 Douglas Fir Plywood: pressure-treated with fire retardant chemicals to meet CAN/ULC S102, Class A Fire Retardant, made with binder containing no added urea-formaldehyde, moisture content 15% or less.

### **2.3 ACCESSORIES**

- .1 Fasteners for Exterior Work and Pressure Treated Wood: hot-dipped galvanized steel to ASTM A153/A153M (for hot-dip fastener products) and ASTM A653/A653M (G-185 coating designation for hot-dip connector and sheet products).

- .2 Fasteners for Fire Retardant Treated Lumber and Plywood: hot-dipped galvanized steel to ASTM A153/A153M (for hot-dip fastener products) and ASTM A653/A653M (G-185 coating designation for hot-dip connector and sheet products).
- .3 Bolts: 12.5 mm diameter unless indicated otherwise, galvanized, complete with nuts and washers.
- .4 Proprietary Fasteners: galvanized toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.
- .5 Surface-applied Wood Preservative: as recommended by pressure impregnated material manufacturer in accordance with CAN/CSA O80.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install members true to line, levels and elevations, square and plumb.
- .2 Construct continuous members from pieces of longest practical length.
- .3 Install spanning members with "crown-edge" up.
- .4 Install furring and blocking as required to space-out and support door frames, casework, cabinets, wall and ceiling finishes, washroom accessories, and other work as required.
- .5 Treat surfaces of ACQ treated lumber exposed by field cutting, trimming or boring with liberal application of wood preservative before installation. Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3-minute soak on lumber and one-minute soak on plywood.
- .6 Use only hot-dipped galvanized steel fasteners with all ACQ pressure treated lumber.
- .7 Install fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.
- .8 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .9 Provide wood blocking where required to provide support for wall or ceiling mounted items specified or detailed including wall mounted door stops. Fasten wood blocking securely to steel studs on each side with minimum of two (2) screws on each stud.
- .10 Provide backboards for mounting electrical equipment as required. Use 19 mm thick DFP or CSP on 19 x 38 mm furring around perimeter and at maximum 300 mm intermediate spacing. Paint both sides of backboards in accordance with Section 09 90 00 before installation.
- .11 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .12 Countersink bolts where necessary to provide clearance for other work.

#### **3.2 SITE APPLIED WOOD TREATMENT**

- .1 Apply preservative treatment in accordance with manufacturer's instructions.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface and site-sawn cuts for minimum 3-minute soak on lumber and one-minute soak on plywood.
- .3 Allow preservative to dry prior to erecting members.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 05 50 00 – Metal Fabrications.
- .2 Section 06 10 00 – Rough Carpentry for Minor Works.
- .3 Section 06 40 00 – Architectural Woodwork.
- .4 Section 07 92 00 – Joint Sealants.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM D1037-12(2020), Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
  - .2 ASTM E84-21, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC) / Woodwork Institute (WI).
  - .1 North American Architectural Woodwork Standards (*NAAWS*), Edition 4.0, 2021.
- .3 Canadian Standards Association (CSA)
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .2 CSA O86-19, Engineering Design in Wood.
  - .3 CSA O112 Series-M1977 (2006), CSA Standards for Wood Adhesives.
  - .4 CSA O141-05 (R2019), Softwood Lumber.
- .4 National Lumber Grades Authority (NLGA).
  - .1 Standard Grading Rules for Canadian Lumber, 2017.
- .5 National Particleboard Association/Composite Panel Association (NPA).
  - .1 NPA A208.2-2009, Medium Density Fiberboard (MDF) for Interior Applications.
- .6 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC S102-18, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Indicate construction details including typical and special installation conditions, materials being supplied and all connections, attachments, anchorage and location of exposed fastenings, as applicable.
  - .2 Indicate dimensions, description of materials and finishes, material thicknesses, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements:
    - .1 Include section drawings of typical installations and accessories.
    - .2 Indicate locations of plumbing and electrical service field connection by others.
  - .3 Submit manufacturer's descriptive literature of specialty items not manufactured by Contractor.

- .3 Samples
  - .1 Provide duplicate samples: 300 mm long unless specified otherwise, of lumber and materials in each finish to be applied at factory.
  - .2 When approved, samples serve as standard for workmanship and appearance for similar items throughout project.
- .4 Closeout Submittals.
  - .1 Submit operation and maintenance data for incorporation into Operations and Maintenance Manual specified in Section 01 78 00.

#### 1.4 QUALITY ASSURANCE

- .1 Qualifications.
  - .1 Manufacturer: minimum of five (5) years' experience in manufacturing architectural woodwork for similar types of projects and adequate facilities and personnel required to perform on this project.
  - .2 **Installer: Manufacturer to perform installation. Any installer other than manufacturer is prohibited, unless pre-approved by the City and Contract Administrator.**
- .2 Regulatory Requirements.
  - .1 Comply with *NAAWS* for grades of raw materials (lumber and wood veneers) and sawing/slicing as specified.
  - .2 Perform work of this Section to specified standards for quality of workmanship, materials, installation and execution of the design intent in accordance with *NAAWS*.
  - .3 Notify Contract Administrator of conflicts between *NAAWS* and this Section.
  - .4 Fire Test Response Characteristics: Provide components that meet CAN/ULC-S102 Flame Spread Rating 25 or less, Smoke Developed Classification 50 or less. Materials provided shall be identical to materials tested.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Maintain relative humidity during fabrication, storage and installation of finish woodwork between 25% and 55% at 21°C in order to keep unfinished interior wood at satisfactory moisture level.
- .2 Transport, handle or store assembled finish woodwork and/or their component parts in manner to preclude damage of any kind.
  - .1 Cover plastic laminate surfaces with heavy kraft paper or put in cartons during shipment.
  - .2 Do not subject items to abnormal heat, extreme dryness, humid conditions, sudden changes in temperature, or direct sunlight.
  - .3 Store items on level surface in area with proper humidity control and ventilation to prevent wetting and/or other damage.
- .3 Woodwork which is damaged in any way or does not comply with these specifications will be rejected by the Contract Administrator and must be removed from the job site and replaced with acceptable materials.
- .4 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location. Store cabinet hardware in locked, clean and dry area.
- .5 Cleaning in accordance with Section 01 74 00.
- .6 Construction Waste Management in accordance with Section 01 74 19.

## 1.6 WARRANTY

- .1 Provide an extended warranty for Work of this Section for a period of three (3) years from date of Substantial Performance of the Work. Contractor hereby warrants that finish carpentry including doors, will not warp, twist, show core lines, split, delaminate, sag, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City.

## Part 2 Products

### 2.1 LUMBER MATERIAL

- .1 Hardwood Lumber (Solid Wood (WD1)): Premium Grade, White Maple, plain sliced to *NAAWS*, no mineral streaks or black flecks accepted, make careful consideration for colour and grain consistency, moisture content 4-9% or less in accordance with following standards:
  - .1 AWMAC/WI North American Architectural Woodwork Standards.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.
  - .3 NHLA Rules for Measurement and Inspection of Hardwood and Cypress.
- .2 Softwood Lumber (Solid Wood (WD-2)): Premium Grade, "Select" No. 1, clear vertical grain Western Red Cedar, quarter cut to NLGA Standard Grading Rules for Canadian Lumber and in accordance with *NAAWS*, special consideration shall be given to uniform colour and very fine vertical grain; no mineral streaks or black flecks accepted, moisture content 4-9% or less in accordance with following standards:
  - .1 CSA O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.
  - .3 Forestry Stewardship Council (FSC) certified.

### 2.2 ACCESSORIES

- .1 Nails and staples: to CSA B111; stainless steel finish elsewhere.
- .2 Joint sealants and caulking: in accordance with Section 07 92 00.
- .3 Levelling Glides: Stainless Steel swiveling stud with 25mm diameter non-skid pad, complete with locking nuts. Load capacity of 750lbs.

### 2.3 FINISHES

- .1 Hardwood Lumber (Solid Wood (WD1)): Factory Applied Finish.
  - .1 Interior Finish (ST) (as indicated) non-MPI - Pigmented Lacquer, satin finish (over stain), as follows:
    - .1 Dulux System.
      - .1 Finish to be performed in shop by Section 06 20 00.
      - .2 Sealer: Dulux VOC compliant, waterborne Satin Acrylic Varnish.
      - .3 Sand lightly (180 grit).
      - .4 Clear Top Coat: Dulux VOC compliant, waterborne Satin Acrylic Varnish.
      - .5 Repeat Steps 2 and 3 as necessary to provide smooth blemish free finish.
- .2 Softwood Lumber (Solid Wood (WD2)): Factory Applied Finish.
  - .1 Interior Finish (as indicated) non-MPI – clear, water-based sealer, as follows:
    - .1 Homecraft Wood Sealer, Sauna Sealant – Water Based Interior Sealer.
      - .1 Apply in accordance with manufacturer's written instructions.



- .3 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.

### **Part 3 Execution**

#### **3.1 CONSTRUCTION**

- .1 Fabricate finish woodwork in accordance with *NAAWS*.
- .2 Wood Bench.
  - .1 Fabricate from 38 mm thick solid hardwood (WD1) to “Custom Grade” standards for materials and workmanship in accordance with *NAAWS*.
    - .1 Co-ordinate with Section 05 50 00, and to profiles indicated from hardwood lumber (WD-1) secured to metal framework as detailed.
    - .2 Install two glides per free-standing wood bench steel leg. Cut and grind smooth bolt length flush with locking nut.
  - .3 General Standing and Running Trim.
    - .1 Fabricate from softwood lumber (WD-2) to *NAAWS* premium grade to profiles indicated.
    - .2 Butt and cope internal joints of trim to make snug and tight. Cut right angle intersections with mitred joints.
    - .3 Fit backs snugly to wall surfaces to eliminate cracks at junction with walls.
    - .4 Only where joints in trim are necessary, use 45° scarfed type joint.

#### **3.2 INSTALLATION**

- .1 Install finish carpentry to *NAAWS*.
- .2 Erect lumber as indicated and in accordance with reviewed shop drawings. Make adequate provisions for erection stresses and seasonal expansion and contraction. Comply with CAN/CSA O86 except as shown or specified otherwise.
- .3 Co-ordinate all custom metal supports and connectors with Section 05 50 00.
- .4 Scribe and cut as required, fit to abutting walls, and surfaces, fit properly into recesses and to accommodate piping, columns, fixtures, outlets, or other projecting, intersecting or penetrating objects.
- .5 Form joints to conceal shrinkage.
- .6 Fastening and sealing.
  - .1 Position items of finished carpentry work accurately, level, plumb, true and fasten or anchor securely.
  - .2 Design and select fasteners to suit size and nature of components being joined. Use proprietary devices as recommended by manufacturer.
  - .3 Set finishing nails to receive filler. Where screws are used to secure members, countersink screw in round cleanly cut hole and plug with wood plug to match material being secured.
  - .4 Replace items of finish carpentry with damage to wood surfaces including hammer and other bruises.

#### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## Part 1 General

### 1.1 RELATED SECTIONS

- .1 Section 04 22 00 – Concrete Unit Masonry.
- .2 Section 06 10 00 – Rough Carpentry for Minor Works.
- .3 Section 06 20 00 – Finish Carpentry.
- .4 Section 06 61 16 – Solid Surfacing Fabrications.
- .5 Section 07 92 00 – Joint Sealants.
- .6 Section 09 21 16 – Gypsum Board Assemblies.

### 1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM C1313-13(2019), Standard Specification for Sheet Radiant Barriers for Building Construction Applications.
  - .2 ASTM D570-98(2018), Standard Test Method for Water Absorption of Plastics.
  - .3 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics.
  - .4 ASTM D1037-12, Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
  - .5 ASTM D3453-12, Standard Specification for Flexible Cellular Materials & Urethane for Furniture and Automotive Cushioning, Bedding, and Similar Applications.
  - .6 ASTM D3574-17, Standard Test Methods for Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams.
  - .7 ASTM D5456-19, Standard Specification for Evaluation of Structural Composite Lumber Products.
  - .8 ASTM E84-20, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .9 ASTM E1333-14, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber.
  - .10 ASTM G21-15, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 American National Standards Institute (ANSI)/National Particleboard Association (NPA).
  - .1 ANSI/NAP A208.1-2016, Particleboard.
  - .2 ANSI/NAP A208.2-2016, Medium Density Fiberboard (MDF) For Interior Applications.
- .3 American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA).
  - .1 ANSI/BHMA A156.9-2020, Cabinet Hardware.
  - .2 ANSI/BHMA A156.11-2019, Cabinet Locks.
  - .3 ANSI/BHMA A156.28-2018, Recommended Practices for Keying Systems.
- .4 Architectural Woodwork Manufacturers Association of Canada (AWMAC) / Woodwork Institute (WI).
  - .1 North American Architectural Woodwork Standards (*NAAWS*), Edition 4.0, 2021.
- .5 Canadian Standards Association (CSA).
  - .1 CSA O112 Series-M1977 (R2006), CSA Standards for Wood Adhesives.
  - .2 CSA O121-17, Douglas Fir Plywood.
  - .3 CSA O141-05(R2019), Softwood Lumber.
  - .4 CSA O151-17, Canadian Softwood Plywood.
  - .5 CSA O153-19, Poplar Plywood.

- .6 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .7 National Electric Manufacturer's Association (NEMA).
  - .1 ANSI/NEMA LD 3-2005, High-Pressure Decorative Laminates (HPDL).
- .8 National Hardwood Lumber Association (NHLA).
  - .1 Rules for Measurement and Inspection of Hardwood and Cypress, 2019.
- .9 National Lumber Grades Authority (NLGA).
  - .1 NLGA Standard Grading Rules for Canadian Lumber, 2017.
- .10 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC S102-18-Rev1, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### 1.3 DEFINITIONS

- .1 Identification of millwork components and related products by surface visibility.
  - .1 Open Interiors: any open storage unit without solid door or drawer fronts.
  - .2 Closed Interiors: any closed storage unit behind solid door or drawer fronts.
  - .3 Exposed Ends: any storage unit exterior side surface that is visible after installation.
  - .4 Other Exposed Surfaces: faces of doors and drawers (both sides), tops and undersides of upper cabinets less than 1830 mm above finished floor.
  - .5 Semi-Exposed Surfaces: interior surfaces which are visible, bottoms of wall cabinets and tops of cabinets 1830 mm or more above finished floor, bottoms of raised gables.
  - .6 Concealed Surfaces: any surface not visible after installation.

### 1.4 ACTION AND INFORMATION SUBMITTALS

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Indicate construction details including typical and special installation conditions, materials being supplied and all connections, attachments, anchorage and location of exposed fastenings, as applicable.
  - .2 Indicate dimensions, description of materials and finishes, material thicknesses, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements:
    - .1 Include section drawings of typical installations and accessories.
    - .2 Indicate locations of plumbing and electrical service field connection by others.
  - .3 Submit manufacturer's descriptive literature of specialty items not manufactured by Contractor.
- .3 Closeout Submittals.
  - .1 Submit operation and maintenance data for incorporation into Operations and Maintenance Manual specified in Section 01 78 00.

### 1.5 QUALITY ASSURANCE

- .1 Qualifications.
  - .1 **Manufacturer:** minimum of five (5) years' experience in manufacturing architectural woodwork for similar types of projects and adequate facilities and personnel required to perform on this project.
  - .2 **Installer: Manufacturer to perform installation. Any installer other than manufacturer is prohibited, unless pre-approved by the City and Contract Administrator.**

- .2 Regulatory Requirements.
  - .1 Perform work of this Section to specified standards for quality of workmanship, materials, installation and execution of the design intent in accordance with *NAAWS*.
  - .2 Notify Contract Administrator of conflicts between *NAAWS* and this Section.

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

- .1 Maintain relative humidity during fabrication, storage and installation of finish woodwork between 25% and 55% at 21°C in order to keep unfinished interior wood at satisfactory moisture level.
- .2 Transport, handle or store assembled finish woodwork and/or their component parts in manner to preclude damage of any kind.
  - .1 Cover plastic laminate surfaces with heavy kraft paper or put in cartons during shipment.
  - .2 Do not subject items to abnormal heat, extreme dryness, humid conditions, sudden changes in temperature, or direct sunlight.
  - .3 Store items on level surface in area with proper humidity control and ventilation to prevent wetting and/or other damage.
- .3 Woodwork which is damaged in any way or does not comply with these specifications will be rejected by the Contract Administrator and must be removed from the job site and replaced with acceptable materials.
- .4 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location. Store cabinet hardware in locked, clean and dry area.
- .5 Cleaning in accordance with Section 01 74 00.
- .6 Construction Waste Management in accordance with Section 01 74 19.

## **1.7 WARRANTY**

- .1 Provide an extended warranty for Work of this Section for a period of three (3) years from date of Substantial Performance of the Work. Contractor hereby warrants that architectural woodwork will not warp, twist, show core lines, split, delaminate, sag, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the City and Contract Administrator, and at no expense to the City.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Basis of Design Products.
  - .1 Plastic Laminate (PL).
    - .1 Nevamar, Armored Protection, Meditation Elm WE2700T.
    - .2 Wilsonart, Standard Laminate, Beigewood 7850-60.
    - .3 Arborite, Essential Nordic Wood, W481 CW.
    - .4 Formica, Natural Ash, 8843-WR Woodbrush Finish.
  - .2 Tack Surface (TS).
    - .1 Forbo Krommenie Bulletin Board.
    - .2 Koroseal Walltalkers TacWall.

- .2 Casework Hardware.
  - .1 Typical Hinges: to ANSI/BHMA A156.9.
    - .1 Semiconcealed (European institutional) hinge: self-closing hinge with six-way adjustment, attached with two-piece, height adjustable mounting plate, nickel finish, 270° opening angle, full overlay.
      - .1 Basis of Design Products.
        - .1 Grass Nexis Slide-On 73.
        - .2 Hafele Aximat 344.06.800.
        - .3 Hettich Seleckta Pro 2000.
      - .2 Doors 1220 mm and over in height require 4 hinges per door.
    - .2 Pulls: to ANSI/BHMA A156.9.
      - .1 Wire D-pull: 96 mm centres, brushed stainless steel finish. Provide bolts of sufficient length to pass through total thickness of drawer front and drawer box front.
        - .1 Basis of Design Products.
          - .1 Onward 1085.
          - .2 Richelieu 33205170.
    - .3 Shelf Supports: to ANSI/BHMA A156.9.
      - .1 Shelf Clips: metal shelf support, 6 mm diameter, nickel plated finish.
        - .1 Basis of Design Products.
          - .1 Richelieu #5833180.
    - .4 Door Bumpers: to ANSI/BHMA A156.9.
      - .1 Door Bumpers: 7 mm diameter (nominal) install in pairs, clear.
        - .1 Basis of Design Products.
          - .1 3M model SJ5302.
          - .2 Bumper Specialties BS-27.
          - .3 Knape & Vogt 2680 CL.
          - .4 Mepla-Alfit 630.000.03.07.
    - .5 Cabinets Locks: to ANSI/BHMA A156.11, keying to ANSI/BHMA A156.28 as indicated below.
      - .1 Basis of Design Products.
        - .1 Ilco 980, with N54G Keyway, matt nickel finish, flush mounted, with appropriate opposite door catches, each keyed differently.
    - .6 Catches: to ANSI/BHMA A156.9, double roller catch, bright zinc finish.
      - .1 Basis of Design Products.
        - .1 Richelieu 6032G.
    - .7 Pencil and Small Box Drawer Slides (up to 140 mm high, maximum 406 mm wide): to ANSI/BHMA A156.9, medium-duty, 100 lb. load capacity.
      - .1 Side-Mounted Full-Extension Drawer Slides - ball bearing, finish to be selected By Contract Administrator.
        - .1 Basis of Design Products.
          - .1 Accuride 3832E – Light-Duty & Full Extension Slide with Lever-Disconnect (no over travel – only full extension)
    - .8 Standard Box Drawer Slides (141 to 260 mm high, maximum 610 mm wide): to ANSI/BHMA A156.9, medium-duty, 100 lb. load capacity.
      - .1 Side-Mounted Full-Extension Drawer Slides - ball bearing, finish to be selected by Contract Administrator.
        - .1 Basis of Design Product.
          - .1 Accuride 7434 – Light-Duty Over-Travel Slice with Rail-Mounting and Progressive Movement

- .9 Large Box and File Drawer Slides (over 260 mm high, maximum 610 mm wide): to ANSI/BHMA A156.9, heavy-duty, 150 lb. load capacity.
  - .1 Side-Mounted Full-Extension, Two-Tier Drawer Slides - ball bearing with overtravel, finish to be selected by Contract Administrator.
    - .1 Basis of Design Product.
      - .1 Accuride 4034 – Medium-Duty & Over-Travel Slide with Progressive Movement
- .10 Large Box and File Drawer Slides (over 260 mm high, maximum 1067 mm wide): to ANSI/BHMA A156.9, heavy-duty, 180 lb. load capacity.
  - .1 Side-Mounted Full-Extension, Two-Tier Drawer Slides - ball bearing with overtravel, finish to be selected by Contract Administrator.
    - .1 Basis of Design Product.
      - .1 Accuride 3641 - Overtravel with Interlock
- .11 Keyboard Tray Slide: to ANSI/BHMA, ADA
  - .1 Left and Right sliding mouse tray options, includes palm rest, articulating arm and track, document holder, built in wire management for both keyboard and mouse.
  - .2 Made of 100% recyclable material, colour: Black
  - .3 Dimensions:
    - .1 Overall depth: 276mm (10.9 inches)
    - .2 Overall width: 480mm (18.9 inches)
    - .3 Basis of Design Product.
      - .1 Richelieu Dynamite C4 Combo 5007438C4.
- .12 Cable Tray: 110 mm high x 28 mm deep, length to suit, 'J' shaped plastic moulding, complete-with double sided tape.
  - .1 Basis of Design Product.
    - .1 Doug Mockett, WM22A-Large J-Shape Underdesk Wiremold Cable Manager w/Flange.
- .13 Grommet: plastic, 60 mm overall diameter, 48 mm boring diameter, white.
  - .1 Basis of Design Product.
    - .1 Richelieu BP60030
- .12 Countertop T Brace.
  - .1 Steel bracket with paint finish, size to suite installation, or as detailed.
  - .2 Basis of Design Product.
    - .1 The Original Granite Bracket, Support Bracket, Countertop, T Brace.
- .3 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
- .4 Supply similar products from single manufacturer.

## 2.2 WOOD MATERIALS

- .1 Softwood Lumber: "Premium Grade" softwood lumber, S4S, moisture content 4-9% or less in accordance with following standards:
  - .1 CSA O141.
  - .2 NLGA Standard Grading Rules for Canadian Lumber.

## 2.3 SHEET MATERIALS

- .1 Softwood Plywood.
  - .1 Douglas Fir Plywood: to CSA O121, standard construction.
  - .2 Canadian Softwood Plywood: to CSA O151, standard construction.

- .3 Poplar Plywood: to CSA O153, standard construction.
- .2 Wood Particleboard: medium density industrial grade (40-50 lb/ft<sup>3</sup>) to ANSI/NAP A208.1-M-2 (up to 22 mm thick), high density (>50 lb/ft<sup>3</sup>) to ANSI/NAP A208.1-M-3 (25 mm thick and thicker), manufactured from 100% recycled wood fiber, made with binder containing no added urea-formaldehyde, flame spread 150 or less to CAN/ULC S102 and ASTM E84.
- .3 Medium Density Fiberboard (MDF): 46-47 lb/ft<sup>3</sup> (up to 22 mm thick) to ANSI/NPA A208.2, manufactured from 100% recycled wood fiber, made with binder containing no added urea-formaldehyde, flame spread 150 or less to CAN/ULC S102 and ASTM E84.
- .4 Melamine Component Panels (MCP): high-wear resistant melamine resin impregnated decorative paper VGS 0.7 mm (.028") in accordance with NEMA Test LD3 (equal or exceeding 400 cycles) thermally fused to industrial grade particleboard core of thickness indicated which meets or exceeds ANSI/NAP A208.1, manufactured from 100% recycled wood fiber, made with binder containing no added urea-formaldehyde, flame spread 150 or less to CAN/ULC S102 and ASTM E84, min. 2 colours to be selected by Contract Administrator from manufacturer's full range.
- .5 Tack Surface (TS): 6 mm thick linoleum resilient homogenous tackable surface material of natural material consisting of linseed oil, granulated cork, resin binders and dry pigments, mixed and calandered to natural jute backing, fire resistance in accordance with CAN/ULC S102 and ASTM E84, self-healing, bacteria resistant, colour to be selected by Contract Administrator from manufacturer's entire range.

## **2.4 PLASTIC LAMINATE MATERIALS**

- .1 Plastic Laminate (PL, PLW).
  - .1 High-Pressure Decorative Laminate HGS, 1.2 mm (.048") to ANSI/NEMA Test LD 3, decorative surface papers, impregnated with melamine resins, bonded under heat and pressure to kraft papers impregnated with phenolic resins.
  - .2 High-Pressure Backer BKH, 1.2 mm (.048") to ANSI/NEMA Test LD3.
- .2 Adhesives for Plastic Laminate.
  - .1 Laminating adhesives as recommended by manufacturer for use with product.
  - .2 Laminating adhesives to contain no urea-formaldehyde.

## **2.5 STEEL MATERIALS**

- .1 Refer to Section 05 50 00. All steel components part of architectural woodwork to be supplied by Section 05 50 00 but installed by work of this Section.

## **2.6 GLAZING**

- .1 Refer to Section 08 80 00 – Glazing. All glazing as part of architectural woodwork to be supplied by Section 08 80 00 but installed by work of this Section.

## **2.7 ACCESSORIES**

- .1 PVC Edging Materials: 1 mm thick solid high impact, purified, colour-through, rigid PVC edging, width to match panel thickness, PVC edging to be factory machine-applied with waterproof hot melt adhesive containing no urea-formaldehyde, and automatically trimmed for uniform appearance. Colour to match face panel unless noted. Barbed T-edging not permitted.
- .2 Joint Sealants: in accordance with Section 07 92 00.



## 2.8 KEYING

- .1 Key cabinet locks to ANSI/BHMA A156.28, keyed alike by room/area or common function. Co-ordinate with the City and submit keying schedule for approval.
- .2 Provide two keys to each independent lock.
- .3 Prior to Substantial Performance, Contractor to turn over all individual keys to the City.
- .4 Do not leave keys in keyway or cabinet.

## 2.9 FABRICATION - GENERAL

- .1 Fabricate architectural woodwork in accordance with reviewed shop drawings and to standards specified for materials and workmanship in accordance with *NAAWS* unless otherwise noted.
- .2 Obtain site dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.
- .3 Set and secure all materials and components in place, rigid plumb and square.
- .4 Adhere laminate to core material in accordance with laminate manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .5 Apply laminate backing sheet to non-exposed reverse side core of plastic laminate work. Exposed plywood or particleboard surfaces or edges are not acceptable.
- .6 Use PVC edging to cover exposed edge of core material except where indicated.
- .7 Shelving to cabinetwork to be adjustable unless otherwise indicated.
- .8 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .9 Millwork blind framing to be 19 x 64 mm wood members.
- .10 Provide intermediate base gables under floor cabinets at 610 mm on-centre maximum.
- .11 Shop install cabinet hardware.
- .12 Allow for scribing of cabinets fitting against walls.

## 2.10 PLASTIC LAMINATE CASEWORK

- .1 Fabricate MCP and plastic laminate faced casework to “Custom Grade” standards for materials and workmanship in accordance with *NAAWS* and as follows:
  - .1 Top and Back Stretcher Rails: 19 mm thick softwood lumber for base unit top horizontal and back stretcher rails.
  - .2 Horizontal Back Support Rail: 19 mm thick particleboard, dado and glued to cabinet ends.
  - .3 Toe Space: 19 mm shop sanded exterior grade veneer core poplar plywood with Type II adhesive, closed to cabinet bottom, 75 mm deep x height as detailed, reinforced with securing blocks.
  - .4 Lower Cabinet Bottoms (closed): 19 mm thick MCP, dadoed and glued into cabinet ends and clamped under pressure during assembly.
  - .5 Lower Cabinet Bottoms (open): 19 mm thick veneer core poplar plywood, plastic laminate faced.
  - .6 Upper Cabinet Bottoms (closed): 19 mm thick MCP, plastic laminate to underside of cabinet bottom to match door face.
  - .7 Lower Cabinet Backs (closed): 6 mm thick MCP.

- .8 Upper Cabinet Backs (closed): 13 mm thick MCP, recessed 19 mm and set into ends.
- .9 Lower and Upper Cabinet Backs (open) 13 mm thick veneer core poplar plywood, plastic laminate faced.
- .10 Upper Cabinet Tops and Bottoms (open): 19 mm thick veneer core poplar plywood, plastic laminate faced, including plastic laminate to underside of cabinet bottom, to match cabinet fronts.
- .11 Lower and Upper Cabinet Gables and End Gables (open): 19 mm thick veneer core poplar plywood, plastic laminate faced, 1 mm PVC exposed edges to match plastic laminate. Top and underside surface of upper cabinet gables to match end gables.
- .12 Lower and Upper Cabinet Gables and End Gables (closed): 19 mm thick MCP except plastic laminate faced on all exposed end gables, 1 mm PVC edge to match exposed plastic laminate door face.
- .13 Cabinet Doors and Drawer Fronts: 19 mm thick veneer core poplar plywood, plastic laminate faced (both sides), 1 mm PVC all 4 edges to match colour of plastic laminate door face. Note - Do not cut-out PVC edging to accommodate door hinges.
- .14 Cabinet Drawer Box (front, back and sides): 13 mm thick MCP with 13 mm edge below drawer bottom, dadoed, glued and clamped under pressure during assembly, 1 mm PVC all edges with colour to match drawer box. Glue drawer box to drawer front and bolt door pulls through both to ensure secure attachment.
- .15 Cabinet Drawer Bottoms: 13 mm thick MCP, captured 3 sides.
- .16 Fixed and Adjustable Shelves (open and closed): 25 mm thick veneer core poplar plywood, plastic laminate faced (colour to match cabinet interior), 1 mm PVC exposed edges (all four edges of adjustable shelving and exposed edge of fixed shelving), PVC colour to match plastic laminate. Clear spans shelves 915 mm and over not allowed without intermediate support.
- .17 Cabinet Closure/Filler Panels: 19 mm thick veneer core poplar plywood, plastic laminate faced, 1 mm PVC edge to match exposed plastic laminate door face.
- .18 Countertops, Vanities, and Backsplashes: solid surfacing material (SSM) in accordance with Section 06 61 16.

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Co-ordinate and verify, by measurement at job site, all dimensions affecting work.
- .2 Report, in writing, any defects in work of other Sections and any other unsatisfactory site conditions. Starting work in particular area of building implies acceptance of conditions and surfaces in that area only.
- .3 Where units or members are required to be fitted neatly into finished walls or openings, fabrication from drawing information are supplemented with actual job site dimensions.
- .4 Where dimensions are not available before fabrication is commenced, co-ordinate agreement between various Sections.
- .5 Examine drawings, specifications, and site to ascertain fabrication and installation procedures so that work may be completed with minimum of job site cutting and fitting.
- .6 Ensure that all components are manufactured in size such that they can be transported to proper job site location.

### **3.2 INSTALLATION**

- .1 Install architectural woodwork in accordance with reviewed shop drawings and to “Custom Grade” standards for quality of workmanship, materials, installation and execution of the design intent in accordance with *NAAWS*.
- .2 Install architectural woodwork, plumb, level, true and straight with no distortions. Shim as required. Where plastic laminate faced casework abuts other finished work, scribe and cut to accurate fit.
- .3 Fit hardware accurately and securely in accordance with manufacturer's instructions. Adjust hardware so that doors and drawers operate smoothly without warp or bind.
- .4 Apply continuous bead of sealant where solid surface material countertops and backsplashes abut adjacent wall finish.
- .5 Provide cutouts for inserts, grilles, electrical receptacle boxes, and other penetrations. Round internal corners, chamfer edges and seal exposed core.
- .6 Install door and drawer pulls to all upper and lower cabinets. Ensure bolts on drawer pulls are of sufficient length to pass through total thickness of drawer front and drawer box front.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
  - .1 Vacuum cabinets inside and out. Wipe off fingerprints, pencil marks, and surface soil etc.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Protect installed architectural woodwork and plastic laminate work from damage until project completion.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.
- .2 Section 06 40 00 – Architectural Woodwork.
- .3 Section 07 92 00 – Joint Sealants.
- .4 Section 09 21 16 – Gypsum Board Assemblies.
- .5 Division 22 – Plumbing.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM E84-21a, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .2 ASTM G21-15(2021)e1, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC S102-18-Rev1, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Manufacturer to prepare shop drawings and submitted to Contract Administrator for approval.
  - .2 Indicate piece sizes, quantities, and co-ordination with adjacent work. Shop drawings shall show all solid surfacing required, giving all overall piece size, sections through each condition and seam locations.
  - .3 Where required, full sized sections shall be drawn to show curved or molded sections.
  - .4 Each solid surface shall be numbered on shop drawings. No fabrication shall begin until shop drawings are reviewed by Contract Administrator. Deviations from Bid Documents shall be clearly noted on shop drawings.
- .3 Samples.
  - .1 Minimum of two (2) each, 200 mm x 200 mm in size, in each colour and finish specified shall be submitted for Contract Administrator's approval. Sufficient number of samples shall be submitted to show full range of colour and markings to be expected. If necessary, colour photographs may accompany sample submittals.
  - .2 If samples are rejected, new samples shall be submitted until approved. No fabrication shall begin until all samples are approved by Contract Administrator.
- .4 Closeout Submittals
  - .1 Provide closeout submittals in accordance with Section 01 78 00.
  - .2 Provide manufacturer's care and maintenance information for incorporation in operation and maintenance manual.
  - .3 Provide one maintenance kit with instructions.

#### **1.4 QUALITY ASSURANCE**

- .1 Installer Qualifications: Engage an experienced installer who has completed work similar in material, design, and extent to that indicated for project that has resulted in construction, with a record of successful in-service performance.
- .2 Qualifications:
  - .1 Shop that employs skilled workers who custom fabricate products similar to those required for this project and whose products have a record of successful in-service performance.
- .3 Fabricator/installer qualifications:
  - .1 Work of this section shall be by a certified fabricator/installer, certified in writing by the manufacturer.
- .4 Fire Test Response Characteristics: Provide components that meet CAN/ULC-S102: Flame Spread Rating 25 or less, Smoke Developed Classification 50 or less.
  - .1 Materials provided shall be identical to materials tested.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Finished solid surface shall be carefully packed and loaded for shipment using all reasonable care and customary precautions against damage in transit. No material which may cause staining or discolouration shall be used for blocking or packing.
- .2 Do not commence installation until ambient and surface temperatures at the site are within manufacturer's recommendations.
- .3 Maintain ambient temperature between manufacturer's recommendations for 48 hours prior to and after installation.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Construction Waste Management in accordance with Section 01 74 19.

#### **1.6 WARRANTY**

- .1 Provide manufacturer's completed warranty against defects in materials and workmanship for ten (10) years from date of Substantial Performance of the Work.
  - .1 Warranty shall provide material to repair or replace defective materials.
  - .2 Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.

### **Part 2 Products**

#### **2.1 MANUFACTURED UNITS**

- .1 Basis of Design Products.
  - .1 Solid Surfacing Material (SSM-1).
    - .1 Corian, Grade 1, Glacier White.
      - .1 Locations: Reception 1:02B, Copy Area 1:08B, First Aid 1:10, and graphic/text/pictograms throughout, and shroud at Pool Deck 1:14.
    - .2 Solid Surfacing Material (SSM-2)
      - .1 Corian, Grade 2, Artista Beige.
        - .1 Counters/Vanities in Washroom 1:06C, Grooming 1:06D, Grooming/Lavatory 1:12C, Female Washroom 1:13B, Grooming 1:13E.

- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
- .3 Supply similar products from single manufacturer.

## **2.2 SOLID SURFACING MATERIAL**

- .1 Solid Surfacing Material (SSM): non-porous, homogenous sheet material composed of polyester or acrylic resins, fire-retardant filler materials, and colouring agents.
  - .1 Nominal sheet thickness:
    - .1 Countertop/Vanity: 13 mm, up to two (2) colours/patterns to be selected by Contract Administrator.
    - .2 Graphic/Text/Pictogram/Shroud: 6 mm, one (1) colour/pattern to be selected by Contract Administrator.

## **2.3 ACCESSORIES**

- .1 Joint adhesive: manufacturer's standard adhesive to create inconspicuous, nonporous joints, with a chemical bond.
- .2 Wood substrate: in accordance with Section 06 40 00.
  - .1 Ensure plastic laminate finish to all exposed surfaces and edges of substrates.
- .3 Sealant: mildew resistant silicone as specified in Section 07 92 00.

## **2.4 FABRICATION**

- .1 Fabricate components in shop to greatest extent practical to size and shape indicated, in accordance with reviewed shop drawings and manufacturer's published requirements.
- .2 Countertops and other components detailed with core substrate shop fabricated and laminated to core. Fabrication tolerance between solid surfacing and substrate shall be zero and precisely flush fit.
- .3 Text/Graphics to have 3 mm rounded edge profile, lazer-cut openings and as detailed.
- .4 Form joints between components using manufacture's standard joint adhesive. Make joints inconspicuous in appearance and without voids. Attach 100 mm wide reinforcing strip under joints.
- .5 Provide holes and cutouts for plumbing, bath accessories, and other components.
- .6 Rout and finish component edges to a smooth, uniform finish. Rout cutouts and sand edges smooth. Repair or reject defective or inaccurate work.
- .7 Finish surfaces to uniform finish.
- .8 Thermoforming:
  - .1 Comply with forming data from manufacturer.
  - .2 Construct matching molds to form components shape.
  - .3 Form pieces to shape prior to seaming and joining.
  - .4 Cut pieces larger than finished dimensions, sand edges, remove nicks and scratches.
  - .5 Heat entire component uniformly between 138°–163°C during forming.
  - .6 Prevent blistering, whitening or cracking of material during forming.
- .9 Provide screw anchors or inserts at location requiring screw fasteners. Direct screw fastening into cast plastic material is not permitted.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Examine substrates to receive solid surfacing. Identify conditions detrimental to proper or timely installation and provide written report to Contractor. Do not commence installation until conditions have been corrected.
- .2 Verify measurements and tolerances and report in writing to Contract Administrator, conditions that are not correct.

#### **3.2 PREPARATION**

- .1 Furnish shop drawings to other trades for co-ordination.
- .2 Precondition solid surfacing in accordance with manufacturer's printed installation instructions.

#### **3.3 INSTALLATION**

- .1 Install components plumb and level, in accordance with reviewed shop drawings, project installation details and manufacturer's printed instructions.
- .2 Form joints using manufacturer's approved adhesive, with joints inconspicuous in finished work.
- .3 Adhere under mount sinks/bowls to countertop using manufacturer's recommended joint adhesive.
- .4 Attach top securely to base unit or support brackets in accordance with manufacturer's printed instructions.
- .5 Seal between wall and component with silicone sealant.
- .6 Adhere top mount sinks/bowls to countertop using manufacturer's recommended adhesive/silicone sealant.
- .7 Provide backsplashes and end splashes as indicated. Adhere to countertops using manufacturer's recommended silicone sealant.
- .8 Remove excessive adhesive and sealants.
- .9 Co-ordinate plumbing installation with plumbing Subcontractor.

#### **3.4 INSTALLATION: TEXT/GRAPHICS**

- .1 Mount text/graphics in accordance with manufacturer's recommended installation instructions and as indicated on drawings.
- .2 Install with 100% silicone sealant, with perimeter bead and sufficient beads of silicone.

#### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.6 PROTECTION**

- .1 Protect surfaces from damage until date of Substantial Performance of the Work.
- .2 Repair or replace to Contract Administrator's satisfaction any solid surface counter not properly fitted or counter found to be broken, stained or chipped.

**3.7 MAINTENANCE**

- .1 Solid surface fabricator shall supply instructions indicating recommended cleaning and maintenance of installed work of this section.
- .2 Catalogs and cuts from producers of recommended cleaning and maintenance materials shall be included in maintenance manual.
- .3 Manual shall include information regarding cleaning methods, stain removal methods and sealers.

**END OF SECTION**



## **Part 1 General**

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM D1709-16ae1, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
  - .2 ASTM D2103-15, Standard Specification for Polyethylene Film and Sheeting.
  - .3 ASTM D4833/D4833M-07(2013)e1, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
  - .4 ASTM E84-18b, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .5 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
- .2 National Fire Protection Association (NFPA).
  - .1 NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films, 2019 Edition.

### **1.2 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store roll materials on end, on pallets in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Cleaning in accordance with Section 01 74 00.
- .4 Waste Management and Disposal in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Sheet Dampproofing Membrane: 14 mil thickness fire-retardant laminate with two layers of multi-axially oriented, linear low-density polyethylene in accordance with NFPA 701, ASTM D2103, and ASTM E84, water/vapour permeance in accordance with ASTM E96/E96M, impact resistance in accordance with ASTM D1709, puncture resistance in accordance with ASTM D4833/D4833M.
- .2 Sheet Dampproofing Tape: manufacturer's purpose made fire retardant pressure sensitive tape. Minimum roll width 100 mm.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Confirm that crawlspace has been backfilled and properly graded prior to commencing work of this Section. Ensure surface beneath sheet dampproofing is smooth level and compacted, with no sharp projections.

### **3.2 INSTALLATION**

- .1 Install sheet dampproofing on floor of crawlspace as indicated in accordance with manufacturer's printed instructions.

- .2 Lap edges minimum 150 mm and tape with manufacturer's purpose made tape.
- .3 Wrap perimeter of sheet damproofing membrane around continuous pressure treated wood nailing strip and secure to concrete grade beam as detailed.
- .4 Cut a slit around concrete piles and any other penetrations to place the initial layer of sheet damproofing. Then cut a piece of sheet damproofing minimum width of 610 mm with "fingers" cut half the width of the sheet. Wrap sheet damproofing around penetration and securely strap with steel banding and completely tape fingers to the bottom layer of sheet damproofing.
- .5 Seal punctures in damproofing membrane. Use patching material at least 150 mm larger than puncture and seal.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by damproofing application.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry.
- .2 Section 07 11 13 – Bituminous Dampproofing.
- .3 Section 07 26 00 – Air/Vapour Barrier Membrane – Self-Adhesive.
- .4 Section 07 26 10 – Vapour Retarders.
- .5 Section 09 22 16 – Non-Structural Metal Framing.
- .6 Section 09 29 00 – Gypsum Board.

### **1.1 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
  - .2 ASTM C203-22, Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
  - .3 ASTM C518-21, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - .4 ASTM C578-22, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - .5 ASTM C612-14(2019), Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .6 ASTM D1621-16, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
  - .7 ASTM D2126-20, Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
  - .8 ASTM D2842-19, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
  - .9 ASTM D4833/D4833M-07(2020), Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
  - .10 ASTM E84-22, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .11 ASTM E96/E96M-22, Standard Test Methods for Water Vapor Transmission of Materials.
  - .12 ASTM E423-71(2019), Standard Test Method for Normal Spectral Emittance at Elevated Temperatures of Nonconducting Specimens.
- .2 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S114-18, Standard Method of Test for Determination of Non-combustibility in Building Materials.
  - .3 CAN/ULC-S701.1-22, Standard for Thermal Insulation, Polystyrene, Boards.
  - .4 CAN/ULC S702.1-21, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
  - .5 CAN/ULC-S702.2-15, Standard for Mineral Fibre Thermal Installation for Buildings, Part 2: Installation.
  - .6 CAN/ULC-S704.1-17, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

- .7 CAN/ULC S770-15 R2020, Standard Test Method for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams.

## 1.2 QUALITY ASSURANCE

- .1 Mock-ups.
  - .1 Provide mock-up of thermal insulation in location(s) identified by Contract Administrator and in accordance with Section 01 45 00.
  - .2 Mock-up on site to be part of final installation. Mock-up to be installed for review of construction and co-ordination with work of other Sections.
  - .3 Do not proceed with installation until mock-up is complete and reviewed by Contract Administrator.
  - .4 Once approved, the mock-up will set a standard of acceptance for remaining installations.

## 1.3 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations. Remove only in quantities required for same day use.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 11.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## Part 2 Products

### 2.1 MANUFACTURERS

- .1 Basis of Design Products.
  - .1 Rigid Board Insulation, Mechanically Attached.
    - .1 Dow Thermax Xarmor (ci) Exterior Insulation.
    - .2 Firestone Enverge CI Foil Exterior Wall Insulation.
    - .3 JM AP Foil-Faced Polyisocyanurate Continuous Insulation.
  - .2 Acoustical/Fire Batt Insulation.
    - .1 Rockwool AFB Acoustical Fire Batt.
  - .3 Two-Component, Low-volume Foamed-In-Place Insulation.
    - .1 Froth-Pak as manufactured by Dow Polyurethane Systems
    - .2 Handi-Foam as manufactured by Fomo Products Inc.
    - .3 Foamsulate as manufactured by Premium Spray Products.
  - .4 Fasteners for Wall Insulation.
    - .1 Dekfast fastening system, #12 Hex screws with recessed steel hexagonal Dekfast plate.
    - .2 Duro-last fastening system, #12 Drill point screws with 75 mm square metal plate.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
- .3 Supply similar products from a single manufacturer.

## 2.2 MATERIALS

- .1 Rigid Board Insulation - Mechanically Attached: Rigid closed-cell polyisocyanurate foam core to ASTM C518 and ASTM C1289, laminated to high performance aluminum foil facers, Type I, Class 1, with maximum flame-spread and smoke-developed indexes of  $\leq 25$  and  $\leq 450$ , respectively per ASTM E84, RSI (R) value of 1.14 (6.5) per 25 mm, compressive strength 172 kPa (25 psi), 1220 mm width x 1220 mm or 2440 mm length board sizes for easy application, butt edge unless indicated otherwise, CFC free and HCFC free, thickness as indicated.
- .2 Acoustical/Fire Batt Insulation: non-combustible, lightweight mineral wool insulation board formed with a thermosetting resin into flexible semi-rigid boards 1220 mm long x width to suit, provides fire resistance to CAN/ULC S102 and CAN/ULC-S114, and sound control to ASTM E423, thickness as indicated.
- .3 Foamed-In-Place Insulation: self-contained, factory pressurized, two-component polyurethane foam insulation to CAN/ULC-S705.1.

## 2.3 ACCESSORIES

- .1 Fasteners for Wall Insulation (above grade): screw and plate fastening system consisting of 75 mm diameter galvanized steel plate with self-drilling, high corrosive-resistant screws.
- .2 Masonry Ties complete-with Insulation Supports: in accordance with Section 04 00 00.
- .3 Thermal Isolation Clip System: in accordance with Sections 07 42 13.
- .4 Mastic (masonry tie penetrations of Air/Vapour Barrier): in accordance with Sections 07 26 00.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Examine substrates and immediately inform Contract Administrator in writing of defects.
- .2 Prior to commencement of work ensure substrates to receive insulation are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris or other material detrimental to uniform bedding of the insulation.

### 3.2 INSTALLATION

- .1 Rigid Insulation.
  - .1 Install rigid board insulation in two (2) equal layers to maintain continuity of thermal protection to building elements and spaces.
  - .2 Fit insulation tight around electrical boxes, plumbing and heating pipes, ducts, doors and window frames and other protrusions in or passing through insulation.
  - .3 Cut and trim insulation boards neatly to fit spaces. Butt all edges tightly. Offset vertical and horizontal joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
  - .4 Install sub-girts to suit wall finish installation.
  - .5 Mechanically fasten insulation boards with screw and plate fastening system specified. Install screw and plate fasteners through insulation to substrate. Fasteners to be spaced in accordance with manufacturer's written instructions. Ensure all insulation boards are securely fastened and bear tight against and flush with the surface of the substrate.
  - .6 In cavity wall assemblies, supplement masonry tie insulation supports with screw and plate fastening system to ensure all boards are securely fastened and bear tight against and flush with the surface of the substrate. Fasteners to be spaced in accordance with manufacturer's written instruction.

- .7 Seal all openings and protrusions with foamed-in-place insulation.
- .8 Co-ordinate installation of insulation with work of other trades.
- .9 Do not cover insulation until it has been reviewed by Contract Administrator.
- .2 Acoustical/Fire Batt Insulation.
  - .1 Install batt insulation in accordance with manufacturer's printed installation instructions.
  - .2 Install batt insulation to maintain continuity of acoustic and fire rating properties where required.
  - .3 Ensure batt insulation fills steel stud cavity. Run continuously from floor to underside floor/roof structure, over door and window openings, and around corners.
  - .4 Fit batt insulation closely around electrical boxes, plumbing and heating pipes, ducts, doors and window frames and other protrusions in or passing through insulation. Do not compress insulation to fit into spaces.
  - .5 Ensure batt insulation is placed around cut openings in gypsum board, behind electrical receptacles, around plumbing, heating or structural items passing through and at abutting walls.
  - .6 Cut and trim batt insulation neatly to fit spaces. Use only batt insulation free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
  - .7 Do not enclose batt insulation until it has been inspected and approved by Contract Administrator.
- .3 Foamed-In-Place Insulation.
  - .1 Apply foamed-in-place insulation in accordance with manufacturer's instructions.

### **3.3 FIELD QUALITY CONTROL**

- .1 Commissioning (including site review) of thermal insulation installation will be carried out by a Building Envelope Commissioning Agency (BECA), retained and paid by City.
- .2 Insulation trade will be responsible for all costs associated with return visits by BECA as a result of work that has failed review procedures.
- .3 Assist BECA with the performance of their duties.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Work in this section primarily covers the supply and installation of a spray-in-place closed-cell polyurethane foam insulation to exterior walls where indicated and as required to ensure a uniform level of thermal protection.
- .2 This section specifies additional requirements for sprayed polyurethane foam, primarily intended for use as the designated vapour barrier.

### **1.2 REFERENCES**

- .1 Canadian Urethane Foam Contractors Association Inc. (CUFCA).
  - .1 CUFCA - SPF Installer Handbook,
  - .2 CUFCA - SPF Contractor Handbook
  - .3 CUFCA - Field Quality Assurance Manual,
  - .4 CUFCA - Field Technical Manual, distributed by the Canadian Urethane Foam Contractors Association Inc.
- .2 South Coast Air Quality Management District (SCAQMD).
  - .1 SCAQMD Rule 1113-13, Architectural Coatings.
- .3 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC-S101-14-REV2, Standard Methods of Fire Tests of Building Construction and Materials.
  - .2 CAN/ULC-S102-18-REV1, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC-S705.1-18, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Material Specification. Includes Amendment 1.2.
  - .4 CAN/ULC-S705.2-20, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density, Application.
  - .5 ULC S718-18, Standard for Site Quality Assurance Program for Spray Polyurethane Foam.

### **1.3 SYSTEM DESCRIPTION**

- .1 Closed-cell polyurethane sprayed polyurethane foam thermal insulation must:
  - .1 Meet requirements for minimum Type 2 air barrier and vapour retarder requirements as per National Research Council, and CMHC specifications' performance requirements;
  - .2 Provide minimum RSI 1.05/25 mm (R6 per inch);
  - .3 Have air leakage rate less than 0.02 L (s.m<sup>2</sup>), vapour resistance of < 60 ng/Pa.s.m<sup>2</sup> in accordance with CUFCA Manual for Installers of Spray Polyurethane Foam Thermal Insulation.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00.
- .2 Samples.
  - .1 Provide two 300 mm x 300 mm samples of finished product to Contract Administrator.
- .3 Test Reports:
  - .1 Submit the CCMC Evaluation Report and the manufacturer's documentation confirming material has been evaluated and conforms to the requirements of the CAN/ULC S705.1 Material Standard.

- .2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.
- .3 When the spray polyurethane foam is the material designated at the vapour barrier in the building component submit documentation to confirm the material meets the requirements of the local building code.
- .4 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions and preparation, special handling criteria, installation requirements, techniques and sequencing, product storage, handling and cleaning procedures, and limitations of the material.

## 1.5 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Contractor performing work under this section must be licensed under the SPF Quality Field Assurance Program (FQAP) by CUFCA. Contractor shall, under the FQAP Licensing Agreement and as required by the CAN/ULC S705.2-05, only purchase and install, for this project, material that conforms to the requirements of CAN/ULC S705.1 Material standard.
  - .2 Installers (Applicators) performing work under this section must be Licensed under the SPF Field Quality Assurance Program (FQAP). The installer shall be trained by CUFCA or by a recognized training provider and certified by CUFCA in accordance with the requirements outlined in the CAN/ULC S705.2 Installation Standard. Installers shall have their photo-identification certification cards in their possession and available on the project site, for inspection upon request at all times.
  - .3 Manufacturer: company with experience in producing of material used for work required for this project, with sufficient production capacity to produce and deliver required units without causing delay in work.
- .2 Mock up
  - .1 If requested, construct on-site mock-up as directed.
  - .2 The mock-up area shall be minimum 5 m<sup>2</sup> and include components of the work such as attachments, penetrations and corners.
  - .3 The mock-up shall be reviewed by the Contractor and Contract Administrator to verify conformance with the specification, workmanship and appearance. Recommended changes to installation methods and procedures may be agreed to at this time.
  - .4 The mock-up may become part of the finished work.
  - .5 This mock-up shall constitute a standard of acceptance for the remaining work.
- .3 Health and Safety Requirements: worker protection:
  - .1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations:
  - .2 Workers must wear gloves, respirators, eye protection and protective clothing when applying foam insulation.
  - .3 Workers must not eat, drink or smoke while applying foam insulation.

## 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in a safe manner as recommended by the manufacturer, as required by the CAN/ULC S705.2-05 Installation Standard.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.



- .3 Storage and Handling Requirements:
  - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect specified materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.7 SITE CONDITIONS**

- .1 Ventilate area to receive insulation by introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.
- .2 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.
- .3 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
- .4 Apply insulation only when chemical, atmospheric and cavity/surface temperatures are within the limitations required by the CAN/ULC S705.2 Installation Standard and as recommended by the manufacturer.

## **1.8 WARRANTY**

- .1 Warrant work under this section against defects in workmanship or material for a minimum period of two (2) years from date of substantial completion; such as, but not limited to de-bonding or cracking.
- .2 Promptly rectify, at Contractor's expense, defects or deficiencies which become apparent during the warranty period.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Insulation: spray polyurethane to CAN/ULC-S705.1 Standard for Thermal Insulation-Spray Applied Rigid Polyurethane Foam, Medium Density, Material- Specification.
  - .1 A copy of an Evaluation Report or Listing (such as the CCMC Evaluation Report) or copies of the test reports from an SCC (Standards Council of Canada) accredited testing laboratory, for each physical property, indicating that the product meets the requirements of ULC S705.1-09 shall be made available upon request. A copy of either the evaluation report or the test reports shall be on file at the SPF FQAP (Field Quality Assurance Program) office.
  - .2 Material containers shall be labeled with the Evaluation Report number of the evaluation agency.
  - .3 Design RSI value as indicated in test report; minimum RSI/50 mm: 2.1 (R6/inch).
- .2 Primers: in accordance with manufacturer's recommendations for surface conditions.
  - .1 Maximum VOC limit 100 g/L to SCAQMD Rule 1113.
- .3 Provide similar products from a single manufacturer.

## **2.2 EQUIPMENT**

- .1 Spray equipment to be in accordance with ULC S705.2 and manufacturer recommendations for type application.
- .2 Each proportioner to supply only 1 spray gun.

## **2.3 ACCESSORIES**

- .1 Prime substrate when required by spray polyurethane manufacturer. The type of primer and the installation of the primer shall follow the requirements of the manufacturer for the surface conditions.
- .2 Air/Vapour barrier membranes, mastics, sealants, liquids complete with required primers to complete the transitions for the air barrier system.

## **Part 3 Execution**

### **3.1 SEQUENCING AND SCHEDULING**

- .1 Co-ordinate this work with the work of all sections referencing this work.
- .2 All foam insulation closures and substrates shall be completed and secure before the work of this section commences.

### **3.2 EXAMINATION**

- .1 Verify that surfaces and conditions are suitable to accept work as outlined in this section.
- .2 Prior to commencement of work report in writing to the Contract Administrator any defects in surfaces or conditions that may adversely affect the performance of products installed under this section.
- .3 Commencement of work outlined in this section shall be deemed as acceptance of existing work and conditions.

### **3.3 PREPARATION**

- .1 Protection
  - .1 Mask and cover adjacent areas to protect from over spray.
  - .2 Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
  - .3 Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
  - .4 Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.
- .2 Surface Preparation
  - .1 Surfaces to receive foam insulation shall be clean, dry and properly fastened to ensure adhesion of the polyurethane foam to the substrate.
  - .2 Ensure that all work by other trades that may penetrate through the thermal insulation is in place and complete.
  - .3 Ensure that surface preparation and any primers required conform to the manufacturers' instructions.

### **3.4 APPLICATION**

- .1 Spray-application of polyurethane foam shall be performed in accordance with CAN/ULC S705.2 and the manufacturers' instructions.

- .2 Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer and the CAN/ULC S705.2 Installation standard.
- .3 Apply in consecutive passes as recommended by manufacturer to thickness as indicated on drawings. Passes shall be not less than 15 mm and not greater than 50 mm.
- .4 Do not install spray polyurethane foam within 75 mm of heat emitting devices such as light fixtures and chimneys.
- .5 Finished surface of foam insulation to be free of voids and imbedded foreign objects.
- .6 Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
- .7 Trim, as required, any excess thickness that would interfere with the application of cladding/covering system by other trades.

### **3.5 TOLERANCES**

- .1 Maximum variation from indicated thickness: -6 mm/+10 mm.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.7 PROTECTION**

- .1 The spray polyurethane foam shall be protected from ultraviolet as per manufacturer's requirements.
- .2 The spray polyurethane foam shall be covered with an appropriate thermal barrier meeting local building codes when installed on the interior of the building.

**END OF SECTION**

## Part 1 General

### 1.1 RELATED SECTIONS

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.
- .2 Section 07 21 00 – Thermal Insulation.
- .3 Section 08 11 16 – Aluminum Doors and Frames
- .4 Section 09 21 16 – Gypsum Board Assemblies.

### 1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM D4541-17, Standard Test Method for Pull Off Strength of Coatings Using Portable Adhesion Testers.
  - .2 ASTM D5147/D5147M-18, Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.
  - .3 ASTM E96/E96M-16, Standard Test Methods for Water Vapour Transmission of Materials.
  - .4 ASTM E283-04(2012), Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  - .5 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
  - .6 ASTM E331-00(2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
  - .7 ASTM E783-02 (2010), Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
  - .8 ASTM E1186-17, Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
- .2 Canadian Construction Materials Centre (CCMC).
  - .1 Air/vapour Barrier Systems for Exterior Walls of Low-Rise Buildings: Performance and Assessment.
- .3 Canada Mortgage and Housing Corporation (CMHC).
  - .1 Guidelines for Delivering Effective Air/vapour Barrier Systems.
- .4 National Building Code of Canada (NBCC).

### 1.3 ACTION AND INFORMATION SUBMITTALS

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Include air/vapour barrier membrane installation details at typical joints and junctions between assemblies, and at all penetrations through membrane.
  - .2 Include manufacturer's technical data sheets.

### 1.4 QUALITY ASSURANCE

- .1 Qualifications.
  - .1 Installation of air/vapour barrier membrane to be by one trade only, approved and trained in installation procedures by the membrane manufacturer.

- .2 Each installer must be thoroughly trained and experienced in the installation of air/vapour barrier specified, and can supervise a maximum of two apprentices. Applicators must perform or directly supervise all air/vapour barrier work on the project.
- .3 Assign one applicator as “Designated Applicator” for this project who is to assume overall responsibility for installing and pre-testing all air/vapour barrier membranes on the project prior to inspection and testing by independent testing agency.
- .2 Regulatory Requirements.
  - .1 Comply with all safety precautions, manufacturers’ instructions, Workplace Hazardous Material Information System, and WCB requirements for materials handling, storage, application and disposal and regarding labeling and provision of material safety data sheets.
- .3 Testing.
  - .1 The air/vapour barrier membrane applicator will be expected to routinely inspect and test their work as work proceeds. The result of their testing and inspection efforts to be recorded in worksheets by the applicator. These worksheets are to be kept on site and be available for routine inspection by the City, Contract Administrator, and independent testing agency. A copy of the worksheets to be submitted to Contract Administrator on a weekly basis. The cost of this requirement is to be borne by the air/vapour barrier membrane trade.
  - .2 The air/vapour barrier membrane applicator will pre-inspect/test all membranes and make all necessary repairs immediately prior to inspection and testing by independent testing agency. Document repairs made and approvals given.
  - .3 The applicator will co-operate with the independent testing agency by making construction drawings and records available to them, including the air/vapour barrier membrane worksheets, and providing him with other information as requested.
  - .4 Assist independent testing agency with the performance of their duties by providing them access to scaffolding, swing stages, etc.
- .4 Documentation.
  - .1 Maintain jobsite records including dates on which membrane was installed, wall areas covered on those dates, name of the Applicator(s) and apprentices, the types and lot numbers of materials used, environmental and substrate conditions including at a minimum temperature, humidity and cleanliness during installation, variations from drawings or specifications, and results of any testing or inspections done by the installation crew. The Designated Applicator’s worksheets must identify all areas of substrate for which he has approved application of air/vapour barrier membrane. A copy of these worksheets shall be submitted to Contract Administrator on a weekly basis.
- .5 Mock-ups.
  - .1 Mock-up critical air/vapour barrier locations and connection details.
  - .2 Locate mock-up on site as part of final installation. Mock-up to be installed for review of construction, co-ordination with work of other Sections, and testing by independent testing agency.
  - .3 Once tested and approved, the mock-up will set a standard of acceptance for remaining installations.
  - .4 Mock-up the following locations and connection details.
    - .1 Roof/wall intersection.
    - .2 Service penetrations.

- .6 Pre-installation Meeting.
  - .1 Hold pre-installation meeting prior to commencement of the air/vapour barrier membrane installation work with air/vapour barrier membrane trade in attendance. Purpose of the meeting is to discuss the quality of workmanship expected, and to ensure that Designated Applicator and the Installers/Apprentices are fully aware of the mock-ups required and testing procedures that will be undertaken on their work to ensure that the quality of workmanship is met. The independent testing agency will be in attendance to identify testing procedures that will be used on the project and to answer any questions.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver all materials to site in the manufacturer's original packaging and standard commercial containers. Packaging to contain manufacturer's name, product name and identification number and other related information.
- .2 Provide and maintain dry, off-ground weatherproof storage. Store roll materials on end, and protect materials from direct sunlight, extreme temperatures, moisture conditions, chemicals, solvents, etc., as per manufacturer's recommendations. Remove only in quantities required for same day use.
- .3 Cleaning in accordance with Section 01 74 00.
- .4 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.6 SITE CONDITIONS**

- .1 Prior to installation, inspect areas to receive air/vapour barrier membrane to ensure they are clean, dry, sound, smooth and continuous.
- .2 Apply primer and air/vapour barrier membrane in dry weather conditions where ambient temperatures are in accordance with manufacturer's instructions. No installation work may be performed on surfaces exposed to inclement weather or when there is threat of precipitation.
- .3 Control exterior environmental conditions (hoarding and heating) for air/vapour barrier membrane installation occurring during the winter months to ensure that moisture does not condense on the structural backup. Use of propane or natural gas burners is not acceptable.
- .4 Do not install solvent based curing sealants or vapour release adhesive materials in enclosed spaces without ventilation.

## **1.7 SEQUENCING**

- .1 Co-ordinate work of this Section with all other applicable Sections to ensure continuity of the building envelope.

## **1.8 WARRANTY**

- .1 Provide an extended warranty for Work of this Section for a period of two (2) years from date of Substantial Performance of the Work. Contractor hereby warrants that membrane work will maintain air and water seal and will not lose adhesion or cohesion, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City.

## Part 2 Products

### 2.1 MATERIALS

- .1 Air/Vapour Barrier Membrane and Membrane Flashing: 1 mm thick self-adhering and self-gasketing (when penetrated under compression with self-tapping screws) membrane composed of bitumen modified with thermoplastic polymers and high density polyethylene film, 914 mm width. The under face is self-adhesive covered by a silicone release paper. Primer as recommended by manufacturer.

### 2.2 ACCESSORIES

- .1 Primer: blend of elastomeric bitumen (or synthetic rubber), volatile solvents, adhesive enhancing additives and resins used to prime substrate to enhance the adhesion of the self-adhesive membrane in varying outdoor temperatures as recommended by the membrane manufacturer.
- .2 Sealer: jointing mastic compatible with bituminous materials.
- .3 Liquid Membrane: two-component high performance polyurethane sealant, 100% solids in content.
- .4 Tapes: self-adhering type, maintaining a minimum thickness of 0.8 mm (30 mil), shall be provided in rolls of dimensions 100 mm and 150 mm.

### 2.3 SOURCE QUALITY CONTROL

- .1 Membrane materials must be approved by the manufacturer for use on the substrate to which it is being applied and for both the conditions during installation and for long-term operating conditions of the building.
- .2 Accessory products including primers, sealers, tapes, etc. that are in direct contact with or form part of the air/vapour barrier systems must be chemically and physically compatible with the materials to which they are being applied and must be approved for that use by their manufacturer and the manufacturers of the air/vapour barrier materials they contact.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Prior to commencement of work, examine all areas to receive sheet air/vapour barrier membrane.
- .2 Ensure that the air/vapour barrier material is structurally supported in all areas including transition areas according to the requirements of the National Building Code. The material must transfer all applicable loads to the appropriate structure support which can carry all the required loads.
- .3 Report in writing to the Contract Administrator, dynamic cracking in the substrate, cracking of greater than 3 mm in width, and any other defects in surfaces or conditions that may adversely affect the performance of products installed under this Section.

### 3.2 PREPARATION

- .1 Smooth, monolithic surfaces are required for proper membrane adhesion. Surfaces must be dry, and free of voids and sharp protrusions. Clean surface with a broom, vacuum cleaner, or compressed air to remove dust, and debris.
- .2 For applications onto cast-in-place concrete or concrete block, the surfaces should be adequately cured prior to application of air/vapour barrier membrane. Carry out an adhesion test before the installation of the membrane.

- .3 Apply primer in 2-coat application over exterior fiberglass faced gypsum board by means of a roller or spray at a coverage of 0.30 litres/m<sup>2</sup> in accordance with manufacturer's instructions. Allow primer to thoroughly dry before applying the self-adhesive membrane.
- .4 Prime only the area which will be covered with membrane in a working day. Areas not covered with membrane in 24 hours must be reprimed. Dry primed surfaces should be covered immediately where contaminants from the air are accumulating on the surface.

### 3.3 INSTALLATION

- .1 Apply air/vapour barrier membrane and all other materials in accordance with manufacturer's written instructions.
- .2 Detail work must be carefully carried out to ensure the air/vapour barrier membrane creates a continuous seal at all construction elements such as foundations, roofs and walls, and at junctures of different materials or construction types. Where installation cannot be carried out using the primary membrane materials, select other materials which may suit the application.
- .3 Install the membrane onto the primed surface by peeling back the paper on the underside and adhering the membrane to the surface. Apply hand pressure over the surface of the membrane in order to remove any trapped air beneath the membrane followed by pressure with a hand roller over entire surface to ensure perfect adhesion of the membrane to the surface.
- .4 Where masonry anchors are already in place prior to the membrane installation, install the membrane horizontally beginning from the bottom of the wall area and work in an upwards direction along the wall surface. At the top of the membrane, strip bend a 50 mm width, and place the lower edge of the membrane strip onto the row of masonry ties below. Start applying hand pressure onto the membrane at its centre, working outwards lengthwise to its extremities, taking care to avoid trapping air beneath the membrane. At the top edge of the membrane strip, where the membrane has been folded back, neatly slit the membrane from the point of contact with the masonry ties outwards towards its edge. Press and adhere the membrane to the wall surface at either side of the masonry ties. Seal all masonry ties at their contact with the membrane with bituthene mastic.
- .5 Subsequent sheets applied above must overlap the sheet below minimum of 50 mm. End laps in the membrane shall maintain a minimum overlap of 50 mm. Stagger vertical joints minimum 300 mm. Apply pressure with a roller over the entire membrane surface to ensure perfect adhesion.
- .6 Carefully install membrane around openings in the wall in such a manner as to prevent air leak at these areas. Install air/vapour barrier membrane to create a continuous seal at construction elements and at junctures of different materials or construction types.
- .7 Double cover all inside and outside corners with initial strip of membrane minimum 300 mm wide, centred on axis of corner. Cover this strip completely with regular application of membrane. Outside corners must be free of sharp edges. Inspect surfaces adjacent to all corners and repair if necessary to provide smooth dense surface.
- .8 Co-ordinate installation of the air/vapour barrier membrane with the roofing trade to ensure continuity of the wall air/vapour barrier membrane with the roofing system vapour barrier.
- .9 At the end of each working day, if the wall area has been only partially covered, apply a bead of mastic along the top edge of the membrane to prevent vertical drainage of precipitation from running in behind the membrane.
- .10 Before covering the membrane with the cavity insulation, inspect and repair as necessary any damaged areas. Cavity insulation shall follow as closely as possible the installation of the membrane.



- .11 Apply transition membrane to prepared surfaces as indicated on the drawings and as required by site conditions. Follow manufacturer's recommendations when installing air/vapour barrier membranes across unsupported openings (e.g., around windows, below edge beams, etc.).

### **3.4 REPAIR**

- .1 Patch and repair misaligned or inadequately lapped seams, tears, punctures or fishmouths to the satisfaction of the independent testing agency and Contract Administrator.
- .2 Patch defects by bonding an additional layer of air/vapour barrier membrane extending minimum 150 mm in all directions from defect and make air tight. Seal around its edges with mastic.

### **3.5 FIELD QUALITY CONTROL**

- .1 Commissioning (including site inspection and testing) of air/vapour barrier membrane installation will be carried out by an independent testing agency paid for by this Section and approved by The City and Contract Administrator.
- .2 Testing procedures of air/vapour barrier mockup to include:
  - .1 Air tightness testing in substantial conformance with the procedures found in ASTM E783. Acceptable criteria - maximum air leakage: 0.05L/sec/m<sup>2</sup> @ 75 pa.
  - .2 Adhesion testing in substantial conformance with the procedures found in ASTM D4541. FIXED-ALIGNMENT ADHESION TESTER, TYPE I to be used for ASTM D4541 membrane adhesion testing. (Com-Ten Portable Fastener Tester is acceptable under Type I). Minimum acceptable bond shall be  $\geq 16$  psi. Membrane shall retain 95% of original bond.
  - .3 Air tightness testing in substantial conformance with the procedures found in ASTM E1186.
- .3 Once tested and approved by independent testing agency, mock-up will set a standard of acceptance for all other installations. Following this, review and testing will be performed at random areas during installation.
- .4 Random field testing of air/vapour barrier membrane installation to include:
  - .1 Air tightness testing of membrane seams, lap joints, and seal to masonry ties and penetrations in substantial conformance with the procedures found in ASTM E1186.
  - .2 Adhesion testing in substantial conformance with the procedures found in ASTM D4541. FIXED-ALIGNMENT ADHESION TESTER, TYPE I to be used for ASTM D4541 membrane adhesion testing. (Com-Ten Portable Fastener Tester is acceptable under Type I). Minimum acceptable bond shall be  $\geq 16$  psi. Membrane shall retain 95% of original bond.
- .5 Air/vapour barrier trade will be responsible for all re-testing costs associated with return visits by the independent testing agency as a result of work that has failed inspection or testing procedures.
- .6 Assist independent testing agency with the performance of his duties by providing him access to scaffolding, swing stages, etc.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.7 PROTECTION**

- .1 Protect finished work from damage after installation.
- .2 Once approved by independent testing agency, cover membrane with building insulation as soon as possible protect the membranes from weather, excessively high temperatures, and damage by other trades.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.

### **1.2 REFERENCE STANDARDS**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM E408-13(2019), Standard Test Method for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-51.33-M89, Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Include reflective vapour barrier membrane installation details at typical joints and junctions between assemblies, and at all penetrations through membrane.
  - .2 Include manufacturer's technical data sheets.

### **1.4 QUALITY ASSURANCE**

- .1 Mock-Ups:
  - .1 Construct mock-up of reflective vapour barrier installation including one lap joint, one inside corner and at one electrical box. Mock-up may be part of finished work.
  - .2 Mock-up will be used to judge quality of work, substrate preparation, and material application.
  - .3 Locate where directed.
  - .4 When accepted, mock-up will demonstrate minimum standard of quality required for this work.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver all materials to site in the manufacturer's original packaging and standard commercial containers. Packaging to contain manufacturer's name, product name and identification number and other related information.
- .2 Provide and maintain dry, off-ground weatherproof storage. Store roll materials on end, and protect materials from direct sunlight, extreme temperatures, moisture conditions, chemicals, solvents, etc., as per manufacturer's recommendations. Remove only in quantities required for same day use.
- .3 Cleaning in accordance with Section 01 74 00.
- .4 Waste Management and Disposal in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Reflective Vapour Barrier: to CAN/CGSB-51.33, Type 1, and ASTM E408, Method A, foil faced radiant and vapour barrier for sauna construction.

### **2.2 ACCESSORIES**

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.
- .2 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install reflective vapour retarder on wall and ceiling assembly as indicated on drawings, prior to installation of cedar finish, to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

### **3.3 PERIMETER SEALS**

- .1 Seal perimeter of reflective vapour barrier as follows:
  - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.
  - .2 Lap sheet over sealant and press into sealant bead.
  - .3 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

### **3.4 LAP JOINT SEALS**

- .1 Seal lap joints of reflective vapour barrier as follows:
  - .1 Attach first sheet to substrate.
  - .2 Apply continuous bead of sealant over solid backing at joint.
  - .3 Lap adjoining sheet minimum 75 mm and press into sealant bead.
  - .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

### **3.5 ELECTRICAL BOXES**

- .1 Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:
  - .1 Wrap boxes with film sheet providing minimum 300 mm perimeter lap flange.
  - .2 Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 07 62 00 – Sheet Metal Flashing and Trim.
- .2 Section 07 92 00 – Joint Sealants.
- .3 Section 09 91 13 – Exterior Painting.
- .4 Section 23 73 00.16 – Air Handling Units – Packaged.

**1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
  - .2 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .3 ASTM E84-21a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 National Building Code of Canada (NBCC).

**1.3 SYSTEM DESCRIPTION**

- .1 Design Requirements.
  - .1 Design acoustic barrier panel system, including its support and attachments to resist positive and negative wind loads in accordance with the requirements of the 2010 National Building Code of Canada, Climatic Information for Building Design for Place of Work.
- .2 Performance Requirements.
  - .1 Acoustical performance of the panels shall be equal to or greater than the following in accordance with ASTM C423 and shall perform as such that noise will not exceed 55 dba from 4575 mm to 5485 mm (15’-0” to 18’-0”) away:

dB Noise Reduction

Octave Frequency (Hz)	63	125	250	500	1K	2K	4K	8K
Noise Reduction Coefficient	0.18	0.75	1.02	1.07	0.98	0.89	0.8	0.86
Transmission Loss (TL)	21	21	30	41	52	59	64	67

Vibro-Acoustics

Octave Band (Hz)	63	125	250	500	1K	2K	4K	8K
Absorption Coefficients	-	0.7	0.9	0.99	0.99	0.9	0.8	-
Transmission Loss (dB)	18	21	27	37	48	54	54	54

**1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Shop Drawings.
  - .1 Submit shop drawings in accordance with Section 01 33 00.
  - .2 Each drawing submission to bear the signature and stamp of a qualified professional Engineer licensed in the jurisdiction of the Place of the Work.
  - .3 Acoustic barrier panel system complete with steel reinforcing to be engineered to meet the requirements of 2010 National Building Code of Canada, Climatic Information for Building Design for at the Place of the Work.
  - .4 Provide product certificates signed by manufacturer of acoustic barrier panel system certifying that products comply with specified acoustical performance requirements specified.

- .5 Indicate panel layout, elevations, gauge of materials, weight loading, core thicknesses, finishes, field connection details, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .6 Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds.
- .2 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

## 1.5 QUALITY ASSURANCE

- .1 Qualifications.
  - .1 Skilled tradespersons to be employed by specialty company recognized and trained as approved installer by manufacturer, normally engaged in this type of work with minimum five (5) years extensive experience in installation of products specified on projects of equal or greater size and degree of complexity. Information confirming this criteria may be requested by Contract Administrator.
- .2 Regulatory Requirements.
  - .1 Metal panel materials including acoustical media to meet flame spread classification 15 and smoke development rating 5 when tested in accordance with ASTM E84.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, level, firm, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## Part 2 Products

### 2.1 MANUFACTURED UNITS

- .1 Basis of Design Products.
  - .1 Acoustic Barrier Panel System.
    - .1 dB Noise Reduction Noise Control Enclosure System.  
[www.dbnoisereduction.com](http://www.dbnoisereduction.com)
    - Vibro-Acoustics Acoustic Enclosure System.  
[www.vibro-acoustics.com](http://www.vibro-acoustics.com)
  - .2 Heavy Duty Spring Loaded Door Stops (each door).
    - .1 Grainger #1XMK7 Heavy Duty Spring Door Stop.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
- .3 Supply all products from single manufacturer.

## **2.2 MANUFACTURED UNITS**

- .1 Barrier Wall Absorption Panels: to ASTM A653/A653M, 150 mm thick tongue and groove, exterior sheet minimum 18-gauge, G90-galvanized steel, interior sheet minimum 22-gauge, G90-galvanized perforated steel, factory finished prime coated, panels filled with mineral wool media. Panel height to extend a minimum of 915 mm above height of air handling unit. Include 50 mm thick panels installed on building face extending from top of barrier down to 1830 mm.
- .2 Structural Support Steel: structural steel shall be provided by the acoustic barrier panel system manufacturer with maximum deflection of assembled panels  $L/180$ . Structural to structural steel connections shall be fully welded. Finish: galvanized finish to all structural steel members.
- .3 Acoustical Media: incombustible, acoustical quality, shot-free non-bagged mineral wool with long, resilient fibers bonded with a thermosetting resin, and shall be packed with 15% compression during panel assembly. Media shall be bacteria and fungus resistant and conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel.
- .4 Acoustic Aerodynamic Baffles: spanning in short direction, from building face to south barrier, 150 mm thick, 760 mm deep, installed at 300 mm on-centre over fluid cooler fans.
  - .1 Or similar additional acoustic treatment over and beyond perimeter enclosure, as required to meet performance stated in paragraph 1.3.2.1.
  - .2 Confirm final size, width, and spacing of baffles as required to meet performance stated in paragraph 1.3.2.1.
- .5 Access Doors: doors shall be provided as noted on the plans with the same construction as the acoustic panels, except that the interior sheet shall be solid. Door shall be mounted in a 10-gauge, galvanized steel angle frame with a single “P” gasket. Hardware shall include two (2) cam-type Ventlok 310 latches, two (2) butt hinges, and custom built padlock hasps. Locking by the City.
- .6 Heavy Duty Spring Loaded Door Stops (each door): 650 mm long zinc plated steel wrapped in vinyl (gray) lear resistant cover, draw bar spring on both ends to keep door from opening too far and to reduce stress on door hinges and closers.
- .7 Isolation Coating: direct to metal coating as recommended by manufacturer.

## **2.3 FINISH**

- .1 Final finish of panels and steel supports by Section 09 91 13.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install acoustic barrier panel system, including all clips, fasteners, joint fillers, trims, furring channels, baffles, flashings, etc. plumb, level and true, and in proper alignment and anchored securely in place in accordance with reviewed shop drawings and manufacturer’s printed instructions.
- .2 Provide isolation coating between galvanized meals and dissimilar metals on exterior walls and structural steel to prevent galvanic or corrosive action.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Promptly clean all panel surfaces with dry wipe after removal of protective coating as installation progresses to remove all stains and marks caused during installation in accordance with recommendations of panel manufacturer.



- .2 Wipe finished surfaces of filings caused by drilling or cutting to prevent discolouration or rust stains resulting from the installation process.
- .3 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.
- .2 Section 07 21 00 – Thermal Insulation.
- .3 Section 07 26 00 – Air/Vapour Barrier Membrane – Self Adhesive.
- .4 Section 07 62 00 – Sheet Metal Flashing and Trim.

### **1.2 REFERENCES**

- .1 American Association of Textile Chemists and Colorists (AATCC).
  - .1 AATCC 127-03, Water Resistance: Hydrostatic Pressure Test.
- .2 American Society for Testing and Materials (ASTM).
  - .1 ASTM A653/A653M-19a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM E84-19b, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .3 ASTM E96/E96M-16, Standard Test Methods for Water Vapor Transmission of Materials.
- .3 National Building Code of Canada (NBCC), 2010.

### **1.3 SYSTEM DESCRIPTION**

- .1 System Description
  - .1 Exterior wall cladding and soffit system consisting of exterior grade solid phenolic panels, complete with required closures, fasteners, trims and accessories.
  - .2 Fastening method consisting of concealed fixed brackets on horizontal carrier rails.
  - .3 Open joints at vertical and horizontal joints and at corners.
- .2 Design Requirements.
  - .1 Design members to withstand dead load and wind loads calculated in accordance with NBCC and applicable local regulations, to maximum allowable deflection of 1/180<sup>th</sup> of span.
  - .2 Provide for positive drainage of condensation occurring behind panels and water entering at joints, to exterior face of panels in accordance with NRC “Rain Screen Principles.”
  - .3 Design system to provide for thermal movement of component materials caused by ambient temperature range of 80°C without causing buckling, failure at joint seals, undue stress on fasteners or other detrimental effects.
  - .4 Design wall cladding to accommodate movement in wall system and between wall system and building structure, caused by structural movements, without permanent distortion, damage, racking of joints, breakage of seals, or water penetration.
  - .5 Maximum deviation from vertical and horizontal alignment of erected panels: 1 to 1000.
- .3 Performance Requirements.
  - .1 Provide panels that have been manufactured, fabricated and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

#### **1.4 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Shop Drawings.
  - .1 Shop drawings to bear signature and stamp of qualified Professional Engineer registered in jurisdiction of Place of Work.
  - .2 Include design calculations attesting to the ability of the panel assembly to withstand the specified loads, including inward and outward loads, and loads under fastenings to the structure.
  - .3 Indicate details of panel system, including exterior building elevations indicating compartmentalization, profiles and product components, including edge conditions, panel joints, fixture location, anchorage, details of subgirt system, fastener spacing, accessories, finish colours, patterns and textures. Changes to fasteners or system must be approved by Contract Administrator.
  - .4 Identify panels as to building location to facilitate panel removal and replacement due to construction and/or occupant damage. Disassembly drawings to show location of points at which disassembly may be most easily started so that replacement of panels may be performed efficiently, with same neat finish as originally installed.
  - .5 Show factory punched slotted weep/vent holes at bottom edge of all panels.
- .3 Samples.
  - .1 Submit 400 mm x 400 mm sample of phenolic wall panels.
  - .2 Sample to consist of actual panel thickness and in selected finish, and to include all necessary components to show vertical and horizontal joint between adjacent panels.

#### **1.5 QUALITY ASSURANCE**

- .1 Qualifications.
  - .1 Phenolic panel fabricator to have minimum five (5) years' experience with phenolic panel and with product fabrication of phenolic panels into phenolic panel assemblies as detailed.
  - .2 Installation of phenolic panel assemblies to be carried out by phenolic panel fabricator's trained installation crew employed by fabricator, or company approved by phenolic panel fabricator. Installers of phenolic panel system to have minimum of five (5) years' experience with installation of specified phenolic panel system on projects of equal or greater size and degree of complexity. Information confirming this criteria may be requested by Contract Administrator. Phenolic panel fabricator to take full responsibility for installation.
- .2 Mock-ups.
  - .1 Provide mock-up of phenolic panel system in location(s) identified by Contract Administrator and in accordance with Sections 01 45 00.
  - .2 Include air/vapour barrier membrane and incorporate outside corner of building.
  - .3 Mock-ups to be full size assemblies located on site as part of final installation.
  - .4 Install mock-ups for review of construction and co-ordination with work of other Sections.
  - .5 Once approved, mock-up will set standard of acceptance for remaining installations.

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

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.

- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 11.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## 1.7 WARRANTY

- .1 Manufacturer's Product Warranty: provide a warranty for Work of this Section from date of Substantial Performance of the Work. Manufacturer hereby warrants solid phenolic panels to be free of manufacturing and material defects and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and The City, and at no expense to The City.
- .2 Manufacturer's Product Warranty: provide an extended warranty for Work of this Section for a period of 10 years from date of Substantial Performance. Manufacturer hereby warrants building paper to be free of manufacturing and material defects, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and The City, and at no expense to The City.

## Part 2 Products

### 2.1 MANUFACTURERS

- .1 Acceptable Products.
  - .1 Phenolic Panels.
    - .1 Trespa Meteon, Manufacturers entire colour range.
    - .2 Fundermax, Manufacturers entire colour range.
  - .2 Clip System: Monarch Metal Inc. MFSSCHAN with horizontal channel rail.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
- .3 Supply similar products from single manufacturer.

### 2.2 MATERIALS

- .1 Phenolic Panels.
  - .1 Flat panels composed of thermosetting resin homogenously reinforced with cellulose fibres and manufactured under high pressure and temperature with integrated decorative surface.
    - .1 Panel Size: Custom panel sizes as required cut from full panel sizes; Refer to drawings. Allow for 19mm lift off clearance to raise the panel over its resting height to mount the panel.
    - .2 Panel Thickness: 12mm panel with laser cut patterns, as drawn, on 6 mm panel, black.
    - .3 Installation: suspension system, comprised of fixed brackets secured to backside of panel (exposed fastener not acceptable) and suspended on horizontal carrier rails.
    - .4 Joints: sheet metal cavity closures.
  - .2 Clip System: intermittently spaced, complete with purpose made steel horizontal and vertical sub-girts designed for structural attachment of cladding to exterior wall assemblies, consisting of:
    - .1 Low-conductivity fiberglass thermal spacers fastened to substrate with corrosion resistant coated steel fasteners and designed to accept either vertical or horizontal factory pre-punched 18-gauge, galvalume steel sub-girts. Refer to drawings.

- .2 Two component corrosion resistant stainless steel channels (25mm deep x 45mm high x 1220mm long) and z-clips (89mm long x 38mm high). Z-clip fastened to phenolic panel for a hidden-fastening system, and slipped on horizontal channel mechanically fastened to vertical strapping substrate.
- .3 Fasteners.
  - .1 Provide fasteners of size, type, diameter, length, type, quantity, and spacing to meet design and performance requirements specified. Provide neoprene washers to fit between panels and backing to set off panels to allow moisture drainage.
  - .2 Fasteners to be stainless steel and concealed at all locations.
- .4 Sheet Metal Cavity Closures: 0.6 mm (24-gauge) galvanized sheet metal cavity closures of profile shown on drawings.
- .5 Rigid Insulation: in accordance with Section 07 21 00.
- .6 Air/Vapour Barrier Membrane - Self-Adhesive: in accordance with Section 07 26 00.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Inspect work of others upon which work of this Section depends. Surfaces and openings to receive panels to be within acceptable tolerances of +/- 3 mm. In addition, surfaces and openings to be even, smooth, sound, clean, dry and free from defects detrimental to work. Notify Contract Administrator in writing of any defects or irregularities which would affect performance or appearance of work of this Section.
- .2 Take field measurements prior to completion of shop manufacturing and fabrication.

#### **3.2 INSTALLATION**

- .1 Clip System.
  - .1 Install clip system complete with purpose made sub-girts in proper alignment and anchored securely in place in accordance with reviewed shop drawings and manufacturer's printed instructions. Maximum deviation from plane alignment of installed panels not to exceed 6 mm in 6 m.
  - .2 Install sub-girts/furring channels plumb, level and true and in proper alignment and anchor securely in place to accommodate wall insulation and metal wall/soffit panels.
  - .3 Install wall insulation in accordance with Section 07 21 00.
- .2 Install phenolic panel assembly plumb, level and true and in proper alignment and anchored securely in place with manufacturer suspension system and in accordance with reviewed shop drawings and manufacturer's written instructions. Maintain the following tolerances:
  - .1 Maximum variation from plane or location: 10 mm in 10 m of length and up to 20 mm in 100 m.
  - .2 Maximum deviation for vertical members: 3 mm in an 8.5 m run.
  - .3 Maximum deviation for a horizontal members: 3 mm in an 8.5 m run.
  - .4 Maximum offset from true alignment between two adjacent members abutting end to end, in line: 0.76 m.
- .3 Fasten panel assembly to sub-girts in manner which transmits all loads to main structure without exceeding capacity of any fastener. Consult panel manufacturer for location, type, and frequency of fasteners.

- .4 Fastening systems connecting wall panels to back-up walls and/or support structures not to compromise performance of air/vapour barrier membrane specified in Section 07 26 00 with respect to air leakage and water penetration.
- .5 Conform to panel manufacturer's written instructions for installation of concealed fixed brackets and horizontal carrier rails.
- .6 Compartmentalize phenolic panel system in accordance with reviewed shop drawings.
- .7 Install inside and outside corners, closure panels, sill flashings, and exposed trim as detailed.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
  - .1 Leave Work area clean at end of each day.
  - .2 Promptly clean all panel surfaces with dry wipe as installation progresses to remove all stains and marks caused during installation in accordance with recommendations of panel manufacturer.
  - .3 Repair or replace damaged or defective installed materials to Contract Administrator's acceptance.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
  - .1 Remove PVC protection film after installation.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .4

### **3.4 PROTECTION**

- .1 Protect installed product and finish surfaces from damage during construction.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A653/A653M-18, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .2 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .3 ASTM B209-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - .4 ASTM D1005-95(2013), Standard Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers.
  - .5 ASTM D1187/D1187M-97(2018), Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
- .2 Canadian Roof Contractor's Association (CRCA).
  - .1 CRCA Roofing Specification Manual, as amended to date.
- .3 Canadian Standards Association (CSA).
  - .1 CSA S136-16, North American Specification for the Design of Cold-Formed Steel Structural Members.

### **1.3 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Galvanized Sheet Steel: 16-gauge, 18-gauge, 22-gauge and 24-gauge continuous hot-dip Z275 zinc coated (galvanized) steel conforming to requirements of ASTM A653/A653M, regular spangle surface.
- .2 Prefinished Sheet Steel: 18-gauge, 22-gauge and 24-gauge continuous hot-dip Z275 zinc coated (galvanized) steel, conforming to requirements of ASTM A653/A653M factory finished to ASTM D5796 with factory applied Valspar WeatherXL or Baycoat Perspectra Series Plus Series paint coating.

### **2.2 ACCESSORIES**

- .1 Joint Sealants: in accordance with Section 07 92 00.
- .2 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide.

- .3 Exposed fasteners: stainless steel purpose made, head colour same as flashing.
- .4 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .5 Bitumen Protective Coating: to ASTM D1187/D1187M.
- .6 Touch-up Paint: as recommended by prefinished material manufacturer.

### **2.3 FABRICATION**

- .1 Fabricate metal flashings including steel cap flashings, through wall steel flashings, steel closure strips, fascia, trims, and other sheet metal work to applicable CRCA FL series specifications and as detailed.
- .2 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 12 mm. Mitre and seal corners with sealant.
- .4 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .5 Downspouts: indicated size and profile formed from 22-gauge prefinished steel sheet. Downspouts to be closed (4-sided) upper portion and (3-sided) open lower portion (refer to drawings), prefinished material on all exposed surfaces, colour to be selected by Contract Administrator.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Flashings and Trim.
  - .1 Install steel sheet metal flashings and trim as detailed.
  - .2 Use concealed fastenings except where approved by Contract Administrator before installation.
  - .3 Install steel sheet metal counterflashing over modified bitumen membrane flashings at intersections of roof with vertical surfaces and curbs. Form joints using S-lock connection with tight fit over hook strips. Lock end joints and caulk with sealant.
  - .4 Apply isolation coating to metal surfaces to be embedded in concrete, mortar, and other dissimilar metals.
- .2 Install downspouts as detailed.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 04 22 00 – Concrete Unit Masonry.
- .2 Section 09 21 16 – Gypsum Board Assemblies.
- .3 Mechanical Specifications.
- .4 Electrical Specifications.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM C679-15(2022), Standard Test Method for Tack-Free Time of Elastomeric Sealants.
  - .2 ASTM D6904-03(2022), Standard Practice for Resistance to Wind Driven Rain for Exterior Coatings Applied on Masonry.
  - .3 ASTM E84-21a, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .4 ASTM E119-20, Standard Test Methods for Fire Tests of Building Construction and Materials.
  - .5 ASTM E595-15(2021), Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment.
  - .6 ASTM E814-13a(2017), Standard Test Method for Fire Tests of Penetration Firestop Systems.
  - .7 ASTM E1966-15(2019), Standard Test Method for Fire-Resistive Joint Systems.
  - .8 ASTM E2174-20a, Standard Practice for On-Site Inspection of Installed Fire Stops.
  - .9 ASTM E2307-20, Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus.
  - .10 ASTM E2393-20a, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
  - .11 ASTM G21-15(2021)e1, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 Firestop Contractors International Association (FCIA).
  - .1 FCIA Manual of Practice (MOP) 7th Edition, 2018.
- .3 International Firestop Council (IFC).
  - .1 IFC 401 Inspection Manual for Firestopped through Penetrations, Joints, Perimeter Fire Barrier Systems, and Fire Rated Duct Enclosures Systems, 5th Edition, 2016.
  - .2 Recommended IFC Guidelines for Evaluating Firestop Systems Engineering Judgments, 2018.
- .4 National Building Code of Canada (NBCC).
- .5 National Fire Protection Association (NFPA).
  - .1 NFPA 101: Life Safety Code, 2021 Edition.
- .6 National Research Council Canada.
  - .1 Best Practice Guide on Fire Stops and Fire Blocks and their impact on Sound Transmission, June 2007.
- .7 Underwriter's Laboratories (UL).
  - .1 UL 1479-14, Standard for Fire Tests of Through-Penetration Firestops.
  - .2 UL 2079-04 (R2014), Standard for Tests for Fire Resistance of Building Joint Systems.

- .8 Underwriter's Laboratories of Canada (ULC).
  - .1 CAN/ULC S101-14-Rev3, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC S102-18-Rev1, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC S115-18, Standard Method of Fire Tests of Fire Stop Systems.
  - .4 ULC List of Equipment and Materials Firestop Systems and Components 2010 Edition.

### **1.3 DEFINITIONS**

- .1 Firestopping: material or combination of materials used to retain integrity of fire-rated construction by maintaining effective barrier against spread of flame, smoke, and hot gases through penetrations in joints between fire-rated wall and floor assemblies.
- .2 Through-penetration: opening or foreign material, pipes, conduits, ducts, cable trays, cable, wire, structural components or any other element passing completely through opening in fire-rated barrier/assembly such that full thickness of rated material(s) is breached either in total or in part.
- .3 Membrane penetration: any penetration of fire-rated barrier that breaches one side but does not pass completely through to other side, including recessed electrical devices.
- .4 System: combination of specific materials and/or devices, including penetrating item(s) required to complete firestop, as tested by independent third party test facility.
- .5 Barrier/Assembly: wall, floor, ceiling or roof assembly or other partition with fire-smoke rating of 0,1,2,3 or up to 4-hours.
- .6 Fire Resistive Joint: any joint or opening, whether static or dynamic, within or between adjacent sections of fire rated interior or exterior walls, floors, ceilings or roof decks.
- .7 Fireblocking: building materials installed to resist the free passage of flame, smoke and toxic gases to other areas of building through concealed spaces.
- .8 Perimeter Fire Barrier System: perimeter joint protection that provides fire resistance to prevent passage of fire from floor to floor within building at opening between exterior wall assembly and floor assembly.
- .9 Intumescent: materials that expand with that to seal around objects threatened by fire.
- .10 F-Rating: time firestop, penetration item, building, material, firestop material, can withstand direct flame without burn through as tested to CAN/ULC S115.
- .11 T-Rating: amount of time through-penetration firestop limits temperature rise on cold side-outside test furnace - as tested to CAN/ULC S115.
- .12 W-Rating Water Leakage Test: systems tested and listed in accordance with UL 1479.
- .13 L-Rating: the amount of air that moves through an opening in cubic feet per minute per square foot of opening area or per lineal foot of joint, at ambient temperatures and 400F - as tested to CAN/ULC S115.

### **1.4 SYSTEM DESCRIPTION**

- .1 Provide firestopping as indicated and in accordance with NBCC and NFPA 101, composed of components that are compatible with each other, substrates forming openings, and items, if any, penetrating firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.

- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by firestopping manufacturer and approved by qualified testing agency for designated fire-resistance-rated systems.
- .3 Firestopping Materials are either “cast-in-place” (integral with concrete placement) or “post installed.” Provide cast-in-place firestop devices prior to concrete placement.
- .4 Provide firestopping with mould and mildew resistance rating of ZERO in accordance with ASTM G21.
- .5 Provide firestopping of smoke barrier penetrations with L-Rating not exceeding 5.0 cfm/sq. ft. or 5.0 cfm/ln. ft. of penetration or joint opening at both ambient and elevated temperatures in accordance with CAN/ULC S115.
- .6 Use only firestop systems that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance and as follows:
  - .1 New and existing service penetrations for passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through new and existing fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
  - .2 Openings between structurally separate sections of wall or floors.
  - .3 New and existing joints (gaps) between top of walls and ceilings or roof assemblies.
  - .4 New and existing wall-to-wall joints (gypsum board to concrete or concrete block walls or control/expansion joints for masonry, concrete or gypsum board).
  - .5 New and existing joints between the bottom of walls (gypsum board to floor system).
  - .6 Control or expansion joints in walls and floors.
  - .7 Openings and penetrations in fire-rated partitions or walls containing fire doors.
  - .8 Openings around structural members which penetrate floors or walls.
  - .9 Systems installed to allow and be designed to accommodate movement (expansion) in all joints as indicated on architectural / structural drawings/specifications and plumbing pipes and sprinkler pipes that require movement during the activation of these systems.
  - .10 Openings around structural members, which penetrate horizontal and vertical fire separations and their fire-resistant membranes.
  - .11 Fire-rated cable pathway devices.
  - .12 Marriage joints between fire rated duct wrap to fire rated floor and wall assemblies.

## **1.5 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00 – Submittals Procedures.
- .2 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for application. Engineered judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- .3 Submit material safety data sheets (MSDS) provided with product delivered to jobsite. MSDS to include following:
  - .1 Technical data on out-gassing; off-gassing and age testing.
  - .2 Curing time.
  - .3 Chemical compatibility to other construction materials.
- .4 Provide certification by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOC's), are non-toxic to building occupants, and comply with following:
  - .1 ASTM E595.

- .2 EPA Method 24.
- .3 Volatile Content: below 250 g/l.
- .4 Silicone firestop not permitted.
- .5 Design system listings to show proposed material, including technical data, reinforcement, anchorage, fastenings and method of installation. Construction details to accurately reflect actual job conditions.

## **1.6 QUALITY ASSURANCE**

- .1 Installer Qualifications.
  - .1 Manufacturer to employ fire protection engineers having minimum five (5) years' experience with manufacturers' design systems. Provide proof of experience upon Contract Administrator's request.
  - .2 Fire protection engineer to oversee project, and provide engineered judgments as required to suit building conditions and Authorities Having Jurisdiction. All Engineered Judgments shall conform to IFC 401 and manufacturer shall be member in good standing with the IFC or FCIA. Provide proof of membership upon Contract Administrator's request.
  - .3 Work is to be undertaken by experienced Site Supervisor in their trade of material or system being used with a minimum of five (5) working years of experience utilizing that material/system, and shall provide a list of not less than five (5) successfully completed projects of similar scale and type.
  - .4 Firestop Contractor shall be a member in good standings with FCIA for a minimum of two years, and who is certified, licensed, or otherwise qualified by firestop manufacturer as having necessary experience, staff, and training to install manufacture's products per specified requirements. Provide proof of membership and certification upon Contract Administrator's request.
  - .5 Manufacturer/supplier's willingness to sell its firestopping products to Contractor or to installer engaged by Contractor does not in itself confer qualification on buyer.
  - .6 Installation Responsibility: assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.
  - .7 When installing non-preformed devices, the work is to be installed by a contractor with at least one of the following qualifications:
    - .1 FM 4991 Approved Contractor.
    - .2 UL Approved Contractor.
    - .3 Hilti Accredited Fire Stop Specialty Contractor
- .2 Regulatory Requirements.
  - .1 Firestop System installation must meet requirements of CAN/ULC S115 tested assemblies that provide fire rating as shown.
  - .2 Proposed firestop materials and methods to conform to applicable governing codes having local jurisdiction.
  - .3 For those firestop applications that exist for which no ULC or cUL tested system is available through manufacturer, manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by IFC 401.
  - .4 A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

- .3 Firestopping systems are not intended to reestablish structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Consult Contract Administrator prior to penetrating any load bearing assembly.
- .4 Firestopping material to be free of asbestos, PCB and lead, and cannot incorporate nor require the use of hazardous solvents.
- .5 Firestopping material must have visibly labeled expiration or packaging date and **must be within the manufacturer specified shelf life at time of installation**. Installation of firestopping material past its specified shelf life is strictly prohibited and will be rejected. Contractor to verify shelf life with Contract Administrator prior to installation.
- .6 Verify on-site to Contract Administrator prior to firestopping installation on all phases of construction that firestopping material is not damaged or frozen or has not exceeded manufacturer's expiry date identified on product or packaging. All firestopping materials must be installed prior to expiration of shelf life.
- .7 Mock-up a minimum of 25% of the proposed ULC or cUL system in accordance with Section 01 45 00.
  - .1 If required, include work by other trades to provide required finish work, such as steel stud / gypsum board trade framing out multi-penetrations openings.
  - .2 Reviewed mock-ups become standard of workmanship and material against which installed work will be checked. Reviewed and approved mock-ups may be used in final construction.
  - .3 Once mock-ups have been completed and materials have had adequate time to properly cure, notify Contract Administrator to perform their review. Minimum 48 hours' notice is required.
- .8 Hold pre-installation meeting prior to commencement of firestop systems. Subcontractors that are affected, such as masonry, gypsum board/steel stud, mechanical and electrical subcontractors to attend. Review standard installation procedures, scheduling / sequencing of other work around or that affects outcome of installation, precautions, annular opening sizes, wall/floor service single and multi - preparations, joints and perimeter joints to ensure that all Subcontractors and Contractor understand full complexity of firestop installation, based on reviewed shop drawings.

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

- .1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- .2 Co-ordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- .3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged or expired materials.
- .6 Cleaning in accordance with Section 01 74 00.
- .7 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.8 SITE CONDITIONS**

- .1 Do not use materials that contain flammable solvents.
- .2 Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

- .3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- .4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed manufacturer's recommended limitations for installation printed on product label and product data sheet.
- .5 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
- .6 Schedule installation of Drop-In firestop devices after placement of concrete but before installation of the pipe penetration. Diameter of sleeved or cored hole to match the listed system for the device
- .7 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

## **1.9 WARRANTY**

- .1 **Manufacturer's Product Warranty:** provide an extended warranty for Work of this Section for a period of two (2) years from date of Substantial Performance of the Work. Manufacturer hereby warrants firestopping products to be free of manufacturing defects, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City.
- .2 **Installation Contractor's Warranty:** provide an extended warranty for Work of this Section for a period of two (2) years from date of Substantial Performance of the Work. Contractor hereby warrants that firestopping will remain as installed, free from any defects and deficiencies, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City.

## **Part 2 Products**

### **2.1 PERFORMANCE REQUIREMENTS**

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- .3 Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.
- .4 Provide a round fire-rated cable management device whenever cables penetrate fire rated walls, where frequent cable changes and additions may occur. The fire-rated cable management device shall consist of a corrugated steel tube with zinc coating, contain and inner plastic housing, intumescent material rings, and inner fabric smoke seal membrane. The length of the sleeve shall be 12.4". The fire-rated cable management device shall contain integrated intumescent firestop wrap strip materials sufficient to maintain the hourly rating of the barrier being penetrated. The fire-rated cable management device shall contain a smoke seal fabric membrane or intumescent firestop plugs sufficient to achieve the L-Rating requirements of the barrier type. Install device per the manufacturer's published installation instructions.

- .5 Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with CAN/ULC-S115-11
  - .1 F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.
- .6 Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with CAN/ULC-S115-11.
  - .1 F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
  - .2 T-Rating: when penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
  - .3 W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.
- .7 Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E814.
  - .1 L-Rating: Not exceeding 5.0 cfm/sq. ft. or 5.0 cfm/ln. ft. of penetration or joint opening at both ambient and elevated temperatures.
- .8 Mould Resistance: Provide penetration firestopping with mould and mildew resistance rating of 0 as determined by ASTM G21.
- .9 Rain and water resistance: provide perimeter joint sealant tested in accordance with ASTM D6904 with less than 1-hour tack free time as tested in accordance with ASTM C679.

## **2.2 MANUFACTURERS**

- .1 Basis of Design Products: subject to compliance with through penetration firestop systems and joint systems listed in ULC Fire Resistance Directory – Volume III or UL Products Certified for Canada (cUL) Directory.

## **2.3 MATERIALS**

- .1 Cast-in place and pre-installed firestop devices for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors.
- .2 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT).
- .3 Sealants or caulking materials for use with sheet metal ducts.
- .4 Sealants, caulking or spray materials for use with fire-rated construction joints and other gaps.
- .5 Pre-formed mineral wool designed to fit flutes of metal profile deck (as backer for spray material).
- .6 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe.
- .7 Foams, intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles.
- .8 Non curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles.
- .9 Wall opening protective materials for use with cUL/ULC listed metallic and specified nonmetallic outlet boxes.
- .10 Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems) tested to 50 Pa. differential.

- .11 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
- .12 Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
- .13 Sealants or caulking materials used for openings between structurally separate sections of wall and floors.
- .14 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected.
- .15 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls.
- .16 Cable discs for single or cable bundles up to 1” diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies.
- .17 Fire Barrier Insulation Block for expansion joints in fire-rated wall assemblies.
- .18 For penetrations through Fire Wall or horizontal Fire Separation provide firestop system with “FT” Rating as determined by ULC or cUL which is equal to fire resistance rating of construction being penetrated.
- .19 For joints provide firestop system with Assembly Rating as determined by CAN/ULC S115 or UL 2079 which is equal to fire resistance rating of construction being penetrated.

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
  - .2 Surfaces to which firestop materials will be applied to be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
  - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
  - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
  - .5 Do not proceed until unsatisfactory conditions have been corrected.

#### **3.2 CO-ORDINATION**

- .1 Co-ordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for work. Ensure device is installed before placement of concrete.
- .2 Responsible trade is to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interference.
- .3 Co-ordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems. Co-ordinate construction and sizing of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- .4 Co-ordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.



### **3.3 INSTALLATION**

- .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory or Omega Point Laboratories Directory, and FCIA MOP.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
  - .1 Seal all holes or voids made by penetrations to ensure air and water-resistant seal.
  - .2 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper performance of fire dampers as it pertains to duct work.
  - .3 Protect materials from damage on surfaces subjected to traffic.
- .3 Firestopping of New Fire Separations.
  - .1 Install firestopping to maintain the integrity of all new fire separations in new fire rated floors and walls whenever affected by the demolition and new construction including:
    - .1 Penetrations through and top of fire-resistance rated masonry, and gypsum board walls.
    - .2 Penetrations through fire-resistance rated floor assemblies.
    - .3 Intersections of fire-resistance rated masonry and gypsum board walls.
    - .4 Control joints in fire-resistance rated floor assemblies, and masonry and gypsum board walls.
    - .5 Openings and sleeves installed for future use through fire separations.
    - .6 Around mechanical and electrical assemblies penetrating fire separations.
    - .7 Rigid ducts greater than 129 cm<sup>2</sup> (20 in<sup>2</sup>): firestopping to consist of bead of firestopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
- .4 Firestopping of Existing Fire Separations.
  - .1 Install firestopping and/or restore integrity of existing fire separations in existing fire rated floor assemblies and walls whenever affected by the demolition and new construction.
  - .2 Patch and restore integrity of existing fire separations at openings in existing fire rated walls resulting from the demolition of doors, windows, ceilings, abutting walls, etc.
  - .3 Install firestopping and/or restore openings (i.e. abandoned and not required for future services, or replaced with services of a smaller size) in existing fire rated floor assemblies and walls remaining after the demolition and removal of mechanical pipes and or ducts and electrical services.
  - .4 Install firestopping at all new penetrations in existing fire separations.

### **3.4 FIELD QUALITY CONTROL**

- .1 Do not conceal firestopping installations until Contract Administrator's inspection agency or Authorities Having Jurisdiction have examined each installation.
- .2 Perform under this Section, patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- .3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.

- .4 Identify firestopping with pressure sensitive, self-adhesive preprinted vinyl warning labels. Attach labels permanently to surfaces of penetrated construction on both sides of all firestopping installations where the labels will be visible to anyone seeking to add to or remove penetrating items or firestopping at a future date. Photograph all installations for record purposes. Include the following information on all warning labels:
  - .1 The words: "WARNING FIRESTOPPING DO NOT DISTURB. NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE"
  - .2 Contractor's name, address and phone number.
  - .3 Firestopping system designation of applicable testing and inspecting agency (ULC or cUL).
  - .4 Date of installation.
  - .5 Firestopping product used and manufacturer's name.
  - .6 Installer's name.
- .5 Cut and remove systems for visual review by Contract Administrator and manufacturer's representative. Once review is completed and accepted, replace firestop system with new. For such exploratory reviews per approved design system listings, allow:
  - .1 Minimum of 2% of each service penetration design listing for each area of 900 m<sup>2</sup>;
  - .2 Cut test perimeter joints every 15 meters;
  - .3 Cut test bottom- and top-of-wall joints, wall-to-wall joints and building expansion joints every 15 meters minimum.
  - .4 All Exploratory Reviews (cut tests) must meet the Firestop Systems minimum thickness, depth and/or widths of the annular requirements. These reviews will be performed 28 days after the installation to allow for curing of the product as a minimum. The Contract Administrator will not accept the installed system to be below the system's minimum requirements (depth and width). Shrinkage of the product installation must be factored into all installations on this Project.

### **3.5 IDENTIFICATION AND DOCUMENTATION**

- .1 The firestop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration and joint location on the entire project.
- .2 The Documentation Form for through penetrations is to include:
  - .1 A Sequential Location Number.
  - .2 The Project Name.
  - .3 Date of Installation.
  - .4 Detailed description of the penetrations location.
  - .5 Tested System or Engineered Judgment Number.
  - .6 Type of assembly penetrated.
  - .7 A detailed description of the size and type of penetrating item.
  - .8 Size of opening.
  - .9 Number of sides of assemblies addressed.
  - .10 Hourly rating to be achieved.
- .3 The Documentation Form for Construction Joints is to include:
  - .1 A Sequential Location Number.
  - .2 The Project Name.
  - .3 Date of Installation.
  - .4 Detailed description of the Construction Joints location.
  - .5 Tested System or Engineered Judgment Number.
  - .6 Type of Construction Joint.
  - .7 The Width of the Joint.
  - .8 The Lineal Footage of the Joint.

- .9 Number of sides addressed.
- .10 Hourly rating to be achieved.
- .11 Installers Name.
  
- .4 Copies of these documents are to be provided to the general contractor at the completion of the project.
  
- .5 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
  - .1 The words: "Warning -Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
  - .2 Contractor's Name, address, and phone number.
  - .3 Through-Penetration firestop system designation of applicable testing and inspecting agency.
  - .4 Date of Installation.
  - .5 Through-Penetration firestop system manufacturer's name.
  - .6 Installer's Name.

### 3.6 ADJUSTING AND CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean off excess fill materials adjacent to openings as work progresses by methods and with cleaning materials recommended by firestopping manufacturer and that do not damage materials in which openings occur. Leave finished work in neat, clean condition with no evidence of spillovers or damage to adjacent surfaces.
  
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
  - .1 Provide final protection and maintain conditions during and after installation that ensure firestopping systems are without damage or deterioration at time of Substantial Performance of the Work. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping systems immediately and install new materials to produce firestopping systems complying with specified requirements.
  
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### 3.7 SCHEDULE OF THROUGH PENETRATION FIRESTOP SYSTEMS

CONCRETE FLOORS			CONCRETE OR BLOCK WALLS		
TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN cUL SYSTEM	TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN cUL SYSTEM
BLANK OPENINGS	1	F-A-0006, C-AJ-0055, C-AJ-0070, C-A-J-0138	BLANK OPENINGS	1	C-AJ-0055, C-AJ-0070
	2	F-A-0006, C-AJ-0055, C-AJ-0070, C-A-J-0138		2	C-AJ-0055, C-AJ-0070
	3	F-A-0006, C-AJ-0055, C-AJ-0086,		3	C-AJ-0055, C-AJ-0086
SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, F-A-1028, F-A-1017	SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, W-J-1067, W-J-1020
	2	C-AJ-1226, F-A-1028, F-A-1017		2	C-AJ-1226, W-J-1067, W-J-1020, W-J-1248
	3	C-AJ-1226, F-A-1017		3	C-AJ-1226, W-J-1041, W-J-1068
	4	C-BJ-1037, C-BJ-1034, F-A-1091		4	C-BJ-1034, C-BJ-1037, W-J-1041, W-J-1042, W-J-1068
SINGLE NON-METALLIC PIPE OR CONDUIT	1	F-A-2240, F-A-2025, CA-J-2078, C-AJ-2035, CA-J-2022	SINGLE NON-METALLIC PIPE OR CONDUIT	1	C-AJ-2109C-AJ-2078, W-J-2332, C-AJ-2024, C-AJ-2035, C-AJ-2022
	2	C-AJ-2035, C-AJ-2022, C-AJ-2021		2	C-AJ-2078, W-J-2332, C-AJ-2024, C-AJ-2035, C-AJ-2022

(I.E. PVC, CPVC, ABS, FRP, ENT)	3	C-A-J-2012, C-AJ-2035-F-A-2012	(I.E. PVC, CPVC, ABS, FRP, ENT)	3	CA-J-2035 C-J-2035 C-AJ-2024
	4			4	
SINGLE/CABLE BUNDLES	1	F-A-3007,C-AJ-3095,C-AJ-3180, C-AJ-3283	SINGLE/CABLE BUNDLES	1	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167
	2	F-A-3007,C-AJ-3095,C-AJ-3334, F-A-3060		2	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167, W-J-3189
	3	F-A-3007, C-AJ 3095, C-AJ-3285		3	C-AJ-3095, C-AJ-3180, W-J-3167
CABLE TRAY	1	C-AJ-4034, C-AJ-4071	CABLE TRAY	4	W-J-3050
	2	C-AJ-4034, C-AJ-4071		1	W-J-4027, C-AJ-4034, C-AJ-4071
	3	C-AJ-4034, C-AJ-4035		2	W-J-4027, C-AJ-4034, C-AJ-4071
SINGLE INSULATED PIPES	1	F-A 5015, F-A 5017, C-AJ-5090, C-AJ-5091, C-AJ-5048	SINGLE INSULATED PIPES	3	C-AJ-4034, C-AJ-4035
	2	F-A 5015, F-A 5017, C-AJ-5090, C-AJ-5090		4	W-J-8007
	3	F-A 5016, C-AJ-5090, F-A-5018		1	C-AJ-5090, C-AJ-5091, C-AJ 5061, W-J-5042
	4	C-BJ-5006		2	C-AJ-5090, C-AJ-5091, C-AJ-5061, W-J-5042
ELECTRICAL BUSWAY	1	C-AJ-6006, C-AJ-6017, F-A-6002, C-AJ-6036	ELECTRICAL BUSWAY	3	C-AJ-5090, C-AJ-5061
	2	C-AJ-6006, C-AJ-6017, F-A 6042, C-AJ-6036		4	C-BJ-5006, W-J-5028
	3	C-AJ-6006, C-AJ-6017		1	C-AJ-6006, C-AJ-6017, C-AJ-6036
MECHANICAL DUCTWORK WITHOUT DAMPERS NON-INSULATED	1	C-AJ-7046, C-AJ-7051, C-AJ-7084	MECHANICAL DUCTWORK WITHOUT DAMPERS NON-INSULATED	2	C-AJ-6006, C-AJ-6017, C-AJ-6036
	2	C-AJ-7046, C-AJ-7051, C-AJ-7084		3	C-AJ-6006, C-AJ-6017
	3	C-AJ-7046, C-AJ-7051		1	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022
MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	2	C-A-J-7145	MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	2	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022
				3	C-AJ-7046, C-AJ-7051
MIXED PENETRANTS	1	C-AJ 8099, C-AJ-8056, C-AJ-8143	MIXED PENETRANTS	1	W-J-7029, W-J-7124
	2	C-AJ-8099, C-AJ-8056, C-AJ-8143		2	W-J-7091, W-J-7112, W-J-7124
	3	C-AJ-8099, C-AJ-8056		1	C-AJ 8099, C-AJ 8056, W-J 8007, C-AJ 8143
	4	C-AJ-8095		2	C-AJ 8099, C-AJ 8056, W-J 8007, C-AJ 8143
			3	C-AJ 8041, C-AJ 8056, W-J 8007, C-AJ 8099	
			4	C-AJ 8095, W-J 8007	

WOOD FLOORS			GYPSUM WALLS		
TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN cUL SYSTEM	TYPE OF PENETRANT	F-RATING (HR)	BASIS OF DESIGN cUL SYSTEM
METAL PIPES OR CONDUIT	1	F-C-1009, F-C-1059, F-C-1168	METAL PIPES OR CONDUIT	1	W-L-1054, W-L-1058, W-L-1164, W-L-1506, W-L-1465
	2	F-C-1009, F-C-1059, F-C-1168		2	W-L-1054, W-L-1058, W-L-1164, W-L-1506, W-L-1465
NON-METALLIC PIPE OR CONDUIT	1	F-C-2011, F-C-2416, , F-C-2007	NON-METALLIC PIPE OR CONDUIT	4	W-L-1110, W-L-1111, W-L-1165
	2			1	W-L2028, W-L-2061, W-L-2020
SINGLE OR BUNDLED CABLES	1	F-C-3012, F-C-3110, F-C-3074	SINGLE OR BUNDLED CABLES	2	W-L-2028, W-L-2061, W-L-2020
	2	F-C-3012, F-C-3110		1	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
INSULATED PIPES	1	F-C-5004, F-C-5037, F-C-5036, F-C-5065	CABLE TRAY	2	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
	2	F-C-5004, F-C-5037		3	W-L-3385, W-L-3277
NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	F-C-7013, F-C-7043	INSULATED PIPES	4	W-L-3139, W-L-3334
	2			1	W-L-4011, W-L-4060, W-L-4081
INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	N/A**	NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	2	W-L-4011, W-L-4060, W-L-4081
	2	N/A**		4	W-L 8014
	1		INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	W-L-5028, W-L-5029, W-L-5047
	2			2	W-L-5028, W-L-5029, W-L-5047
	1		4	W-L-5073	
	1		1	W-L-7040, W-L-7042, W-L-7155	
	2		2	W-L-7040, W-L-7042, W-L-7155	
	1		1	W-L-7059, W-L-7153, W-L-7156, W-L-7151	
	2		2	W-L-7059, W-L-7153, W-L-7156, W-L-7151	
	1		1	W-L-1095, W-L-8013	

MIXED PENETRANTS		F-C-8009, F-C-8014, F-C-8026, F-C- 8038	MIXED PENETRANTS	2 4	W-L-1095, W-L-8013 W-L-8014
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**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 40 00 – Architectural Woodwork.
- .2 Section 08 11 00 – Metal Doors and Frames.
- .3 Section 09 21 16 – Gypsum Board Assemblies.
- .4 Section 09 65 00 – Resilient Flooring.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM C509-06(2021), Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
  - .2 ASTM C510-16(2022), Standard Test Method for Staining and Colour Change of Single- or Multi-component Joint Sealants.
  - .3 ASTM C717-19, Standard Terminology of Building Seals and Sealants.
  - .4 ASTM C834-17, Standard Specification for Latex Sealants.
  - .5 ASTM C919-22, Standard Practice for Use of Sealants in Acoustical Applications.
  - .6 ASTM C920-18, Standard Specification for Elastomeric Joint Sealant.
  - .7 ASTM C1193-16, Standard Guide for Use of Joint Sealants.
  - .8 ASTM C1248-18, Standard Test Method for Staining of Porous Substrate by Joint Sealants.
  - .9 ASTM C1253-14(2019), Standard Test Method for Determining Outgassing Potential of Sealant Backing.
  - .10 ASTM C1330-18, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
  - .11 ASTM C1518-16, Standard Specification for Precured Elastomeric Silicone Joint Sealants.
  - .12 ASTM C1520-20, Standard Guide for Paintability of Latex Sealants.
  - .13 ASTM D412-16(2021), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
  - .14 ASTM D624-00(2020), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
  - .15 ASTM E90-09(2016), Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 Workplace Hazardous Materials Information System (WHMIS).

### **1.3 QUALITY ASSURANCE**

- .1 Regulatory Requirements.
  - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labeling and provision of material safety data sheets acceptable to Labour Canada.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

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

- .2 Product Data.
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Manufacturer's product to describe:
    - .1 Caulking compound.
    - .2 Primers.
    - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
  - .3 Submit two (2) copies of WHMIS MSDS.
- .3 Samples.
  - .1 Submit two (2) samples of each type of material and colour.
  - .2 Cured samples of exposed sealants for each colour where required to match adjacent material.
- .4 Manufacturer's Instructions.
  - .1 Submit instructions to include installation instructions for each product used.
- .5 Closeout Submittals.
  - .1 Submit in accordance with Section 01 78 00.
  - .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect joint sealants from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.6 SITE CONDITIONS**

- .1 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Clean porous materials such as concrete by brushing, grinding, blast cleaning, mechanical abrading or combinations of these methods to provide a clean, sound substrate for optimum sealant adhesion. Remove loose particles that are present from grinding, abrading, or blast cleaning by blowing out joint with oil-free compressed air prior to application of a primer and/or sealant.
- .3 Use only non-staining sealants on existing exterior building components.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Joint Sealants and Sealant Primers: as recommended by sealant manufacturer for use with their product on applicable substrates.
  - .1 Silicone Sealant: to ASTM C1518 at all locations unless otherwise indicated.
  - .2 Interior Latex Acrylic Sealant: to ASTM C834 and C1520 for interior joints in surfaces to be painted.
  - .3 Acoustical Sealant to ASTM C919.
  - .4 Expanding Joint Sealant to ASTM D3574.
- .2 Preformed Compressible Joint Filler Material.
  - .1 Closed-cell foam backing rod to ASTM C1330.
  - .2 Polyethylene, Urethane, Neoprene or Vinyl Foam.
    - .1 Extruded open cell foam backer rod.
    - .2 Size: oversize 30% to 50%.
  - .3 Neoprene or Butyl Rubber.
    - .1 Round solid rod, Shore A hardness 70.
  - .4 High Density Foam.
    - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m<sup>3</sup> density, or neoprene foam backer, size as recommended by manufacturer.
  - .5 Bond Breaker Tape.
    - .1 Self-adhesive, pressure sensitive tape mad from TFE-fluorocarbon (Teflon) or polyethylene which sealant will not adhere to.
- .3 Joint Cleaner.
  - .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.
  - .2 Primer: as recommended by manufacturer.

### **2.2 SEALANT MATERIALS**

- .1 Do not use caulking that emits strong odours, contains toxic chemicals, or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which off-gas to the exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off-gas time.

## **Part 3 Execution**

### **3.1 PREPARATION OF JOINT SURFACES**

- .1 Prior to commencement of work, verify that site joints and surfaces have been provided as specified under work of other sections, and that joint conditions will not adversely affect execution, performance or quality of completed work, and that they can be put into acceptable condition by means of preparation specified in this section.
- .2 Examine joint sizes and conditions to establish correct depth to width relationship for installation of joint filler materials and sealants.



- .3 Ascertain that sealers and coatings applied to sealant substrates are compatible with sealant used and that full bond between sealant and substrate is attained. Request samples of sealed or coated substrate from their fabricators for testing of compatibility and bond, if necessary, or test on site to Contract Administrator's acceptance.
- .4 Clean bonding joint surfaces of harmful matter substances including dust, oil grease, loose mortar and other matter which may impair work. Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.
- .5 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .6 Ensure that releasing agents, coatings or other treatments have either not been applied to joint surfaces or that they are entirely removed.
- .7 Ensure joint surfaces are dry and frost free.
- .8 Verify that specified environmental conditions are ensured before commencing work.
- .9 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .10 Defective work resulting from application to unsatisfactory joint conditions will be considered the responsibility of those performing the work of this section.

### **3.2 PRIMING**

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

### **3.3 JOINT FILLER MATERIAL**

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Pack joints continuously with closed cell backer rod joint backing material allowing a recess to receive sealant. Installation of backer rod with a sharp tool such as putty knife is not permitted. Ensure surface skin of the backer rod is not punctured or cut during installation. A puncture in the backer rod may result in outgassing into the uncured sealant resulting in voids or other defects in the cured sealant.
- .3 Backer rod to be installed under adequate compression to hold it in-place in the joint opening and to resist the pressure applied when tooling a non-sag sealant into place. Backer rod diameter to be 25% greater than the joint width. Install backer rod without stretching. Under no circumstances should backer rod that is too small for the joint be doubled up or braided together to fit the opening.
- .4 Where joint configuration and/or size does not permit the use of a backer rod, install bond breaker tape. The tape shall be installed continuously with no skips or voids in the tape application.
- .5 Install joint filler to achieve correct joint depth and shape (ratio 1:2) with approximately 30% compression.

### **3.4 APPLICATION**

- .1 Sealant.
  - .1 Apply sealants to manufacturer's printed instructions.
  - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
  - .3 Apply sealant in continuous beads.

- .4 Apply sealant using gun with proper size nozzle.
- .5 Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
- .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
- .8 Remove excess compound promptly as work progresses and upon completion.
- .9 Install continuous bead or joint sealant along all gypsum board control joints.
- .2 Curing.
  - .1 Cure sealants in accordance with sealant manufacturer's instructions.
  - .2 Do not cover up sealants until proper curing has taken place.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean adjacent surfaces immediately.
  - .3 Remove excess and droppings, using recommended cleaners as work progresses.
  - .4 Remove masking tape after initial set of sealant.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.6 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by joint sealants installation.

**END OF SECTION**

<b>DOOR &amp; FRAME ABBREVIATIONS:</b>					
<b>ABBREV</b>	<b>DOOR &amp; FRAME TYPE</b>	<b>SPEC NO</b>	<b>ABBREV</b>	<b>DOOR OPERATIONS</b>	<b>SPEC NO</b>
AL	Aluminum	08 44 13	CA	Card Access (see Electrical)	
HM	Hollow Metal Welded	08 11 00	DA	Double Acting	
X	Existing		HO	Hold Open Device	08 71 00
			PR	Pair	
			<b>ABBREV</b>	<b>DOOR &amp; FRAME FINISHES</b>	
			NFS	Non-Rated Fire Separation	
			P	Paint	09 90 00
			PF	Prefinished	
<b>ABBREV</b>	<b>DOOR PROTECTION</b>	<b>SPEC NO</b>	<b>ABBREV</b>	<b>FRAME PROTECTION</b>	<b>SPEC NO</b>
KP1	Stainless Steel Kickplate, one side, 300 mm high.	08 71 00			

<b>TYPICAL NOTES:</b>	
1.	Doors shall be 900 mm wide unless otherwise noted.
2.	Doors shall be 2135 mm high unless otherwise noted.
3.	Doors shall be 45 mm thickness unless otherwise noted.
4.	Door and frame type shall be hollow metal welded (HM) unless otherwise noted.
5.	Doors and frames shall receive paint finish unless otherwise noted.
6.	Doors shall be Style A unless otherwise noted.
7.	Frames shall be Style 1 unless otherwise noted.
8.	Install door frames 50 mm from adjacent perpendicular wall finish unless otherwise noted; for masonry walls install 100 mm unless otherwise noted.
9.	Kickplates when indicated on one side of door to be on push side, unless otherwise noted.
10.	Coordinate electrical requirements to door frames - refer to electrical drawings.
11.	All interior HM frames shall wrap around wall type indicated (i.e. nominal throat dimension is equal to wall width unless otherwise indicated - refer to drawings)
12.	Set overhead door stop to maximum opening at all concealed door stops (verify with design Contract Administrator before doors are prepared).
13.	Refer to drawing sheet A4.1 for aluminum frame types (W#).
<b>REMARKS:</b>	
R1	New door and frame to suit existing opening, confirm dimensions on site.
R2	Existing door to be removed and frame is to be prepped as cased opening.
R3	Refer to Aluminum Frame Styles on Drawing Sheet A4.1.
R4	Paint interior side of door and frame only.
R5	Install kickplate on both doors.
R6	Paint door and frame on Staff Lounge side only.
R7	Refer to Exterior Elevation for paint pattern.
R8	Paint door and frame on Pool Deck side only.

ROOM NAME	DOOR NO	DOOR							FRAME				FIRE RATING	HDWE GROUP	REMARKS
		WIDTH	HEIGHT	THICK	TYPE	FINISH	STYLE	PROT	TYPE	FINISH	STYLE	PROT			
STAFF LOUNGE	B:01	X	X	45	X HM	P	X	X	X HM	P	X	-	-	12	R6
STAFF LOUNGE CLOSET	B:01.1	600	2135	45	HM	P	1	-	HM	P	1	-	-	9	
VESTIBULE 1:01 (Exterior)	1:01.1	PR2000	2135	45	AL	PF	-	-	AL	PF	W1	-	-	1	R3
VESTIBULE 1:01 (Interior)	1:01.2	PR 2000	2135	45	AL	PF	-	-	AL	PF	W2	-	-	2	R3
Bariatric UTR	1:04	1000	2135	45	HM	P	A	KP1	HM	P	1	-	-	3	
UTR	1:06B	1000	2135	45	HM	P	A	KP1	HM	P	1	-	-	3	
CORRIDOR 1:05	1:05	1000	2135	45	AL	PF	-	-	AL	PF	W7	-	-	13	R3
CHLORINE ROOM	1:07	X	X	X	X HM	-	X	-	X HM	-	X	-	X	X	
PRIVATE OFFICE	1:08	900	2135	45	HM	P	B	KP1	HM	P	1	-	-	4	
OPEN OFFICE	1:09A	900	2135	45	HM	P	B	KP1	HM	P	1	-	-	4	
COPY AREA (Lobby side)	1:09B.1	900	2135	45	HM	P	B	KP1	HM	P	1	-	-	5	
COPY Area (Pool Side)	1:09B.2	900	2135	45	AL	-	-	-	AL	-	W3d	-	-	6	R3
FIRST AID	1:10	1200	2135	45	HM	P	C	KP1	HM	P	1	-	-	7	
MALE CHANGE CORRIDOR 1:12A	1:12A	1000	2135	45	AL	PF	-	-	AL	PF	W7	-	-	13	R3
FEMALE CHANGE CORRIDOR 1:13A	1:13A	1000	2135	45	AL	PF	-	-	AL	PF	W7	-	-	13	R3
POOL DECK	1:14.1	PR 1830	X	P	X HM	P	X	-	X HM	P	X	-	-	X	R4
POOL DECK	1:14.2	PR 1830	X	P	X HM	P	X	-	X HM	P	X	-	-	X	R4
POOL DECK	1:14.3	915	X	P	X HM	P	X	-	X HM	P	X	-	-	X	R4
MPR	1:15	1000	2135	45	AL	PF	-	-	AL	PF	W5b	-	-	8	R3
SAUNA	1:16B	1000	2135	45	AL	PF	-	-	AL	PF	W6	-		8	R3
JANITORIAL	1:17A	PR 1830	2020	45	HM	P	A	KP1	HM	P	1	-	45 MIN	10	R5
ELECTRICAL	1:17B	900	2135	45	HM	P	A	-	HM	P	1	-	45 MIN	11	

ROOM NAME	DOOR NO	DOOR							FRAME				FIRE RATING	HDWE GROUP	REMARKS
		WIDTH	HEIGHT	THICK	TYPE	FINISH	STYLE	PROT	TYPE	FINISH	STYLE	PROT			
X STAIR ST-1 (Interior)	ST-1	X 915	X	X	X HM	P	C	X	X HM	P	1	-	X	12	
X STAIR ST-1 (Exterior)	ST-1.1	X 915	X	X	X HM	P	C	X	X HM	P	1	-	X	X	R7
X STAIR ST-2 (Interior)	ST-2	900	2135	45	X HM	P	A	-	X HM	P	1	-	X	X	R8
X STAIR ST-1 (Exterior)	ST-2.1	X 915	X	X	X HM	-	C	X	X HM	-	1	-	X	X	
***															

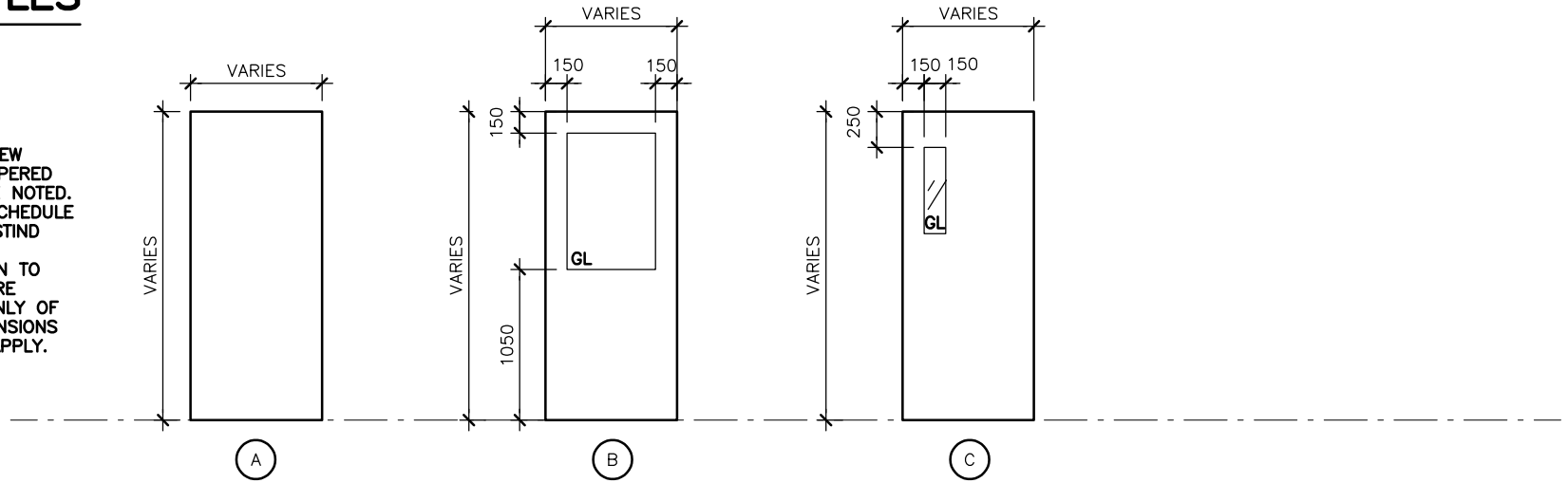
**END OF SECTION**

# DOOR STYLES

1 : 50

**NOTES:**

1. GLAZING (GL) IN NEW DOORS TO BE TEMPERED UNLESS OTHERWISE NOTED.
2. REFER TO DOOR SCHEDULE FOR NEW AND EXISTING DOOR MATERIAL.
3. DOOR STYLES GIVEN TO EXISTING DOORS ARE REPRESENTATIVE ONLY OF THEIR STYLE. DIMENSIONS SHOWN MAY NOT APPLY.



# FRAME STYLES

1 : 50

**NOTES:**

1. REFER TO DOOR SCHEDULE AND SPECIFICATIONS FOR FRAME MATERIAL.



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 04 22 00 – Concrete Unit Masonry.
- .2 Section 06 10 00 – Rough Carpentry for Minor Works.
- .3 Section 07 92 00 – Joint Sealants.
- .4 Section 08 06 10 – Door Schedule.
- .5 Section 08 71 00 – Door Hardware.
- .6 Section 08 80 00 – Glazing.
- .7 Section 09 21 16 – Gypsum Board Assemblies.
- .8 Section 09 91 13 – Exterior Painting.
- .9 Section 09 91 23 – Interior Painting.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA).
  - .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
  - .2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association, (CSDMA).
  - .1 Recommended Specifications for Commercial Steel Door and Frame Products, 2006.
  - .2 Recommended Dimensional Standards for Commercial Steel Doors and Frames, 2009.
  - .3 Canadian Fire Labeling Guide for Commercial Steel Doors and Frame Products, 2009.
  - .4 Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames, 2012.
- .5 National Fire Protection Association (NFPA).
  - .1 2022 NFPA 80, Standard for Fire Doors and Other Opening Protectives.
  - .2 2022 NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- .6 Underwriters' Laboratories of Canada (ULC).
  - .1 CAN/ULC S104-15, Standard Method for Fire Tests of Door Assemblies.
  - .2 CAN/ULC S105-16, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC S104.
  - .3 CAN/ULC S701.1-22, Standard for Thermal Insulation, Polystyrene Boards.
  - .4 CAN/ULC S702.1-21, Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
  - .5 CAN/ULC S702.2-15, Standard For Mineral Fibre Thermal Insulation for Buildings, Part 2: Installation
  - .6 CAN/ULC S704-17, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.



### **1.3 SYSTEM DESCRIPTION**

- .1 Design Requirements.
  - .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.
  - .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, arrangement of hardware, fire ratings and finishes.
  - .2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and finishes.
  - .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and in door schedule.

### **1.5 QUALITY ASSURANCE**

- .1 Regulatory Requirements.
  - .1 Steel fire rated doors and frames to be labeled and listed by organization accredited by Standards Council of Canada in conformance with CAN4 S104, CAN4 S105, NFPA 80 and NFPA 252 for ratings specified or indicated.
  - .2 Provide fire labeled frame products for those openings requiring fire protection ratings, as scheduled. Test products in strict conformance with CAN4 S104 or NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

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

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, well ventilated area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Protect by suitable means until installation. Brace and stack to prevent racking, bending, twisting and other damage.
- .4 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .5 Cleaning in accordance with Section 01 74 00.
- .6 Waste Management and Disposal in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Hot Dipped Galvanized Steel Sheet: to ASTM A653/A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Recommended Specifications for Commercial Steel Door and Frame Products.

- .2 Reinforcement channel: to CSA G40.20-04/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.
- .3 Door Core Materials.
  - .1 Honeycomb Core: structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m<sup>3</sup> minimum sanded to required thickness.
  - .2 Insulated Core (door and panel).
    - .1 Expanded polystyrene to CAN/ULC-S701.1, density 16 to 32 kg/m<sup>3</sup>.
    - .2 Polyurethane to CAN/ULC S704 rigid, modified poly/isocyanurate, closed cell board, density 32 kg/m<sup>3</sup>.
  - .3 Temperature Rise Rated (TRR): core composition to limit temperature rise on unexposed side of door to 250°C at rating(s) indicated in Door Schedule. Core to be tested as part of complete door assembly, in accordance with CAN4 S104 or NFPA 252, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.
- .4 Adhesives.
  - .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
  - .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
  - .3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.
- .5 Glazing stops: fabricate as formed channel, 0.9 mm (20-gauge) base steel thickness, minimum 16 mm height typical, accurately fitted, butted at corners and fastened with counter-sunk oval head sheet metal screws (secured from room side and not corridor or public side).
- .6 Frame floor anchors and channel spreaders: 1.6 mm (16-gauge) base steel thickness.
- .7 Guard boxes: 0.8 mm (22 gauge) base steel thickness.
- .8 Hinge reinforcing: 3.4 mm (10-gauge) base steel thickness.
- .9 Lock and strike reinforcing: 1.6 mm (16-gauge) base steel thickness.
- .10 Fasteners: expansion bolts to ASTM F1554, galvanized.
- .11 Astragals: 2.1 mm (14-gauge) base steel thickness.
- .12 Metallic paste filler: to manufacturer's standard.
- .13 Primer: touch-up primer to ASTM A780/A780M.
- .14 Paint: field paint steel doors and frames in accordance with Section 09 90 00.
- .15 Glazing: in accordance with Section 08 80 00.
- .16 Joint Sealants: in accordance with Section 07 92 00.
- .17 Door bumpers: single stud black rubber/neoprene type.

## 2.2 FABRICATION

- .1 General.
  - .1 Fabricate steel doors and frames as detailed to Canadian Steel Door and Frame Manufacturers' Association, (CSDFMA) specifications.
  - .2 Fabricate doors and frames to profiles and maximum face sizes as indicated, approved shop drawings and ULC or WHI requirements as applicable.

- .3 Make provision for glazing on doors and frames as indicated, and provide necessary glazing stops.
- .4 Build-in required hardware reinforcing and guard boxes.
- .5 Attach ULC or WHI labels to required fire rated doors and frames as indicated.
- .6 Lock Seam Edge: door made with an outer pan which is punched for hinges and latching hardware, then bent on each stile to form the door edge. The bending has a lock seam edge for interlocking the inside pan which has also been punched for the latching hardware.
- .7 Welded Seam Seamless Edge: lockseam door which has the lockseam tackwelded every 150 mm long the full height of the door. These welds are then ground smooth and the seam is filled and finished to provide a seamless edge.
- .2 Hollow Metal (HM / HMI) Door Fabrication.
  - .1 Doors: swing type, flush, with provision for glazed openings as indicated.
  - .2 Form each face sheet for exterior doors from 1.2 mm (18-gauge) galvanized sheet steel with insulated polystyrene or polyurethane core laminated under pressure to face sheets, welded seam seamless edge.
  - .3 Form each face sheet for interior doors from 1.2 mm (18-gauge) galvanized sheet steel with honeycomb core laminated under pressure to face sheets, welded seam seamless edge.
  - .4 Bevel hinge and lock door edges 3 mm in 50 mm. Square edges on hinge and/or lock stiles are not acceptable
  - .5 Provide flush steel top caps to exterior doors with waterproof filler. Provide inverted, recessed, spot welded channel closure to top and bottom of interior doors. Fill all gaps of spot welded channels.
  - .6 Reinforce doors where required, for surface mounted hardware.
  - .7 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
  - .8 Reinforce perimeter of glazing openings exceeding 800 mm with minimum 0.8 mm (22-gauge) channels spot welded to door face skins all four sides.
  - .9 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
  - .10 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
  - .11 Fabricate doors requiring top and bottom concealed exit devices to hardware templates in relation to door bottom clearance.
  - .12 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in strict conformance with CAN4 S104 or NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
  - .13 Manufacturer's nameplates on doors are not permitted.
  - .14 Construct matching transoms/panels in same manner as doors.
  - .15 Provide astragal to paired doors to ULC or WHI requirements where required.
- .3 Hollow Metal (HM/HMI) Welded Frame Fabrication.
  - .1 Fabricate exterior and interior double returned welded-frames from 1.6 mm (16-gauge) galvanized steel, fully welded construction in accordance with CSA W59.
  - .2 Fabricate custom frames as detailed from minimum 1.6 mm (16-gauge) galvanized steel, fully welded construction. Exact gauge of frame to be determined by application in accordance with CSA W59.
  - .3 Accurately mitre or mechanically joint frame product and securely weld entire joint on inside of profile.

- .4 Cope accurately and securely weld butt joints of mullions. Grind welded joints and corners to flat plane, fill with metallic paste and sand to uniform smooth finish.
  - .5 Grind welded joints and corners to flat plane, fill with metallic paste and sand to uniform smooth finish.
  - .6 Securely attach floor anchors to inside of each jamb profile.
  - .7 Weld in two (2) temporary jamb spreaders per frame to maintain proper alignment during shipment.
  - .8 Reinforce head of frames wider than 1200 mm.
  - .9 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
  - .10 Protect strike and hinge reinforcements using steel guard boxes welded to frames.
  - .11 Prepare frame for door silencers, three (3) for single door, two (2) at head for double door.
  - .12 Manufacturer's nameplates on frames and screens are not permitted.
  - .13 Conceal fastenings except where exposed fastenings are indicated.
  - .14 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
  - .15 Insulate exterior frame components with expanded polystyrene or polyurethane insulation.
  - .16 Provide steel jamb anchors securely welded inside each jamb to frames in masonry walls in accordance with requirements of ULC or WHI.
  - .17 For power-assist door operators typically secured to door frame, provide additional reinforcing to support backside of mounting plate.
- .4 Knock-Down Frames (HMKD).
- .1 Fabricate interior knock-down frames from 1.6 mm (16-gauge) base steel thickness.
  - .2 Ship knock-down frames unassembled.
  - .3 Provide frames with mechanical joints which inter-lock securely and provide functionally satisfactory performance when assembled and installed in accordance with CSDFMA Recommended Installation Guide for Steel Doors and Frames.
  - .4 Provide knock-down frames with manufacturers' proprietary design of wall anchorage comprising single, adjustable tension type per jamb and provision for secure attachment of each jamb base to stud runners.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 General.
  - .1 Install labeled steel fire rated doors and frames to NFPA 80 and NFPA 252 except where specified otherwise.
  - .2 Install doors and frames to CSDFMA Installation Guide
- .2 Frame Installation.
  - .1 Set frames plumb, square, level and at correct elevation.
  - .2 Frame Anchorage.
    - .1 Provide appropriate anchorages and connections to adjacent floor and wall construction.
    - .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
    - .3 Provide two (2) anchors for rebate opening heights up to 1525 mm and one (1) additional anchor for each additional 760 mm of height or fraction thereof.

- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
  - .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
  - .5 Continuously caulk perimeter of all frames (both sides between frame and surrounding construction) and all seams at glazing stops (both sides of glazing).
  - .6 Maintain continuity of vapour barrier as applicable.
  - .7 Install glazing for frames in accordance with Section 08 80 00.
  - .8 Install neoprene door bumpers in frames (following field painting of frames).
- .3 Door Installation.
- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00.
  - .2 Provide even margins between doors and jambs and doors and finished floor (and thresholds) as follows:
    - .1 Hinge side: 1.0 mm.
    - .2 Latchside and head: 1.5 mm.
    - .3 Finished floor and thresholds: 13 mm.
  - .3 Adjust operable parts for correct function.
- .4 Field Repairs.
- .1 Touch up finishes damaged during installation with primer.
  - .2 Fill surfaces with imperfections with metallic paste filler and sand to uniform smooth finish.
- .5 Glazing.
- .1 Install glazing for doors and frames in accordance with Section 08 80 00.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.3 SCHEDULES**

- .1 Refer to Section 08 06 10.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.
- .2 Section 07 26 00 – Air/Vapour Barrier Membrane - Self-Adhesive.
- .3 Section 07 62 00 – Sheet Metal Flashing and Trim.
- .4 Section 07 92 00 – Joint Sealants.
- .5 Section 08 71 00 – Door Hardware.
- .6 Section 08 71 13 – Automatic Door Operators.
- .7 Section 08 80 00 – Glazing.
- .8 Section 09 21 16 – Gypsum Board Assemblies.
- .9 Section 09 22 16 – Non-Structural Metal Framing.

### **1.2 REFERENCES**

- .1 American Architectural Manufacturers Association (AAMA).
  - .1 AAMA CW-10-15, Care and Handling of Architectural Aluminum from Shop to Site.
  - .2 AAMA TIR-A8-16, Structural Performance of Composite Thermal Barrier Framing Systems.
  - .3 AAMA 505-17, Dry Shrinkage and Composite Performance Thermal Cycling Test Procedure
  - .4 AAMA 611-14, Voluntary Specification for Anodized Architectural Aluminum.
  - .5 AAMA 2604-17a, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
- .2 Aluminum Association (AA).
  - .1 Aluminum Standards and Data, 2017 Edition.
  - .2 Aluminum Alloy Castings - Properties, Processes, and Applications, 2004 Edition.
  - .3 Introduction to Aluminum Alloys and Tempers, 2000 Edition.
  - .4 Designation System for Aluminum Finishes, 2003 (R2009).
- .3 American Society for Testing and Materials (ASTM).
  - .1 ASTM B456-17 Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
  - .2 ASTM B633-15 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
  - .3 ASTM C864-05(2015), Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
  - .4 ASTM E283-04(2012), Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  - .5 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
  - .6 ASTM E331-00(2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

- .4 Canadian Standards Association (CSA).
  - .1 AAMA/WDMA/CSA 101/I.S.2/A440-17, North American Fenestration Standard / Specification for Windows, Doors, and Skylights.
  - .2 CAN/CSA S157-17/S157.1-17, Strength Design in Aluminum/Commentary on CSA S157-05, Strength Design in Aluminum.
- .5 National Building Code of Canada (NBCC).

### 1.3 SYSTEM DESCRIPTION

- .1 Design Requirements.
  - .1 Provide thermally broken and non-thermally broken tubular extruded aluminum sections with supplementary support framing, shop fabricated, vision glass, related flashings, anchorage and attachment devices.
  - .2 Design and size components to meet requirements of NBCC, Climatic Information for Building Design at Place of Work, and to meet or exceed requirements for loads on walls acting as guards, but not less than sizes and dimensions indicated in contract documents.
  - .3 Integrate exterior aluminum framing sections with high density polyurethane thermal break to form rigid composite assembly without use of fasteners or other thermal bridging elements.
  - .4 Provide system to accommodate following, without damage to components or deterioration of seals:
    - .1 Expansion and contraction within system caused by cycling temperature changes without causing detrimental effect to system components including buckling, failure of joint seals, or undue stress on fasteners.
    - .2 Movement between system and perimeter framing components.
    - .3 Dynamic loading and release of loads.
    - .4 Deflection of structural support framing.
  - .5 Maintain continuous air/vapour barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
- .2 Performance Requirements.
  - .1 Exterior Aluminum Entrance Framing.
    - .1 Air Infiltration: not to exceed  $0.0003 \text{ m}^3/\text{s}/\text{m}^2$  at static air pressure differential of 300 Pa in accordance with ASTM E283.
    - .2 Water Resistance: no water leakage at minimum static air pressure differential of 8 psf as defined by AAMA 501 in accordance with ASTM E331.
    - .3 Uniform Load: apply static air design load of 20 psi in positive and negative direction in accordance with ASTM E330, and exhibit no deflection in excess of  $L/175$  of span of any framing member. At structural test load equal to 1.5 times specified design load, no glass breakage or permanent set in framing members in excess of 0.2% of their clear spans.
  - .2 Exterior Aluminum Doors.
    - .1 Air Infiltration (doors-single): not to exceed  $2.78 \text{ m}^3/\text{h}/\text{m}$  per linear foot of perimeter crack, measured at reference differential pressure across assembly of 75 Pa as measured in accordance with ASTM E283.
    - .2 Air Infiltration (doors-double): not to exceed  $5.56 \text{ m}^3/\text{h}/\text{m}$  per linear foot of perimeter crack, measured at reference differential pressure across assembly of 75 Pa as measured in accordance with ASTM E283.

#### **1.4 QUALITY ASSURANCE**

- .1 Qualifications.
  - .1 Fabricator: approved by aluminum-framed entrance and storefront manufacturer with fabrication of manufacturer's aluminum-framed entrances and storefronts on projects of equal or greater size and degree of complexity.
  - .2 Installer: approved by aluminum-framed entrance and storefront manufacturer and with minimum five (5) years' experience with installation of manufacturer's aluminum-framed entrances and storefronts on projects of equal or greater size and degree of complexity.
  - .3 Information confirming above criteria may be requested by Contract Administrator.
  - .4 Aluminum-framed entrance and storefront manufacturer to take full responsibility for fabrication and installation.
- .2 Mock-up.
  - .1 Construct mock-ups in accordance with Section 01 45 00.
  - .2 Supply mock-up including intermediate mullion, corner mullion, sill muntin, column cover, vision glass light, and insulated infill panel and glass as applicable.
    - .1 Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.

#### **1.5 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data.
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for components, anchorage and fasteners, glass and infill, and internal drainage details and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings.
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Manitoba.
  - .2 Indicate system dimensions, framed opening requirements and tolerances, adjacent construction, anchor details anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required.
- .4 Samples.
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
  - .3 Submit two (2) samples illustrating prefinished aluminum surface for each finish, colour, texture, specified glass units, insulated infill panels, glazing materials illustrating edge and corner.
- .5 Delegated Design Submittals.
  - .1 Include framing member structural and physical characteristics, calculations, dimensional limitations, special installation requirements.
- .6 Closeout Submittals.
  - .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

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

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



- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Handle work of this Section in accordance with AAMA CW-10.
  - .2 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .3 Store and protect from nicks, scratches, and blemishes.
  - .4 Protect prefinished aluminum surfaces. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
  - .5 Replace defective or damaged materials with new.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.7 SITE CONDITIONS**

- .1 Do not install sealants when ambient and surface temperature is less than 5°C.
- .2 Maintain this minimum temperature during and after installation of sealants until cured.

## **1.8 WARRANTY**

- .1 **Manufacturer's Product Warranty:** provide an extended warranty for Work of this Section for a period of two (2) years from date of Substantial Performance of the Work. Manufacturer hereby warrants aluminum-framed doors and frames to be free of manufacturing and material defects, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City and at no cost to the City.
- .2 **Installation Contractor's Warranty:** provide an extended warranty for Work of this Section for a period of two (2) years from date of Substantial Performance of the Work. Contractor hereby warrants that work of this Section will remain rigid and weathertight, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City and at no cost to the City.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 **Extruded Aluminum:** tubular extruded aluminum section to Aluminum Association AA 6063-T54 alloy and temper in accordance with ASTM B221M and CAN/CSA S157/S157.1. Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 1.8 mm wall thickness at any location for the main frame
- .2 Aluminum frame members 50 mm x 115 mm nominal size, for centre glazing.
- .3 **Member Wall Thickness:** wall thickness sufficient to meet the specified structural requirements.
- .4 **Thermal Break (exterior framing):** extruded aluminum profiles with minimum 6 mm separation consisting of a two-part chemically curing, high-density polyurethane, mechanically and adhesively joined to aluminum profiles, designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
- .5 **Tolerances:** in accordance with Aluminum Association Aluminum Standards and Data.

- .6 Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- .7 Exposed Formed Sheet Aluminum: to be 1.5 mm thick sheet of alloy and temper suitable for their purpose and finish to sizes and profiles indicated, colour and finish to match doors and frames.
- .8 Sealants: in accordance with Section 07 92 00.
- .9 Glazing: in accordance with Section 08 80 00.

## **2.2 ALUMINUM DOORS**

- .1 Construct doors of porthole extrusions with minimum wall thickness of 2.3 mm.
- .2 Door stiles nominal 50 mm depth x 90 mm wide (medium stile)  $\pm 10$  mm.
- .3 Top rail nominal 90 mm wide  $\pm 10$  mm.
- .4 Bottom rail nominal 170 mm  $\pm 10$  mm.
- .5 Reinforce mechanically-jointed corners of doors to produce sturdy door unit.
- .6 Glazing stops: interlocking snap-in type for dry glazing, tamperproof type.

## **2.3 COMPONENTS**

- .1 Insulating Glass Units (IGU); Refer to Section 08 80 00.
- .2 Insulated Back-Up Spandrel Panels (exposed): aluminum, 3.0 mm minimum thickness with sealed corners, colour to match window mullions c/w semi-rigid or rigid polystyrene insulation core to RSI value of 3.5.
- .3 Glazing Gaskets: in accordance with ASTM C864 and be extruded of a silicone compatible EPDM rubber that provides for silicone adhesion.
- .4 Thermal Barrier: thermal separator extruded of a silicone compatible elastomer that provides for silicone adhesion.
- .5 Isolation Coating: alkali resistant bituminous paint as recommended by manufacturer.

## **2.4 ACCESSORIES**

- .1 Fasteners: 300 series stainless steel or 400 series stainless steel cadmium plated of size, type, quantity and length to meet load requirements of aluminum entrances and storefronts in accordance with building code and all applicable local regulations. Size and quantity to perform their intended function.
- .2 Exposed Formed Sheet Aluminum: break formed aluminum components (including closures at jambs as indicated) to be 3 mm thick sheet of alloy and temper suitable for their purpose and finish to sizes and profiles indicated, colour to match entrance frames.

## **2.5 FABRICATION**

- .1 Doors and framing to be by same manufacturer.
- .2 Fabricate aluminum-framed entrances and storefronts from extrusions of size and shape shown on reviewed shop drawings in accordance with AAMA/WDMA/CSA 101/I.S.2/A440. Member wall thickness sufficient to meet the specified structural requirements.

- .3 Integrate aluminum-framed entrance framing sections specified with a glass-reinforced nylon thermal break to form a rigid composite assembly without the use of fasteners or other thermal bridging elements.
- .4 Accurately machine, assemble, and seal all joints to provide neat, flush, hairline, and weathertight joints.
- .5 Visible manufacturer's identification labels not permitted.
- .6 Brace frames to maintain squareness and rigidity during shipment and installation.
- .7 Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- .8 Make allowance for anticipated deflection of structure to ensure that structural loads are not transmitted to aluminum entrance framing.
- .9 Fabricate vertical and horizontal members from tubular extrusions designed for shear block corner construction.
- .10 Reinforce with aluminum or galvanized steel plates for finishing hardware to templates supplied.
- .11 Fabrication Tolerances.
  - .1 Co-ordinate with fabrication of glass units specified in Section 08 80 00, to ensure proper fit and installation into frames provided by work of this Section.

## **2.6 FINISHES**

- .1 Shop Finishing:
  - .1 Exterior and Interior Exposed Aluminum Surfaces.
    - .1 AA-M12C22 A31 (0.4 mils) Architectural Class II Clear Anodic Coating in accordance with Aluminum Association Designation System for Aluminum Finishes.
  - .2 Appearance: visibly free of flowlines, streaks, sags, blisters and other surface imperfections.
  - .3 Repair of factory applied finish: use exterior grade air-drying touch-up material from coating manufacturer.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for aluminum doors and frames installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Contract Administrator.
  - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

### **3.2 INSTALLATION**

- .1 Aluminum Doors and Frames.
  - .1 Install aluminum doors and frames in accordance with manufacturer's instructions and reviewed shop drawings.
  - .2 Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

- .3 Make allowance for deflection of structure to ensure that structural loads are not transmitted to aluminum-framed entrances and storefronts.
  - .4 Provide alignment attachments and shims as required to permanently fasten system to building structure. Clean weld surfaces as required and apply protective primer to field welds and adjacent surfaces.
  - .5 Set all components level, square, plumb, at proper elevations and in alignment with other work.
  - .6 Provide thermal isolation where components penetrate or disrupt building insulation.
  - .7 Field apply isolation coating to aluminum in contact with concrete, mortar, plaster, and other dissimilar metals.
  - .8 Co-ordinate attachment and seal of perimeter air barrier membrane to aluminum entrances and storefront framing.
  - .9 Install low density foam insulation in shim spaces at perimeter of assembly to maintain continuity of air barrier.
  - .10 Seal joints between aluminum entrances and storefront framing and other building components with caulking in accordance with Section 07 92 00 – Joint Sealants.
  - .11 Install doors and hardware in accordance with hardware templates and manufacturer's instructions. Adjust operable parts for correct function.
- .2 Prefinished Metal Trim Closures.
    - .1 Install trim closures as indicated, level in length, straight in alignment with storefront mullions and adjacent materials.
    - .2 Secure in place in accordance with manufacturer's instructions.
    - .3 Install continuous bead of caulking along edge of jamb flashing and adjacent building materials.
  - .3 Glazing.
    - .1 Site glaze aluminum doors and frames in accordance with Section 08 80 00, using glazing method recommended by framing manufacturer for use with their system.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
  - .2 Remove protective material from prefinished aluminum surfaces.
  - .3 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
  - .4 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by installation.

**3.5 SCHEDULES**

- .1 Refer to Section 08 06 10.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.
- .2 Section 09 21 16 – Gypsum Board Assemblies.
- .3 Section 09 22 16 – Non-Structural Metal Framing.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM A480/A480M-19a, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .2 ASTM E119-19, Standard Test Methods for Fire Tests of Building Construction and Materials.
  - .3 ASTM E2074-00e1, Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB 1.40, Anticorrosive Structural Steel Alkyd Primer.
  - .2 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA):
  - .1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

### **1.3 SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Indicate sizes and locations of each type of access panel, rough opening sizes, materials, finishes, accessories, installation details and relationship to adjacent construction.
- .3 Closeout Submittals: Provide maintenance data for cleaning and maintenance of stainless steel finishes for incorporation into manual specified in Section 01 78 00.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Apply temporary protective coating to anodic and stainless steel finished surfaces. Remove coating after erection. Do not use coatings that will become hard to remove or leave residue.
- .3 Leave protective covering in place until final cleaning of building.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Steel sections: CSA G40.20/G40.21.
- .2 Stainless steel: to ASTM A480/A480M, cold rolled, annealed and pickled, Type 304, with 4 finish.

- .3 Aluminum:
- .4 Shop coat primer: to CAN/CGSB 1.40.
- .5 Zinc rich primer: to CAN/CGSB 1.181.
- .6 Isolation coating: alkali resistant bituminous or epoxy paint.

## **2.2 MANUFACTURED UNITS**

- .1 Wall and Ceiling Panels – Non-Fire Rated (Typical).
  - .1 Access door, non-fire-rated, flush, single leaf.
  - .2 Frame: 16-gauge cold rolled sheet steel. Provide 6 mm mounting holes.
    - .1 For masonry and concrete surfaces: 25 mm exposed flange.
    - .2 For wall board surfaces: 22-gauge drywall corner bead at perimeter.
    - .3 For acoustical tile ceilings: frameless type.
  - .3 Hinge: concealed pin type, spring loaded to allow for door removal, set to open 180°. Continuous piano hinge on sizes larger than 900 mm with stainless steel pin.
  - .4 Latching/locking devices:
    - .1 Key operated cylinder lock and keys in accordance with paragraph 2.3.5.
    - .2 Interior latch release mechanism.
  - .5 Finish: phosphate dipped and prime coated for cold rolled steel.
  - .6 Locations: As required by mechanical and electrical.

## **2.3 WALL AND CEILING PANELS – GENERAL**

- .1 Access doors for access to mechanical and electrical equipment concealed behind walls and ceilings.
- .2 Provide fire-rated access doors in rated assemblies; non-rated doors elsewhere.
- .3 Sizes: as follows unless indicated otherwise:
  - .1 For body entry: 600 x 600 mm minimum.
  - .2 For hand entry: 300 x 300 mm minimum.
- .4 Construction: rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180°.
- .5 Provide keyed cylinder locks; Cylinders and keys for all locking panels are to be keyed alike. Provide 10 keys.

## **Part 3 Execution**

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

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

### **3.2 INSTALLATION**

- .1 Install access panels in accordance with reviewed shop drawings and manufacturer's instructions.
- .2 Co-ordinate with other trades for rough openings, perimeter framing and blocking.
- .3 Locate access panels within view of equipment and ensure equipment is accessible for operating, inspecting, adjusting, servicing without using special tools.
- .4 Adjust operating components to ensure smooth, trouble-free operation.

- .5 Replace defective parts and components at no additional cost to the Contract.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by access door installation.

**END OF SECTION**



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 08 06 00 – Door Schedule.
- .2 Section 08 11 00 – Metal Doors and Frames.
- .3 Section 08 11 16 – Aluminum Doors and Frames.
- .4 Section 08 71 13 – Automatic Door Operators.

### **1.2 REFERENCES**

- .1 Builders Hardware Manufacturers Association (BHMA).
  - .1 ANSI/BHMA A156.1-2021, Butts and Hinges.
  - .2 ANSI/BHMA A156.2-2017, Bored and Preamsembled Locks and Latches.
  - .3 ANSI/BHMA A156.3-2020, Exit Devices.
  - .4 ANSI/BHMA A156.4-2019, Door Controls - Closers.
  - .5 ANSI/BHMA A156.5-2020, Cylinders and Input Devices for Locks.
  - .6 ANSI/BHMA A156.6-2021, Architectural Door Trim.
  - .7 ANSI/BHMA A156.7-2016, Template Hinge Dimensions.
  - .8 ANSI/BHMA A156.8-2021, Door Control - Overhead Stops and Holders.
  - .9 ANSI/BHMA A156.13-2017, Mortise Locks and Latches.
  - .10 ANSI/BHMA A156.15-2021, Closer Holder, Electromagnetic and Electromechanical.
  - .11 ANSI/BHMA A156.16-2018, Auxiliary Hardware.
  - .12 ANSI/BHMA A156.17-2019, Self-Closing Hinges and Pivots.
  - .13 ANSI/BHMA A156.18-2020, Materials and Finishes.
  - .14 ANSI/BHMA A156.21-2019, Thresholds.
  - .15 ANSI/BHMA A156.22-2021, Door Gasketing and Edge Seal System.
  - .16 ANSI/BHMA A156.26-2021, Continuous Hinges.
  - .17 ANSI/BHMA A156.28-2018, Recommended Practices for Mechanical Keying Systems.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).
  - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction) standard hardware location dimensions.
- .3 City of Winnipeg Accessibility Design Standards, Third Edition, 2015.
- .4 National Building Code of Canada (NBCC).

### **1.3 QUALITY ASSURANCE**

- .1 Requirements of Regulatory Agencies.
  - .1 City of Winnipeg Accessibility Design Standards.
- .2 Ensure maximum opening force no greater than 38N (8.5 lbs) in accordance with City of Winnipeg Accessibility Design Standards.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Shop Drawings.
  - .1 Submit hardware schedule in accordance with Section 01 33 00.
  - .2 Indicate hardware proposed, including make, model, material, function, finish, and all other pertinent information for each door.
- .2 Samples.
  - .1 Submit samples of each type of hardware specified, when requested by Contract Administrator in accordance with Section 01 33 00.

- .2 Identify each sample indicating applicable specification paragraph number, brand name and number, finish, and hardware package number.
- .3 Closeout Submittals.
  - .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.
  - .2 Supply two (2) sets of wrenches for hardware adjustment.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Package each item separately or in like groups, label each item or package as to item identification and intended location.
- .2 Deliver all hardware to site in the manufacturer's original packaging. Packaging to contain manufacturer's name, product name and identification number and other related information.
- .3 Provide and maintain dry, off-ground weatherproof storage. Protect hardware in accordance with manufacturer's recommendations. Remove only in quantities required for same day use.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Construction Waste Management in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Hardware manufacturers and Basis of Design Products as specified in Schedule at end of this Section.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with Bidding Procedures B8.
- .3 Supply similar products from single manufacturer.
- .4 Auto operators as specified in Section 08 71 13 to be supplied by this section.

### **2.2 FASTENINGS**

- .1 Supply and use only manufacturer's fastening devices required for satisfactory installation and operation of hardware.
- .2 Exposed fastening devices to match finish of hardware.
- .3 Use fasteners compatible with material through which they pass.

### **2.3 KEYING**

- .1 Door locks to be keyed to facility approved Best cores for all exterior locks and Schlage cores for all interior locks. Prepare detailed keying schedule in conjunction with the City.
- .2 Provide three (3) keys for every lock in this Contract.
- .3 Provide seven (7) master keys for each MK group.
- .4 All keys, permanent cylinder cores, and key records are to be sent directly to the City via registered delivery.
- .5 Supply all lock cylinders with Factory Construction Keying. Supply ten (10) construction keys.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Installation of door hardware is responsibility of door hardware supplier.
- .2 Supply Sections 08 11 00 with complete instructions and templates for preparation of their work to receive hardware.
- .3 Supply manufacturers' instructions for proper installation of each hardware component.
- .4 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .5 Use of "Lock-tite" or other sealants during hardware installation will not be accepted.
- .6 Hang doors on 3 hinges for doors up to 900 mm wide and 2200 mm high. For doors wider than 900 mm or higher than 2200 mm use four (4) hinges.
- .7 Locked outswing doors to have NRP hinges.
- .8 Provide adapter plates to door closers where door or frame conditions require.
- .9 Install kickplates and edge guards as specified. Install kickplates on one side of door unless otherwise specified. Install kickplates and edge guards with oval head countersunk screws.
- .10 Drill protection plates for other hardware as required.
- .11 Remove construction cores when directed by Contract Administrator. Permanent cores to be installed by others.

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

- .1 Hardware may be inspected by hardware consultant for compliance with specification.
  - .1 If removal of hardware causes delay to job, incorrect material will be used until correct material is provided.
  - .2 Incorrect material will be removed and replaced with specified material at no cost to the City.
- .2 If "Lock-tite" or other sealants are found, installer may be requested to replace hardware at no cost to the City.

#### **3.3 ADJUSTING**

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to provide tight fit at contact points with frames.

#### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.5 HARDWARE SCHEDULE**

- .1 Refer to Door Schedule Section 08 06 10.
- .2 Hardware Sets following this Section.

**END OF SECTION**

## Hardware Sets

### SET #01 - Exterior

Doors: 1:01.1

2	Continuous Hinge	661HD UL 2108 EPT	AL	CST
1	Exit Device	MLR TS 2601	630	CPR
1	Exit Device	MLR TS 2603	630	CPR
1	Rim Cylinder	12E-72 STD	626	CBE
1	Construction Core	7190224		CBE
2	Door Push & Pull	3012-2	C32D	CSM
1	Closer	8916 AFJ	689	CDM
1	Low Energy Operator	<b>Reuse Existing</b>		
2	Overhead Stop	912S	626	CDM
2	Power Transfer	EPT-5	630	CPR
2	Door Position Switch	9540 X B		CRC
1	Power Supply	RPSMLR2	No Finish	CPR
1	Backplate	BP89	689	CDM
1	Actuator (Vestibule side)	9LP36-HW	32D	CRC
1	Actuator (Exterior)	<b>Reuse Existing 150mm Round Actuator</b>		
2	Door Sweep	W-24S 914	CA	CKN
1	Threshold	CT-10 1828	AL	CKN
1	Weatherstrip			

NOTE: Mode of Operation: Authorized credential will shunt the door contact, energize the exterior actuator and retract the latch in the exit devices allowing the door to be pulled open or if required, pressing the actuator will activate the automatic door operator. Free exit at all times by pressing the bar on the exit device.

### SET #02 - Interior Vestibule

Doors: 1:01.2

2	Continuous Hinge	661HD UL 2108	AL	CST
2	Dummy Touchbar	N673DR-3	630	CPR
2	Door Push & Pull	3012-2	C32D	CSM
1	Closer	8916 AFJ	689	CDM
1	Low Energy Operator	<b>Reuse Existing</b>		
2	Overhead Stop	912S	626	CDM
1	Backplate	BP89	689	CDM
2	Actuators	By Automatic Door Operators		
1	Power Supply	By Electrical		

**SET #03 - UTR**

Doors: 1:04, 1:06B

3	Butt	CB191 114mm x 101mm	32D	CST
1	Lockset	9K3-7D15D STD S3	626	CBE
1	Construction Core	7190224		CBE
1	Electric Strike	4104-05	32D	CRC
1	Low Energy Operator	<b>Reuse Existing</b>	689	CDM
1	Wall Stop	S120	26D	CSM
2	Actuators (PTO)	<b>Reuse Existing</b>	32D	CRC
1	Door Contoller	ILO6KT	BLACK	CRC
1	Power Supply	By Electrical		

NOTE: ILO6KT consists of the following: 1-ILO6 controller, 2-P921 light annunciator, 1-P9535 magnetic door contact, 1-PBC6MW in the event of emergency, 1-R919-MA switch, 2-921 emergency light/sounder, 2-950 6" HANDI/PTO switch, 1-R972LEFM09 switch.

MODE OF OPERATION: Door is normally closed and locked. Entry by Exterior Push to Open (PTO) button activates the Auto-Operator and allows entry or by manual means. Activating the Interior Push to Lock (PTL) button locks the door, deactivates the exterior PTO button & activates exterior Occupied Light. Egress can be by Interior PTO button or manually opening the door. System is reset by PTO button and door contact. Interior Emergency Button unlocks the door and activates an interior and exterior audible and visual alert. Resetting is by manual means.

**SET #04 - Offices**

Doors: 1:08, 1:09A

3	Butt	CB191 114mm x 101mm	32D	CST
1	Lockset	9K3-7AB15D STD S3	626	CBE
1	Construction Core	7190224		CBE
1	Overhead Door Holder/Stop	454F	US32D	CSM

**SET #05 - Lobby/Copy**

Doors: 1:09B.1

3	Butt	CB191 114mm x 101mm	32D	CST
1	Lockset	9K3-7D15D STD S3	626	CBE
1	Construction Core	7190224		CBE
1	Electric Strike	4104-05	32D	CRC
1	Closer	8916 AF89	689	CDM
1	Wall Stop	S120	26D	CSM

NOTE: Card reader by access control supplier.

**SET #06 - Copy/Pool**

Doors: 1:09B.2

3	Butt	CB191 114mm x 101mm	32D	CST
1	Deadlock	MS1850S	628	CAD
1	Mortise Cylinder	1E-004 L/C	626	CBE
1	Mortise Cylinder	1EA-6A4	626	CBE
2	Door Push & Pull	3012-2	C32D	CSM
1	Closer	8916 AFJ	689	CDM
1	Door Stop	S102L	26D	CSM
1	Backplate	BP89	689	CDM

**SET #07 - First Aid**

Doors: 1:10

4	Butt	CB191 114mm x 101mm	32D	CST
1	Lockset	9K3-7D15D STD S3	626	CBE
1	Construction Core	7190224		CBE
1	Closer	8916-AFP	689	CDM
1	Overhead Hold Open/Stop	913H	626	CDM
1	Wall Stop	S120	26D	CSM

**SET #08 - Multi Purpose Room / Sauna**

Doors: 1:15 / 1:16B

3	Butt	CB191 114mm x 101mm	32D	CST
2	Door Push & Pull	3012-2	C32D	CSM
1	Closer	8916-AFJ	689	CDM
1	Overhead Hold Open/Stop	912H	626	CDM
1	Backplate	BP89	689	CDM

**SET #09 – Basement Staff Lounge Closet**

Doors: B:01.1

3	Butt	CB191 114mm x 101mm	32D	CST
1	Passage Leverset	9K3-N[F75]	626	CBE

**SET #10 - Janitorial**

Doors: 1:17A

6	Butt	CB191 114mm x 101mm	32D	CST
1	Flush Bolt	F65 UL 305	C26D	CSM
1	Lockset	9K3-7D15D STD S3	626	CBE
1	Construction Core	7190224		CBE
2	Closer	8916-AFP	689	CDM
2	Kick Plate	K10A 254 x 950	32D	CSM
1	Astragal	W-8 2135	AL	CKN
1	Smoke Seal			

**SET #11 - Electrical**

Doors: 1:17B

3	Butt	CB191 114mm x 101mm	32D	CST
1	Lockset	9K3-7D15D STD S3	626	CBE
1	Construction Core	7190224		CBE
1	Closer	8616 AF86P	689	CDM
1	Kick Plate	K10A 254 x 950	32D	CSM
1	Door Stop	S102L	26D	CSM
1	Smoke Seal			

**SET #12 – Stairwell and Staff Lounge**

Doors: ST-1 / B:01

1	Pushbutton Lockset	L1021B-41 5" Backset	26D	SX
1	Core	1C-7A2	626	BE
1	Construction Core	7190224		CBE

NOTE: Confirm 5" backset.

**SET #13 – Change Room Entries**

Doors: 1:05 / 1:12A / 1:13A

3	Butt	CB191 114mm x 101mm	32D	CST
2	Door Push & Pull	3012-2	C32D	CSM
1	Low Energy Operator	by Automatic Door Operators		
2	Actuators	by Automatic Door Operators		
1	Power Supply	By Electrical		



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 08 06 00 – Door Schedule.
- .2 Section 08 11 00 – Metal Doors and Frames.
- .3 Section 08 11 16 – Aluminum Doors and Frames.
- .4 Section 08 71 00 – Door Hardware.
- .5 Section 09 21 16 – Gypsum Board Assemblies.
- .6 Section 09 22 16 – Non-Structural Metal Framing.
- .7 Division 26 – Electrical.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - .2 ASTM B221M-21, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric].
- .2 Aluminum Association (AA).
  - .1 Designation System for Aluminum Finishes, 2009.
- .3 Builders Hardware Manufacturers Association (BHMA).
  - .1 ANSI/BHMA A156.10-2017, Power Operated Pedestrian Doors.
  - .2 ANSI/BHMA A156.19-2019, Power Assist and Low Energy Power Operated Doors.
- .4 City of Winnipeg Accessibility Design Standards, Third Edition, 2015.
- .5 International Code Council/American National Standards Institute (ICC/ANSI).
  - .1 ICC/ANSI A117.1-2017, Accessible and Usable Buildings and Facilities.
- .6 National Building Code of Canada (NBCC).

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Product Data.
  - .1 Submit manufacturer's catalogue data, detail sheets and specifications in accordance with Section 01 33 00.
- .2 Shop Drawings.
  - .1 Submit in accordance with Section 01 33 00.
  - .2 Include elevations, details, method of anchorage, location of presence sensors and door actuators, electrical connections, and details of joining with other construction.
  - .3 Provide manufacturer's catalogue data, detail sheets and specifications.
  - .4 Templates, diagrams and shop drawings to be supplied to fabricators and installers of related work for coordination of operators with doors, frames, hardware and other work.
- .3 Closeout Submittals.
  - .1 Provide operating and maintenance instructions, parts lists and wiring diagrams for incorporation into Operations and Maintenance Manual specified in Section 01 78 00.

## 1.4 QUALITY ASSURANCE

- .1 Manufacturer's Qualifications: factory-authorized and trained distributor having minimum of five (5) year's experience specializing in work of this Section, and who maintains parts inventory and trained personnel capable of providing service.
- .2 Requirements of Regulatory Agencies.
  - .1 Meet requirements of disabled in accordance with ICC A117.1.
  - .2 Meet requirements of City of Winnipeg Accessibility Design Standards.
- .3 All automatic equipment to comply with ANSI/BHMA A156.19.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## Part 2 Products

### 2.1 MANUFACTURED UNITS

- .1 Basis of Design Products.
  - .1 Surface Mounted Automatic Swing Door Operator (ADO)
    - .1 Surface Mounted Automatic Swing Door Operator.
      - .1 Horton 4100 LE Low Energy Door Operator.
      - .2 LCN 4600 Series Low Energy Door Operator.
      - .3 Stanley M-Force Low Energy Door Operator.
    - .2 Wall Mounted Column Type Push Plate Actuators.
      - .1 BEA 10LPR36-HW Full-Length Actuator.
      - .2 LCN 8310-836T Full Length Actuator.
      - .3 Wikk Industries S-136-3 INGRESS'R (stainless steel).
    - .3 Overhead-Mounted Presence Sensor.
      - .1 BEA Bodyguard-T Overhead Presence Sensor.
  - .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
  - .3 Supply all similar products from single manufacturer.

### 2.2 MATERIALS

- .1 Extruded Aluminum: to ASTM B221M, 6063-T5 alloy and temper.

### 2.3 SURFACE MOUNTED AUTOMATIC SWING DOOR OPERATOR (ADO)

- .1 Mode of Operation: spring close. Operator opens door by energizing motor and stops door by stalling motor against mechanical stop. Door closes slowly by means of spring energy with closing force of 26.6N (6 lb-force) minimum controlled by gear system and motor being used as dynamic brake without power. Complete automatic door cycle 18 to 20 seconds. Door operation not to require any fluids or gases under pressure to be used in opening and closing of door.

- .2 Fail-Safe Operation: to operate as manual door in event of power failure with 62N maximum applied to door stile.
- .3 Components.
  - .1 Operator Housing: nominal 140 mm wide x 127 mm high aluminum extrusion with finished end caps and prepared for surface mounting to door frames. Housing to extend full width of door header. All structural sections to have minimum thickness of 3.7 mm and be fabricated from 6063-T5 aluminum alloy.
  - .2 Power Operator: completely assembled and sealed unit including helical gear-driven transmission, overriding clutch (to provide easy manual operation, spring-close), mechanical spring and bearings all located in cast aluminum housing and filled with special lubricant for extreme temperature conditions. Attach DC shunt-wound permanent magnet motor with sealed ball bearings to transmission system. Operate motor from 115-volt supply requiring less than 5 amps at full power stall. Resilient mount complete unit with provisions for easy replacement, without removing door from pivots or frame. Include KEYED on/off switch (not toggle) mounted on header to turn power on or off, master keyed with mortise cylinder.
  - .3 Electronic Control: self-contained unit including necessary transformer, relays, rectifiers, and other electronic components for proper operation and switching of power operator. Plug-in type relays for individual replacement. All connecting harnesses to have interlocking plugs. Controls include time delay for normal cycle and adjustable hold-open (2 to 60 seconds) time delay module. Include "Time Out" feature which will turn off opening force when door is stopped for one second. If this occurs, door begins to close, and operator immediately resets and will accept another opening signal.
  - .4 Connecting Hardware.
    - .1 Pull-type Operation: parallel inswing power arm and track assembly, urethane covered roller riding in track fabricated of 6061-T6 aluminum alloy attached to top door rail.
    - .2 Push-type Operation: two-piece outswing power arm and connecting arm assembly with self-aligning rod ends and connecting door bracket.
  - .5 Overhead-Mounted Presence Sensor.
    - .1 Presence Sensor: overhead-mounted infrared presence sensor on approach side of door to detect stationary or moving persons within the sensing pattern. The sensor to have a sensing pattern that is fully adjustable by remote control for sensitivity, pattern width and pattern depth.
  - .6 Door Actuators.
    - .1 Wall Mounted Column Type Push Plate Actuator: 152 mm wide x 38 mm deep x 915 mm high, satin stainless steel push plate, surface mounted, hard wired c/w blue wheelchair logo and PUSH TO OPEN text.
    - .2

## 2.4 FINISHES

- .1 Exposed Aluminum Finishes.
  - .1 AA-M12C22 A31 (0.4 mils) Architectural Class II Clear Anodic Coating in accordance with Aluminum Association Designation System for Aluminum Finishes.

## Part 3 Execution

### 3.1 EXAMINATION

- .1 Verify that door openings and doors are properly installed and ready for installation of door operators.
- .2 Verify that electrical service is available, properly located and of proper type.

### **3.2 INSTALLATION**

- .1 Install header case and automatic door operators plumb, square, level and true to line by factory-trained installers in accordance with reviewed shop drawings, manufacturer's printed instructions, and ANSI/BHMA A156.19.
- .2 Aluminum surfaces in contact with masonry, concrete, and steel to be protected from contact by use of neoprene gaskets where indicated or coat of bituminous paint to prevent galvanic or corrosive action.
- .3 Install actuators at locations shown on architectural drawings.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: verify that electrical connections are made correctly and with dedicated grounding.

### **3.4 ADJUSTING**

- .1 Adjust door operators for proper operation, without binding or scraping and without excessive noise.
- .2 After repeated operation of completed installation, readjust door operators and controls for optimum operating condition and safety.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
  - .1 After installation, clean operator components as recommended by manufacturer.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.6 SCHEDULES**

- .1 Refer to Section 08 06 10.

**END OF SECTION**

## Part 1 General

### 1.1 RELATED SECTIONS

- .1 Section 08 11 00 – Metal Doors and Frames.
- .2 Section 08 11 16 – Aluminum Doors and Frames.
- .3 Section 10 28 00 – Toilet and Bath Accessories.

### 1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
  - .1 ANSI Z97.1-15(R2020), Standard for Safety Glazing Materials Used in Buildings.
- .2 American Society for Testing and Materials (ASTM).
  - .1 ASTM C1036-16, Standard Specification for Flat Glass.
  - .2 ASTM C1048-18, Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
  - .3 ASTM C1172-19, Standard Specification for Laminated Architectural Flat Glass.
  - .4 ASTM C1503-18, Standard Specification for Silvered Flat Glass Mirror.
  - .5 ASTM D823-17, Standard Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels.
  - .6 ASTM D1212-91(2013) Standard Test Methods for Measurement of Wet Film Thickness of Organic Coatings.
  - .7 ASTM D2240-15e1, Standard Test Method for Rubber Property - Durometer Hardness.
  - .8 ASTM E283-18, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
  - .9 ASTM E330/E330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
  - .10 ASTM E331-00(2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls and Doors by Uniform Static Air Pressure Difference.
  - .11 ASTM E547-00(2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.
  - .12 ASTM E1105-15, Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference.
- .3 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
  - .2 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
  - .3 CAN/CGSB-12.4-M91, Heat Absorbing Glass.
  - .4 CAN/CGSB 12.8-97 AMEND, Insulating Glass Units.
- .4 Canadian Standards Association (CSA).
  - .1 AAMA/WDMA/CSA 101/I.S.2/A440-17, North American Fenestration Standard / Specification for windows, doors, and skylights.
  - .2 CAN/CSA A440.2-14/A440.3-14, Fenestration Energy Performance/User Guide to CSA A440.2-14, Fenestration Energy Performance.
  - .3 CSA A440.4-07(R2016), Window, Door and Skylight Installation.

- .5 Consumer Product Safety Commission (CPSC).
  - .1 CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials.
- .6 Insulating Glass Manufacturers Alliance (IGMA).
  - .1 TR-1200-83(07), Guidelines for Commercial Insulating Glass Dimensional Tolerances.
  - .2 TM-4000-02(07), Insulating Glass Manufacturing Quality Procedures.
- .7 National Building Code of Canada (NBCC).

### **1.3 SYSTEM DESCRIPTION**

- .1 Design Requirements.
  - .1 Design and size insulating glazing units to withstand wind loads, dead loads and positive and negative live loads in accordance with ASTM E330/E330M, and the National Building Code of Canada, Climatic Information for Building Design for at the Place of the Work, but not less than specified thickness and dimension.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with Section 01 33 00.
- .2 Product Data.
  - .1 Submit manufacturer's printed product literature, specifications and data sheet.
  - .2 Indicate dimensional tolerances of insulating glass units (IGU) in accordance with IGMA TR-1200 to be installed in Sections 08 11 00 and 08 11 16.
- .3 Test Reports.
  - .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .4 Certificates.
  - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .5 Closeout Submittals.
  - .1 Provide maintenance data including cleaning instructions for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Construction Waste Management in accordance with Section 01 74 19.

### **1.6 SITE CONDITIONS**

- .1 Install glazing when ambient temperature is 10°C minimum. Maintain ventilated environment for 24 hours after application.

- .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

## 1.7 WARRANTY

- .1 Provide an extended warranty for Work of this Section for a period of 10 years from date of Substantial Performance of the Work. Contractor hereby warrants insulating glass units against failure of seal, cracking of coatings, and deposits on inner faces of glass detrimental to vision, and these or other observed defects and deficiencies to be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City.

## Part 2 Products

### 2.1 MATERIALS

- .1 Clear Annealed Float Glass: to ASTM C1036 and CAN/CGSB 12.3, Type 1, Class 1 (clear), thickness as indicated.
- .2 Clear Tempered Safety Glass (SG): to ASTM C1048, ANSI Z97.1, and CAN/CGSB-12.1, Type 1, Class 1 (clear), clean-cut (with minimum serration, hackle, etc.), ground and polished edges where exposed, 6 mm thick, unless noted otherwise.
- .3 Laminated Glass (LG): to ASTM C1172 and CAN/CGSB-12.1, Type 1 (laminated), 6 mm overall thickness consisting of 3 mm tempered glass each side of 0.060" thick clear polyvinyl butyral (PVB) interlayer.
- .4 Insulating Glass Units (IGU): to CAN/CGSB-12.8, IGMA TR-1200 and IGMA TM-4000, consisting of two or three lites of glass as indicated, separated by high performance window spacers and air spaces which are hermetically sealed by an organic compound and kept continually dehydrated by a specially formulated desiccant material inside the spacer.
  - .1 IGU-1: Double Glazing: overall 25 mm thick double-pane insulating glass unit – exterior pane 6 mm tempered safety glass (SG) with low e (surface #2), interior pane 6 mm tempered safety glass (SG), one (1) argon gas filled air space, complete-with air spacer. Note - edge deletion is required for low e coating.
  - .2 IGU-2: Triple Glazing: overall 44 mm thick triple-pane insulating glass unit – exterior pane of 6 mm tempered safety glass (SG) with low emissivity coating (surface #2), mid pane of 4 mm annealed float glass, inner pane of 4 mm annealed float glass with low emissivity coating (surface #5), with two (2) argon gas filled air spaces, complete-with air spacers. Note - edge deletion is required for low e coating.
- .5 Glazing Channel (where noted): continuous, clear anodized aluminum, profile as indicated on plans and to accommodate 10 mm glazing, square edge, wet glazed.
- .6 Unframed Mirror (W:MR): to ASTM C1503, select tempered float glass, electrolytically copper-plated by galvanic process, grind and polish edges exposed in final assembly, 6 mm thick, size as indicated.

### 2.2 ACCESSORIES

- .1 Glazing Tape.
  - .1 Co-extruded EPDM gasket with integral glazing tape.
  - .2 Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume 2%, designed for compression of 25%, to effect an air and vapour seal; size to suit application as recommended by manufacturer.

- .2 Glazing Gasket: elastomeric of durometer compatible with glazing tape.
- .3 Setting Blocks: neoprene, 80 - 90 Shore “A” durometer hardness to ASTM D2240, minimum 100 mm x width of glazing rabbet space minus 1.5 mm x height to suit glazing method, glass light weight and area.
- .4 Spacer Shims: neoprene, 50 - 60 Shore “A” durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.
- .5 Mirror Attachment Accessories: concealed stainless steel clips.
- .6 Primer-sealers and Cleaners: to glass manufacturer's standard.
- .7 Cleaners: to glass manufacturer's standard.

### **2.3 FABRICATION**

- .1 Fabricate insulating glass units (IGU) in accordance with IGMA TM-4000.
- .2 Co-ordinate with Section 08 11 16, the dimensional tolerances of insulating glass units (IGU) to be installed in aluminum doors and frames in accordance with IGMA TR-1200.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verify that openings for glazing are correctly sized and within tolerance.
- .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

### **3.2 PREPARATION**

- .1 Remove protective coatings and clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

### **3.3 INSTALLATION**

- .1 Exterior Wet/Dry Method (preformed tape and sealant).
  - .1 Glaze VISIONstrip in place as required for flush or offset glazing in accordance with manufacturer’s instructions.
  - .2 Place a toe bead of sealant compatible to VISIONstrip, 150 mm in each direction from each corner filling the void beneath the VISIONstrip to the sill of the frame.
  - .3 EPDM or neoprene setting blocks shall be positioned at quarter points from both ends of the sill.
  - .4 Place the vision glazing unit in the opening, resting on the appropriately placed setting blocks. Centre the glazing unit and then push firmly to the VISIONstrip.
  - .5 Install the removable stop and VISIONstrip in the face clearance provided to maintain the appropriate compression and render the glazing system weather-tight.
  - .6 Use edge blocking when required in accordance with the glass manufacturer’s written instructions.
- .2 Exterior Dry Method (preformed glazing).
  - .1 Perform work in accordance with IGMA and for glazing installation methods.



- .2 Cut glazing tape to length; install on glazing light. Seal corners by butting tape and sealing junctions with sealant.
- .3 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.
- .4 Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- .5 Install removable stops without displacing glazing tape. Exert pressure for full continuous contact.
- .6 Trim protruding tape edge.
- .3 Interior Dry Method (tape and tape).
  - .1 Cut glazing tape to length and set against permanent stop, projecting 1.6 mm above sight line.
  - .2 Place setting blocks as per manufacturer's instructions.
  - .3 Resting glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
  - .4 Place glazing tape on free perimeter of glazing in same manner as noted above.
  - .5 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact. Knife trim protruding tape. Do not cut or abrade tempered glass.
- .4 Mirror (W:MR).
  - .1 Set mirrors with stainless steel clips. Place plumb and level, and anchor rigidly to wall construction.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
  - .1 Remove glazing materials and labels from finish surfaces.
  - .2 Remove labels after work is complete.
  - .3 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.5 SCHEDULES**

- .1 Refer to Section 08 06 10.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 08 80 00 – Glazing.

### **1.2 REFERENCES**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI Z97.1-2009, Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- .2 American Society for Testing and Materials (ASTM).
  - .1 ASTM D882-12, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
  - .2 ASTM D1004-13, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
  - .3 ASTM D1044-13, Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion.
  - .4 ASTM D2582-09, Standard Test Method for Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
  - .5 ASTM E84-21a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .3 International Window Film Association (IWFA).

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Indicate all pattern layouts, locations of seams, installation instructions, and other information required by Contract Administrator for approval.
- .3 Samples.
  - .1 Submit 500 x 500 mm sample of surface film specified installed on 6 mm thick clear float glass in accordance with specifications.
- .4 Maintenance Data.
  - .1 Provide maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

### **1.4 QUALITY ASSURANCE**

- .1 Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years' experience.
- .2 Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.
  - .1 Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
  - .2 Provide a commercial building reference list of five (5) properties where the installer has applied window film. This list will include the following information:
    - .1 Name of building.
    - .2 The name and telephone number of a management contact.
    - .3 Type of glass.
    - .4 Type of film.
    - .5 Amount of film installed.

.6 Date of completion.

- .3 Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - .1 Finish areas designated by Contract Administrator.
  - .2 Do not proceed with remaining work until workmanship, colour, and sheen are approved by Contract Administrator.
  - .3 Refinish mock-up area as required to produce acceptable work.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Store rolls of film flat on cross supports. Do not stand rolls of film on end.
- .4 Handle all products with appropriate precautions and care as stated manufacturer's instructions. Remove only in quantities required for same day use.
- .5 Cleaning in accordance with Section 01 74 00.
- .6 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.6 SITE CONDITIONS**

- .1 Maintain constant 21°C air temperature at installation area for 72 hours before, during and 48 hours after installation.

## **1.7 WARRANTY**

- .1 Manufacturer's Product Warranty: provide an extended warranty for Work of this Section for a period of one (1) year from date of Substantial Performance of the Work. Manufacturer hereby warrants that surface film will maintain all properties without cracking, crazing or peeling of film, and maintain adhesion properties without blistering, bubbling or delaminating from glass, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City.
- .2 Warranty to include full cost of film, removal, and re-application labour.
- .3 Manufacturer to also warrant against glass failure due to thermal shock fracture of glass caused only as direct result of application of glazing surface film for period of one (1) year from date of substantial completion of the Work.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Basis of Design Products.
  - .1 Glazing Surface Film (GSF).
    - .1 Arlon DPF 47WF Vinyl Film.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.

## **2.2 MATERIALS**

- .1 Glazing Surface Film (GSF): 150 micron (6 mil) PVC film coated with high performance clear adhesive, coupled with lay-flat release liner. Good resistance to water, humidity and solvents.
  - .1 Perforation Size: 1.5 mm.
  - .2 Perforation Pattern: 70 Printable/30 Open.
  - .3 Colour(s)/Design: Custom printed design. Details to be provided by Contract Administrator.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Examine glass under natural daylight and identify cracks, blisters, bubbles, discoloration, edge defects or other anomalies that may cause, film to delaminate, or vision transparency or distortion problems. Report findings to Contract Administrator.

### **3.2 PREPARATION**

- .1 Clean glass before beginning installation using neutral cleaning solution.
- .2 Ensure no deleterious material adheres to glass by balding surface of glass using industrial razors.
- .3 Ensure dust, grease, and chemical residue are removed from surface of glass before installation of film.
- .4 Before beginning work, place absorbent material on sill or at sash frame to absorb moisture accumulation generated by film application.

### **3.3 INSTALLATION**

- .1 Apply and attach film to glass in accordance with manufacturer's written instructions.
- .2 Cut film edges straight and square in accordance with manufacturer's written instructions.
- .3 Splicing.
  - .1 Splice film only when glass is greater in width than film.
  - .2 Splice film only after receipt of written approval from Contract Administrator.
  - .3 Use butt factory edges only.
- .4 Use only water and film slip solution on glass to facilitate positioning of film.
- .5 Ensure finished surface of film is vision free of blisters, bubbles, tears, scratches, edge defects, delaminating or vision distortion when viewed under natural daylight from 2 m minimum.
- .6 Ensure removal of excess water from between film and glass.
- .7 Remove left over material from work area and return work area to original condition.
- .8 Do not apply film to insulated glass units.

### **3.4 FIELD QUALITY CONTROL**

- .1 View completed installation from distance of 2 m against bright uniform sky or background.
- .2 Film to appear uniform in appearance with no visible streaks, creases, air bubbles, banding, thin spots, pin holes or other visible distortion.
- .3 Installation deemed acceptable when Visual Quality Standard for applied glazing surface film, as adopted by IWFA are passed.

- .4 Return to work place after 30 days but no longer than 40 days for final cleaning and inspection of installed film. Remove and replace without glass replacement, film that shows blisters, bubbles, tears, scratches, edge defects or vision distortion in film when viewed under natural daylight from 2 m minimum.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
  - .1 Allow installation to cure one (1) month prior to cleaning.
  - .2 Wash film and both sides of glass using cleaning solution recommended by film manufacturer. Dry with soft clean cloths or soft paper towels.
  - .3 Follow manufacturers written instructions for care and maintenance of film.
  - .4 Use only cleaning solution recommended by manufacturer for regularly scheduled cleaning of film.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

<b>ROOM FINISH ABBREVIATIONS</b>					
<b>ABBREV</b>	<b>MATERIAL</b>	<b>SPEC NO</b>	<b>ABBREV</b>	<b>MATERIAL</b>	<b>SPEC NO</b>
C	Concrete		SC	Self-Coved Base	09 65 00
CMU	Concrete Masonry Unit	04 22 00			09 31 00
CMU-GLZ	Concrete Masonry Unit, Glazed finish		SDM	Sheet Dampproofing Membrane	07 11 19
CT	Tile	09 31 00	SDM	Unfinished	
EP	Epoxy Paint	09 90 00	VS	Vinyl Sheet	09 65 00
EX-	Existing		WD-CD	Wood - Cedar	06 20 00
FG	Floor Grate (Recessed)	12 48 13			
GB	Gypsum Board	09 21 16			
GL	Glazing	08 80 00			
P	Paint	09 90 00			
PF	Prefinished				
PW	Plywood	06 08 99			

**TYPICAL NOTES:**

1. All sub-floor material to be concrete unless otherwise noted.
2. All measurements indicated are millimeters and are indicated as height above floor finish (AFF), unless otherwise noted.
3. Where two wall materials are indicated, refer to interior elevations for further clarification.
4. All welding seams to match field colour, unless otherwise noted.
5. All self cove base to be 150 mm above finished floor (AFF), unless otherwise noted.
6. All new walls to receive paint (P) or epoxy paint (EP) finish, unless otherwise noted.
7. All GB walls to be painted INT9.2B/G2 unless otherwise noted.
8. All GB walls to be epoxy painted (EP) Non-MPI G5/Semi-Gloss unless otherwise noted. All gloss levels to be confirmed prior to start of work.
9. All CMU walls to be epoxy painted INT4.2J/G5 unless otherwise noted.
10. All GB-EP ceiling to be painted INT4.2F with gloss level to match walls unless otherwise noted.
11. Provide paint colour P- to all Locker Room bench brackets.
12. Provide paint colour P- to all exposed columns impacted by area of work, unless otherwise noted.
13. Provide paint colour P- to all new metal door frames, unless otherwise noted.
14. Provide paint colour P- to all new metal doors, unless otherwise noted.

<b>REMARKS:</b>	
R1	Refer to interior elevation(s) for extent of CT coverage and/or paint pattern.
R2	Cove base tile around the exhaust duct bench (3 sides) is to be same colour as floor tile colour on Pool Deck.
R3	Patch and repair floor and wall to receive new CT in patched/repaired locations only.
R4	Paint exposed faces of steel column c/w new steel plate(s).
R5	Entirety of walls/partitions to be painted, inclusive of roof structure, exposed steel columns, existing glazed masonry units, existing masonry band. Roof structure and portion of walls above ceiling plane to be painted black. Refer to interior elevations for patterns and indications.
R6	Paint rated shaft constructed under stair landing.
R7	New tile base along north wall only for tie-in of new interior partition.
R8	CT1 applies to all 3 wall surfaces in shower alcove. On west wall, bring CT1 up to steel column.
R9	Where lockers are installed against the wall, apply CT1 only to area above lockers.
R10	Built-in exhaust bench along Grid Line B to be finished in CT3, all exposed sides.
R11	Install cove base up to bank of lockers. Cove base is not required behind lockers.
R12	Paint new exhaust duct stemming from exhaust bench. Colour: black.
R13	Install vinyl sheet over existing rigid vinyl tile. Prior to installation, patch existing flooring to level finish.
R14	Tile floor finish to extend beneath wood cedar bench and tie into existing tiled supply bench. Refer to Drawing A7.4 for floor finish pattern. Cove tile bases to be applied on all walls, inclusive of unexposed areas beneath cedar benches.
R15	Paint exposed face of steel column. Colour to match east wall.
R16	Tile base CT-9 is to be applied on walls where floor tile CT-7 is installed. Tile base CT-4 is to be applied where floor tile CT-5 and CT-6 are installed. Refer to Drawing A7.3 and A7.4 for floor finish pattern. Confirm final tile base locations with Contract Administrator.





ROOM NO.	ROOM NAME	FLOOR		BASE		NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		REMARKS
		MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	
<b>DRAWING A2.2 - MAIN FLOOR</b>														
1:01	VESTIBULE	FG / VS	-	SC	RF	EX-CMU-GLZ	EP	EX-CMU / CMU	EP	GL / CMU	- / EP	EX-CMU-GLZ	EP	
1:02A	LOBBY	VS	-	SC	RF	GL / CMU	- / EP	CMU	EP	CMU	EP	CMU	EP	
1:02B	RECEPTION	VS	-	SC	VS	-	-	CMU	EP	CMU / GL	EP / -	CMU / DW	EP	
1:03	CORRIDOR	VS	-	SC	RF	EX-CMU	EP	EX-CMU / CMU	EP	-	-	EX-CMU / CMU	EP	
1:04	BARIATRIC UTR	CT4	-	CT4	-	CMU	EP / CT1	EX-CMU / CMU	CT1 / EP	CMU	EP	EX-CMU / CMU	EP	R8, R15
1:05	CORRIDOR	CT4	-	CT4	-	CMU	EP	CMU	EP	CMU	EP / CT3	-	-	R1
1:06A	UNIVERSAL CHANGE CORR	CT4	-	CT4	-	CMU	EP	CMU	EP	CMU	EP	CMU	EP	
1:06B	UTR	CT4	-	CT4	-	CMU	EP	CMU	EP	CMU	EP	CMU	EP	
1:06C	WASHROOM	CT4	-	CT4	-	CMU	EP	-	-	CMU	EP	CMU	EP	
1:06D	GROOMING	CT4	-	CT4	-	-	-	CMU	EP	CMU	EP	-	-	
1:06E	LOCKERS	CT4	-	CT4	-	EX-CMU-GLZ / EX-CMU	CT1	EX-CMU-GLZ	CT1	CMU	EP	CMU	EP	R9, R11
1:06F	SHOWER	CT4	-	CT4	-	CMU	CT1	CMU	CT1	CMU	CT1	-	-	

ROOM NO.	ROOM NAME	FLOOR		BASE		NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		REMARKS
		MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	
1:06G	SHOWER	CT4	-	CT4	-	CMU	CT1	CMU	CT1	EX-CMU-GLZ / CMU	CT1	-	-	
1:06H	CHANGE	CT4	-	CT4	-	CMU	EP	EX-CMU-GLZ	CT1	CMU	EP	CMU	EP	
1:06I	CHANGE	CT4	-	CT4	-	-	-	CMU	EP	CMU	EP	CMU	EP	
1:06J	CHANGE	CT4	-	CT4	-	-	-	CMU	EP	CMU	EP	CMU	EP	R4
1:06K	CHANGE	CT4	-	CT4	-	-	-	CMU	EP	CMU	EP	CMU	EP	
1:06L	CORRIDOR	CT4	-	CT4	-	CMU	EP	-	-	CMU	EP	-	-	
1:06M	SHOWERS	CT5 CT6 CT7	-	CT9 / CT4	-	CMU	CT1	CMU	CT1	CMU	CT1	CMU	EP	R16
1:06N	LOCKERS	CT4	-	CT4	-	-	-	CMU	EP	CMU	EP	CMU	EP	R4, R11
1:07	CHLORINE ROOM	-	-	-	-	-	-	-	-	-	-	-	-	
1:08	PRIVATE OFFICE	VS	-	SC	VS	GB	EP	GB	EP	GB / GL	EP	GB	EP	
1:09A	OPEN OFFICE	VS	-	SC	VS	GB	EP	GB	EP	GB / GL	EP	GB	EP	
1:09B	COPY AREA	VS	-	SC	VS	CMU	EP	GB	EP	CMU / GL	EP	CMU	EP	
1:10	FIRST AID	CT8	-	CT9	-	CMU	EP	CMU	EP	CMU	EP	CMU	EP	

ROOM NO.	ROOM NAME	FLOOR		BASE		NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		REMARKS
		MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	
1:11	CORRIDOR	VS	-	SC	-	EX-CMU	EP	-	-	CMU	EP	GL	-	R1
1:12A	MALE CHANGE CORRIDOR	CT4	-	CT4	-	-	-	CMU	EP	CMU	EP	CMU	EP / CT3	
1:12B	WASHROOM	CT4	-	CT4	-	CMU	EP	CMU	EP	-	-	CMU	EP	
1:12C	GROOMING & LAVATORY	CT4	-	CT4	-	-	-	CMU	EP	CMU	EP	CMU	EP	
1:12D	LOCKERS	CT4	-	CT4	-	CMU	EP	CMU	EP	CMU	EP	CMU	EP	R11
1:12E	SHOWERS	CT4	-	CT4	-	CMU	CT1	CMU	CT1	CMU	CT1	CMU	CT1	
1:12F	CORRIDOR	CT4	-	CT4	-	CMU	EP/CT2	-	-	CMU	EP	CMU	EP	
1:12G	CORRIDOR	CT5 CT6 CT7	-	CT9 / CT4	-	CMU	EP/CT2	CMU	EP	-	-	CMU	EP	R16
1:13A	FEMALE CHANGE CORRIDOR	CT4	-	CT4	-	EX-CMU	EP	GL / CMU	EP	CMU	EP	CMU	EP / CT3	R1
1:13B	WASHROOM	CT4	-	CT4	-	CMU	EP	CMU	EP	CMU	EP	CMU	EP	
1:13C	SHOWERS	CT4	-	CT4	-	CMU	CT1	CMU	CT1	-	-	EX-CMU- GL	CT1	
1:13D	LOCKERS	CT4	-	CT4	-	-	-	CMU	EP	EX-CMU- GLZ	CT1	EX-CMU- GLZ	CT1	R9, R11
1:13E	GROOMING	CT4	-	CT4	-	-	-	CMU	EP	CMU	EP	EX-CMU- GLZ	CT1	

ROOM NO.	ROOM NAME	FLOOR		BASE		NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		REMARKS
		MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	MATL	FIN	
1:13F	CORRIDOR	CT5 CT6 CT7	-	CT9/ CT4	-	CMU	CT2	CMU	EP	CMU	EP	EX-CMU	CT1	R1, R4, R16
1:14	POOL DECK	EX-CT/ CT8	-	EX-CT/ CT9/ CT8	-	EX-CMU- GLZ /CMU / GL	EP / CT3	EX-CMU- GLZ	EP	EX-CMU- GLZ	EP	EX-CMU- GLZ	EP	R1, R2, R5, R7, R10, R12
1:14	POOL DECK (NEW CONSTRUCTION - EXTERIOR OF MPR)	EX-CT/ CT8	-	CT9	-	-	-	GB / GL	CT2 / -	GB / GL	CT2 / -	GB	CT2	R1
1:15	MPR	EX-CT/ CT8	-	CT9	-	GB / GL	CT2 / -	GB / GL	CT2 / -	EX-CMU	-	GB	EP	
1:16A	SAUNA SHOWER	EX-CT/ CT8	-	CT8	-	-	-	GB	CT2	GB / GL	CT2 / -	-	-	
1:16B	SAUNA	CT-8	-	CT9	-	WD-CD	-	WD-CD	-	WD-CD	-	WD-CD	-	R14
1:17A	JANITORIAL	EX-CT/ CT4	-	EX-CT/ CT9	-	EX-CT	-	EX-CT / EX-GB	-	GB	EP	EX-CT	-	R3
1:17B	ELECTRICAL	EX-CT	-	EX-CT	-	GB	EP	EX-CT	-	EX-CT	-	EX-CT	-	
ST-1	STAIR	EX-CMU	-	C	-	EX-CMU	-	EX-CMU	-	EX-CMU	-	EX-CMU	-	
ST-2	STAIR	EX-CMU	-	C	-	EX-CMU	-	EX-CMU	-	EX-CMU	-	EX-CMU	-	R6

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 04 22 00 – Concrete Unit Masonry.
- .2 Section 06 10 00 – Rough Carpentry for Minor Works.
- .3 Section 07 92 00 – Joint Sealants.
- .4 Section 08 06 00 – Door Schedule.
- .5 Section 08 11 00 – Metal Doors and Frames.
- .6 Section 08 11 16 – Aluminum Doors and Frames
- .7 Section 09 06 00.13 – Room Finish Schedule.
- .8 Section 09 22 16 – Non-Structural Metal Framing.
- .9 Section 09 31 00 – Tiling.
- .10 Section 09 65 00 – Resilient Flooring.
- .11 Section 09 81 00 – Acoustic Insulation.
- .12 Section 09 91 23 – Interior Painting.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2 ASTM C473-19, Standard Test Methods for Physical Testing of Gypsum Panel Products.
  - .3 ASTM C474-15(2020), Standard Test Methods for Joint Treatment Materials for Gypsum Board Construction.
  - .4 ASTM C475/C475M-17, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  - .5 ASTM C840-20, Standard Specification for Application and Finishing of Gypsum Board.
  - .6 ASTM C954-18, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
  - .7 ASTM C1177/C1177M-17, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - .8 ASTM C1178/C1178M-18 Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
  - .9 ASTM C1186-08(2016), Standard Specification for Flat Fiber-Cement Sheets.
  - .10 ASTM C1278/1278M-17, Standard Specification for Fiber-Reinforced Gypsum Panel.
  - .11 ASTM C1280-18, Standard Specification for Application of Gypsum Sheathing Board.
  - .12 ASTM C1396/C1396M-17, Standard Specification for Gypsum Board.
  - .13 ASTM C1629/C1629M-19, Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
  - .14 ASTM D3273-16, Standard Test Method for Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
  - .15 ASTM D4977/D4977M, Standard Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion.
  - .16 ASTM D5420-16, Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).

- .17 ASTM E119-20, Standard Test Methods for Fire Tests of Building Construction and Materials.
- .18 ASTM E136-19a, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.
- .19 ASTM E695-03(2015)e1, Standard Method for Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-71.25-[M88], Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.
- .3 Gypsum Association (GA).
  - .1 GA 214-17, Recommended Levels of Gypsum Board Finish.
  - .2 GA 216-18, Application and Finishing of Gypsum Panel Products.
  - .3 GA-238-19, Guidelines for the Prevention of Mold Growth on Gypsum Board.
  - .4 GA 253-18, Application of Gypsum Sheathing.
  - .5 GA 600-18, Fire Resistance Design Manual.
- .4 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC S101-14-REV2, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC S102-2018-REV1, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC S114-2018, Standard Method of Test for Determination of Non-Combustibility In Building Materials.

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data.
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples.
  - .1 Submit for review and acceptance of each unit.
  - .2 Samples will be returned for inclusion into work.
  - .3 Submit duplicate 300 mm long samples of corner and casing beads, vinyl mouldings, shadow mould.

### **1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements.
- .4 Store gypsum board assemblies materials level off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .1 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
  - .2 Protect from weather, elements and damage from construction operations.
  - .3 Handle gypsum boards to prevent damage to edges, ends or surfaces.

- .4 Protect prefinished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
- .5 Replace defective or damaged materials with new.
- .5 Cleaning in accordance with Section 01 74 00.
- .6 Waste Management and Disposal in accordance with Section 01 74 19.

## 1.5 SITE CONDITIONS

- .1 Maintain temperature minimum 10°C and maximum 21°C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.
- .2 Apply board and joint treatment to dry, frost free surfaces.
- .3 Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

## Part 2 Products

### 2.1 MATERIALS

- .1 Non-rated Gypsum Board: to ASTM C1396/C1396M, 16 mm thick unless otherwise indicated, 1220 mm wide x maximum practical length, ends square factory cut, edges tapered.
- .2 Fire-rated Gypsum Board: to ASTM C1396/C1396M and ASTM E136, Type X, 16 mm thick unless otherwise indicated, 1220 mm wide x maximum practical length, ends square factory cut, edges tapered.
- .3 Non-rated and Fire-rated Water/Mould-resistant Gypsum Board: to ASTM C1396/C1396M and ASTM D3273, 16 mm thick unless otherwise indicated, 1220 mm wide x maximum practical length, ends square factory cut, edges tapered, water resistant through core, paintable surface.
- .4 Tile Backer Board: to ASTM C1178/C1178M, ASTM C1278/C1278M and ASTM D3273, 16 mm fiber-reinforced gypsum panel that provides strength and water resistance as well as superior tile bond for ceramic tile, 1220 mm wide x maximum practical length, ends square factory cut, edges tapered, water resistant through core, paintable surface
- .5 Cement Board Sheathing: to ASTM C1186, Portland cement board with fully embedded alkali resistant glass-fibre mesh facing, indicated thickness, 1220 mm wide x maximum practical length, ends square factory cut.

### 2.2 COMPONENTS

- .1 Gypsum Board Ceiling Suspension System.
  - .1 Complete suspension system in accordance with manufacturer's system assembly consisting of the following components to suit complete installation:
    - .1 Main Beam: double-web construction, minimum 0.0179" (prior to protective coating) in accordance with ASTM C645, hot dipped galvanized in accordance with ASTM A653/A653M).
      - .1 Structural Classification: ASTM C635/C635M Heavy duty.
    - .2 Primary Cross Tees: double-web steel construction, minimum 0.0179" (prior to protective coating) in accordance with ASTM C645, hot dipped galvanized in accordance with ASTM A653/A653M).
      - .1 Structural Classification: ASTM C635/C635M Heavy duty.
    - .3 Framing Angles.



- .4 Transition Moulding: Drywall to Acoustical ceiling. Pre-painted integral acoustical flange and drywall taping flange, hot dipped cold rolled steel.
  - .5 Direct Light Coves: aluminum extrusion for drywall applications.
  - .6 Indirect Light Coves: aluminum extrusion indirect light coves and ledges with integral drywall taping flange.
  - .7 Rotary Shade Enclosures: aluminum extrusion shade enclosures with integral drywall taping flange.
  - .8 Accessories and Clips.
  - .9 Screws for wallboard application shall be bugle head screws in accordance with thickness of material used.
  - .10 Framing screws for mechanical fastening metal components shall be galvanized 7/16" pan head or wafer head Phillips drive with sharp point or self-drilling points depending on the metal to be fastened.
  - .11 Trims and Beads: as specified above.
- .2 Gypsum Board Shaft Enclosure Systems.
- .1 Gypsum Board: fire-rated mould-resistant gypsum board 15.9 mm and 19 mm thick x 1220 mm wide x longest practical length.
  - .2 Shaft Liner Board: fire-rated mould-resistant gypsum liner board; 25 mm thick; height to suit installation conditions.
  - .3 Framing System: studs and tracks; 64 mm deep, manufactured from galvanized steel, 20 gauge thick, as used in shaft enclosure wall fire tests by Warnock Hersey International.
  - .4 Resilient Channel: drywall resilient channel manufactured from 0.530 mm galvanized steel.
  - .5 Acoustical Insulation: friction fit glass or mineral fibre insulation, 25 mm, 65 mm, and 75 mm thick.
  - .6 Joint Treatment: mould resistant drywall compound and tape conforming to ASTM C475/C475M.
  - .7 Corner Bead: 29 mm, 32 mm flanges.
  - .8 Sheet Metal Screws: for attaching metal to metal; self-drilling, self-tapping, pan head sheet metal screws, 12.7 mm x No. 8 with rust resistant finish.
  - .9 Gypsum Board Screws: Type S-12 for 20-gauge framing, for attaching gypsum board to metal framing; lengths as specified.
  - .10 Acoustical Caulking: as recommended by manufacturer.

### **2.3 ACCESSORIES**

- .1 Gypsum Board Fasteners: self-drilling screws to ASTM C954.
- .2 Fasteners for Cement Board Sheathing: 32 mm No. 8 x 9.5 mm HD self-drilling corrosion resistant (stainless steel or galvanized to ASTM A123/A123M) wafer head screws in accordance with ASTM C1186, unless otherwise recommended by cement board manufacturer.
- .3 Joint Tape: to ASTM C475, 51 mm wide, high strength, coated, alkali-resistant, glass fibre reinforcing tape.
- .4 Standard Joint Compound: to ASTM C475/C475M, asbestos-free.
- .5 Mould Resistant Joint Compound: to ASTM C475/C475M, asbestos-free, mould-resistant.
- .6 Metal Corner Beads: roll formed from 0.40 mm thick cold formed galvanized steel, beading angle, flange length as required.
- .7 Metal Casing Beads: roll formed from 0.40 mm thick cold formed galvanized steel, type "L" or "J" as required, beading angle or casing with one side knurled for joint filling.

- .8 Paper Faced Metal Corner and Casing Beads: roll formed flanges from 0.40 mm thick cold formed galvanized steel laminated to exposed paper tape.
- .9 Furring Channels (Hat Shaped): roll formed from 0.49 mm thick cold formed galvanized steel with knurled face to accept screw attachment of gypsum board.
- .10 Resilient Channels (to reduce air-borne sound transmission): roll formed from 0.49 mm thick cold formed galvanized steel.
- .11 Acoustic Sealant: in accordance with Section 07 92 00 – Joint Sealants.
- .12 Vinyl Control Joint: deep rigid polyvinylchloride (PVC) “V” joined at bottom with flexible connection permitting full 9 mm movement and tear off strips.
- .13 Vinyl Shadow and Reveal Bead: to ASTM C1047, vinyl with perforated flange to accept joint compound or veneer plaster for flush finish, sizes as detailed.
- .14 ACS to Gypsum Board Transition Moulding: Provided by Section 09 51 13 but installed by the Section. Co-ordinate with Section 09 51 13 installation.
- .15 Access Doors (to mechanical and electrical systems): in accordance with Mechanical and Electrical Divisions unless noted otherwise.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of the Contract Administrator.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.

#### **3.2 INSTALLATION**

- .1 Gypsum Board.
  - .1 Apply gypsum board in accordance with ASTM C840, ASTM C1280, GA 216, and GA 253.
  - .2 Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.
  - .3 Apply single and double layer gypsum board to metal furring or framing using screw fasteners. Spacing and length of fasteners in accordance with manufacturer's written instructions.
  - .4 Install mould-resistant gypsum board on partial wall surfaces containing plumbing fixtures.
  - .5 Install wall furring where indicated for gypsum board wall finishes to ASTM C840.
- .2 Install cement board sheathing to metal framing using screw fasteners in accordance with ASTM C1186.
  - .1 Space fasteners 150 mm on-centre at perimeter and 150 mm on-centre along intermediate framing.
  - .2 Locate fasteners not less than 10 mm from edges and ends of sheathing panels.
  - .3 Length of fasteners in accordance with ASTM C1186.

- .4 Fasteners must be driven so as to bear tight against and flush with surface of sheathing. Fasteners must NOT be countersunk.
- .3 Suspended and Furred Ceilings.
  - .1 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840.
  - .2 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
  - .3 Install work level to tolerance of 1:1200.
  - .4 Frame for furring channels, perimeter of openings for access panels, light fixtures, diffusers and grilles.
  - .5 Install 22 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
  - .6 Furr for gypsum board faced vertical bulkheads as detailed.
- .4 Wall Furring.
  - .1 Install wall furring for gypsum board wall finishes to ASTM C840.
  - .2 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
  - .3 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .5 Acoustic Insulation: Refer to Section 09 81 00.
- .6 Accessories.
  - .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on-centre.
  - .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joint with sealant.
  - .3 Apply bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes and ducts in partitions where perimeter sealed with acoustic sealant.
  - .4 Install access doors to electrical and mechanical fixtures specified in respective sections. Rigidly secure access door frames to furring or framing systems.
- .7 Control Joints.
  - .1 Construct control joints of preformed units as specified set in gypsum board facing and supported independently on both sides of joint.
  - .2 Locate control joints at 7315 mm on-centre horizontally and vertically on walls and ceilings unless otherwise indicated.
  - .3 Install control joints straight and true.

### 3.3 CONSTRUCTION

- .1 Gypsum Board Finish Levels: to GA 214 and GA 216, except use mould-resistant joint compound on mould-resistant gypsum board, and as follows:
  - .1 Level 1: Embed tape at joints in ceiling plenum areas, concealed areas and where indicated unless higher level of finish is required for fire resistance rated and sound rated assemblies.
  - .2 Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners and trim flanges where indicated.
  - .3 Level 3: Embed tape and apply separate first and fill coats of joint compound to tape, fasteners and trim flanges where indicated and for surfaces receiving medium- or heavy-textured finishes before painting or heavy wallcoverings where lighting conditions are not critical.

- .4 Level 4 (typical): Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners and trim flanges.
- .5 Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners and trim flanges, and apply skim coat of joint compound over entire surface where indicated and for surfaces to receive gloss or semi-gloss paint finish and surfaces subject to severe lighting.
- .2 Taping and Filling.
  - .1 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
  - .2 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
  - .3 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
  - .4 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .3 Gypsum Board Shaft Enclosure Systems.
  - .1 Install gypsum board shaft enclosures in strict accordance with manufacturer's directions.
  - .2 Install track at top and bottom and sides of opening. Secure at 610 mm centres maximum with suitable power driven fasteners.
  - .3 As shaft enclosure walls are erected, apply acoustic caulking under tracks and edges of each layer of facing board around abutting perimeter, and where required for effective acoustic seal.
  - .4 Install acoustical insulation to fill cavity between studs and other voids, to form effective sound blanket.
  - .5 Apply corner beads to all external angles. Tape and fill flush, all joints and fastener heads in accordance with manufacturer's directions.
  - .6 Finished work smooth, seamless, plumb, true and flush with square, neat corners.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by gypsum board assemblies installation.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry.
- .2 Section 07 92 00 – Joint Sealants.
- .3 Section 08 06 00 – Door Schedule.
- .4 Section 08 11 00 – Metal Doors and Frames.
- .5 Section 08 11 16 – Aluminum Doors and Frames.
- .6 Section 09 21 16 – Gypsum Board Assemblies.
- .7 Section 09 81 00 – Acoustic Insulation.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A568/A568M-19a, Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low Alloy, Hot Rolled and Cold Rolled, General Requirements for.
  - .2 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
  - .3 ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .4 ASTM A924/A924M-20, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  - .5 ASTM C645-18, Standard Specification for Nonstructural Steel Framing Members.
  - .6 ASTM C754-20, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
  - .7 ASTM C840-20, Standard Specification for Application and Finishing of Gypsum Board.
- .2 Canadian Sheet Steel Building Institute (CSSBI).
  - .1 CSSBI S18-2007, Guide Specification for Non-Loadbearing Steel Framing.
- .3 Canadian Standards Association (CSA).
  - .1 CAN/CSA S136-16, North American Specification for the Design of Cold-Formed Steel Structural Members.
- .4 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal framing and include product characteristics, performance criteria, physical size, finish and limitations.

#### **1.4 QUALITY ASSURANCE**

- .1 Stud Height Limitations: to be in accordance with ASTM C645 and ASTM C754 “Limiting Height Table” for stud width and spacing used, and CAN/ULC S101 when steel studs are used as part of a fire rated assembly.
- .2 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .3 Store materials in a dry, enclosed area protected from exposure to moisture, and in strict accordance with manufacturer's recommendations.
- .4 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .5 Cleaning in accordance with Section 01 74 00.
- .6 Waste Management and Disposal in accordance with Section 01 74 19.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Steel Stud Framing for Screw Attachment of Gypsum Board: to be roll formed from 0.49 mm, standard duty 0.91 mm and 1.22 mm thick cold formed steel with hot dipped galvanized coating.
- .2 Stud Widths: as indicated on plans and to include factory pre-punched cutouts for services and channel bridging.
- .3 Slotted Top Track: to be of same material as studs and sized to suit. Leg length of top track to be 63 mm long, and slotted to suit vertical deflection of structure.
- .4 Bottom Track: to be of same material as studs and sized to suit stud. Leg length of bottom track to be 30 mm.
- .5 Radius Track: to be of same material as studs and sized to suit stud, for curved partitions and bulkheads.
- .6 Stud Bridging Channels: to be provided on all steel stud framing consisting of 13 mm x 38 mm roll formed from 1.2 mm thick cold formed steel with hot dipped galvanized coating.
  - .1 Up to 3050 mm high partition – one (1) row mid height.
  - .2 Over 3050 mm high partition - maximum 1525 mm on-centre.
- .7 Fasteners: to secure metal framing together to be No. 8 x 16 mm Wafer Head Speed Tec Framing Screw.
- .8 Resilient Channels (to reduce air-borne sound transmission): roll formed from 0.49 mm thick cold formed galvanized steel.

- .9 Furring Channels (Hat Shaped): roll formed from 0.49 mm thick cold formed galvanized steel with knurled face to accept screw attachment of gypsum board.
- .10 Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self-sticking adhesive on one face, lengths as required.
- .11 Acoustical Sealant: in accordance with Section 07 92 00.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for non-structural metal framing application in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of the Contract Administrator.
  - .2 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Contract Administrator.

#### **3.2 INSTALLATION**

- .1 Ensure height and spacing of steel studs and furring members meet the requirements of ASTM C645, ASTM C754, and CSSBI S18 to provide proper support for gypsum board and any other wall mounted items.
- .2 Provide co-operation to other trades to accommodate window and door frames, mechanical and electrical items and any other special supports or anchorage for work specified in other Sections required to be incorporated into or co-ordinated with framing system.
- .3 Install partitions to underside of roof/floor structure above unless otherwise indicated.
- .4 Align tracks at top and bottom of partitions and secure 610 mm on-centre maximum and maximum 50 mm from each end using shield screws, power driven fasteners, or other suitable fasteners.
- .5 Place studs vertically as indicated 400 mm on-centre maximum and maximum 50 mm from abutting walls and each side of corners and openings.
- .6 Install partitions to accommodate vertical deflection of structure to avoid transmission of structural loads onto framing by use of 63 mm leg slotted top tracks. Steel stud framing to be 13 mm short of underside of roof/floor structure and free to move.
- .7 Attach studs to track using sheet metal framing screws.
- .8 Install doubled (boxed) studs at each side of openings in stud walls where openings are more than one stud space. Fasten studs together to act as single structural unit. Install track at head and sills to accommodate intermediate studs. Install intermediate studs above and below openings at same spacing as wall studs.
- .9 Install 1.2 mm heavy gauge doubled (boxed) studs at jambs and heads of all door openings. Fasten studs together to act as single structural unit. Extend doubled (boxed) studs each side of door opening to underside of roof/floor structure above.
- .10 Install minimum 0.91 mm studs where partition are finished with water/mould-resistant gypsum board, cement board or tile backerboard.

- .11 Install radius steel stud track at all curved partitions and bulkheads, and at all intricate curves, bends and arches as applicable.
- .12 Install steel stud framing between studs for attachment of electrical receptacles and other mechanical and/or electrical systems.
- .13 Construct chase walls where indicated, consisting of two parallel steel stud partitions as indicated. Tie walls together at centre and quarter points with cross ties. Securely fasten to studs.
- .14 Install resilient furring channels transverse to framing members where indicated. Start rows of channel 50 mm up from floor and within 152 mm from ceiling. Space rows at maximum 400 mm on-centre maximum. Locate splices over framing and secure channel ends to framing.
- .15 Install acoustical sealant under tracks around perimeter of sound control partitions indicated.
- .16 Finished work to be rigid, secure, square, level, plumb and erected to maintain dimensions and contours.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by non-structural metal framing application.

**END OF SECTION**



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 04 22 00 – Concrete Unit Masonry.
- .2 Section 09 06 00.13 – Room Finish Schedule.
- .3 Section 09 21 16 – Gypsum Board Assemblies.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM C485-16, Standard Test Method for Measuring Warpage of Ceramic Tile.
  - .2 ASTM C794-18, Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants.
  - .3 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
  - .4 ASTM C1248-18, Standard Test Method for Staining of Porous Substrate by Joint Sealants.
- .2 American National Standards Institute (ANSI).
  - .1 ANSI A108/A118/A136.1-2017, American National Standards Specifications for Installation of Ceramic Tile.
  - .2 ANSI A137.1-2017, American National Standards Specifications for Ceramic Tile.
  - .3 ANSI A326.3-2017, American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials.
- .3 Terrazzo Tile and Marble Association of Canada (TTMAC).
  - .1 2019-2021 Specification Guide 09 30 00 Tile Installation Manual.

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Samples.
  - .1 Submit sample each colour, texture, size, and pattern of tile and colour matching grout for approval.
- .3 Product Data.
  - .1 Submit manufacturer's technical information and colour charts for each product specified.
- .4 Shop Drawings.
  - .1 Submit shop drawings indicating products, floor and elevation layouts, and colour patterning.
  - .2 Shop drawings to indicate details of special fittings, surface joints, joint layouts, trims, etc.
  - .3 Shop drawings must be submitted in sufficient time to allow for review & ordering of tiles so as not to cause a delay in the work.
- .5 Closeout Submittals.
  - .1 Submit operation and maintenance data for incorporation into Operations and Maintenance Manual specified in Section 01 78 00.

### **1.4 QUALITY ASSURANCE**

- .1 Mock-ups.
  - .1 Mock-up installation of each type of tile installation in designated areas for review in accordance with Section 01 45 00.

- .2 Locate mock-up on site as part of final installation including trims and any transitions to dissimilar materials. Mock-up will be reviewed for quality workmanship, tile pattern, grout colour, and overall appearance.
- .3 Once approved, mock-ups will serve as a standard of acceptance for workmanship and overall appearance for the remaining areas. Do not proceed with installation until mock-up area is complete and approved by Contract Administrator.
- .4 Do not proceed with tile installations until mock-up areas are complete and approved by Contract Administrator.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions to avoid chipping edges or damaging units in any way.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.6 SITE CONDITIONS**

- .1 Comply with requirements of WHMIS regarding use, handling, storage, and disposal of hazardous materials.
- .2 Provide continuous ventilation during and after tile installation. Run ventilation system 24 hours per day during installation and provide continuous ventilation and for 48 to 72 hours after installation. Do not let contaminated air re-circulate through existing building air distribution system.

## **1.7 MAINTENANCE**

- .1 Comply with requirements of Section 01 78 00.
- .2 Provide maintenance materials as follows:
  - .1 Tile Units, mortar and grout: supply quantity of full-size units equal to 5% of amount installed for each type of unit. Provide mortar and grout of quantity sufficient to install maintenance materials.
- .3 Maintenance materials to be from same production run as installed materials.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Basis of Design Products.
  - .1 Tile (CT):
    - .1 CT-1: Daltile, Chord Colour Body Porcelain, 12" x 24", matte finish, allow for one (1) colour.
    - .2 CT-2: Daltile, Keystone Colour Through Body Porcelain, 2" hexagon mosaic, matte finish, allow for up to four (4) colours.
      - .1 CT-2A: Pepper White D037
      - .2 CT-2B: Ocean Blue D159

- .3 CT-2C: Sea Speckle D372
- .4 CT-2D: Navy D189
- .3 CT-3: Daltile, Keystone Colour Through Body Porcelain, 1” hexagon mosaic, matte finish, allow for up to four (4) colours.
  - .1 CT-3A: Pepper White D037
  - .2 CT-3B: Ocean Blue D159
  - .3 CT-3C: Sea Speckle D372
  - .4 CT-3D: Navy D189
- .4 CT-4: Daltile, Keystone Colour Through Body Porcelain, 1” x 1” mosaic, matte finish, allow for up to three (3) colours incorporated in a custom random pattern – dark tone, complete-with matching Coved Porcelain Tile.
- .5 CT-5: Daltile, Keystone Colour Through Body Porcelain, 1” x 1” mosaic, matte finish, allow for up to three (3) colours incorporated in a custom random pattern – medium tone.
- .6 CT-6: Daltile, Keystone Colour Through Body Porcelain, 1” x 1” mosaic, matte finish, allow for up to three (3) colours incorporated in a custom random pattern – light tone.
- .7 CT-7: Daltile, Keystone Colour Through Body Porcelain, 1” x 1” mosaic, matte finish, allow for up to three (3) colours incorporated in a custom random pattern – light-white tone.
- .8 CT-8: Daltile, Keystone Colour Through Body Porcelain, 1” x 1” mosaic, matte finish, Pepper White D037 to match existing Pool Deck mosaic tile, complete-with matching Coved Porcelain Tile.
- .9 CT-9: Daltile, Keystone Colour Through Body Porcelain, 1” x 1” mosaic, matte finish, Artisan Brown D144 to match existing Pool Deck tile base, complete-with matching Coved Porcelain Tile.
- .2 Surface Primer.
  - .1 Custom Building Products, MBP-Multi-Surface Bonding Primer.
- .3 Waterproof Membrane.
  - .1 Custom Build Products, RedGard Waterproofing and Crack Isolation Membrane.
- .4 Mortar.
  - .1 Custom Building Products VersaBond Professional LFT Mortar.
- .5 Epoxy Grout.
  - .1 Custom Building Products, CEG-Lite 100% Solids Epoxy Grout.
- .6 Corner Trims.
  - .1 Schluter Systems Canada Inc., Rondec-AE, complete-with matching connectors as required.  
and
  - .2 Schluter Systems Canada Inc., Schiene-AE.
- .7 Floor Transition Strip (Typical).
  - .1 Schluter Systems Canada Inc., Schiene-AE.
- .8 Transition Strip (PT to no finish).
  - .1 Profilitec, Ramptec ZRR.
- .9 Surface Joint.
  - .1 Schluter Systems Canada Inc., Dilex-AKWS, colour(s) to selected by Contract Administrator from manufacturer’s full colour range.
- .10 Silicone Sealant.
  - .1 Custom Building Products, Commercial 100% Silicone Sealant.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.

## 2.2 MATERIALS

- .1 Ceramic Tile (CT): to ANSI A137.1.
- .2 Surface Primer: single-component, water-based primer, formulated with aggregates and polymers to promote mechanical adhesion on nonporous substrates.
- .3 Waterproof Membrane: ready to use, liquid-applied elastomeric waterproofing material that cures to a continuous monolithic membrane barrier with outstanding adhesion and reduced crack transmission complying with ANSI A118.10 and A118.12.
  - .1 NOTE: Typical for walls and floor. Provide continuous coverage to floor, and full height of walls.
- .4 Mortar: Improved modified dry-set cement mortar, fast setting non-sagging for large and heavy tile thin-set applications, complying with ANSI A108/A118.4/A136.1 and ISO 13007 C2TFS1P1.
- .5 Epoxy Grout: to ISO 13007 classification R2T/RG, ANSI A118.3, two-component, 100% solid, water-cleanable, non-sagging, epoxy grout, chemical- and stain-resistant.
  - .1 Colour(s): selected by Contract Administrator from manufacturer's standard range.
- .6 Corner Trim (exact locations to be confirmed with Contract Administrator and indicated on shop drawings): Anodized aluminum profile consisting of a trapezoid-perforated anchoring leg which is secured in the mortar bond coat beneath the tile, and a rounded profile exposed surface. Sized to suit tile installation.
- .7 Corner Trim (exact locations to be confirmed with Contract Administrator and indicated on shop drawings): Anodized aluminum profile consisting of a trapezoid-perforated anchoring leg which is secured in the mortar bond coat beneath the tile, and a profile with 20° sloped exposed surface. Sized to suit tile installation.
- .8 Floor Transition Strip: Anodized aluminum profile consisting of a trapezoid-perforated anchoring leg which is secured in the mortar bond coat beneath the tile, and a profile with 20° sloped exposed surface. Sized to suit tile installation.
- .9 Surface Joint: Anodized aluminum profile consisting of a trapezoid-perforated anchoring legs which are secured in the mortar bond coat beneath the tiles complete with soft PVC movement zone.
- .10 Silicone Sealant: 100% silicone resins and fine fillers, suitable for pools and wet areas, conforming to ASTM C920, Type S, Grade NS, Class 25, Use T, NT, A, I, M and G, ASTM C1248, and ASTM C794 properties. Meets or exceeds TCNA EJ171 Movement Joint Guidelines for Ceramic, Glass & Stone. Colour(s): selected by Contract Administrator from manufacturer's standard range.
- .11 Water: potable, clean, and free of chemicals and contaminants detrimental to mortar or grout mixes.

## Part 3 Execution

### 3.1 PREPARATION

- .1 Ensure surfaces are plumb, level, true with square corners, smooth and dry, free of paint, grease, sealers, irregularities or loose material, and meet all requirements listed in TTMAC Tile Specification Guide and ANSI A108/A118/A136.1.
- .2 Work penetrating substrate to be completed before installing ceramic tile.
- .3 Clean and scarify existing glazed concrete unit masonry, removing all contaminants and create a good bonding surface.

- .4 Seal and prime wall surface to receive tile in accordance with manufacturer's instructions.
- .5 Notify Contract Administrator in writing of unacceptable substrate conditions. Beginning of installation implies acceptance of existing conditions.

### **3.2 INSTALLATION**

- .1 Install all tile work in accordance with TTMAC Tile Specification Guide, ANSI A108/A118/A136.1, and manufacturer's printed instructions.
- .2 Install minimum of two (2) coats of waterproofing membrane to surface in accordance with ANSI A108/A118/A136.1 and manufacturer's instructions. Embed 150 mm wide fiberglass mesh at all corners, seams and changes of planes.
- .3 Lay out all tilework according to drawings and patterns so that perimeter and all cut tiles are no less than one half in size and locate cuts so as to be least conspicuous.
- .4 Align all joints to give straight grout lines parallel to walls. Make internal angles square, external angles bullnosed.
- .5 Place edge strips at exposed tile edges unless otherwise indicated.
- .6 All joint widths to be maximum 3 mm unless noted otherwise.
- .7 Fit tile around corners, fitments, fixtures, and other built-in objects to maintain uniform joint appearance. Make cut edges smooth, even and free from chipping. Edges resulting from splitting not acceptable.
- .8 For tile with raised or textured backs, bonding material must be pressed into back of tile to ensure minimum of 95% coverage. Set tile in place while bond coat is wet and tacky, prior to skinning over. Slide tile back and forth to ensure proper bond and level surface. Avoid lippage by leveling tiles to conform to 1 mm tolerance over 3 mm joint. Backbutter as required, to ensure 95% bond coverage (backbutter by applying adhesive to back of tile using flat edge of trowel). Clean backs of tiles to ensure proper bonding. Clean excess mortar from surface, prior to mortar setting. Sound tiles after setting and replace any hollow sounding tiles before grouting.
- .9 When appropriate, mix tiles from several boxes prior to installation to assure that colour variations from tile to tile are evenly distributed throughout field.
- .10 Follow grout manufacturer's recommendations as to grouting procedures and precautions.
- .11 Test grout on sample of tile prior to installation to determine need for special sealers, grout releases, or cleaning procedures.
- .12 Clean all surfaces after completion of grouting and remove any grout haze.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**3.4 PROTECTION**

- .1 Protect tile bases on walls from impact, vibration, heavy hammering on adjacent and opposite walls for at least 14 calendar days after installation.

**3.5 SCHEDULES**

- .1 Refer to Section 09 06 00.13.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.
- .2 Section 09 21 16 – Gypsum Board Assemblies.
- .3 Section 09 84 13 – Fixed Sound-Absorptive Panels.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A641/A641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
  - .2 ASTM A653/A653M-20, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .4 ASTM C635/C635M-17, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
  - .5 ASTM C636/C636M-19, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
  - .6 ASTM D1037-12(2020), Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
  - .7 ASTM D2486-17, Standard Test Methods for Scrub Resistance of Wall Paints.
  - .8 ASTM D3273-16, Standard Test Method for Resistance to Growth of Mould on the Surface of Interior Coatings in an Environmental Chamber.
  - .9 ASTM D4828-94(2020), Standard Test Methods for Practical Washability of Organic Coatings.
  - .10 ASTM E84-21, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .11 ASTM E1264-19, Standard Classification for Acoustical Ceiling Products.
  - .12 ASTM E1414/E1414M-21, Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
  - .13 ASTM E1477-98a(2017), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- .2 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102-18-REV1, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 SYSTEM DESCRIPTION**

- .1 Design Requirements.
  - .1 Maximum deflection: 1/360th of span to ASTM C635 deflection test.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, and acoustic unit support at ceiling fixture.

- .3 Samples.
  - .1 Submit 150 mm x 150 mm sample of each type of acoustical units.
  - .2 Submit 200 mm length of each type of wall moulding and suspension system including main runner and cross tee.
  - .3 Submit 200 mm length of each type of perimeter trim.
- .4 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

## **1.5 QUALITY ASSURANCE**

- .1 Single-source responsibility: provide acoustical panel units and grid components by single manufacturer.
- .2 Surface Burning Characteristics: identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
  - .1 Surface Burning Characteristics: tested per ASTM E84 and complying with CAN/ULC-S102 and ASTM E1264 for Class A products, Flame Spread 25 or less, Smoke Developed 50 or less (UL labeled).
- .3 Mock-up.
  - .1 Prepare room mock-up of ceiling as directed by Contract Administrator.
  - .2 Locate mock-up installation on site as part of final installation. Mock-up will be reviewed for workmanship, seam welding, base coving, and overall appearance.
  - .3 Once approved, mock-ups will set standard of acceptance for remaining installations.

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

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions to avoid chipping edges or damaging units in any way.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.7 SITE CONDITIONS**

- .1 Permit wet work to dry before commencement of installation.
- .2 Maintain uniform minimum temperature of 15°C and humidity of 20 - 40% before, during and after installation.
- .3 Store materials in work area 48 hours prior to installation.

## **1.8 SEQUENCING**

- .1 Co-ordinate ceiling work to accommodate components of other sections including, but not limited to gypsum board, mechanical systems, electrical systems, diffusers, speakers, and light fixtures.



## 1.9 WARRANTY

- .1 Manufacturer's Product Warranty: provide an extended warranty for Work of this Section for a period of 30 years from date of Substantial Performance of the Work. Manufacturer hereby warrants acoustical ceilings to be free of manufacturing and material defects, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City. Failures include, but are not limited to:
  - .1 Acoustical Panels: visible sag, mould/mildew & bacteria.
  - .2 Grid System: rusting and manufacturer's defects.

## 1.10 MAINTENANCE

- .1 Comply with requirements of Section 01 78 00.
- .2 Provide maintenance materials as follows:
  - .1 Acoustical Ceiling Units: supply quantity of full-size units equal to 5% of amount installed for each type of unit.
  - .2 Exposed Suspension System Components: supply quantity of each exposed suspension component equal to 2% of amount installed.
- .3 Maintenance materials to be from same production run as installed materials.

## Part 2 Products

### 2.1 MANUFACTURED UNITS

- .1 Basis of Design Products.
  - .1 Acoustical Ceiling System (ACS).
    - .1 Suspension System.
      - .1 Armstrong Prelude XL 15/16", White.
    - .2 Acoustic Units.
      - .1 Armstrong Ceramaguard.
      - .2 ACS to Gypsum Board Transition Moulding
    - .3 ACS perimeter trim:
      - .1 Axiom 100mm high, Classic Trim, White.
    - .4 ACS to Gypsum Board Transition Moulding (provided by this Section but installed by Section 09 21 16).
      - .1 Armstrong Shadow Reveal Transition Moulding 7902. Finish to match suspension system.
  - .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
  - .3 Supply similar products from single manufacturer.
  - .4 Supply all products from same dye lot or production run.

### 2.2 MATERIALS

- .1 Acoustical Ceiling Systems (ACS).
  - .1 Non-Rated Suspension System (Typical).
    - .1 All main beams and cross tees: commercial quality hot-dipped galvanized steel to ASTM A653/A653M, double-web steel construction with 24 mm (15/16") exposed flange design, exposed surfaces chemically cleansed, capping pre-finished galvanized steel in baked polyester paint, rotary stitching.
      - .1 Structural Classification: ASTM C635/C635M Intermediate duty.

- .2 Colour: flat white.
- .2 Acoustic Units.
  - .1 Classification: Type XX (high density ceramic-like composition), Pattern C E, to ASTM E1264.
  - .2 Surface Texture: fine fissured
  - .3 Composition: wet-formed ceramic and mineral fibre composite
  - .4 Noise Reduction Coefficient (NRC): 0.55
  - .5 Ceiling Attenuation Class (CAC): 40
  - .6 Light reflectance (LR): 0.79
  - .7 Edge Type: Square Lay-in
  - .8 Colour: white
  - .9 Size:
    - .1 610 mm x 610 mm x 16 mm thick.
  - .10 Fire Resistance: Class A to ASTM E84 and CAN/ULC S102.
  - .11 Surface Finish: factory-applied plastic paint finish.
  - .12 Antimicrobial Treatment: guaranteed resistance against growth of mold/mildew and bacteria to ASTM D3273.
  - .13 Dimensional Stability: superior resistance to sagging in high humidity conditions up to but not including standing water and outdoor applications.
  - .14 VOC Emissions: Low VOC emission to CDPH/EHLB/Standard Method Version 1.2, 2017.
- .2 Acoustical Ceiling Systems (ACS-1):
  - .1 Similar to ACS, with exception for size: 1200 mm x 610 mm x 16mm thick, where indicated on drawings.

## 2.3 ACCESSORIES

- .1 Edge Mouldings and Trim: manufacturer's standard metal mouldings of types and profiles for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated. Provide mouldings with exposed flange of same width as exposed runner. Finish to match suspension system.
- .2 Perimeter Angle: manufacturer's standard 22 mm (7/8") metal angle mouldings that fit suspension system indicated. Provide matching bullnose corner cover at all radiused concrete masonry unit corners. Finish to match suspension system.
- .3 Perimeter Trim: extruded aluminum trim, corrosion resistant, 100mm high, 19mm wide, for installation around perimeter of ACS planes at Pool Deck.
- .4 Attachment Devices: size for 5 times design load indicated in ASTM C635, Table 1, Direct Hung unless otherwise indicated.
- .5 Wire for Hangers and Ties: ASTM A641/A641M, Class 1 zinc coating, soft temper, pre-stretched, with yield stress load of at least 3 times design load, but not less than 12-gauge (02.7 mm) diameter.

## 2.4 FABRICATION

- .1 Fabricate acoustical units for suspended ceiling system to ASTM E1264.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Do not install acoustic tiles in ceiling suspension system until work above ceiling has been inspected by Contract Administrator.
- .2 Do not proceed with installation until all wet work such as painting has been completed and thoroughly dried out.

#### **3.2 PREPARATION**

- .1 Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Co-ordinate panel layout with mechanical, electrical, and sprinkler fixtures.

#### **3.3 INSTALLATION**

- .1 Install suspension system and panels in accordance with manufacturer's written instructions, and in compliance with ASTM C636/C636M and with authorities having jurisdiction.
- .2 Suspend main beam from overhead construction with hanger wires spaced 1220 mm on-centre along length of main runner and within 6" of ends. Install hanger wires plumb and straight spaced.
- .3 Install wall mouldings at intersection of suspended ceiling, vertical surfaces, and lay-in diffusers. Miter corners where wall mouldings intersect or install corner caps.
- .4 Install acoustical panels in co-ordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall mouldings.
- .5 Install trim and mouldings in accordance with manufacturer's written instructions.

#### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
  - .1 Replace damaged and broken panels.
  - .2 Clean exposed surfaces of acoustical ceiling, including trim, edge mouldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## Part 1 General

### 1.1 RELATED SECTIONS

- .1 Section 04 22 00 – Concrete Unit Masonry.
- .2 Section 06 10 00 – Rough Carpentry for Minor Works.
- .3 Section 06 40 00 – Architectural Woodwork.
- .4 Section 07 92 00 – Joint Sealants.
- .5 Section 09 06 00.13 – Room Finish Schedule.
- .6 Section 09 21 16 – Gypsum Board Assemblies.

### 1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM C109/C109M-20b, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
  - .2 ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
  - .3 ASTM D2047-17, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
  - .4 ASTM E84-20, Standard Test Method for Surface Burning Characteristics of Building Materials.
  - .5 ASTM E492-09(2016)e1, Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine.
  - .6 ASTM F710-19e1, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
  - .7 ASTM F970-17, Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading.
  - .8 ASTM F1303-04(2014), Standard Specification for Sheet Vinyl Floor Covering with Backing.
  - .9 ASTM F1344-15, Standard Specification for Rubber Floor Tile.
  - .10 ASTM F1516-13(2018), Standard Practice for Sealing Seams of Resilient Flooring Products by the Heat Weld Method (when Recommended).
  - .11 ASTM F1861-16, Standard Specification for Resilient Wall Base.
  - .12 ASTM F1869-16a, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
  - .13 ASTM F1913-19, Standard Specification for Vinyl Sheet Floor Covering Without Backing.
  - .14 ASTM F2169-15(2020), Standard Specification for Resilient Stair Treads.
  - .15 ASTM F2170-19a, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
  - .16 ASTM F2659-10(2015), Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter.
  - .17 ASTM F3191-16, Standard Practice for Field Determination of Substrate Water Absorption (Porosity) for Substrates to Receive Resilient Flooring.
- .2 Canadian Standards Association (CSA).
  - .1 CSA B651-18, Accessible Design for the Built Environment.

- .3 American Concrete Institute (ACI).
  - .1 ACI 302.2R-06, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
- .4 South Coast Air Quality Management District (SCAQMD).
  - .1 Rule 1168 - Adhesive and Sealant Applications, 2017.
- .5 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC S102.2-18, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.
- .6 National Floor Covering Association of Canada (NFCA).
  - .1 NFCA Floor Covering Reference Manual - 2016
- .7 Workplace Hazardous Materials Information System (WHMIS).

### **1.3 SYSTEM DESCRIPTION**

- .1 Performance Requirements.
  - .1 The VOC content of the adhesives, sealants, and sealant primers used must be less than the VOC content limits of the South Coast Air Quality Management District (SCAQMD) Rule #1168.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with Section 01 33 00.
- .2 Shop Drawings.
  - .1 Indicate locations and lengths of seams for all floor areas and self- cove forming details at inside and outside corners.
  - .2 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada and Health and Welfare Canada for resilient flooring adhesive. Indicate VOC content.
- .3 Samples.
  - .1 Submit 300 x 300 mm sample of each type of resilient flooring specified for final approval prior to ordering.
- .4 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

### **1.5 QUALITY ASSURANCE**

- .1 Qualifications.
  - .1 Skilled tradespersons to be employed by specialty company recognized and trained as approved installer by manufacturer, normally engaged in this type of work with extensive experience in installation of products specified.
- .2 Mock-ups.
  - .1 Resilient Flooring.
    - .1 Prepare mock-up of each resilient flooring installation in accordance with Section 01 45 00.
    - .2 Mock-up to include heatweld seaming, typical self-coved base, self-coved base at bullnosed concrete block, and transition strip to adjacent flooring material.

- .3 Prepare mock-up on site as part of final installation. Mock-up will be reviewed for quality of workmanship, seam welding, and overall appearance.
- .4 Once approved, mock-ups will set standard of acceptance for remaining installations.
- .5 Do not proceed with resilient flooring installation until mock-up area is complete and approved by Contract Administrator.
- .2 Convene pre-installation meeting prior to commencement of resilient flooring installation work with resilient flooring trade and Contract Administrator in attendance. Discuss the following:
  - .1 Floor moisture, pH and bond test results.
  - .2 Facility room temperatures/HVAC requirements.
  - .3 Floor flatness.
  - .4 Mock-up requirements.
  - .5 Installation and application procedure for all products specified including adhesive application, seaming, self-coved base (inside/outside corners), rubber base, etc.

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

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations. Store roll materials on end in upright position, not in leaning position or on side of roll.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Construction Waste Management in accordance with Section 01 74 19.

## **1.7 SITE CONDITIONS**

- .1 Moisture content of the concrete subfloor must not exceed requirements of ASTM F1869, ASTM F2170, and ACI 302.2R for work of this Section. The concrete subfloor must be sufficiently cured, and not exhibit negative alkalinity carbonization or dusting.
- .2 Concrete subfloor to be free of foreign materials, and turned over to the flooring installer broom clean.
- .3 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .4 Maintain air temperature and structural base temperature at flooring installation area is above 20°C and relative humidity between 35% and 55% for 48 hours before, during and 48 hours after installation.
- .5 Provide continuous ventilation during and after resilient flooring installation. Run ventilation system 24 hours per day during installation and provide continuous ventilation and for 48 to 72 hours after installation.

## 1.8 WARRANTY

- .1 Manufacturer's Product Warranty: provide an extended warranty for Work of this Section from date of Substantial Performance of the Work to term of warranty specified. Manufacturer hereby warrants resilient flooring against excessive wear, and to be free of manufacturing and material defects subject to proper care and maintenance, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City.
  - .1 Vinyl Sheet (VS).
    - .1 20 years against manufacturing and material defects.

## 1.9 MAINTENANCE

- .1 Comply with requirements of Section 01 78 00.
- .2 Provide maintenance materials as follows:
  - .1 Resilient Flooring (VS): 5% of floor area for each type, colour and pattern of flooring installed. Sheet material to be supplied in one continuous length.
  - .2 Adhesives: Sufficient volume to install maintenance materials but not less than unopened 1 litre can of each type of adhesive.
- .3 Maintenance materials to be from same production run as installed materials.

## Part 2 Products

### 2.1 MANUFACTURED UNITS

- .1 Basis of Design Product.
  - .1 Vinyl Sheet (VS).
    - .1 Johnsonite Tarkett iQ Granit.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.

### 2.2 MATERIALS

- .1 Vinyl Sheet (VS): 2.0 mm total thickness, non-cushioned homogeneous sheet vinyl PVC flooring in accordance with ASTM F1913, with polyurethane (PUR) reinforced wear layer composed of 50% binder, 2 m wide rolls, heat welded seams, colour(s) to be selected from manufacturer's entire selection. (RollSmart adhesive).

### 2.3 ACCESSORIES

- .1 Cement Based Patching Compound: ultra fast-drying, self-curing, polymer-modified cement-based patching compound for filling minor voids, holes, cracks, and depressions in concrete prior to the installation of resilient flooring.
- .2 Welding Rods: manufacturer's standard, multi-coloured when available, to match resilient sheet flooring unless otherwise indicated.
- .3 Primers and Adhesives: water-resistant type recommended by flooring manufacturer for use with their product on applicable substrates as well as cement based patching and skimcoating compound.
  - .1 Primer, Vinyl Sheet Adhesive.
    - .1 VOC Content: comply with Rule 1168 of South Coast Air Quality Management District (SCAQMD).

- .4 Cove Former: minimum 19 mm radius vinyl as recommended by manufacturer for use with their product.
- .5 PVC Cove Cap: manufacturer's standard PVC rounded cove cap, colour to be selected from manufacturer's entire selection.
- .6 Reducer Strip: 3 mm to subfloor, rubber, glue down moulding, colour to be selected from manufacturer's entire selection.
- .7 Joint Sealants: in accordance with Section 07 92 00.

## **2.4 COLOURS**

- .1 Contract Administrator may select multiple colours for resilient products from manufacturer's entire selection. For each product specified, not more than one (1) colour will be selected.
- .2 Contract Administrator may select multiple colours for accessories to co-ordinate or contrast with resilient flooring.

## **2.5 PRODUCT MAINTENANCE**

- .1 Vinyl sheet shall not require periodic polishing, waxing, or applied floor finish treatment for maintaining original appearance. Periodic dry buffing with rotary machine (max 1500 RPM) is acceptable.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Inspect concrete slab for proper tolerance and dryness as referenced above. Report any discrepancies in writing to Contractor and Contract Administrator. Do not proceed until conditions are acceptable for proper installation.
- .2 Installation of resilient flooring not to be carried sooner than the specified curing time of concrete subfloor (normal density concrete curing time is approximately 28 calendar days for development of design strength). Report any discrepancies in writing to Contractor and Contract Administrator. Do not proceed until conditions are acceptable for proper installation.
- .3 Commencement of installation implies acceptance of all conditions noted above.

### **3.2 PREPARATION**

- .1 Prepare substrate for installation of products specified in this Section in accordance with manufacturer's printed substrate preparation guidelines to ensure proper adhesion of resilient flooring specified.
- .2 Store materials on end or as recommended by manufacturer in designated areas ready for installation and allow to acclimatize at min 20°C temperature for at least 48 hours prior to installation.
- .3 Moisture Testing: in accordance with ASTM F710, ASTM F2659 and ASTM F3191, perform relative humidity test to ASTM F2170 and proceed with installation only after substrates have maximum relative humidity of 75%, or perform calcium chloride test to ASTM F1869 and proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb/1000 ft<sup>2</sup> in 24 hours.
- .4 Alkalinity Testing: perform pH testing to ASTM F710. Proceed with installation only if pH readings are between 7.0 and 8.5.



- .5 Further to the floor flatness responsibilities of Section 03 30 00, remove sub-floor ridges, bumps, or roughness in accordance with ASTM F710 that would telegraph through resilient flooring materials and affect installation.
- .6 Fill minor low spots and surface irregularities, cracks, joints, and other defects in concrete floor surfaces with cement-based patching compound as specified and recommended by resilient flooring manufacturer and in accordance with ASTM F710 prior to commencement of installation of flooring materials. Thickness of patching compound to ensure flat floor and that installation of resilient flooring against adjacent materials (lippage) does not exceed difference of 1 mm. Steel trowel and float to leave smooth, flat, hard surface. Prohibit traffic until filler is cured and dry.
- .7 Fill all saw-cuts in concrete floors and toppings with cement based patching and skimcoating compound specified or as recommended by resilient flooring manufacturer prior to installation of resilient flooring materials and in accordance with ASTM F710. Patching and skimcoating compound shall be moisture, mildew, and alkali-resistant, and shall provide a minimum 3,000 psi compressive strength after 28 days when tested in accordance with ASTM C109/C109M. Steel trowel and float to leave smooth, flat, hard surface. Prohibit traffic until patching and skimcoating compound is cured and dry.
- .8 All floors to be clean, dry, smooth, level, structurally sound and free from moisture, alkali, dust, solvents, paint, wax, oil, grease, sealing compounds and other contaminants that may prevent the resilient floor adhesive from bonding.
- .9 Materials used in sub-floor preparation to be as recommended by resilient flooring manufacturer, and chemically and physically compatible with resilient flooring products specified to ensure proper adhesion.
- .10 Vacuum all areas to be covered with resilient flooring immediately prior to spreading adhesive.
- .11 Perform bond testing to determine compatibility of resilient flooring to the substrate. Prime concrete as required to resilient flooring manufacturer's printed instructions.
- .12 At locations to receive self-coved base confirm that gypsum board walls terminate no more than 6 mm above subfloor in accordance with Section 09 29 00.

### **3.3 INSTALLATION**

- .1 Vinyl Sheet (VS).
  - .1 Install vinyl sheet flooring in accordance with reviewed shop drawings and manufacturer's printed installation instructions.
  - .2 Apply manufacturer recommended adhesive uniformly using trowel in accordance with manufacturer's recommendations. Do not spread more adhesive than can be covered before initial set takes place. If adhesive over dries, remove and re-coat affected areas.
  - .3 Lay flooring with seams parallel to building lines to produce minimum number of seams in accordance with reviewed shop drawings.
  - .4 Run vinyl sheet floor grain in one direction and as per manufacturer's printed instructions.
  - .5 Rout joints and heatweld all seams with welding rods in accordance with ASTM F1516, using approved heat welding equipment. Welding rods to be trimmed neatly and left flush with surface of material. Complete trimming after cool down. Blistering or scratching of flooring material along heat welded seams will not be accepted.
  - .6 Scribe and fit tightly to door frames. Seal at edge of door frames with small, neat, continuous bead of caulking. Cut flooring and fit neatly around fixed objects.
  - .7 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
  - .8 Install transition/ edge strips at unprotected or exposed edges where flooring terminates or abuts another flooring material.

- .9 Install resilient sheet flooring in same sequence as produced in factory to minimize colour variations.
- .10 Continue flooring over areas which will be under built-in furniture, cabinets, equipment, lockers, etc.
- .11 Install flooring into floor drain collar. Install fastening clamp and strainer.
- .12 As installation progresses and after installation, roll flooring with 45 kg roller to ensure full and consistent adhesion, roll-out adhesive ridges (trowel marks), and eliminate air pockets in accordance with manufacturer's recommendations.
- .13 After installing, allow setting time of 48 hours before cleaning. Initial cleaning and preparation in accordance with manufacturer's maintenance instructions.
- .14 Self-Coved Base (SC).
  - .1 Install self-coved base in accordance with reviewed shop drawings and manufacturer's printed installation instructions.
  - .2 Form cove bases in one piece of same material as adjacent resilient sheet flooring extending up wall to height of 100 mm unless otherwise indicated.
  - .3 Install flooring material with continuous seam parallel to building walls as border coving.
  - .4 Use longest practical lengths to minimize vertical joints. Where vertical joints occur, line with joints in field.
  - .5 Install cove base with PVC cover former. At door frames and other projections taper cove former 300 mm back from frame to provide flush cove at face of frame or projection.
  - .6 Adhere self-coved bases to wall surfaces with same adhesive as for resilient sheet flooring.
  - .7 External (outside) corners: form material using butterfly piece fitted net without any gaps. Heat weld seams in accordance with manufacturers current published installation procedures. Side fill piece (boot) with welded seam along base of self-coved not permitted.
  - .8 Internal (inside) corner: form and cut material in line with corner fitted net without any gaps. Heat weld seams in accordance with manufacturers current published installation procedures.
  - .9 Install PVC cap at top of exposed edge unless otherwise indicated. Cover top edge of PVC cap with continuous neat bead of silicone sealant. Colour of sealant to match adjacent wall surface.
  - .10 Install self-coved base at toe space of casework unless indicated otherwise.

### **3.4 FIELD QUALITY CONTROL**

- .1 Instruct resilient flooring manufacturer representative to visit site at commencement of work as well as periodically throughout duration of work to confirm that conditions are acceptable prior to flooring installation, and that proper procedures are followed during flooring installation.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
  - .1 Remove excess adhesive from floor, base and wall surfaces without damage. Clean floor and base surface to flooring manufacturer's printed instructions.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.6 PROTECTION**

- .1 Prohibit traffic on floor for 48 hours after installation, or according to manufacturer's instructions. Thereafter, protect new floors from damage during final stages of construction until substantial completion of project.

### **3.7 SCHEDULES**

- .1 Refer to Section 09 06 00.13.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 09 21 16 – Gypsum Board Assemblies.
- .2 Section 09 22 16 – Non-Structural Metal Framing.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2 ASTM C553-13, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .3 ASTM C665-17, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - .4 ASTM D1621-16, Standard Test Method for Compressive Properties Of Rigid Cellular Plastics.
  - .5 ASTM E84-19b, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102-18, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S114-18, Standard Method of Test for Determination of Non-combustibility in Building Materials.
  - .3 CAN/ULC-S702.1-14, Standard for Thermal Insulation Mineral Fibre for Buildings.
  - .4 CAN/ULC-S702.2-15, Standard for Mineral Fibre Thermal Installation for Buildings, Part 2: Installation.

### **1.3 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations. Remove only in quantities required for same day use.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Semi-Rigid Mineral Wool Acoustic Insulation - Friction Fit: non-combustible, lightweight mineral wool insulation board formed with a thermosetting resin into flexible semi-rigid boards to ASTM C553, ASTM C665, and CAN/ULC S102, sound absorption co-efficient to ASTM C423, thickness as indicated.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Acoustic Insulation.
  - .1 Install acoustic insulation within interior partition stud cavities to provide acoustic properties to building elements and spaces. Fit insulation closely around electrical boxes, plumbing and heating pipes, ducts, doors and window frames and other protrusions in or passing through insulation. Do not compress batt insulation to fit into spaces.
  - .2 Ensure insulation fills space between studs. Run continuously from floor to ceiling of structure, over door frames and openings and around corners.
  - .3 Ensure insulation is placed around cut openings in gypsum board, behind outlet boxes, around plumbing, heating or structural items passing through and at abutting walls.
  - .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures.
  - .5 Do not enclose insulation until it has been reviewed and approved by Contract Administrator.

#### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 09 51 13 – Acoustical Panel Ceilings.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM C423-17, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2 ASTM E84-20, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC-S102-18, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.3 SUBMITTALS**

- .1 Make all submittals in accordance with Section 01 33 00.
- .2 Shop Drawings.
  - .1 Detail fabrication and installation of all sound-absorptive wall panels including elevations showing joint patterns as shown on drawings, sections, details of components and attachments to other construction.
  - .2 Indicate sound-absorptive wall panel size and profile, lay-out, spacing, and installation method.
- .3 Samples.
  - .1 Include representative sample of devices and accessories to be provided for installation.
  - .2 Certificates: provide product certificates signed by manufacturer of fixed sound-absorptive panels certifying that products comply with specified acoustical performance requirements.
- .4 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

### **1.4 QUALITY ASSURANCE**

- .1 Qualifications.
  - .1 Manufacturer and Installer Qualifications: provide sound-absorptive panels components produced by manufacturer specified with resources adequate to deliver a product of consistent quality in terms of appearance and physical properties for all project scopes and scales without risk of delay or interruption.
  - .2 Installation work to be performed by a specialty company recognized and trained as approved installer by manufacturer, and with no less than five (5) years of successful experience on projects of similar size, requirements and complexity.
- .2 Regulatory Requirements.
  - .1 Fire Test Response Characteristics: provide components that meet CAN/ULC-S102 Flame Spread Rating 25 or less, Smoke Developed Classification 50 or less.
  - .2 Materials provided shall be identical to materials tested, and as a composite assembly.

- .3 Mock-ups.
  - .1 Prepare mock-up of all sound-absorptive panels specified in accordance with Section 01 45 00. Locate mock-up as part of final installation.
  - .2 Mock-up will be reviewed for quality of workmanship, and overall appearance and assembly.
  - .3 Once approved, mock-up will set standard of acceptance for remaining installations.
  - .4 Do not proceed with sound-absorptive panels installation until mock-up area is complete and approved by Contract Administrator.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions. Panels must only be handled by persons wearing clean light-weight gloves.
- .4 Cleaning and Waste Management in accordance with Section 01 74 00.
- .5 Construction Waste Management in accordance with Section 01 74 19.

### **1.6 SITE CONDITIONS**

- .1 Do not begin installation of sound-absorptive panels until dust generating activities have been completed and installation area has been enclosed and maintained at approximately same humidity and temperature conditions as planned for occupancy.
- .2 Allow panels to acclimatize in the Place of the Work for 24 hours minimum prior to installation.
- .3 Maintain temperature and humidity as recommended by panel manufacturer.

### **1.7 SEQUENCING**

- .1 Co-ordinate installation of sound-absorptive panels to accommodate components of other sections including, but not limited to masonry, gypsum board, painting, mechanical systems, and electrical systems including diffusers, speakers, and light fixtures.

### **1.8 WARRANTY**

- .1 Manufacturer's Product Warranty: provide an extended warranty for Work of this Section from date of Substantial Performance of the Work to term of warranty specified. Manufacturer hereby warrants sound-absorptive panels to be free of manufacturing and material defects, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City.
  - .1 Polyester Sound-Absorptive Wall Panels (AWP): limited lifetime warranty.
  - .2 Polyester Sound-Absorptive Ceiling Baffles (ACP): limited lifetime warranty.

### **1.9 MAINTENANCE**

- .1 Provide maintenance materials from same production run as installed materials in accordance with Section 01 78 00 and as follows:
  - .1 Provide one (1) extra panel of each type and colour of sound-absorptive wall and ceiling baffles specified complete-with mounting hardware, matching installed material in manufacturer's original packages and clearly labeled as maintenance stock.

## Part 2 Products

### 2.1 MANUFACTURERS

- .1 Basis of Design Products.
  - .1 P.E.T Sound-Absorptive Wall Panels (AWP).
    - .1 Hush Acoustics Panels.
  - .2 P.E.T. Sound-Absorptive Ceiling Baffles (ACB).
    - .1 Hush Acoustics Baffles.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
- .3 Supply products from single manufacturer and from same dye lot or production run.

### 2.2 MANUFACTURED UNITS

- .1 P.E.T. Sound-Absorptive Wall Panels (AWP).
  - .1 Material: 100% non-woven polyester fiber.
  - .2 Recycled Content: Minimum 60%.
  - .3 Density: 216.65 kg/m<sup>3</sup> acoustically absorptive and dimensionally stable PET.
  - .4 Environmental Certifications: Green Gold Certified.
  - .5 Emissions: 0 Formaldehyde Emission, Test Method GB 18580-2001 Section 6.2.
  - .6 Fire Rating: Class A to ASTM E84 and CAN/ULC-S102.
  - .7 Noise Reduction Coefficient (NRC): 0.85 to ASTM C423.
  - .8 Material Thickness: 9 mm thick.
  - .9 Edge: score edges at 45°, maintaining a 4 mm flat edge thickness.
  - .10 Weight: 1950 g/m<sup>2</sup>
  - .11 Nominal Panel Size: hexagon sized to 1040mm wide, from edge to edge.
  - .12 Mounting: in accordance with the elevations and detail sections, and as follows:
    - .1 Installation of panel direct attached to z-clips for a hidden fastening system. Install 19 mm thick pressure treated plywood furring on wall behind panel, complete with supporting z-clip.
    - .2 Seams: butt joints.
  - .13 Colours: Up to four (4) colours to be selected from manufacturer's full colour range.
- .2 P.E.T. Sound-Absorptive Ceiling Baffles (ACB).
  - .1 Material: 100% non-woven polyester fiber.
  - .2 Recycled Content: Minimum 60%.
  - .3 Density: 216.65 kg/m<sup>3</sup> acoustically absorptive and dimensionally stable PET.
  - .4 Environmental Certifications: Green Gold Certified.
  - .5 Emissions: 0 Formaldehyde Emission, Test Method GB 18580-2001 Section 6.2.
  - .6 Fire Rating: Class A to ASTM E84 and CAN/ULC-S102.
  - .7 Noise Reduction Coefficient (NRC): 0.85 to ASTM C423.
  - .8 Material Thickness: 9 mm thick.
  - .9 Weight: 1950 g/m<sup>2</sup>
  - .10 Nominal Blade Size: Refer to drawing detail, length cut to suit baffle layout. Joints to be mitered. Include mitered matching end cap at each exposed end.
  - .11 Mounting: in accordance with reflected ceiling plan, detail sections, and as follows:
    - .1 Installation is friction fit sound absorptive ceiling baffle assembly, suspended from heavy duty metal t-bar by this Section. Metal t-bar is bolted to custom fabricated powder coated mounting clips mounted to Acoustic Ceiling System cross-t-bar.



- .12 Colour: Up to two (2) colour to be selected from manufacturer's full colour range.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Site Verification of Conditions.
- .1 Examine surfaces scheduled to receive directly attached acoustical panels for unevenness, irregularities and dampness that would affect quality and execution of work.
  - .2 Do not proceed with installation of acoustical panels until unacceptable conditions are corrected.
- .2 Environmental Requirements.
- .1 Do not install sound-absorptive panels until building is closed in and HVAC system is operational.

#### **3.2 INSTALLATION**

- .1 Install sound-absorptive wall and ceiling panels in accordance with reviewed shop drawings and manufacturer's printed instructions using type of mounting accessories indicated, and by persons wearing clean light-weight gloves.
- .2 Install sound-absorptive wall and ceiling panels in locations indicated with surfaces and edges plumb, and in alignment with other panels. Scribe to fit adjoining work accurately at borders and penetrations. Butt joints tightly. Provide for shimming and adjustments as required to maintain consistent alignment of joints and of finished panel faces.
- .3 Remove and replace panels that are damaged and are unacceptable to Contract Administrator.

#### **3.3 CLEANING**

- .1 Clean exposed surfaces of sound-absorptive panels to manufacturer's printed instructions.

#### **3.4 PROTECTION**

- .1 Protect installed work from damage due to subsequent construction activity, including temperature and humidity limitations and dust control, so that the work will be without damage and deterioration at the time of Substantial Performance of the Work.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes: All labour, materials, tools and other equipment, services and supervision required to complete all exterior painting and decorating work as indicated to full extent of drawings and specifications.
- .2 Work under this contract includes, but is not necessarily limited to:
  - .1 Surface preparation of substrates as required for acceptance of painting, including cleaning, small crack repair, patching, caulking, and making good surfaces and areas to limits defined under MPI preparation requirements.
  - .2 Specific pre-treatments noted herein or specified in MPI Architectural Painting Specification Manual.
  - .3 Priming (except where pre-primed with approved primer under other Sections of work) and painting of structural steel, miscellaneous metal, ornamental metal and primed steel equipment.
  - .4 Re-painting of existing surfaces and finishes when adjacent to new painting work where applicable including surface preparation, prime and finish coats in accordance with MPI Repainting requirements.
  - .5 Provision of safe and adequate ventilation as required over and above temporary ventilation supplied by others, where toxic and/or volatile / flammable materials are being used.
- .3 Contractor to do all work of this Section in a professional manner and clean all areas affected by painting and coating. Any area not cleaned to the satisfaction of the City may be cleaned by the City and charged to the Contractor. All work is to pass the inspection of the City.
- .4 The Contractor is responsible to cover or remove such items as grills, lights, smoke and heat detectors, fire pull stations, temperature sensors, etc., to ensure that no paint is applied to these items.
- .5 No extras will be paid due to misinterpretation of this Section.
- .6 Refer to drawings and schedules for type, location and extent of finishes required. Include all touch-ups and field painting necessary to complete work shown, scheduled or specified.

### **1.2 RELATED SECTIONS**

- .1 Section 04 22 00 – Concrete Unit Masonry.
- .2 Section 05 50 00 – Metal Fabrications.
- .3 Section 06 10 00 – Rough Carpentry.
- .4 Section 07 42 13.20 – Acoustic Barrier Panel System.
- .5 Section 07 92 00 – Joint Sealants.
- .6 Section 08 06 00 – Door Schedule.
- .7 Section 08 11 00 – Metal Doors and Frames.
- .8 Section 09 21 16 – Gypsum Board Assemblies.

### **1.3 REFERENCES**

- .1 Green Seal Environmental Standards.
  - .1 GS-11, Green Seal Standard for Paints, Coatings, Stains, and Sealers, October 26, 2015.

- .2 Master Painters Institute (MPI).
  - .1 MPI Architectural Painting Specification Manual, latest edition, including Identifiers, Evaluation, Systems, Preparation and Approved Product List (hereafter referred to as MPI Painting Manual).
  - .2 MPI Green Performance Standard (GPS-1-12 and GPS-2-12) For Paints and Coatings.
- .3 South Coast Air Quality Management District (SCAQMD).
  - .1 Rule 1113 - Architectural Coatings, 2016.

#### **1.4 QUALITY ASSURANCE**

- .1 Contractor to have minimum of five (5) years proven satisfactory experience and show proof before commencement of work that he will maintain qualified crew of painters throughout duration of work. When requested, provide list of last three (3) comparable jobs including, name and location, Contract Administrator / project manager, start / completion dates and value of painting work.
- .2 Engage only qualified journeypersons, as defined by local jurisdiction, in painting and decorating work. Apprentices may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
- .3 All materials, preparation and workmanship to conform to requirements of MPI Painting Manual.
- .4 Use only paint manufacturers and products as listed under Approved Product List section of MPI Painting Manual, except where specifically specified otherwise (see reference to “special” painting, coating, or decorating system, below).
- .5 Where “special” painting, coating or decorating system applications (i.e. non-MPI listed products or systems) are to be used, provide as part of this work, certification of all surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to the City.
- .6 Receive written confirmation of specific surface preparation procedures and primers used for all fabricated steel items from fabricator / supplier to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

#### **1.5 REGULATORY REQUIREMENTS**

- .1 Conform to latest edition of Industrial Health and Safety Regulations issued by applicable authorities having jurisdiction in regard to site safety (ladders, scaffolding, ventilation, etc.).
- .2 Conform to requirements of local authorities having jurisdiction in regard to storage, mixing, application and disposal of all paint and related waste materials. Refer to Waste Management and Disposal.

#### **1.6 SAMPLES AND MOCK-UPS**

- .1 Comply with the requirements of Section 01 45 00.
- .2 When requested by Contract Administrator, prepare and paint designated surface, area, room or item (in each colour scheme) to requirements specified herein, with specified paint or coating showing selected colours, gloss / sheen, textures and workmanship to MPI Painting Manual standards for review and approval. Surface, area, room and/or items, when approved, become acceptable standard of finish quality and workmanship for similar on-site work.

#### **1.7 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.

- .2 Samples.
  - .1 Provide duplicate minimum 300 mm x 300 mm samples of surfaces or acceptable facsimiles requested painted with specified paint or coating in colours, gloss / sheen and textures required to MPI Painting Manual standards for review and approval.
  - .2 Samples must have paint codes clearly printed on each sample for approval by Contract Administrator.
  - .3 Samples, when approved, become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.
- .3 Quality Assurance / Control Submittals.
  - .1 Submit consent of surety with Bid Submission as proof of ability to supply 100% two (2) year Maintenance Bond, if MPI Accredited Quality Assurance Association's guarantee option is not used.
  - .2 If requested, submit list of all painting materials to Contract Administrator for review prior to ordering materials.
  - .3 If requested, submit work schedule for various stages of work when painting occupied areas for Contract Administrator's review and the City's approval.
  - .4 Submit two (2) sets of Material Safety Data Sheets (MSDS) prior to commencement of work for review and for posting at job site as required.
- .4 Closeout Submittals.
  - .1 Provide itemized list complete with manufacturer, paint type and colour coding for all colours used for the City's later use in maintenance.
  - .2 Provide properly packaged maintenance materials as noted herein and obtain signed receipt.

## **1.8 PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Deliver all painting materials in sealed, original labeled containers bearing manufacturer's name, brand name, type of paint or coating and colour designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.
- .2 Store all paint materials in original labeled containers in secure (lockable), dry, heated and well ventilated single designated area meeting minimum requirements of both paint manufacturer and authorities having jurisdiction and at minimum ambient temperature of 7°C. Only material used on this project to be stored on site.
- .3 Where toxic and/or volatile / explosive / flammable materials are being used, provide adequate fireproof storage lockers and take all necessary precautions and post adequate warnings (e.g. no smoking) as required.
- .4 Take all necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect environment from hazard spills. Store materials that constitute fire hazard (paints, solvents, drop clothes, etc.) in suitable closed and rated containers and removed from site on daily basis.
- .5 Comply with requirements of authorities having jurisdiction, in regard to use, handling, storage and disposal of hazardous materials.
- .6 Cleaning in accordance with Section 01 74 00.
- .7 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.9 SITE CONDITIONS**

- .1 Unless specifically pre-approved by Contract Administrator, and applied product manufacturer, perform no painting or decorating work when ambient air and substrate temperatures are below 10°C for interior work.

- .2 Perform no exterior painting work unless adequate continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above minimum requirements for 24 hours before, during, and after paint application. Provide supplemental ventilating and heating equipment to meet minimum requirements.
- .3 Perform no painting or decorating work when relative humidity is above 85% or when dew point is less than 3°C variance between air / surface temperature.
- .4 Perform no painting or decorating work when maximum moisture content of substrate exceeds:
  - .1 12% for masonry (concrete unit masonry).
  - .2 15% for wood.
- .5 Conduct all moisture tests using properly calibrated electronic Moisture Meter, except test concrete floors for moisture using simple cover patch test.
- .6 Test concrete and masonry surfaces for alkalinity as required.
- .7 Concrete and masonry surfaces must be installed at least 28 days prior to painting and decorating work and must be visually dry on both sides.
- .8 Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect quality of finished surfaces.
- .9 Perform no painting or decorating work unless minimum lighting level of 323 Lux (30 foot candles) is provided on surfaces to be painted or decorated.

#### **1.10 SCHEDULING**

- .1 Schedule painting operations to prevent disruption of and by other trades.
- .2 Schedule painting operations in occupied facilities to prevent disruption of occupants in and about building. Execute after facility working hours in accordance with facility's operating requirements. Schedule work such that painted surfaces will have dried before occupants are affected. Obtain written authorization from Contract Administrator for changes in work schedule.

#### **1.11 MAINTENANCE MATERIALS**

- .1 At project completion provide four (4) liters of each type and colour of paint from same production run (batch mix) used in unopened cans, properly labeled and identified for the City's later use in maintenance. Store where directed.

### **Part 2 Products**

#### **2.1 MANUFACTURERS**

- .1 Basis of Design Products:
  - .1 Existing and New Galvanized Metal (Exterior): REX 5.3J/EXT 5.3J, W.B. Light Industrial Coating (Over W.B. Primer).  
High Contact/High Traffic Areas (doors, frames, railings, pipes, etc.):
    - .1 Primer (Existing, Spot or Full Prime as required): MPI# 301.
    - .2 Primer (New, Full Prime): MPI# 134.
    - .3 G5 Top Coats (Minimum 2 coats): MPI# 163.

- .2 Existing and New Structural Steel and Metal Fabrications (Exterior): REX 5.1K / EXT 5.1M, W.B. Light Industrial Coating (Over W.B. Primer).
  - .1 Primer (Existing, Spot or Full Prime as required): MPI# 107.
  - .2 Primer (New, Full Prime): MPI# 301.
  - .3 G5 Top Coats (Minimum 2 coats): MPI# 163.
- .2 Supply all materials from single manufacturer for each system used.

## **2.2 MATERIALS**

- .1 Only materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, etc.) listed in latest edition of MPI Approved Product List (APL) are acceptable for use on this project. Supply all such material from single manufacturer for each system used.
- .2 Other materials such as linseed oil, shellac, thinners, solvents, etc.: highest quality product of MPI listed manufacturer and compatible with paint materials being used as required.
- .3 Use lead and mercury free materials with low VOC content where possible.
- .4 All paint materials to have good flowing and brushing properties and dry or cure free of blemishes, sags, air entrapment, etc. Refer to Field Quality Control / Standard of Acceptance requirements, below.
- .5 Paints and coatings to meet flame spread and smoke developed ratings designated by local Code requirements and/or authorities having jurisdiction.

## **2.3 EQUIPMENT**

- .1 Painting and Decorating Equipment: to best trade standards for type of product and application.
- .2 Spray Painting Equipment: of ample capacity, suited to type and consistency of paint or coating being applied and kept clean and in good working order at all times.

## **2.4 MIXING AND TINTING**

- .1 Unless otherwise specified herein or pre-approved, supply all paint ready-mixed and pre-tinted. Re-mix all paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .2 Mix paste, powder or catalyzed paint mixes in strict accordance with manufacturer's written instructions.
- .3 Addition of thinner, where used, not to exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- .4 If required, thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Contract Administrator.

## **2.5 FINISH AND COLOURS**

- .1 Unless otherwise specified herein, perform all painting work in accordance with MPI Premium Grade finish requirements.
- .2 Colours as selected by Contract Administrator from manufacturer's full range of colours after award of Contract.

- .3 Generally and unless otherwise specified, base quantity of colours and finishes on following criteria:
  - .1 No more than three (3) exterior paint (P) colours will be selected for entire project.
- .4 Doors: different colour than door frames and trim with walls different colour than either. Unless otherwise noted or scheduled all doors, frames, and trim receive G5 (semi-gloss) finish.
- .5 Access doors, exposed piping and electrical panels: to match adjacent surfaces (i.e. same colour, texture and sheen), unless otherwise noted or where pre-finished.

**2.6 GLOSS / SHEEN RATINGS**

- .1 Paint gloss: defined as sheen rating of applied paint, in accordance with following MPI values:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat finish	0 to 5	10 max.
G2	Velvet finish	0 to 10	10 to 35
G3	Eggshell finish	10 to 25	10 to 35
G4	Satin finish	20 to 35	35 min.
G5	Semi-Gloss finish	35 to 70	
G6	Gloss finish	70 to 85	
G7	High-Gloss finish	> 85	

- .2 Gloss level ratings of all painted surfaces: as specified herein and as noted in Section 09 06 00.13.

**Part 3 Execution**

**3.1 CONDITION OF SURFACES**

- .1 Prior to commencement of work of this section, thoroughly examine (and test as required) all conditions and surfaces scheduled to be painted and report in writing to Contractor and Contract Administrator any conditions or surfaces that will adversely affect work of this Section.
- .2 Assess degree of surface deterioration (DSD) using assessment criteria indicated in MPI Maintenance Repainting Manual. In general, DSD ratings and descriptions are as follows:

Condition	Description
DSD-0	Sound Surface (may include visual [aesthetic] defects that do not affect film’s protective properties.
DSD-1	Slightly Deteriorated Surface (may show fading; gloss reduction, slight surface contamination, minor pin holes, scratches, etc.) / Minor cosmetic defects (runs, sags, etc.)
DSD-2	Moderately Deteriorated Surface (small areas of peeling, flaking, slight cracking, staining, etc.
DSD-3	Severely Deteriorated Surface (heavy peeling, flaking, cracking, checking, scratches, scuffs, abrasion, small holes and gouges.
DSD-4	Substrate Damage (repair or replacement of surface required by others.)

- .3 Other than repair of DSD-1 to DSD-3 defects included under this scope of work, structural and DSD-4 substrate defects discovered prior to and after surface preparation or after first coat of paint to be made good and sanded by others ready for painting, unless otherwise agreed to by the City and painter to be included in this Section.

- .4 Commence no repainting work until all such DSD-4 adverse conditions and defects have been corrected and surfaces and conditions are acceptable to Painting Subcontractor and Contract Administrator. Subcontractor not responsible for conditions of substrate or for correcting defects and deficiencies in substrate, which may adversely affect painting work except for minimal work normally performed by Painting Subcontractor and as, indicated herein. Painting Subcontractor is responsible to see that surfaces are properly prepared before any paint or coating is applied and paint surface as specified providing that the City accepts responsibility for uncorrected DSD-4 substrate conditions.

### **3.2 PREPARATION OF SURFACES**

- .1 Prepare all surfaces in accordance with MPI requirements. Refer to MPI Painting Manual in regard to specific requirements for following:
  - .1 Environmental conditions.
  - .2 Shop primed ferrous metal surfaces.
  - .3 Structural steel and miscellaneous metals.
  - .4 Galvanized and zinc coated metal.
  - .5 Concrete masonry units.
- .2 Clean all surfaces to be painted as follows:
  - .1 Remove all dust, dirt, and other surface debris by vacuuming or wiping with dry clean clothes.
  - .2 Wash surfaces with solution of 8 oz. tri-sodium phosphate per gallon of clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
  - .3 If mildew is present, scrub surfaces with a solution of 20% chlorine bleach and 1% liquid detergent in clean warm water.
  - .4 Rinse surfaces with clean water until foreign matter is flushed from surface.
  - .5 Allow surfaces to drain completely and allow to dry thoroughly.
  - .6 Sand, clean, dry, etch, neutralize and/or test all surfaces under adequate illumination, ventilation and temperature requirements.
- .3 Remove and securely store all miscellaneous hardware and surface fittings / fastenings (e.g. electrical plates, mechanical louvers, door and window hardware (e.g. hinges, knobs, locks, trim, frame stops), removable rating / hazard / instruction labels, washroom accessories, light fixture trim, etc. from wall and ceiling surfaces, doors and frames, prior to painting. Carefully clean and replace all such items upon completion of painting work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (e.g. lacquer finishes). Remove doors before painting to paint bottom and top edges and then re-hang.
- .4 Protect all adjacent interior and exterior surfaces and areas, including rating and instruction labels on doors, frames, equipment, piping, etc., from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.
- .5 Substrate defects: make good and sand by others ready for painting particularly after first coat of paint. Start of finish painting of defective surfaces (e.g. gypsum board) indicates acceptance of substrate after which Contractor to bear cost of making good defects including re-painting of entire defective surface (no touch-up painting).
- .6 Confirm preparation and primer used with fabricator of steel items. Refer to Quality Assurance.
- .7 Move and cover all furniture and portable equipment as required to carry out painting operations. Replace as painting operations progress.



### **3.3 APPLICATION**

- .1 Do not paint unless substrates are acceptable and/or until all environmental conditions (heating, ventilation, lighting and completion of other subtrade work) are acceptable for applications of products.
- .2 Apply paint or stain in accordance with MPI Painting Manual Premium Grade finish requirements.
- .3 Apply paint in workmanlike manner using skilled and trade qualified applicators as noted under Quality Assurance.
- .4 Apply paint and coatings within appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications.
- .5 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.
- .6 Apply minimum of four (4) coats of paint where deep or bright colours are used to achieve satisfactory results.
- .7 Sand and dust between each coat to provide anchor for next coat and to remove defects visible from distance up to 1000 mm.
- .8 Do not apply finishes on surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, ensure each coat is sufficiently dry and hard before following coat is applied.
- .9 Continue paint finish behind all wall-mounted items.

### **3.4 FIELD QUALITY CONTROL / STANDARD OF ACCEPTANCE**

- .1 Inspect all surfaces, preparation and paint applications.
- .2 Painted exterior surfaces: considered to lack uniformity and soundness if any of following defects are apparent to Contract Administrator:
  - .1 brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
  - .2 evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
  - .3 damage due to touching before paint is sufficiently dry or any other contributory cause.
  - .4 damage due to application on moist surfaces or caused by inadequate protection from weather.
  - .5 damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
- .3 Make good painted surfaces rejected by Contract Administrator at expense of Contractor. Small affected areas may be touched up; Repaint large affected areas or areas without sufficient dry film thickness of paint. Remove runs, and sags of damaged paint by scraper or by sanding prior to application of paint.

### **3.5 PROTECTION**

- .1 Protect all exterior surfaces and areas, including landscaping, walks, drives, all adjacent building surfaces (including glass, aluminum surfaces, etc.) and equipment and any labels and signage from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.

- .2 As painting operations progress, place “Wet Paint” warning signs in occupied areas to approval of the City.
- .3 Erect barriers or screens to limit or direct traffic away or around work area as required.

### **3.6 CLEAN-UP**

- .1 Progress and Final Cleaning: clean in accordance with Section 01 74 00.
- .2 Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.
- .3 Keep work area free from unnecessary accumulation of tools, equipment, surplus materials and debris.
- .4 Clean equipment and dispose of wash water / solvents as well as all other cleaning and protective materials (e.g. rags, drop cloths, masking papers, etc.), paints, thinners, paint removers / strippers in accordance with safety requirements of authorities having jurisdiction.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.
  - .2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes: All labour, materials, tools and other equipment, services and supervision required to complete all painting and decorating work as indicated in Section 08 06 10 and Section 09 06 00.13 and to full extent of drawings and specifications.
- .2 Work under this contract includes, but is not necessarily limited to:
  - .1 Surface preparation of substrates as required for acceptance of painting, including cleaning, small crack repair, patching, caulking, and making good surfaces and areas to limits defined under MPI preparation requirements.
  - .2 Surface preparation and prime painting surfaces for wall coverings prior to installation in accordance with MPI and wall covering manufacturer's requirements.
  - .3 Specific pre-treatments noted herein or specified in MPI Architectural Painting Specification Manual.
  - .4 Priming (except where pre-primed with approved primer under other Sections of work) and painting of structural steel, miscellaneous metal, ornamental metal and primed steel equipment.
  - .5 Priming and back-priming of wood materials as noted herein or specified in MPI Architectural Painting Specification Manual.
  - .6 Painting of all semi-concealed areas (e.g. inside of light troughs and valances, behind grilles, and projecting edges above and below sight lines).
  - .7 Painting of exposed to view mechanical (heating, ventilating and plumbing) services and equipment, e.g., ducts, sprinkler piping, etc., and electrical work, unless pre-finished.
  - .8 Re-painting of existing surfaces and finishes when adjacent to new painting work where applicable including surface preparation, prime and finish coats in accordance with MPI Repainting requirements.
  - .9 Provision of safe and adequate ventilation as required over and above temporary ventilation supplied by others, where toxic and/or volatile / flammable materials are being used.
  - .10 Painting of plywood used as backboards for mounting electrical equipment.
- .3 Contractor to do all work of this Section in a professional manner and clean all areas affected by painting and coating. Any area not cleaned to the satisfaction of the City may be cleaned by the City and charged to the Contractor. All work is to pass the inspection of the City.
- .4 The Contractor is responsible to cover or remove such items as grilles, lights, smoke and heat detectors, fire pull stations, temperature sensors, etc., to ensure that no paint is applied to these items.
- .5 No extras will be paid due to misinterpretation of this Section.
- .6 Refer to drawings and schedules for type, location and extent of finishes required. Include all touch-ups and field painting necessary to complete work shown, scheduled or specified.

### **1.2 RELATED SECTIONS**

- .1 Section 04 22 00 – Concrete Unit Masonry.
- .2 Section 05 50 00 – Metal Fabrications.
- .3 Section 06 10 00 – Rough Carpentry.
- .4 Section 07 92 00 – Joint Sealants.

- .5 Section 08 06 00 – Door Schedule.
- .6 Section 08 11 00 – Metal Doors and Frames.
- .7 Section 09 06 00.13 – Room Finish Schedule.
- .8 Section 09 21 16 – Gypsum Board Assemblies.

### **1.3 REFERENCES**

- .1 Green Seal Environmental Standards.
  - .1 GS-11, Green Seal Standard for Paints, Coatings, Stains, and Sealers, October 26, 2015.
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  - .1 Rule 1113 - Architectural Coatings, 2016.

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- .1 Contractor to have minimum of five (5) years proven satisfactory experience and show proof before commencement of work that he will maintain qualified crew of painters throughout duration of work. When requested, provide list of last three (3) comparable jobs including, name and location, Contract Administrator / project manager, start / completion dates and value of painting work.
- .2 Engage only qualified journeypersons, as defined by local jurisdiction, in painting and decorating work. Apprentices may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
- .3 All materials, preparation and workmanship to conform to requirements of MPI Painting Manual.
- .4 Use only paint manufacturers and products as listed under Approved Product List section of MPI Painting Manual, except where specifically specified otherwise (see reference to “special” painting, coating, or decorating system, below).
- .5 Where “special” painting, coating or decorating system applications (i.e. non-MPI listed products or systems) are to be used, provide as part of this work, certification of all surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to the City.
- .6 Receive written confirmation of specific surface preparation procedures and primers used for all fabricated steel items from fabricator / supplier to ascertain appropriate and manufacturer compatible finish coat materials to be used before painting any such work.

### **1.5 REGULATORY REQUIREMENTS**

- .1 Conform to latest edition of Industrial Health and Safety Regulations issued by applicable authorities having jurisdiction in regard to site safety (ladders, scaffolding, ventilation, etc.).
- .2 Conform to requirements of local authorities having jurisdiction in regard to storage, mixing, application and disposal of all paint and related waste materials. Refer to Waste Management and Disposal.

## **1.6 SAMPLES AND MOCK-UPS**

- .1 Comply with the requirements of Section 01 45 00.
- .2 When requested by Contract Administrator, prepare and paint designated surface, area, room or item (in each colour scheme) to requirements specified herein, with specified paint or coating showing selected colours, gloss / sheen, textures and workmanship to MPI Painting Manual standards for review and approval. Surface, area, room and/or items, when approved, become acceptable standard of finish quality and workmanship for similar on-site work.

## **1.7 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Samples.
  - .1 Provide duplicate minimum 300 mm x 300 mm samples of surfaces or acceptable facsimiles requested painted with specified paint or coating in colours, gloss / sheen and textures required to MPI Painting Manual standards for review and approval.
  - .2 Samples must have paint codes clearly printed on each sample for approval by Contract Administrator.
  - .3 Samples, when approved, become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.
- .3 Quality Assurance / Control Submittals.
  - .1 Submit consent of surety with Bid Submission as proof of ability to supply 100% two (2) year Maintenance Bond, if MPI Accredited Quality Assurance Association's guarantee option is not used.
  - .2 If requested, submit list of all painting materials to Contract Administrator for review prior to ordering materials.
  - .3 If requested, submit work schedule for various stages of work when painting occupied areas for Contract Administrator's review and the City's approval.
  - .4 Submit two (2) sets of Material Safety Data Sheets (MSDS) prior to commencement of work for review and for posting at job site as required.
- .4 Closeout Submittals.
  - .1 Provide itemized list complete with manufacturer, paint type and colour coding for all colours used for the City's later use in maintenance.
  - .2 Provide properly packaged maintenance materials as noted herein and obtain signed receipt.

## **1.8 PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Deliver all painting materials in sealed, original labeled containers bearing manufacturer's name, brand name, type of paint or coating and colour designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.
- .2 Store all paint materials in original labeled containers in secure (lockable), dry, heated and well ventilated single designated area meeting minimum requirements of both paint manufacturer and authorities having jurisdiction and at minimum ambient temperature of 7°C. Only material used on this project to be stored on site.
- .3 Where toxic and/or volatile / explosive / flammable materials are being used, provide adequate fireproof storage lockers and take all necessary precautions and post adequate warnings (e.g. no smoking) as required.

- .4 Take all necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect environment from hazard spills. Store materials that constitute fire hazard (paints, solvents, drop clothes, etc.) in suitable closed and rated containers and removed from site on daily basis.
- .5 Comply with requirements of authorities having jurisdiction, in regard to use, handling, storage and disposal of hazardous materials.
- .6 Cleaning in accordance with Section 01 74 00.
- .7 Waste Management and Disposal in accordance with Section 01 74 19.

## **1.9 SITE CONDITIONS**

- .1 Unless specifically pre-approved by Contract Administrator, and applied product manufacturer, perform no painting or decorating work when ambient air and substrate temperatures are below 10°C.
- .2 Perform no painting or decorating work unless adequate continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above minimum requirements for 24 hours before, during, and after paint application. Provide supplemental ventilating and heating equipment to meet minimum requirements.
- .3 Perform no painting or decorating work when relative humidity is above 85% or when dew point is less than 3°C variance between air / surface temperature.
- .4 Perform no painting or decorating work when maximum moisture content of substrate exceeds:
  - .1 12% for concrete and masonry (concrete brick/block).
  - .2 15% for wood.
  - .3 12% for gypsum board.
- .5 Conduct all moisture tests using properly calibrated electronic Moisture Meter, except test concrete floors for moisture using simple cover patch test.
- .6 Test concrete and masonry surfaces for alkalinity as required.
- .7 Concrete and masonry surfaces must be installed at least 28 days prior to painting and decorating work and must be visually dry on both sides.
- .8 Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect quality of finished surfaces.
- .9 Perform no painting or decorating work unless minimum lighting level of 323 Lux (30 foot candles) is provided on surfaces to be painted or decorated.

## **1.10 SCHEDULING**

- .1 Schedule painting operations to prevent disruption of and by other trades.
- .2 Schedule painting operations in occupied facilities to prevent disruption of occupants in and about building. Execute after facility working hours in accordance with the City's operating requirements. Schedule work such that painted surfaces will have dried before occupants are affected. Obtain written authorization from Contract Administrator for changes in work schedule.

## 1.11 MAINTENANCE MATERIALS

- .1 At project completion provide four (4) liters of each type and colour of paint from same production run (batch mix) used in unopened cans, properly labeled and identified for the City's later use in maintenance. Store where directed.

## Part 2 Products

### 2.1 MANUFACTURERS

- .1 Basis of Design Products:
  - .1 Existing and New Gypsum Board (Epoxy Paint): RIN 9.2E / INT 9.2F, Epoxy-Modified Latex (over latex primer/sealer). G5 Top Coat:
    - .1 Primer (New, Full Prime): MPI #50.
    - .2 Top Coats (Minimum 2 coats): MPI #215.
  - .2 Existing Glazed Concrete Masonry Units (Epoxy Paint): RIN 4.2F, Epoxy-Modified Latex. G5 Top Coat:
    - .1 Primer (Full Prime): MPI #215.
    - .2 Top Coats (Minimum 2 coats): MPI #215.
  - .3 New Concrete Masonry Units (Epoxy Paint): INT 4.2J, Epoxy-Modified Latex. G5 Top Coat:
    - .1 Primer (New, Full Prime): MPI #4.
    - .2 Top Coats (Minimum 2 coats): MPI #215.
  - .4 New Block Filler:
    - .1 Block Filler: MPI#4, Block Filler, Latex, interior/Exterior.
  - .5 Existing and New Interior Galvanized Metal (Epoxy Paint): RIN 5.3D / INT 5.3D, Galvanized Metal (Not Chromate Passivated). G5 Top Coat:
    - .1 Primer (New, Full Prime): MPI #101.
    - .2 Top Coats (Minimum 2 coats): MPI #77.
  - .6 Existing and New Interior Structural Steel and Metal Fabrications (Epoxy Paint): RIN 5.1J / INT 5.1k, Epoxy- Modified Latex (over w.b. rust-inhibitive primer). G5 Top Coat.
    - .1 Primer (New, Full Prime): MPI #107.
    - .2 Top Coats (Minimum 2 coats): MPI #215.
  - .7 Fire-Retardant Coatings (plywood panels in janitor rooms and plywood backboards in mechanical/electrical rooms for mounting electrical equipment): INT 6.2F, Fire Retardant, Pigmented (water-based).
    - .1 Intumescent Fire Retardant Paint (base coat applied in 2 coats with no top coat) – MPI #64 (ULC approved).
- .2 Supply all materials from single manufacturer for each system used.

### 2.2 MATERIALS

- .1 Only materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, etc.) listed in latest edition of MPI Approved Product List (APL) are acceptable for use on this project. Supply all such material from single manufacturer for each system used.
- .2 Other materials such as linseed oil, shellac, thinners, solvents, etc.: highest quality product of MPI listed manufacturer and compatible with paint materials being used as required.

- .3 All paint materials to have good flowing and brushing properties and dry or cure free of blemishes, sags, air entrapment, etc. Refer to Field Quality Control / Standard of Acceptance requirements, below.
- .4 Paints and coatings to meet flame spread and smoke developed ratings designated by local Code requirements and/or authorities having jurisdiction.
- .5 Where indoor air quality (odour) is issue, use only MPI listed materials having minimum E3 rating.
- .6 VOC Content of Field-Applied Interior and Paints and Coatings.
  - .1 VOC Content: comply with GS-11 - Green Seal™ Environmental Standard for Paints and Coatings.
  - .2 VOC Content (not covered by GS-11): comply with Rule 1113 of South Coast Air Quality Management District.

### **2.3 EQUIPMENT**

- .1 Painting and Decorating Equipment: to best trade standards for type of product and application.
- .2 Spray Painting Equipment: of ample capacity, suited to type and consistency of paint or coating being applied and kept clean and in good working order at all times.

### **2.4 MIXING AND TINTING**

- .1 Unless otherwise specified herein or pre-approved, supply all paint ready-mixed and pre-tinted. Re-mix all paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.
- .2 Mix paste, powder or catalyzed paint mixes in strict accordance with manufacturer's written instructions.
- .3 Addition of thinner, where used, not to exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- .4 If required, thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Contract Administrator.

### **2.5 FINISH AND COLOURS**

- .1 Unless otherwise specified herein, perform all painting work in accordance with MPI Premium Grade finish requirements.
- .2 Colours as selected by Contract Administrator from manufacturer's full range of colours after award of Contract.
- .3 Generally, and unless otherwise specified in Section 08 06 10 or 09 06 00.13, base quantity of colours and finishes on following criteria:
  - .1 No more than five (5) interior paint colours will be selected for entire project, including:
    - .1 No more than three (3) deep colours.
- .4 Doors: different colour than door frames and trim with walls different colour than either. Unless otherwise noted or scheduled all doors, frames, and trim receive G5 (semi-gloss) finish.
- .5 Plywood service panels (e.g. electrical, telephone and cable vision panels) including edges.



- .6 Access doors, exposed piping and electrical panels: to match adjacent surfaces (i.e. same colour, texture and sheen), unless otherwise noted or where pre-finished.
- .7 Inside of light valances: white in G3 finish.
- .8 Inside of all duct work behind louvers, grills and diffusers: flat black (non-reflecting) for minimum of 460 mm or beyond sight line, whichever is greater.

**2.6 GLOSS / SHEEN RATINGS**

- .1 Paint gloss: defined as sheen rating of applied paint, in accordance with following MPI values:

<b>Gloss Level</b>	<b>Description</b>	<b>Units @ 60 degrees</b>	<b>Units @ 85 degrees</b>
<b>G1</b>	Matte or Flat finish	0 to 5	10 max.
<b>G2</b>	Velvet finish	0 to 10	10 to 35
<b>G3</b>	Eggshell finish	10 to 25	10 to 35
<b>G4</b>	Satin finish	20 to 35	35 min.
<b>G5</b>	Semi-Gloss finish	35 to 70	
<b>G6</b>	Gloss finish	70 to 85	
<b>G7</b>	High-Gloss finish	> 85	

- .2 Gloss level ratings of all painted surfaces: as specified herein and as noted in Section 09 06 00.13.

**Part 3 Execution**

**3.1 CONDITION OF SURFACES**

- .1 Prior to commencement of work of this section, thoroughly examine (and test as required) all conditions and surfaces scheduled to be painted and report in writing to Contractor and Contract Administrator any conditions or surfaces that will adversely affect work of this Section.
- .2 Assess degree of surface deterioration (DSD) using assessment criteria indicated in MPI Maintenance Repainting Manual. In general, DSD ratings and descriptions are as follows:

<b>Condition</b>	<b>Description</b>
<b>DSD-0</b>	Sound Surface (may include visual [aesthetic] defects that do not affect film’s protective properties.
<b>DSD-1</b>	Slightly Deteriorated Surface (may show fading; gloss reduction, slight surface contamination, minor pin holes, scratches, etc.) / Minor cosmetic defects (runs, sags, etc.)
<b>DSD-2</b>	Moderately Deteriorated Surface (small areas of peeling, flaking, slight cracking, staining, etc.
<b>DSD-3</b>	Severely Deteriorated Surface (heavy peeling, flaking, cracking, checking, scratches, scuffs, abrasion, small holes and gouges.
<b>DSD-4</b>	Substrate Damage (repair or replacement of surface required by others.)

- .3 Other than repair of DSD-1 to DSD-3 defects included under this scope of work, structural and DSD-4 substrate defects discovered prior to and after surface preparation or after first coat of paint to be made good and sanded by others ready for painting, unless otherwise agreed to by the City and painter to be included in this Section.

- .4 Commence no repainting work until all such DSD-4 adverse conditions and defects have been corrected and surfaces and conditions are acceptable to Painting Subcontractor and Contract Administrator. Subcontractor not responsible for conditions of substrate or for correcting defects and deficiencies in substrate, which may adversely affect painting work except for minimal work normally performed by Painting Subcontractor and as, indicated herein. Painting Subcontractor is responsible to see that surfaces are properly prepared before any paint or coating is applied and paint surface as specified providing that the City accepts responsibility for uncorrected DSD-4 substrate conditions.

### **3.2 PREPARATION OF SURFACES**

- .1 Prepare all surfaces in accordance with MPI requirements. Refer to MPI Painting Manual in regard to specific requirements for following:
  - .1 Environmental conditions.
  - .2 Shop primed ferrous metal surfaces.
  - .3 Structural steel and miscellaneous metals.
  - .4 Galvanized and zinc coated metal.
  - .5 Gypsum board.
  - .6 Concrete masonry units.
- .2 Clean all surfaces to be painted as follows:
  - .1 Remove all dust, dirt, and other surface debris by vacuuming or wiping with dry clean clothes.
  - .2 Wash surfaces with solution of 8 oz. tri-sodium phosphate per gallon of clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
  - .3 If mildew is present, scrub surfaces with a solution of 20% chlorine bleach and 1% liquid detergent in clean warm water.
  - .4 Rinse surfaces with clean water until foreign matter is flushed from surface.
  - .5 Allow surfaces to drain completely and allow to dry thoroughly.
  - .6 Sand, clean, dry, etch, neutralize and/or test all surfaces under adequate illumination, ventilation and temperature requirements.
- .3 Remove and securely store all miscellaneous hardware and surface fittings / fastenings (e.g. electrical plates, mechanical louvers, door and window hardware (e.g. hinges, knobs, locks, trim, frame stops), removable rating / hazard / instruction labels, washroom accessories, light fixture trim, etc. from wall and ceiling surfaces, doors and frames, prior to painting. Carefully clean and replace all such items upon completion of painting work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (e.g. lacquer finishes). Remove doors before painting to paint bottom and top edges and then re-hang.
- .4 Protect all adjacent surfaces and areas, including rating and instruction labels on doors, frames, equipment, piping, etc., from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.
- .5 Substrate defects: make good and sand by others ready for painting particularly after first coat of paint. Start of finish painting of defective surfaces (e.g. gypsum board) indicates acceptance of substrate after which Contractor to bear cost of making good defects including re-painting of entire defective surface (no touch-up painting).
- .6 Confirm preparation and primer used with fabricator of steel items. Refer to Quality Assurance.
- .7 Move and cover all furniture and portable equipment as required to carry out painting operations. Replace as painting operations progress.

### **3.3 APPLICATION**

- .1 Do not paint unless substrates are acceptable and/or until all environmental conditions (heating, ventilation, lighting and completion of other subtrade work) are acceptable for applications of products.
- .2 Apply paint or stain in accordance with MPI Painting Manual Premium Grade finish requirements.
- .3 Apply paint in workmanlike manner using skilled and trade qualified applicators as noted under Quality Assurance.
- .4 Apply paint and coatings within appropriate time frame after cleaning when environmental conditions encourage flash-rusting, rusting, contamination or manufacturer's paint specifications require earlier applications.
- .5 Painting coats specified are intended to cover surfaces satisfactorily when applied at proper consistency and in accordance with manufacturer's recommendations.
- .6 Apply minimum of four (4) coats of paint where deep or bright colours are used to achieve satisfactory results.
- .7 Sand and dust between each coat to provide anchor for next coat and to remove defects visible from distance up to 1000 mm.
- .8 Do not apply finishes on surfaces that are not sufficiently dry. Unless manufacturer's directions state otherwise, ensure each coat is sufficiently dry and hard before following coat is applied.
- .9 Continue paint finish behind all wall-mounted items (e.g. markerboards and tackboards).
- .10 Seal gypsum board wall surfaces with latex sealer or equivalent as recommended by wall protection manufacturer to promote adhesion prior to installation of wall covering where noted.

### **3.4 MECHANICAL / ELECTRICAL EQUIPMENT AND RELATED SURFACES**

- .1 Unless otherwise specified or noted, paint all "unfinished" conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and texture to match adjacent surfaces, in following areas:
  - .1 Where exposed-to-view in all areas.
  - .2 In all interior high humidity interior areas.
  - .3 In all boiler room, mechanical and electrical rooms.
  - .4 Do not paint over nameplates.
- .2 In unfinished areas leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .3 Paint inside of all ductwork where visible behind louvers, grilles and diffusers for minimum of 460 mm or beyond sight line, whichever is greater, with primer and one coat of matt black (non-reflecting) paint.
- .4 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .5 Paint red or band all fire protection piping and sprinkler lines in accordance with mechanical specification requirements. Keep sprinkler heads free of paint.
- .6 Paint yellow or band all natural gas piping in accordance with mechanical specification requirements.

- .7 Backprime and paint face and edges of plywood service panels for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .8 Paint electrical equipment backboards indicated on drawings and/or as specified in Section 06 10 00 and 09 06 00.13. Unless otherwise recommended by manufacturer apply following to achieve ULC Class ‘A’ rating (Flame Spread 15, Fuel Contributed 15, and Smoke Developed 15, when tested in accordance with ASTM E84 and NFPA 255). Use primers and sealers suitable for substrate and approved by fire-resistant paint manufacturer as compatible with fire-retardant paint.
  - .1 Fire-retardant paint: 1 base coat.
  - .2 Fire resistant coating: 1 top coat.

### **3.5 FIELD QUALITY CONTROL / STANDARD OF ACCEPTANCE**

- .1 Inspect all surfaces, preparation and paint applications.
- .2 Painted surfaces: considered to lack uniformity and soundness if any of following defects are apparent to Contract Administrator:
  - .1 brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
  - .2 evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
  - .3 damage due to touching before paint is sufficiently dry or any other contributory cause.
  - .4 damage due to application on moist surfaces or caused by inadequate protection from weather.
  - .5 damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
- .3 Make good painted surfaces rejected by Contract Administrator at expense of Contractor. Small affected areas may be touched up; Repaint large affected areas or areas without sufficient dry film thickness of paint. Remove runs, and sags of damaged paint by scraper or by sanding prior to application of paint.

### **3.6 PROTECTION**

- .1 Protect all interior surfaces and areas, including glass, aluminum surfaces, etc. and equipment and any labels and signage from painting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.
- .2 As painting operations progress, place “Wet Paint” warning signs in occupied areas to approval of the City.
- .3 Erect barriers or screens to limit or direct traffic away or around work area as required.

### **3.7 CLEAN-UP**

- .1 Progress and Final Cleaning: clean in accordance with Section 01 74 00.
- .2 Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.
- .3 Keep work area free from unnecessary accumulation of tools, equipment, surplus materials and debris.

- .4 Clean equipment and dispose of wash water / solvents as well as all other cleaning and protective materials (e.g. rags, drop cloths, masking papers, etc.), paints, thinners, paint removers / strippers in accordance with safety requirements of authorities having jurisdiction.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.
  - .2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.8 SCHEDULES**

- .1 Refer to Section 08 06 10.
- .2 Refer to Section 09 06 00.13.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 08 99 – Rough Carpentry for Minor Works.
- .2 Section 09 21 26 – Gypsum Board Assemblies.
- .3 Section 09 22 16 – Non-Structural Metal Framing.
- .4 Section 10 28 00 – Toilet and Bath Accessories.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A653/A653M-19a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
  - .2 ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Shop drawings.
  - .1 Submit in accordance with Section 01 33 00.
  - .2 Indicate fabrication details, plans, elevations, sizes, hardware and accessories, finishes, and installation details
- .2 Samples.
  - .1 Submit duplicate 300 x 300 mm samples of panel in accordance with Section 01 33 00.
  - .2 Show finish on both sides, two finished edges, and core construction.
- .3 Closeout Submittals
  - .1 Provide maintenance data for plastic laminate for incorporation into manual specified in Section 01 78 00.

### **1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00.
- .2 Protect finished laminated plastic surfaces during shipment and installation. Do not remove until immediately prior to final inspection.
- .3 Cleaning in accordance with Section 01 74 00.
- .4 Waste Management and Disposal in accordance with Section 01 74 19.

### **1.5 WARRANTY**

- .1 Manufacturer's Product Warranty: provide an extended warranty for Work of this Section for a period specified, from date of Substantial Performance of the Work. Manufacturer hereby warrants toilet compartments to be free of manufacturing and material defects, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City and as follows:
  - .1 Toilet Compartments: Manufacturer's standard 25 year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship. Manufacturer's standard one (1) year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

## Part 2 Products

### 2.1 MATERIALS

- .1 Compact Laminate Phenolic: solidly fused plastic laminate with matte-finish melamine surfaces, coloured face sheets, and black phenolic-resin core that are integrally bonded. Edges are black. Finish to be similar to Plastic Laminate as specified in Section 06 40 00; Confirm exact finish with Contract Administrator.
- .2 Sheet Steel: commercial grade, stretcher levelled sheet steel to ASTM A653/A653M with Z275 (G90) zinc coating.
- .3 Stainless steel sheet: to ASTM A666, Type 304.
- .4 Attachment: stainless steel tamper-resistant type screws and bolts.

### 2.2 MANUFACTURED UNITS

- .1 Floor Mounted-Overhead Braced Toilet Compartments – Standard, no sight.
  - .1 Location: Basement Staff Lounge B:01
  - .2 Doors and Panels.
    - .1 Panels: 13 mm thick compact laminate phenolic.
    - .2 Doors: 19 mm thick compact laminate phenolic.
    - .3 Doors and panels to be 1830 mm high with maximum 100 mm floor clearance.
  - .3 Stiles and Pilasters.
    - .1 19 mm thick compact laminate phenolic.
  - .4 Overhead Braces.
    - .1 19 mm thick compact laminate phenolic.
  - .5 Hardware and Fittings.
    - .1 All panel, stile, and urinal screen mounting brackets, pilaster shoes, and all door hardware to be type-304 heavy-gauge satin finished stainless steel, except as noted.
    - .2 Doors to be equipped with:
      - .1 Hinge: one-piece, full-height, 1.6 mm, self-closing.
      - .2 Keeper: stainless steel.
      - .3 Latch: Slides on shock-resistant nylon track.
      - .4 Coat hook by Section 10 28 00 Toilet and Bath Accessories.
      - .5 All doors to include thumb turn lever to activate latch without fingertip grip application. Both standard and barrier-free latches to allow emergency access from exterior.
      - .6 Provide D-pulls on both sides of all barrier free accessible toilet stalls.
    - .3 All brackets and channels to be full height of panels/Stiles, 1.2 mm
    - .4 All fasteners to be stainless steel tamper-resistant type screws and bolts.
- .2 Floor Mounted-Overhead Braced Toilet Compartments – Privacy, no sight.
  - .1 Main Floor Change Rooms
  - .2 Doors and Panels.
    - .1 Panels: 13 mm thick compact laminate phenolic.
    - .2 Doors: 19 mm thick compact laminate phenolic.
    - .3 Doors and panels to be 2400 mm high with maximum 50 mm floor clearance.
  - .3 Wall Hung Urinal Screens.
    - .1 13 mm thick compact laminate phenolic.
  - .4 Stiles.
    - .1 19 mm thick compact laminate phenolic.
  - .5 Overhead Braces.
    - .1 19 mm thick compact laminate phenolic.

- .6 Hardware and Fittings.
  - .1 All panel, stile, and urinal screen mounting brackets, pilaster shoes, and all door hardware to be type-304 heavy-gauge satin finished stainless steel, except as noted.
  - .2 Doors to be equipped with:
    - .1 Hinge: one-piece, full-height, 1.6 mm, self-closing.
    - .2 Keeper: one-piece, full height 3.2 mm.
    - .3 Latch: Slides on shock-resistant nylon track.
    - .4 Safety Coat hook by Section 10 28 00 Toilet and Bath Accessories.
    - .5 All doors to include thumb turn lever to activate latch without fingertip grip application. Both standard and barrier-free latches to allow emergency access from exterior.
    - .6 Provide D-pulls on both sides of all barrier free accessible toilet stalls.
  - .3 All brackets and channels to be full height of panels/Stiles, 1.2 mm
  - .4 All fasteners to be stainless steel tamper-resistant type screws and bolts.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Examine areas to receive toilet compartments for correct height and spacing of anchorage/blocking, and soundness of surfaces that would affect installation of mounting brackets.
- .2 Verify spacing of plumbing fixtures to assure compatibility with installation of compartments.
- .3 Do not begin installation of compartments until conditions are satisfactory.

#### **3.2 INSTALLATION**

- .1 Install dividers/compartments rigid, straight, plumb, and level and in accordance with reviewed shop drawings and manufacturer's printed instructions.
- .2 Stiles to be securely and rigidly fastened to the ceiling using 19 mm diameter expansion shields with spacer and nuts for levelling of stiles. Fastening to be concealed and protected by a 100 mm high die-formed stainless-steel stile shoe.
- .3 Installation methods to conform to manufacturer's recommendations for backing and proper support.
- .4 Maintain uniform clearance at vertical edge of doors.
- .5 Attach fixing brackets securely to ceiling and wall surfaces using screws and shields as recommended by manufacturer.
- .6 Attach panel and pilaster to brackets with through type sleeve bolt and nut.
- .7 Equip each door with hinges, latch set, and combination coat hook and door bumper, and D-pulls. Adjust and align hardware for easy and proper function. Set door open position at 30° to front. Location of D-pulls to be determined at shop drawings.

#### **3.3 ADJUSTING**

- .1 Adjust hardware for proper operation after installation.
- .2 Set hinge on in-swinging doors to hold doors open when unlatched.

#### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.



- .1 Leave Work area clean at end of each day.
- .2 Clean surfaces after installation using manufacturer's recommended cleaning products and procedures.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 05 50 00 – Metal Fabrications.
- .2 Section 06 10 00 – Rough Carpentry for Minor Works.
- .3 Section 09 21 16 – Gypsum Board Assemblies.
- .4 Section 10 21 13 – Solid Phenolic Toilet Compartments
- .5 Section 22 42 02 – Plumbing Fixtures.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM A480/A480M-17, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - .2 ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3 ASTM C1503-08(2013), Standard Specification for Silvered Flat Glass Mirror.
- .2 Canadian Standards Association (CSA).
  - .1 CAN/CSA-B651-12(R2017), Accessible Design for Built Environment.

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Shop Drawings.
  - .1 Submit shop drawings in accordance with Section 01 33 00.
  - .2 Indicate size and description of components, surface finish, hardware and locks, attachment devices, description of blocking requirements for accessories including grab bars.
- .2 Closeout Submittals.
  - .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.
  - .2 Provide special tools required for accessing, assembly/disassembly or removal of accessories.

### **1.4 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates, details and instructions for building in anchors and inserts.
- .3 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .4 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .5 Cleaning in accordance with Section 01 74 00.
- .6 Waste Management and Disposal in accordance with Section 01 74 19.

## **Part 2 Products**

### **2.1 MANUFACTURERS**

- .1 Basis of Design Products as scheduled at end of this Section.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
- .3 Provide similar products from single manufacturer.

### **2.2 MATERIALS**

- .1 Stainless Steel: to ASTM A480/A480M, Type 304, No. 4 satin finish.
- .2 Sheet Steel: to ASTM A653/A653M with G90 designation zinc coating.
- .3 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields as recommended by accessory manufacturer for component and its intended use.
- .4 Adhesive: epoxy type contact cement.
- .5 Locking: where provided, locks by same manufacturer to be keyed alike.

### **2.3 FABRICATION**

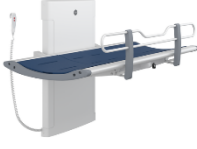



- .1 Weld and grind joints of fabricated elements flush and smooth. Use mechanical fasteners only where approved.
- .2 Wherever possible form exposed surfaces from one sheet of stock, free of joints.
- .3 Brake form sheet metal work with 1.5 mm radius bends.
- .4 Form surfaces flat without distortion. Maintain flat surfaces with scratches or dents.
- .5 Paint backside of components where contact is made with building finishes to prevent electrolysis.
- .6 Shop assemble components and package complete with anchors and fittings.
- .7 Provide steel anchor plates and components for installation on studding and building framing.






## **Part 3 Execution**







### **3.1 INSTALLATION**






- .1 Install and secure accessories rigidly in place as follows:
  - .1 Steel Stud Walls: install steel back-plate or wood blocking to stud prior to gypsum board finish. Provide plate with threaded studs or plugs.
  - .2 Hollow Masonry Units or existing plaster/gypsum board: use toggle bolts drilled into cell/wall cavity.
  - .3 Use tamper-resistant fasteners.
- .2 Fill units with necessary supplies shortly before final acceptance of building.




**3.2 SCHEDULES**

CODE	MANUFACTURER/MODEL NUMBER	TYP. IMAGE	DESCRIPTION
W:ACS	Pressalit, R8538, Nursing Bench – Adjustable Height with Safety Rail.		Adult Change Station: Electric height adjustable, fold down type, where highest height does not exceed 865mm from the finished floor. Includes wired hand control with flexible hose. Max 200 kg (440 lbs).
W:AHD	World Dryer: AirStyle Model B By Division 26		Hand Dryer: surface mounted, hard wired, stainless steel brushed.
W:BCS	Koala Kare Products KB200-SS Horizontal Wall Mounted Baby Changing Station  ASI Group Canada 9013-9 Bradley 962-11 Frost 1124-S		Baby Change Station: injection-molded polypropylene with antimicrobial additive embedded into the bed surface. Type 304 brushed stainless steel finish veneer. Reinforced steel-on-steel hinge mechanism and metal mounting chassis with mounting hardware included. Contoured changing surface complete with nylon safety strap and bag hooks. Dual cavity liner dispenser holds approximately 50 KB150-99 bed liners.
W:FDS	Bobrick B-5191  Bradley 9558  Frost 972  ASI Group Canada 8203		Fold Down Seat: surface mounted, stainless steel frame fabricated from 16-gauge square and 18 gauge round tubing, and stainless steel mounting brackets; one piece seat fabricated from water-resistant solid phenolic material from 8 to 13 mm thickness, with drain slots, secured to frame with stainless steel carriage bolts and acorn nuts, meets ADA guidelines. Designed to carry a minimum load of 2.7 kN (600 lbs.)

CODE	MANUFACTURER/MODEL NUMBER	TYP. IMAGE	DESCRIPTION
W:FM1	Bobrick B-290 Bradley Frost		Framed Mirror: to ASTM C1503, complete-with 304 stainless steel satin finish frame.
W:FM2	Frost		Framed Mirror: to ASTM C1503, complete-with 304 stainless steel satin finish frame.
W:GR1	Kohler Delta American Standard		Grab Rail: 32 mm diameter, satin stainless steel, peened gripping surface, concealed mounting.
W:GR2	Kohler Delta American Standard		Grab Rail: 32 mm diameter, satin stainless steel, peened gripping surface, concealed mounting.
W:GR3	Kohler Delta American Standard		Grab Rail: 32 mm diameter, satin stainless steel, peened gripping surface, concealed mounting.

CODE	MANUFACTURER/MODEL NUMBER	TYP. IMAGE	DESCRIPTION
W: GR4	Kohler Delta American Standard		L-Shape Grab Rail: 32 mm diameter, satin stainless steel, peened gripping surface, concealed mounting.
W: GR5	Kohler Delta American Standard		L-Shape Grab Rail: 32 mm diameter, satin stainless steel, peened gripping surface, concealed mounting.
W: HD	World Dryer: AirStyle Model B By Division 26		Hair Dryer: surface mounted, hard wired, brushed stainless steel.
W:HSD	Bobrick B-2012 Frost 714-S		Hand Soap Dispenser: wall mounted, sensed, battery operated, body of Type 304 stainless steel, brushed finish, 800-850 ml capacity, powered with 3 Alkaline C batteries, Provide blocking in wall as required.
W:LSD	Bobrick B-2012 Frost 714-S		Hand Sanitizer Dispenser: wall mounted, sensed, battery operated, body of Type 304 stainless steel, brushed finish, 800-850 ml capacity, powered with 3 Alkaline C batteries, Provide blocking in wall as required.
W:MBR	Bobrick B-224 x 36 Bradley 9954 Frost 1114		Mop/Broom Rack: surface mounted 22-gauge, stainless steel with 4 spring-loaded mop/broom holders, satin finish. Coordinate final installation location with The City.

CODE	MANUFACTURER/MODEL NUMBER	TYP. IMAGE	DESCRIPTION
W:PTD	Paper Towel Dispenser		Salvaged from First Aid 1:10 and Women's Washroom 1:05.1 and reinstall in new First Aid 1:10 and Janitorial 1:17A. Salvaged and Reinstalled in Staff Lounge B:01.
W: SND	Bobrick B-2706C (free vend) Frost 608-3 (coin)		Sanitary Napkin Dispenser: surface mounted, Free Vend Stainless steel, fits 30 tampons and 20 sanitary napkins, locking door, push button operation.
W:SD	Sharps Disposal		Salvaged from Specialty Change Room 1:03 and 1:15 and reinstall in Bariatric UTR 1:04 and UTR 1:05B.
W:NTW	ASI Group Canada 20852 Bobrick B-270 Bradley A410		Napkin/Tampon Waste: surface mounted, satin stainless steel, type 304, 22-gauge, all-weld construction, self-closing door, removable leak-proof plastic receptacle.
W:SCR	ASI 1204, 1200-V, 1200-SHU (max length 1829mm)  Bobrick B-6047, 204-2/3, 204-1 (max length 1829mm)  Bradley 9539, 9537, 9522  Frost 1145 Series, 1144-502, 1144-501L		Shower Curtain Rod: 18-gauge satin stainless steel heavy-duty shower curtain rod, 32 mm diameter and 78 mm diameter flanges with 20-gauge snap on escutcheons for concealed mounting.  Shower Curtain: white, 10 oz. nylon-reinforced anti-bacterial 8-gauge vinyl fabric, rust proof grommets every 150 mm, 1065 mm/1780 mm x 1830 mm complete with stainless steel spring wire hooks with snap fastener for use with 25 mm and 32 mm diameter rods.

CODE	MANUFACTURER/MODEL NUMBER	TYP. IMAGE	DESCRIPTION
W:SRH	Frost 1150 - Safety Coat Hook		Safety Robe Hook: spring loaded collapsible coat hook designed to collapse when loaded in excess of 11 kilograms (25 lbs.), epoxy colour coated 16-gauge, stainless steel hooks on stainless steel circular base Type 304, No. 4 satin finish. Coat hooks to consist of a combination of three (3) colours from manufacturer's colour selection.
W:SSS	ASI Group Canada 0692 Bobrick 295x18		Stainless Steel Shelf: surface mounted, 18-gauge, type 304 satin stainless steel shelf, with returned edges, complete with welded mounting brackets.
W:TPD	Bobrick B-4288		Toilet Paper Dispenser: Surface mounted, 22-gauge, stainless steel, dispensing two standard-core tissue rolls up to 135 mm diameter, extra roll automatically drops in place when bottom roll is depleted, theft resistant spindles, tumbler lock.
W:UM	By Section 08 80 00		Unframed Mirror. Continuous mirror over vanity.
W:WD	Waste Disposal		Not-In-Contract.

**END OF SECTION**



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 08 99 – Rough Carpentry for Minor Works.
- .2 Section 09 21 16 – Gypsum Board Assemblies.
- .3 Section 09 91 23 – Interior Painting.

### **1.2 REFERENCES**

- .1 National Fire Prevention Association (NFPA).
  - .1 2018 NFPA 10, Standard for Portable Fire Extinguishers.
- .2 Underwriters Laboratories of Canada (ULC).
  - .1 CAN/ULC S504-12, Standard for Dry Chemical Fire Extinguishers.
  - .2 CAN/ULC S508-02-R13, Standard for Dry Chemical Fire Extinguishers.

### **1.3 QUALITY ASSURANCE**

- .1 Regulatory Requirements.
  - .1 Conform to NFPA 10 requirements for portable fire extinguishers.

### **1.4 ACTION AND INFORMATION SUBMITTALS**

- .1 Shop Drawings.
  - .1 Submit shop drawings in accordance with Section 01 33 00.
  - .2 Indicate location, type, size, anchor or mounting details, and accessories.
- .2 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Section 01 74 19.

### **1.6 WARRANTY**

- .1 Manufacturer's Product Warranty: provide an extended warranty for Work of this Section for a period of six (6) years from date of Substantial Performance of the Work. Manufacturer hereby warrants fire extinguishers to be free of manufacturing and material defects, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City, and at no expense to the City.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Fire Extinguishers (FE): 10 lb. ‘ABC’ multi-purpose dry chemical fire extinguishers in accordance with NFPA 10 and CAN/ULC S504, 130 mm cylinder diameter x 200 mm wide x 540 mm high, squeeze grip operation, pull pin safety lock, wall hook, glossy corrosion resistant red polyester powder paint finish.
- .2 Cabinets.
  - .1 Semi-Recessed Fire Extinguisher Cabinet (FE-S): 230 mm wide x 610 mm high x 150 mm deep semi-recessed fire extinguisher cabinet constructed of 0.8 mm (22-gauge), steel tub and 1.5 mm (16-gauge), steel door & trim with 50 mm return frame, a full length semi-concealed piano hinge and flush stainless steel door latch. Entire cabinet finished in white baked enamel paint and glazed with 5 mm clear tempered glass.
  - .2 Wall Brackets (FE#-W) (no cabinet): manufacturer’s standard steel mounting wall brackets including extinguisher specified above.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install in accordance with manufacturer’s instructions, plumb and level.
- .2 Mounting height of extinguishers (on brackets or in cabinets) to be in accordance with NFPA guidelines.
- .3 Securely fasten to structure, square and plumb, to comply with manufacturer’s instructions.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean surfaces after installation using manufacturer’s recommended cleaning procedures.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 06 10 00 – Rough Carpentry for Minor Works.
- .2 Section 09 29 16 – Gypsum Board Assemblies.
- .3 Section 09 31 00 – Tiling
- .4 Section 09 65 00 Resilient Flooring

### **1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB).
  - .1 CAN/CGSB-44.40-2001 AMEND, Steel Clothing Locker.
  - .2 CAN/CSA-B651-04, Barrier-Free Design for Built Environment.

### **1.3 SUBMITTALS**

- .1 Make all submittals in accordance with Section 01 33 00.
- .2 Shop Drawings.
  - .1 Indicate type and class of locker, thicknesses of metal, fabricating and assembly methods, assembled banks of lockers, tops, hooks, shelves, bases, trim, numbering, filler panels, end/back panels, doors, handles, locking method, ventilation method, finishes.
- .3 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

### **1.4 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Fabricator shall have 10 years or more experience in fabrication of stainless steel or metal materials and shall be experienced in performing work of similar size and scope.
  - .2 Fabricator shall be capable of providing field service representation.
  - .3 Installer shall be approved by the manufacturer and be experienced in performing work of similar size and scope.
- .2 Pre Installation Meeting: Conduct pre-installation meeting prior to installation to verify project requirements and conditions.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Protect exposed material surfaces after installation. Do not remove until immediately prior to final inspections or unless told otherwise.
- .5 Cleaning in accordance with Section 01 74 00.
- .6 Waste Management and Disposal in accordance with Section 01 74 19.

## 1.6 WARRANTY

- .1 Manufacturer's Product Warranty: provide an extended warranty for Work of this Section for a period of two (2) years from date of Substantial Performance of the Work. Manufacturer hereby metal lockers against defects in materials and workmanship subject to proper care and maintenance, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and City, and at no expense to City.

## Part 2 Products

### 2.1 MANUFACTURERS

- .1 Acceptable Products.
  - .1 Lockers.
    - .1 Shanahan's Coin Series Senator Lockers.
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
- .3 Supply all products from single manufacturer.

### 2.2 MANUFACTURED UNITS

- .1 Lockers: to CAN/CGSB-44.40.
  - .1 Size: Double Tier 305 mm wide x 305 mm deep x 1830 mm high
  - .2 Body: fabricated from 24-gauge galvanized steel; edges to be formed to provide a strong and rigid assembly when bolted or riveted together with tamperproof fasteners; locker backs to be flanged at right angles providing a triple thickness of metal at back corner connections; shelves, tops and bottoms to be interchangeable and flanged, and not less than 22-gauge and formed into a sturdy pan with lip formed front edge for additional strength and safety.
  - .3 Frame: 16-gauge galvanized channel formed steel, welded to form a one-piece construction; top and bottom cross members of not less than 18-gauge steel formed as open box channel and welded to vertical members; no fasteners to be exposed on fronts of locker doors and frames.
  - .4 Doors: fabricate with 16-gauge outer galvanized steel panel and 20-gauge inner galvanized steel panel to form a welded and rigid box construction that resists prying; outer panel to be double flanged on all four edges and inner panels single flanged on all four edges; door to be flush with frame and include recessed handle and recessed name plate; two rubber bumpers per door fastened to the inner face of the door with tamperproof fasteners.
  - .5 Trims: constructed of 20ga galvanized steel, varies sizes to complete finished end panels, filler panels, top trims and continuous metal bases.
  - .6 Finishing: Doors, body, frames, and trims to be powder coated finish, 2mm thick, smooth. Colour selected by Contract Administrator. Allow for two (2) colours.

### 2.3 ACCESSORIES

- .1 ADA Bottom Shelves: construction matching Body and Frame, installed at 400mm above finished floor.
  - .1 Female Lockers: allow for ten (10) ADA compliant lower lockers.

- .2 Male Lockers: allow for (6) ADA compliant lower lockers.
- .3 Universal Change: allow for thirteen (13) ADA compliant lower lockers.
- .2 Hinges: Stainless steel spring-loaded, self-closing, recessed in the door and fastened to the frame with tamperproof fasteners; two hinges per multi-tiered door.
- .3 Door Pull: Stainless Steel pull handle, ADA compliant.
- .4 Lock Mechanism: Type 304 stainless steel and non-corrosive parts; master control cylinder and customer cylinder key. Coin operated with slot concealed by door pull when locked. Coin return function. Safety pin attached to split ring to be included for all customer keys.
- .5 Ventilation: backs to be fully ventilated with 10mm perforated holes.
- .6 Number plates: Black polypropylene with silver embossed number plates.
- .7 Coat Hooks: Three (3) hooks per compartment, fastened to locker sides and back with tamperproof fasteners.

## **2.4 FINISHES**

- .1 Thoroughly machine clean cold rolled steel surfaces with iron phosphoric acid based cleaner and finish with high performance polymer powder coating.
- .2 Doors, body, frames, and trims to be powder coated finish, 2mm thick, smooth. Colour selected by Contract Administrator. Allow for two (2) colours. Contract Administrator to select colours from manufacturer's full colour range. Frame colour to match body and door colour. Second colour utilized to identify ADA compliant bottom lockers.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Assemble and install lockers in accordance with manufacturer's written instructions.
- .2 Safely and securely fasten lockers to CMU walls.
- .3 Install filler panels (false fronts and corners) where indicated and where obstructions occur.
- .4 Install locker numbers.
- .5 Install customer cylinder key before turn over.

### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 26 00 00 Electrical
- .2 Section 28 00 00 Electronic Safety and Security

### **1.2 SUBMITTALS**

- .1 Make all submittals in accordance with Section 01 33 00.
- .2 Product Data.
  - .1 Submit manufacturer's descriptive literature indicating materials, finishes and installation instructions.
  - .2 Show dimensions, locations of components, special installation conditions and other related data required for co-ordination.
  - .3 Show wiring diagram for electrical components in coordination with equipment specified function.
- .3 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

### **1.3 DELIVERY, STORAGE, AND HANDLING**

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .3 Cleaning in accordance with Section 01 74 00.
- .4 Waste Management and Disposal in accordance with Sections 01 74 19.

### **1.4 WARRANTY**

- .1 Manufacturer's Product Warranty: provide Warranty for Work of this Section for a period of one (1) year from date of Substantial Performance of the Work. Manufacturer hereby warrants equipment to be free of manufacturing and material defects, and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City and at no cost to the City.
- .2 Installation Contractor's Warranty: provide an extended warranty for Work of this Section for a period of two (2) years from date of Substantial Performance of the Work. Contractor hereby warrants that work of this Section will remain rigid and weathertight and these or other observed defects and deficiencies will be repaired or replaced to the satisfaction of the Contract Administrator and the City and at no cost to the City.

## Part 2 Products

### 2.1 MANUFACTURERS

- .1 Basis of Design Product.
  - .1 Alvarado SW1000 Pedestrian Gate
- .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
- .3 Supply products from single manufacturer and from same dye lot or production run.

### 2.2 MANUFACTURED UNITS

- .1 Motorized Pedestrian Gate:
  - .1 Post:
    - .1 Dimensions: 1063mm high.
    - .2 Internal Frame: powder coated internal frame housing electronics, motor, power supply and mechanical components.
    - .3 Finish: #304 stainless steel with thermoplastic polymer cap.
  - .2 Barrier:
    - .1 Dimensions: 864mm wide x 1168mm high with 152mm bottom clearance.
    - .2 Material: 12mm thick acrylic panel with abrasion resistant coating.
    - .3 Function: motorized bi-directional access control
    - .4 Etching: artwork/signage to be confirmed by Contract Administrator and The City.
  - .3 Passage Modes:
    - .1 Controlled Passage: Connection to authorization access system (push button) by Electrical. Barrier moves away from the signal direction to the open position (90°). Barrier remains open for a defined period of time (minimum 6 seconds) and returns to closed position.
    - .2 Controlled Passage Override: Connection between authorization access system and override switch by Electrical. Override switch to activate and deactivate authorization access system.
    - .3 Barrier Breakaway: When barrier is forced open without use of authorization access system, local alarm to sound to notify Staff that manual opening has occurred. Local alarm is built-in Motorized Pedestrian Gate's Post. After defined time, the gate resets and resumes normal operation.
    - .4 Fire Alarm: Connection to fire alarm system by Electrical. Dry contact to be provided by Electrical at appropriate input point. When contact is received, gate opens in the exit direction (on Pool Deck) and remains open until input is removed. Upon removal, normal operation resumes.
    - .5 Power Failure: Gate to fail-safe upon power failure and can move in either direction. When power is restored, normal operation resumes.
    - .6 Power Supply: By Electrical.
- .4 Operating Temperatures: 10°C to 60°C (50°F to 140°F) with 15-85% Relative Humidity, non-condensing.
- .5 Locations: Along Grid Line B, between Pool Deck and:
  - .1 Universal Change Room.
  - .2 Male Change Room.
  - .3 Female Change Room.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install units in accordance with manufacturer's printed installation instructions.
- .2 Install plumb, level, straight, rigidly supported, and securely fastened.
- .3 Confirm location(s) before rough-in and installation.
- .4 Adjust units for smooth and proper operation.
- .5 Test Passage Modes listed under 2.2.1.3 with the City and Contract Administrator present.

#### **3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Clean surfaces after installation using manufacturer's recommended cleaning procedures.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

#### **3.3 PROTECTION**

- .1 Protect equipment from damage until completion of construction.

**END OF SECTION**



## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Division 26 – Electrical.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA).
  - .1 CSA C22.1-15, Canadian Electrical Code, Part I (23rd Edition), Safety Standard for Electrical Installations.

### **1.3 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Data to include:
    - .1 Manufacturer, equipment description, make or model numbers, materials and finishes, accessories, options.
    - .2 Quantities and locations of tracks and lift units.
    - .3 Layout and details of track, hardware, accessories.
    - .4 Indicate loading to be imposed on supporting structure.
    - .5 How all anchorage, accessory items, and finishes.
    - .6 Electrical service requirements.
    - .7 List of recommended spare parts.
    - .8 Equipment anchors, supports, and overhead brackets, struts and braces to support tracks shall be designed by a Professional Engineer registered in the Province of Manitoba; and shop drawings shall be stamped by the same Professional Engineer who designed the components.
  - .2 Certificates of Compliance.
  - .3 Manufacture's Literature and Data:
    - .1 Lifting Capacity.
    - .2 Lifting Speed.
    - .3 Horizontal Displacement Speeds.
    - .4 Horizontal Axis Motor.
    - .5 Vertical Axis Motor.
    - .6 Emergency Brake.
    - .7 Emergency Lowering Device.
    - .8 Emergency Stopping Device.
    - .9 Electronic Soft-Start and Soft-Stop Motor Control.
    - .10 Current Limiter for Circuit Protection.
    - .11 Low Battery disconnects System.
    - .12 Strap Length
    - .13 All Equipment anchors and supports. Submittals shall include weights, dimensions, center of gravity, Standard connections, manufacturer's recommendations and behavior problems (E.G. Vibrations and Thermal Expansions) associated with the equipment or piping so the proposed installation can be properly reviewed.
  - .4 Individual Room Layouts showing location of lift system installation shall be approved before proceeding with the installation of lifts.
- .3 Closeout Submittals.
  - .1 Provide operation and maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

- .2 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in the City's name and registered with manufacturer.

#### **1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements.
  - .1 Ensure electrical connection is adequate and in conformance with the CSA C22.1 and all local codes.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Supplier to deliver equipment to site in manufacturer's unopened packaging clearly indicating manufacturer's name, intended location in building, and any other identifying symbols or information.
- .2 Contractor to receive equipment and safely store in convenient location until installation begins. Store in ventilated areas, protected from extreme changes of temperature or humidity. Damaged equipment will not be accepted.
- .3 Equipment to be accompanied by copies of operations manual, service manual, schematics, wiring diagrams and parts list.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Waste Management and Disposal in accordance with Sections 01 74 19.

#### **1.6 WARRANTY**

- .1 Provide manufacturer's standard warranty for each type of equipment specified.

### **Part 2 Products**

#### **2.1 MANUFACTURED UNITS**

- .1 Basis of Design Product.
  - .1 Ceiling Lift and Track
    - .1 Human Care, HeliQ 300 lift (300 kg) and track system with power travers and in-rail charging.
- .2 Substitutions not permitted.
- .3 Supply all similar products from single manufacturer.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install plumb, level, straight, rigidly supported, and securely fastened to abutting surfaces as applicable, free from superimposed loads.
- .2 Install lift as per Manufacturer's Instruction and under the Supervision of Manufacturer's Qualified Installer in accordance with reviewed shop drawings.
  - .1 Consult with Manufacturer's guidelines for stabilization requirements.
  - .2 Consult with Manufacturer's guidelines for isolation from other fixtures within the ceilings.
  - .3 Ensure that Rails Systems are properly grounded to meet ULC Requirements.
  - .4 Secure rigidly in place using fasteners of type recommended by manufacturer.
  - .5 Co-ordinate installation of anchors, brackets and hangers with work of other trades. Ensure all blocking, furring and framing is in place.

- .6 Co-ordinate connection of electrical services.
- .3 Load Testing.
  - .1 Load tests for each patient lift track system prior to system use. Follow lift manufacturer's instructions using recommended procedures and testing equipment and apparatus. Do not use the ceiling lifts for load testing.
  - .2 Document each load test. Provide label for each track installation that has been proof tested. Indicate the limits to which it was testing, the test date. Labels shall be signed by the individual who conducted the test. Provide copies or same information in commissioning report.
  - .3 Replace materials that are become damaged or defective from load testing. Re-test newly replaced equipment.
- .4 Operational Testing.
  - .1 When the installation is complete, test lift system to confirm functionality.
  - .2 Test track to ensure lift travels freely. Test each individual lift mechanism to ensure proper function.
  - .3 Provide test report and submit copies, signed by authorized lift installer, to Contractor. Include one copy in operation and maintenance manual.

### **3.2 FIELD QUALITY CONTROL AND ADJUSTING**

- .1 Contractor responsible for supervising installation, for startup and testing equipment, and for adjustments to place equipment into full operation to satisfaction of the Contract Administrator and the City. Co-operate with other trades concerned in this matter.
- .2 Supplier is entirely responsible for correct functioning of equipment they supply. Equipment will not be accepted by the City until the City is provided with statement to effect that equipment is installed and working to their complete satisfaction.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
  - .1 Remove packaging debris and clean adjacent surfaces immediately after installation.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 DEMONSTRATION**

- .1 Provide demonstration and training for all equipment in accordance with Section 01 79 00, manufacturer's recommendations and requirements of this Section.
- .2 Each manufacturer is to provide authorized representative to demonstrate operation of their equipment and systems to the City's personnel.

### **3.5 PROTECTION**

- .1 Protect installed equipment from construction activity until project completion.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 09 06 00.13 – Room Finish Schedule.

### **1.2 SYSTEM DESCRIPTION**

- .1 One-piece roll-up matting with recessed perimeter frame.

### **1.3 REFERENCES**

- .1 American Society for Testing and Materials (ASTM).
  - .1 ASTM B221M-13, Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes [Metric].
- .2 British Standards Institution (BSI).
  - .1 BS 2782—0:2011, Methods of Testing Plastic. Introduction.

### **1.4 SYSTEM DESCRIPTION**

- .1 Loading: Design frame sections to support uniformly distributed load of minimum 300 psf.

### **1.5 ACTION AND INFORMATION SUBMITTALS**

- .1 Make all submittals in accordance with requirements of Section 01 33 00.
- .2 Shop Drawings.
  - .1 Provide manufacturer's product specifications and installation instructions.
  - .2 Indicate layout and types of floor mats and frames not less than half-scale sections of typical installations, details of patterns or designs, anchors, and accessories, and field measurements of slab recess to receive frames.
- .3 Samples.
  - .1 Submit 300 mm x 300 mm section of floor mat and frame material.
- .4 Closeout Submittals.
  - .1 Provide maintenance data for incorporation into Operation and Maintenance Manual specified in Section 01 78 00.

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

- .1 Deliver all material to site in manufacturer's original unopened packaging with labels clearly identifying product name and manufacturer.
- .2 Store materials in a dry, enclosed area protected from exposure to moisture, construction activity, and direct sunlight in strict accordance with manufacturer's recommendations.
- .3 Handle all products with appropriate precautions and care as stated manufacturer's instructions.
- .4 Cleaning in accordance with Section 01 74 00.
- .5 Construction Waste Management in accordance with Section 01 74 19.

### **1.7 SEQUENCING**

- .1 Co-ordinate with cast-in-place concrete so that frames are available for placing integrally with floor slabs.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Basis of Design Products.
  - .1 Aluminum Floor Grating (FG).
    - .1 Babcockdavis EnvIRONtread II BGV34C-FLBC with the following components:
      - .1 Grate: BGV34C reversible grate with recycled fibre-reinforced rubber treads alternating with aluminum divider bars and vinyl spacers.
      - .2 Frame: BFV34LBC, level bed cast-in-place, recessed aluminum frame.
  - .2 Requests for substitutions will be considered subject to specified requirements and in accordance with *B7 Substitutes of the Bidding Procedures*.
  - .3 Supply similar products from single manufacturer.

### **2.2 MATERIALS**

- .1 Aluminum extrusions: to ASTM B221, 6061-T6, 6063-T5, 6063-T6, 6105-T5.
- .2 Tread Inserts: recycled nylon reinforced buffed rubber mechanically secured to tread rails. Tread colour: Grey.
- .3 Fasteners: non-corrosive screws and anchors for securing frames together and to floors.

### **2.3 FABRICATION**

- .1 Fabrication Tolerances: Obtain field measurements of recessed areas prior to fabrication, including squareness and levelness of recess.
- .2 Shop fabricate floor mats and frames to greatest extent possible in sizes shown on drawings.
- .3 Provide single mat for each installation, but do not exceed manufacturer's maximum size recommendation for mats intended for removal and cleaning.
- .4 Butt corners of framing elements with hairline joints or provide prefabricated corner units without joints.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Examine substrates and conditions under which work is to be performed, and notify Contract Administrator in writing of conditions detrimental to proper and timely completion of work.
- .2 Do not proceed with installation until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- .1 Install entrance floor mats and frames in accordance with reviewed shop drawings, manufacturer's written instructions, at locations shown and with top of frames level with adjoining finished flooring.
- .2 Co-ordinate top of mat surfaces with doors that swing across mats to ensure under door clearance.
- .3 Provide necessary shims, spacer, and anchorages for proper location and secure attachment of frames to concrete.
- .4 Grout frames into recessed concrete using chemical resistant 100% solids epoxy grout.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 PROTECTION**

- .1 Upon completion of frame installations, provide temporary cover of plywood on mat recesses, and cover frames with plywood protective flooring.
- .2 Maintain protection until construction traffic has ended and project is near time of substantial completion.

### **3.5 SCHEDULES**

- .1 Refer to Section 09 06 00.13.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED REQUIREMENTS**

- .1 Section 22 05 05 Selective Demolition for Plumbing .
- .2 Section 22 05 15 Plumbing Specialties and Accessories
- .3 Section 22 10 10 Plumbing Pumps
- .4 Section 22 11 16 Domestic Water Piping
- .5 Section 22 13 16.13 Sanitary Waste and Vent Piping - Cast Iron and Copper
- .6 Section 22 13 16.16 Sanitary Waste and Vent Piping - Plastic
- .7 Section 22 33 00 Electrical Domestic Water Heaters
- .8 Section 22 42 13 Commercial Water Closets , Urinals and Bidets
- .9 Section 22 42 16 Commercial Lavatories and Sinks
- .10 Section 22 42 19 Commercial Bathtubs and Showers
- .11 Section 22 47 00 Drinking Fountains

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for review and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate on drawings:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .3 Shop drawings and product data accompanied by:
    - .1 Detailed drawings of bases, supports, and anchor bolts.
    - .2 Acoustical sound power data, where applicable.
    - .3 Points of operation on performance curves.
    - .4 Manufacturer to certify current model production.
    - .5 Certification of compliance to applicable codes.
  - .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator before final inspection.
  - .2 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .3 Maintenance data to include:
    - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2 Data to include schedules of tasks, frequency, tools required and task time.
  - .4 Performance data to include:
    - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    - .2 Equipment performance verification test results.
    - .3 Special performance data as specified.
    - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .5 Approvals:
    - .1 Submit 2 copies of draft Operation and Maintenance Manual to Contract Administrator for approval. Submission of individual data will not be accepted unless directed by Contract Administrator.
    - .2 Make changes as required and re-submit as directed by Contract Administrator.
  - .6 Additional data:
    - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
  - .7 Site records:
    - .1 Contract Administrator will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.



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

#### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One glass for each gauge glass.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials and equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not used.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

### **3.3 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 -ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.5 DEMONSTRATION**

- .1 Contract Administrator will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:

- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.7 PROTECTION**

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

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 This Section includes requirements for selective demolition and removal of plumbing, sprinkler systems and related mechanical components and incidentals required to complete work described in this Section ready for new construction.

### **1.2 RELATED REQUIREMENTS**

- .1 Section 02 41 00.08– Demolition - Minor Works
- .2 Section 02 81 00– Hazardous Materials General Provisions
- .3 Section 02 82 10 Asbestos Abatement - Type 1 ( Low Risk) Precautions
- .4 Section 02 82 12 Asbestos Abatement - Glove Bag

### **1.3 REFERENCE STANDARDS**

- .1 CSA Group (CSA):
  - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

### **1.4 DEFINITIONS**

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Remove and Salvage: Detach items from existing construction and deliver them to City ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Action Submittals: Provide the following in accordance with Section 01 33 00– Submittal Procedures before starting work of this Section:
  - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in

accordance with Section 01 74 19– Construction Waste Management and Disposal.

- .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

## **1.6 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

## **1.7 SITE CONDITIONS**

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering on date that tender is accepted.
- .2 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition.
- .3 Existing Hazardous Substances: Departmental Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
  - .1 Hazardous substances are as defined in the Hazardous Products Act.
  - .2 Hazardous substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.
- .4 Discovery of Hazardous Substances: Immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
  - .1 Refer to Section 02 81 00 Hazardous Materials General Provisions.
  - .2 Hazardous substances will be as defined in the Hazardous Products Act.
  - .3 Stop work in the area of the suspected hazardous substances.
  - .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
  - .5 Proceed only after written instructions have been received from Departmental Representative

## **1.8 SALVAGE AND DEBRIS MATERIALS**

- .1 Demolished items become Contractor's property and will be removed from Project site.
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 41 00.18 Demolition Minor Works.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 General Patching and Repair Materials: Refer to Section 01 73 29 Cutting and Patching for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.

- .2 Plumbing Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.
- .3 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

#### **3.2 PREPARATION**

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
  - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
  - .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
  - .3 Prevent debris from blocking drainage inlets.
  - .4 Protect mechanical systems that must remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the employees and users is minimized and as follows:
  - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
  - .2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

#### **3.3 EXECUTION**

- .1 Coordinate requirements of this Section with information contained as follows:
  - .1 Disconnect and cap mechanical services in accordance with requirements of local Authority Having Jurisdiction.
  - .2 Do not disrupt active or energized utilities without approval of the City.
  - .3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.
  - .4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.

- .5 At end of each day's work, leave worksite in safe condition.
- .6 Perform demolition work in a neat and workmanlike manner:
  - .1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
  - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

### **3.4 CLOSEOUT ACTIVITIES**

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre) except where explicitly noted otherwise for materials being salvaged for re use in new construction in accordance with Section 02 41 00.18 Demolition Minor Works .
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances in accordance with requirements of Section 02 81 00 Hazardous Materials General Provisions.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM A126-04 (2009), Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
  - .2 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
  - .1 ANSI/AWWA C700-09, Standard for Cold Water Meters-Displacement Type, Bronze Main Case.
  - .2 ANSI/AWWA C701-12, Standard for Cold Water Meters-Turbine Type for Customer Service.
  - .3 ANSI/AWWA C702-10, Standard for Cold Water Meters-Compound Type.
- .3 CSA Group (CSA)
  - .1 CSA-B64 Series-11, Backflow Preventers and Vacuum Breakers.
  - .2 CSA B79-08, Commercial and Residential Drains and Cleanouts.
  - .3 CAN/CSA-B356-10, Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).
- .5 Plumbing and Drainage Institute (PDI)
  - .1 PDI-WH201-R2010, Water Hammer Arresters Standard.

### **1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-installation Meetings:
  - .1 Convene pre-installation meeting 1 week prior to beginning of work , with Citys representative and Contract Administrator in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building construction subtrades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.



- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .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 Manufacturers' Field Reports: manufacturers' field reports specified.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for plumbing specialties and accessories for incorporation into manual.
  - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect plumbing materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **Part 2 Products**

#### **2.1 FLOOR DRAINS**

- .1 Floor Drains and Trench Drains: to CSA B79.

#### **2.2 CLEANOUTS**

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Access Covers:
  - .1 Wall Access: face or wall type, stainless steel cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
  - .2 Floor Access: cast box with anchor lugs and:
    - .1 Plugs: bolted bronze with neoprene gasket.
    - .2 Cover for Unfinished Concrete Floors: cast iron round gasket, vandal-proof screws.

- .3 Cover for Terrazzo Finish: polished brass, nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
- .4 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
- .5 Cover for Carpeted Floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

### **2.3 WATER HAMMER ARRESTORS**

- .1 Stainless steel construction, piston bellows type: to PDI-WH201.

### **2.4 BACK FLOW PREVENTERS**

- .1 Preventers: to CSA-B64 Series, application reduced pressure principle type double check valve assembly as indicated, back flow preventer with intermediate with intermediate vacuum breaker atmospheric vent.

### **2.5 VACUUM BREAKERS**

- .1 Breakers: to CSA-B64 Series, vacuum breaker atmospheric laboratory faucet intermediate hose connection.

### **2.6 PRESSURE REGULATORS**

- .1 Capacity: as indicated.
  - .1 Inlet pressure: 1034 kPa.
  - .2 Outlet pressure: 413 kPa.
- .2 Up to NPS 1-1/2 bronze bodies, screwed: to ASTM B62.
- .3 NPS 2 and over, semi-steel bodies, Class 125, flanged: to ASTM A126, Class B.
- .4 Semi-steel spring chambers with bronze trim.

### **2.7 BACKWATER VALVES**

- .1 Valve body with bronze seat, revolving bronze flapper and threaded cover.
- .2 Access:
  - .1 Surface access.
  - .2 Access pipe with cover: maximum 300 mm depth.
  - .3 Steel housing with gasketted steel cover.
  - .4 Concrete access pit with cover, as indicated.

### **2.8 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

## **2.9 WATER MAKE-UP ASSEMBLY**

- .1 Complete with backflow preventer pressure gauge on inlet and outlet, pressure reducing valve to CAN/CSA-B356, pressure relief valve on low pressure side and gate valves on inlet and outlet.

## **2.10 TRAP SEAL PRIMERS**

- .1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.

## **2.11 STRAINERS**

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.
- .3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 MANUFACTURER'S INSTRUCTIONS**

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

### **3.3 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions and as specified.

### **3.4 CLEANOUTS**

- .1 Install cleanouts at base of soil and waste stacks, and rainwater leaders, at locations required code, and as indicated.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 4.

### **3.5 WATER HAMMER ARRESTORS**

- .1 Install on branch supplies to fixtures or group of fixtures where indicated.

### **3.6 BACK FLOW PREVENTERS**

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
  - .1 Drains.
  - .2 Backwater Valves.
  - .3 Water Make-up Assembly.
- .2 Pipe discharge to terminate over nearest funnel floor drain .

### **3.7 BACKWATER VALVES**

- .1 Install in access pit as indicated.

### **3.8 HOSE BIBBS AND SEDIMENT FAUCETS**

- .1 Install at bottom of risers, at low points to drain systems, and as indicated.

### **3.9 TRAP SEAL PRIMERS**

- .1 Install for floor drains and elsewhere, as indicated.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Contract Administrator.
- .3 Install flex tubing to floor drain.

### **3.10 STRAINERS**

- .1 Install with sufficient room to remove basket for maintenance.

### **3.11 WATER MAKE-UP ASSEMBLY**

- .1 Install on valved bypass.
- .2 Pipe discharge from relief valve to nearest floor drain.

### **3.12 START-UP**

- .1 General:
  - .1 In accordance with Section 01 91 13 - Commissioning supplemented as specified herein.
- .2 Timing: start-up only after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

### **3.13 TESTING AND ADJUSTING**

- .1 General:
  - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13 - Commissioning supplemented as specified.

- .2 Timing:
  - .1 After start-up deficiencies rectified.
  - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Application tolerances:
  - .1 Pressure at fixtures: +/- 70 kPa.
  - .2 Flow rate at fixtures: +/- 20%.
- .4 Adjustments:
  - .1 Verify that flow rate and pressure meet design criteria.
  - .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .5 Floor drains:
  - .1 Verify operation of trap seal primer.
  - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
  - .3 Check operations of flushing features.
  - .4 Check security, accessibility, removability of strainer.
  - .5 Clean out baskets.
- .6 Vacuum breakers, backflow preventers, backwater valves:
  - .1 Test tightness, accessibility for O&M of cover and of valve.
  - .2 Simulate reverse flow and back-pressure conditions to test operation of vacuum breakers, backflow preventers.
  - .3 Verify visibility of discharge from open ports.
- .7 Roof drains:
  - .1 Check location at low points in roof.
  - .2 Check security, removability of dome.
  - .3 Adjust weirs to suit actual roof slopes, meet requirements of design.
  - .4 Clean out sumps.
  - .5 Verify provisions for movement of roof systems.
- .8 Access doors:
  - .1 Verify size and location relative to items to be accessed.
- .9 Cleanouts:
  - .1 Verify covers are gas-tight, secure, yet readily removable.
- .10 Water hammer arrestors:
  - .1 Verify proper installation of correct type of water hammer arrester.
- .11 Pressure regulators, PRV assemblies:
  - .1 Adjust settings to suit locations, flow rates, pressure conditions.
- .12 Strainers:
  - .1 Clean out repeatedly until clear.
  - .2 Verify accessibility of cleanout plug and basket.

- .3 Verify that cleanout plug does not leak.
- .13 Hose bibbs, sediment faucets:
  - .1 Verify that flow and pressure meet design criteria.
  - .2 Check for leaks, replace compression washer if required.
- .14 Hydronic system water Make-up Assembly:
  - .1 Verify flow, pressure, and connection.
- .15 Soap Dispensing Systems:
  - .1 Verify location and reach.
  - .2 Check for leaks.

### **3.14 CLOSEOUT ACTIVITIES**

- .1 Commissioning Reports: in accordance with Section 01 91 13 - Commissioning: reports, supplemented as specified.
- .2 Training: provide training in accordance with Section 01 91 13 - Commissioning: Training of O&M Personnel, supplemented as specified.

### **3.15 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.16 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by plumbing specialties and accessories installation.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for plumbing pumps.

### **1.2 REFERENCE STANDARDS**

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

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
- .3 Shop Drawings.
  - .1 Submit shop drawings to indicate:
    - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
    - .2 Wiring and schematic diagrams.
    - .3 Dimensions and recommended installation.
    - .4 Pump performance and efficiency curves.
- .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 Manufacturers' Field Reports: manufacturers' field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals, include:
  - .1 Manufacturers name, type, model year, capacity and serial number.
  - .2 Details of operation, servicing and maintenance.
  - .3 Recommended spare parts list with names and addresses.

### **1.4 QUALITY ASSURANCE**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work in accordance with Section 01 31 19 Project Meetings .
    - .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.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for recycling in accordance with Section 01 47 19- Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal 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 as approved by Departmental Representative.
  - .5 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.
  - .6 Fold up banding, flatten and place in designated area for recycling.

## **Part 2 Products**

### **2.1 DOMESTIC HOT WATER CIRCULATING PUMPS**

- .1 As per the equipment schedules on the drawings
- .2 Acceptable Manufacturers are: Bell & Gossett, Wilo, Armstrong, ITT

### **2.2 CONDENSATE PUMPS**

- .1 As per the equipment schedules on the drawings
- .2 Acceptable Manufacturers are: Sarco, Armstrong, Skidmore, Little Giant.

## **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 data sheet.

### **3.2 INSTALLATION**

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.
- .3 Align vertical pit mounted pump assembly after mounting and securing cover plate.



### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Check power supply.
  - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.
- .4 Adjust flow from water-cooled bearings.
- .5 Adjust impeller shaft stuffing boxes, packing glands.

### **3.4 START-UP**

- .1 General:
  - .1 Procedures:
    - .1 Check power supply.
    - .2 Check starter O/L heater sizes.
    - .3 Start pumps, check impeller rotation.
    - .4 Check for safe and proper operation.
    - .5 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
    - .6 Test operation of hands-on-auto switch.
    - .7 Test operation of alternator.
    - .8 Adjust leakage through water-cooled bearings.
    - .9 Adjust shaft stuffing boxes.
    - .10 Adjust leakage flow rate from pump shaft stuffing boxes to manufacturer's recommendations.
    - .11 Check base for free-floating, no obstructions under base.
    - .12 Run-in pumps for 12 continuous hours.
    - .13 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
    - .14 Adjust alignment of piping and conduit to ensure full flexibility.
    - .15 Eliminate causes of cavitation, flashing, air entrainment.
    - .16 Measure pressure drop across strainer when clean and with flow rates as finally set.
    - .17 Replace seals if pump used to degrease system or if pump used for temporary heat.
    - .18 Verify lubricating oil levels.

### **3.5 PERFORMANCE VERIFICATION (PV) PRESSURE BOOSTER PUMPS**

- .1 General:

- .1 In accordance with Section 01 91 13 -Commissioning, supplemented as specified.
- .2 Obtain manufacturer's approval, before performing PV, to ensure warranties remain intact.
- .3 Application tolerances:
  - .1 Flow: +/- 10 %.
  - .2 Pressure: Plus 20 %, minus 5 %.
- .4 PV procedures:
  - .1 Open pump balancing valve fully.
  - .2 Measure differential pressure (DP) across pump.
  - .3 Measure amperage and voltage and compare with manufacturer's data sheets and motor nameplate data.
  - .4 If suction is different size than discharge connection, add velocity head correction factor to DP.
  - .5 Mark this DP on manufacturer's pump curve.
  - .6 If flow rate is higher than specified, slow close balancing valve until specified DP is reached.
  - .7 Repeat measurements of amps and volts. Compare with manufacturer's data sheets.
  - .8 Calculate BHP and compare with nameplate data.

### **3.6 REPORTS**

- .1 In accordance with Section 01 91 13 - Commissioning: reports, supplemented as specified.
- .2 Include:
  - .1 PV results on approved PV Report Forms.
  - .2 Product Information report forms.
  - .3 Pump performance curves (family of curves) with final point of actual performance.

### **3.7 TRAINING**

- .1 In accordance with Section 01 91 13 - Commissioning: Training of O&M Personnel, supplemented as specified.

**END OF SECTION**

## Part 1 General

### 1.1 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers International (ASME)
  - .1 ANSI/ASME B16.15-13, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
  - .2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.24-11, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
  - .5 ASME B16.26-13, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .6 ASME B31.9-14, Building Services Piping.
  - .7 ASME B36.19M-04, Stainless Steel Pipe.
- .2 ASTM International (ASTM)
  - .1 ASTM A182/A 182M-16, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
  - .2 ASTM A269-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - .3 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .4 ASTM A312/A312M-16, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
  - .5 ASTM A351/A351M-16, Castings, Austenitic, for Pressure Containing Parts.
  - .6 ASTM A403/A403M-16, Wrought Austenitic Stainless Steel Piping Fittings.
  - .7 ASTM A536-84 (2014), Standard Specification for Ductile Iron Castings.
  - .8 ASTM B32-08 (2014), Standard Specification for Solder Metal.
  - .9 ASTM B42-15a, Seamless Copper Tube, Standard Sizes.
  - .10 ASTM B88M-14, Standard Specification for Seamless Copper Water Tube (Metric).
  - .11 ASTM F876-15, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
  - .12 ASTM F877-11, Standard Specification for Crosslinked Polyethylene (PEX) Hot and Cold Water Distribution System.
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
  - .1 ANSI/AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .2 ANSI/AWWA C151/A21.51-09, Ductile Iron Pipe, Centrifugally Cast, for Water.

- .3 AWWA C904-06, Crosslinked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) through 3 In. (76mm), for Water Service.
- .4 CSA Group (CSA)
  - .1 CSA B137.5-13, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
  - .2 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC S101-07, Fire Endurance Tests of Buildings Construction and Materials.
  - .2 CAN/ULC S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
  - .3 CAN/ULC S115-11, Standard Method of Fire Tests of Firestop.
- .6 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (SDS).
- .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
  - .1 MSS-SP-67-02a, Butterfly Valves.
  - .2 MSS-SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
- .9 National Research Council (NRC)
  - .1 National Plumbing Code of Canada (NPC) 2015.
- .10 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data
  - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
  - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Place materials defined as hazardous or toxic in designated containers.
- .2 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.

## **Part 2 Products**

### **2.1 PIPING**

- .1 Domestic hot, cold and recirculation systems, within building.
  - .1 Above ground:
    - .1 Copper tube, hard drawn, type L: to ASTM B88M.
    - .2 PEX Piping to CSA B137.5.
  - .2 Buried or embedded:
    - .1 Copper tube, soft annealed, type K: to ASTM B88M, in long lengths and with no buried joints.
    - .2 PEX Piping to CSA B137.5.

### **2.2 FITTINGS**

- .1 Bronze pipe flanges and flanged fittings, Class 150: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger:
  - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
  - .2 PEX fittings to CSA B137.5 and F1960.
- .6 NPS 1 ½ and smaller:
  - .1 Wrought copper to ANSI/ASME B16.22 ,cast copper to ANSI/ASME B16.18 ; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.
  - .2 PEX fittings to CSA B137.5.

### **2.3 JOINTS**

- .1 Rubber gaskets, 1.6 mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: 5 tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.
- .7 NPS 1 ½ and smaller: PEX fittings to CSA B137.5.
- .8 NPS 2 and larger: PEX fittings to CSA B137.5 and ASTM F1960. Elbows, adapters, couplings, plugs, tees, multi-port tees and valves.

### **2.4 GATE VALVES**

- .1 NPS 2 and under, soldered:

- .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
  - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 1/2 and over, in mechanical rooms, flanged:
  - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23.02 - Valves - Cast Iron.
- .4 NPS 2 1/2 and over, other than mechanical rooms, flanged:
  - .1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.

## **2.5 GLOBE VALVES**

- .1 NPS2 and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01 - Valves - Bronze.
  - .2 Lockshield handles: as indicated.
- .2 NPS 2 and under, screwed:
  - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23.01 - Valves - Bronze.
  - .2 Lockshield handles: as indicated.

## **2.6 SWING CHECK VALVES**

- .1 NPS 2 and under, soldered:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
  - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.

## **2.7 BALL VALVES**

- .1 NPS 2 and under, screwed:
  - .1 Class 150.
  - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, soldered:
  - .1 To ANSI/ASME B16.18, Class 150.
  - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 and under, mechanical:

- .1 To CSA B137.5 and ASTM F1960.
- .2 Lead free brass body.

### **Part 3 Execution**

#### **3.1 APPLICATION**

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

#### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturers written instruction.
- .2 Install pipe work in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:
  - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
  - .2 Bend tubing without crimping or constriction. Minimize use of fittings.

#### **3.3 VALVES**

- .1 Isolate equipment, fixtures and branches with gate or ball vales.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

#### **3.4 PRESSURE TESTS**

- .1 Conform to requirements of Section 21 05 01 Common Work Results for Mechanical.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

#### **3.5 FLUSHING AND CLEANING**

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean Provincial potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

#### **3.6 PRE-START-UP INSPECTIONS**

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.

- .4 Ensure that air chambers, expansion compensators are installed properly.

### **3.7 START-UP**

- .1 Timing: start up after:
  - .1 Pressure tests have been completed.
  - .2 Disinfection procedures have been completed.
  - .3 Certificate of static completion has been issued.
  - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
  - .1 Establish circulation and ensure that air is eliminated.
  - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
  - .3 Bring HWS storage tank up to design temperature slowly.
  - .4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
  - .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

### **3.8 PERFORMANCE VERIFICATION**

- .1 Scheduling:
  - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
  - .1 Verify that flow rate and pressure meet Design Criteria.
  - .2 TAB HWC in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
  - .4 Sterilize HWS and HWC systems for Legionella control.
  - .5 Verify performance of temperature controls.
  - .6 Verify compliance with safety and health requirements.
  - .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
  - .8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .3 Reports:



- .1 In accordance with Section 01 91 13 - Commissioning (Cx) : Reports, using report forms as specified in Section 01 91 13 - Commissioning (Cx): Report Forms and Schematics.
- .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

### **3.9 OPERATION REQUIREMENTS**

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

### **3.10 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM B32-08, Standard Specification for Solder Metal.
  - .2 ASTM B306-02, Standard Specification for Copper Drainage Tube (DWV).
  - .3 ASTM C564-03a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 CSA Group (CSA)
  - .1 CSA B67-1972 (R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
  - .2 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.
  - .3 CAN/CSA-B125.3-05, Plumbing Fittings.
- .3 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 COPPER TUBE AND FITTINGS**

- .1 Above ground sanitary and vent Type DWV to: ASTM B306.
  - .1 Fittings.
    - .1 Cast brass: to CAN/CSA-B125.3.
    - .2 Wrought copper: to CAN/CSA-B125.3.
  - .2 Solder: lead free, to ASTM B32.

### **2.2 CAST IRON PIPING AND FITTINGS**

- .1 Buried sanitary and vent minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating

- .1 Joints:
  - .1 Mechanical joints:
    - .1 Neoprene or butyl rubber compression gaskets: to CAN/CSA-B70.ASTM C564 or
    - .2 Stainless steel clamps.
  - .2 Hub and spigot:
    - .1 Caulking lead: to CSA B67.
    - .2 Cold caulking compounds.
- .2 Above ground sanitary and vent: to CAN/CSA-B70.
  - .1 Joints:
    - .1 Hub and spigot:
      - .1 Caulking lead: to CSA B67.
    - .2 Mechanical joints:
      - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

### **Part 3 Execution**

#### **3.1 APPLICATION**

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

#### **3.2 INSTALLATION**

- .1 In accordance with Section 23 05 15 - Common installation requirements for HVAC pipework.
- .2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

#### **3.3 TESTING**

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

#### **3.4 PERFORMANCE VERIFICATION**

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
  - .1 Verify domes are secure.

- .2 Ensure weirs are correctly sized and installed correctly.
- .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM D2235- 04, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  - .2 ASTM D2564- 04e1, Standard Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 CSA Group (CSA)
  - .1 CAN/CSA-Series B1800- 06, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (SDS).
- .4 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide two copies WHMIS SDS - Material Safety Data Sheets in accordance with Section 02 81 00 Hazardous Materials General Provisions.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions .
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 Products**

### **2.1 PIPING AND FITTINGS**

- .1 For above ground and buried DWV piping to:
  - .1 CAN/CSA B1800.

### **2.2 JOINTS**

- .1 Solvent weld for PVC: to ASTM D2564.

- .2 Solvent weld for ABS: to ASTM D2235.

### **Part 3 Execution**

#### **3.1 APPLICATION**

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

#### **3.2 INSTALLATION**

- .1 In accordance with Section 23 05 15 - Common installation requirements for HVAC pipework.

#### **3.3 TESTING**

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

#### **3.4 PERFORMANCE VERIFICATION**

- .1 Cleanouts:
  - .1 Ensure accessible and that access doors are correctly located.
  - .2 Open, cover with linseed oil and re-seal.
  - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
  - .1 Verify domes are secure.
  - .2 Ensure weirs are correctly sized and installed correctly.
  - .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

#### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/Canadian Standards Association (ANSI/CSA)
  - .1 ANSI Z21.10.1-2004 /CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.
  - .2 ANSI Z21.10.1A-2006 /CSA 4.1A-2006, Addenda 1 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.
  - .3 ANSI Z21.10.1b-2006 /CSA 4.1b-2006, Addenda 2 to ANSI Z21.10.1-2004/CSA 4.1-2004, Gas Water Heaters - Volume I, Storage Water Heaters With Input Ratings of 75,000 Btu Per Hour or Less.
  - .4 ANSI Z21.10.3A-2007 /CSA 4.3-2007, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous.
- .2 CSA Group (CSA)
  - .1 CSA B51-03 (R2007), Boiler, Pressure Vessel, and Pressure Piping Code.
  - .2 CAN/CSA-B139-04, Installation Code for Oil Burning Equipment.
  - .3 CAN/CSA-B140.0-03, Oil Burning Equipment: General Requirements.
  - .4 CAN/CSA-B149.1-05, Natural Gas and Propane Installation Code.
  - .5 CAN/CSA-B149.2-05, Propane Storage and Handling Code.
  - .6 CSA B140.12-03, Oil-Burning Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools.
  - .7 CAN/CSA C22.2 No.110-94 (R2004), Construction and Test of Electric Storage Tank Water Heaters.
  - .8 CAN/CSA-C191-04, Performance of Electric Storage Tank Water Heaters for Household Service.
  - .9 CAN/CSA-C309-M90 (R2003), Performance Requirements for Glass-Lined Storage Tanks for Household Hot Water Service.
- .3 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for domestic water heater, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

- .2 Indicate:
  - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

### **1.3 CLOSEOUT SUBMITTALS**

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

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove in accordance with Section 01 74 19 - Waste Management and Disposal.

### **1.5 WARRANTY**

- .1 For the Work of this Section 22 30 05 - Domestic Water Heaters, 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to number of years specified for each product.
- .2 Contractor hereby warrants domestic water heaters in accordance with the City's requirements, but for number of years specified for each product.

## **Part 2 Products**

### **2.1 ELECTRIC WATER HEATER**

- .1 To CAN/CSA C22.2 No.110, CAN/CSA-C191 and CAN/CSA-C309 for glass-lined storage tanks, with immersion type elements,, and surface mounted or immersion type adjustable thermostats.

### **2.2 DHW HEATER AND STORAGE TANK**

- .1 DHW heater:
  - .1 General: packaged unit to ASME standards, stamped for 1100 kPa WP. Provide CGA certification.
  - .2 Heat exchanger: multi-tube, 2 pass, copper and bronze, with NPS 1 extruded and finned tubes rolled into heavy tube sheets. Inlet and outlet headers to include drain valves and thermowells.
  - .3 Combustion chamber: line with 50 mm insulating refractory.
  - .4 Burners: high chromium stainless steel, die stamped, raised port, fixed primary air.
  - .5 Cabinet: baked enamel, welded steel, insulated with foil-faced fibreglass.
  - .6 Trim:
    - .1 Self-actuated modulating valves with 2 ply thermostatic bellows, copper capillary tubing, separate built-in well, tight disc shut-off removable



composition disc stem with lubricator temperature adjustment setting reference scale, maximum, pressure differential of 28 kPa.

- .7 Controls:
  - .1 Motorized electric shut-off valve, downstream block/test valve, test connection, pressure gauge.
  - .2 Thermopilot safety with 100% shut-off, adjustable electric high limit control.
  - .3 Minimum input valve, on-off.
  - .4 Flow switch, interlocked with ignition system to prevent operation in event of low flow.

### **2.3 TRIM AND INSTRUMENTATION**

- .1 Drain valve: NPS 1 with hose end.
- .2 Thermometer: 100 mm dial type with red pointer and thermowell filled with conductive paste.
- .3 Pressure gauge: 75 mm dial type with red pointer, syphon, and shut-off cock.
- .4 Thermowell filled with conductive paste for control valve temperature sensor.
- .5 ASME rated temperature and pressure relief valve, sized for full capacity of having discharge terminating over floor drain and visible to operators.
- .6 Magnesium anodes adequate for 20 years of operation and located for easy replacement.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturer's recommendations.
- .2 Provide insulation between tank and supports.

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.

### **3.4 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CAN/CSA-B45 Series-02 (R2013), Plumbing Fixtures, (Consists of B45.0, B45.1, B45.2, B45.3, B45.4, B45.5, B45.6, B45.7, B45.8 and B45.9).
  - .2 CSA B125.3-12, Plumbing Fittings.
  - .3 CSA B651-12, Accessible Design for the Built Environment.
- .2 National Research Council Canada (NRC)
  - .1 National Building Code of Canada 2015 (NBC).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for washroom fixtures and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate fixtures and trim:
    - .1 Dimensions, construction details, roughing-in dimensions.
    - .2 Factory-set water consumption per flush at recommended pressure.
    - .3 (For water closets, urinals): minimum pressure required for flushing.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Include:
  - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
  - .2 Details of operation, servicing, maintenance.
  - .3 List of recommended spare parts.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect specified materials and equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CSA B125.3.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: as indicated.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 Fixture piping:
  - .1 Hot and cold water supplies to fixtures:
    - .1 Chrome plated flexible supply pipes with screwdriver stop, reducers, escutcheon.
  - .2 Waste:
    - .1 Brass P trap with clean out on fixtures not having integral trap.
    - .2 Chrome plated in exposed places.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: refer to architectural documents.

### **3.3 ADJUSTING**

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
  - .3 Adjust flush valves to suit actual site conditions.
  - .4 Adjust urinal flush timing mechanisms.

- .5 Set controls of automatic flush valves for WCs and urinals to prevent unnecessary flush cycles.
- .3 Checks:
  - .1 Water closets, urinals: flushing action.
  - .2 Aerators: operation, cleanliness.
  - .3 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
  - .1 Verify temperature settings, operation of control, limit and safety controls.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CAN/CSA-B45 Series-02 (R2008), Plumbing Fixtures.
  - .2 CAN/CSA-B125.3-05, Plumbing Fittings.
  - .3 CAN/CSA-B651-04, Accessible Design for the Built Environment.
- .2 National Research Council Canada (NRC)
  - .1 National Building Code of Canada 2015 (NBC).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include:
  - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
  - .2 Details of operation, servicing, maintenance.
  - .3 List of recommended spare parts.

### **1.4 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures to be product of one manufacturer.
- .6 Trim to be product of one manufacturer.
- .7 Refer to mechanical drawings for plumbing fixture specifications.

- .8 Chair carriers:
  - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

### **Part 3 Execution**

#### **3.1 APPLICATION**

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

#### **3.2 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
  - .2 Wall-hung fixtures: as indicated, measured from finished floor.
  - .3 Physically handicapped: to comply with most stringent of either NBC or CAN/CSA-B651.

#### **3.3 ADJUSTING**

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
  - .1 Aerators: operation, cleanliness.
  - .2 Vacuum breakers, backflow preventers: operation under all conditions.
  - .3 Wash fountains: operation of flow-actuating devices.
- .4 Thermostatic controls:
  - .1 Verify temperature settings, operation of control, limit and safety controls.

#### **3.4 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CAN/CSA-B45 Series-02 (R2008), Plumbing Fixtures.
  - .2 CAN/CSA-B125.3-05, Plumbing Fittings.
  - .3 CAN/CSA-B651-04, Accessible Design for the Built Environment.
- .2 National Research Council Canada (NRC)
  - .1 National Building Code of Canada 2015 (NBC).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.
- .2 Include:
  - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
  - .2 Details of operation, servicing, maintenance.
  - .3 List of recommended spare parts.

### **1.4 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 Custom built showers:

- .1 Accessories:
  - .1 Approximately 75 mm dia. dial thermometer on mixing valve outlet.
  - .2 Ball valve and union for shut-off and volume control on mixing valve outlet.
  - .3 Additional valved cold water branch for cold water run-out to showerheads.
  - .4 Escutcheons on pipes entering enclosure.
  - .5 Piping, valves, fittings in enclosure: chrome plated.
- .2 Enclosure for thermostatic mixing valve:
  - .1 450 x 610 mm from 1.6 mm thick steel, wall mounted cabinet with 2.5 mm thick door with full length piano hinges, glass viewing panel, and key-operated tumbler lock.
  - .2 Finishes:
    - .1 Exterior: white primer.
    - .2 Interior: white primer and white gloss enamel.
- .3 Electronic shower water flow controls:
  - .1 Infra-red proximity type:
    - .1 Electronic, activated by infra-red sensor responding to presence of person.
    - .2 Sensor: waterproof, LED through sensor lens, housed behind rugged type 304 stainless steel surface-mounted plate, sensitivity adjustable from 50 mm to 1220 mm, factory set to 450 mm.
    - .3 Water conservation: adjustable, 3 minutes maximum run time.
    - .4 Controls: modular plug-in type connections, slow-closing solenoid with manual over-ride, for 860 kPa, 60 degrees C.
    - .5 Transformer: , UL and CSA listed, sized for up to 8 solenoids, to operate up to 8 showers.
  - .2 Push-button type:
    - .1 Electronic, activated by proximity sensor responding to depression of pushbutton.
    - .2 Sensor: waterproof, LED through sensor lens with 5 second minimum block out feature to prevent misuse, housed behind rugged chrome plated brass push button assembly, self-calibrating, sensitivity adjustable from 50 mm to 1220 mm, factory set to 450 mm.
    - .3 Water conservation: push button start/stop, adjustable run time but 3 minutes maximum.
- .8 Fixture piping:
  - .1 Hot and cold water supplies to each fixture.
    - .1 Chrome plated flexible supply pipes each with screw driver stop, reducers, escutcheon.
  - .2 Waste:



- .1 Brass P trap with cleanout on each fixture not having integral trap.
- .2 Chrome plated in all exposed places.

### **Part 3 Execution**

#### **3.1 APPLICATION**

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

#### **3.2 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
  - .2 Physically handicapped: to comply with most stringent of either NBC or CAN/CSA B651.

#### **3.3 ADJUSTING**

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
  - .1 Aerators: operation, cleanliness.
  - .2 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
  - .1 Verify temperature settings, operation of control, limit and safety controls.

#### **3.4 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 Air-Conditioning and Refrigeration Institute (ARI)
  - .1 ARI 1010-02, Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
- .2 CSA Group (CSA)
  - .1 CAN/CSA-B45 Series-02 (R2008), CSA Standards on Plumbing Fixtures.
  - .2 CAN/CSA-B125.3-05, Plumbing Fittings.
  - .3 CAN/CSA-B651-04, Accessible Design for the Built Environment.
- .3 National Research Council Canada (NRC)
  - .1 National Building Code of Canada 2015 (NBC).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for fountains and coolers, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate, for all fixtures:
    - .1 Dimensions, construction details, roughing-in dimensions.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00 - Closeout Submittals.
- .2 Include:
  - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
  - .2 Details of operation, servicing, maintenance.
  - .3 List of recommended spare parts.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

## **Part 2 Products**

### **2.1 MANUFACTURED UNITS**

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixture piping:
  - .1 Hot and cold water supplies to each fixture:
    - .1 Chrome plated rigid supply pipes each with handwheel screwdriver stop, reducers, escutcheon.
  - .2 Waste:
    - .1 Brass P trap with cleanout on each fixture not having integral trap.
    - .2 Chrome plated in all exposed places.
- .6 Chair carriers:
  - .1 Factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 Mounting heights:
  - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
  - .2 Wall-hung fixtures: as indicated, measured from finished floor.
  - .3 Physically handicapped: to comply with most stringent of either NBC or CAN/CSA B651.
- .2 Drinking fountains and water coolers :
  - .1 In accordance with ARI 1010.

### **3.3 ADJUSTING**

- .1 Conform to water conservation requirements specified this Section.
- .2 Adjustments:
  - .1 Adjust water flow rate to design flow rates.
  - .2 Adjust water cooler, drinking fountain flow stream to ensure no spillage.
- .3 Checks:
  - .1 Refrigerated water coolers: operation, temperature settings.

- .4 Thermostatic controls:
  - .1 Verify temperature settings, operation of control, limit and safety controls.

### **3.4 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Use of mechanical systems during construction.

### **1.2 USE OF SYSTEMS**

- .1 Use of new and existing heat and ventilation systems for supplying temporary heat and ventilation is permitted only under the following conditions:
  - .1 Entire system is complete, pressure tested, cleaned, flushed out.
  - .2 Specified water treatment system has been commissioned, water treatment is being continuously monitored.
  - .3 Building has been closed in, areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
  - .4 There is no possibility of damage.
  - .5 Supply ventilation systems are protected by 60 % filters, inspected daily, changed every week or more frequently as required.
  - .6 Return systems have approved filters over openings, inlets, outlets.
  - .7 Systems will be:
    - .1 Operated as per manufacturer's recommendations and instructions.
    - .2 Operated by Contractor.
    - .3 Monitored continuously by Contractor.
  - .8 Warranties and guarantees are not relaxed.
  - .9 Regular preventive and other manufacturers recommended maintenance routines are performed by Contractor at own expense and under supervision of Departmental Representative.
  - .10 Refurbish entire system before static completion; clean internally and externally, restore to "as- new" condition, replace filters in air systems.
- .2 Filters specified in this Section are over and above those specified in other Sections of this project.
- .3 Exhaust systems are not included in approvals for temporary heating ventilation.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 National Air Duct Cleaners Association (NADCA)
  - .1 ACR Standard, 2006 edition: Assessment, Cleaning and Restoration of HVAC Systems.
- .2 North American Insulation Manufacturers Association (NAIMA)
  - .1 NAIMA 2005, Cleaning Fibrous Glass Insulated Duct Systems - Recommended Practices.
- .3 United States Environmental Protection Agency (US EPA)
  - .1 US EPA 1999, 40 CFR Parts 152 and 156.

### **1.2 DEFINITIONS**

- .1 HVAC System: complete air duct system from outside air intake louvers to furthest air supply terminal unit and including:
  - .1 Rigid supply and return ductwork;
  - .2 Flexible ductwork;
  - .3 Mixing plenum boxes;
  - .4 Return air plenums including ceiling plenums;
  - .5 Cooling and heating coils and compartments;
  - .6 Condensate drain pans, eliminator blades and humidifiers;
  - .7 Fans, fan blades and fan housing;
  - .8 Filter housing and frames;
  - .9 Acoustically insulated duct linings;
  - .10 Diffusers, registers and terminal units;
  - .11 Dampers and controls;

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- .1 Site Evaluation: conduct site visit 2 weeks before start of work specific co-ordinated cleaning plan determining how areas of facility and HVAC systems will be protected during cleaning operations.
  - .1 Ensure plan identifies sequence and schedule of survey and cleaning operations for each individual HVAC system and for complete facility.
    - .1 Take account of elbows, bends, turning vanes, dampers, transitions, take-offs, ..... and other internal features.
- .2 Scheduling: Hours of Operation: complete work during non-business hours as follows:
  - .1 Monday to Thursday between 18:00 hours and 07:00 hours.
  - .2 Friday from 18:00 h to Monday at 07:00 h.
  - .3 Work may not be carried out during statutory holidays.
  - .4 Hours of operation are subject to change with 12 hours notice.

- .3 Damaged or broken equipment and components found during initial testing and inspection shall be brought to the attention of the Contract Administrator and department representative for assessment.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit cleaning plan developed during site evaluation.
  - .1 Ensure plan includes sequence of operation, identification of camera and cleaning apparatus insertion points and schedule for work.
- .3 Product Data:
  - .1 Submit manufacturer's printed product literature and data sheets for antimicrobial agents and include product characteristics, performance criteria and limitations.
  - .2 Provide two copies of WHMIS SDS in accordance with Section 02 81 00 Hazardous Materials General Provisions for antimicrobial agents or coatings.
- .4 Testing Laboratory Services: submit name and address of laboratory engaged for work of this Section.
  - .1 Submit laboratory analysis report of particulate collection indicating:
    - .1 Location of collection;
    - .2 Particulate grade;
    - .3 Particulate size;
    - .4 Percentage concentration of individual particulates in each sample.
- .5 US EPA Registration: submit verification of EPA Registration of antimicrobial agent.
- .6 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility, as described in PART 3 - CLEANING - Waste Management.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Post Cleaning Inspection Report: submit 4 copies of Final Inspection Report, including data collected, observations and recommendations as well as following information:
  - .1 Name and address of facility;
  - .2 Name and address of HVAC cleaning contractor;
  - .3 Description of HVAC systems with information identifying systems cleaned;
  - .4 Identification scheme for location points in systems that were inspected with accompanying notes describing methods of inspection or tests used;
  - .5 Identification of points where samples were collected and type of analysis used for each collection;
  - .6 Identification of each sample collected;
  - .7 Comments complete with photographs of each sampling location and other observed system features;
  - .8 Identify systems tested, observations, actions taken and recommendations for future maintenance.



- .3 Submit verification of delivery of hazardous or toxic waste materials to contaminated waste facility.

### **1.6 EXTRA MATERIALS**

- .1 Extra Stock Materials:
  - .1 Supply 4 extra filters for each HVAC System cleaned.
  - .2 Ensure filters are correct match, size, type and configuration of existing HVAC Systems.

### **1.7 QUALITY ASSURANCE**

- .1 Contractor: to be determined.
- .2 Project Co-ordinator: to be determined.

## **Part 2 Products**

### **2.1 ACCESS DOORS AND PANELS**

- .1 Equipment Access Doors and Panels: construct from same materials as equipment panelling complete with sealing gasket and positive locking device.
  - .1 Size access doors and panels in equipment to allow for inspection and cleaning.
- .2 Ductwork Access Doors: construct access doors from 1.27 mm minimum ..... with gasketed seal.
  - .1 Ensure access door is 25 mm greater in every dimension than access opening.
  - .2 Access door size 200 mm x 200 mm minimum.
  - .3 Secure access doors with sheet metal screws on 75 mm centres minimum. Ensure 3 screws per side minimum.
- .3 Access Doors and Panels Acoustic Lining:
  - .1 Install acoustic lining to match existing.
  - .2 Self-adhesive glass fibre tape capable of adhering to both acoustic lining and metal access door or panel materials.
  - .3 Water-based duct sealer for repairing cut acoustic lining.

### **2.2 ANTIMICROBIAL AGENT**

- .1 Use antimicrobial agents registered with US EPA-40 CFR.

### **2.3 SYSTEM FILTERS**

- .1 Supply and install new filters for each HVAC System cleaned.

### **2.4 AIR DUCT CLEANING EQUIPMENT**

- .1 Manually propelled full contact brushes:
  - .1 Ensure brushes are specifically manufactured and shaped to fit individual ducts, equipment and components of HVAC system.
    - .1 Ensure brushes are sized to fit various duct sizes in HVAC system.

- .2 Ensure brushes make scrubbing motion and full contact with HVAC system interior surfaces to be cleaned.
- .2 Brushes: manually propelled with integrally-mounted bristles.
  - .1 Ensure equipment has capacity to continue to push brush after bristles are distorted.
  - .2 Replace worn and ineffective brushes when required.

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Close down HVAC system.
- .2 Locate and identify externally visible HVAC system features which may affect cleaning process including:
  - .1 Control devices;
  - .2 Fire and smoke control dampers;
  - .3 Balancing dampers: indicate and record positions for resetting;
  - .4 Air volume control boxes: indicate and record positions for resetting;
  - .5 Fire alarm devices;
  - .6 Monitoring devices and controls;
- .3 Cut openings in equipment panels and ductwork for access to system interior.
  - .1 Square or rectangular opening sizes: 200 mm minimum each side.
  - .2 Circular opening sizes: 200 mm minimum diameter.
- .4 Installation of Access Doors and Panels: install access doors and panels for equipment where it is practical to facilitate system inspection and cleaning.
  - .1 Install access doors and panels for inspection and cleaning of equipment as follows:
    - .1 Heating and cooling coils;
    - .2 Fan units;
    - .3 Filters;
    - .4 Dampers;
    - .5 Sensors;
- .5 Installation of Access Doors in Ductwork: install access doors in ductwork where it is practical to facilitate system inspection and cleaning.
  - .1 Access door installation is not permitted in flexible ductwork.
    - .1 Inspect flexible ductwork only by disconnecting from main duct and inspecting from open end.
- .6 When acoustically lined duct is cut for access, repair cut edges of acoustic lining using self-adhesive fibre glass tape and water based duct sealer.
  - .1 Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.
- .7 Remove and reinstall ceiling tiles to gain access to HVAC system as required.

- .1 Replace ceiling tiles damaged or soiled by air duct cleaning procedures.

### **3.2 EXAMINATION/PRE-CLEANING INSPECTION**

- .1 Verification of Conditions:
  - .1 Make visual inspection of interior of HVAC system using remote controlled robotic camera.
  - .2 Insert camera at pre-established strategic locations to evaluate condition and cleanliness of HVAC systems and components.
- .2 Evaluation and Assessment:
  - .1 Identify location and type of internal components.
  - .2 Identify extent of potential problems.
  - .3 If toxic or hazardous materials or deposits are suspected after initial inspection immediately stop work and inform Departmental Representative and Contract Administrator.
    - .1 Do not proceed further with inspection operations until written approval from Departmental Representative and Contract Administrator.

### **3.3 PARTICULATE COLLECTION**

- .1 Before starting duct cleaning, identify locations for sample collection and collect particulate samples.
- .2 Take samples from interior surfaces of HVAC system using sterile wipes for submission to independent testing laboratory.
- .3 For each HVAC system collect 4 samples from each HVAC unit as follows:
  - .1 Sample 1: collect from inside ventilation unit downstream of air filters but before fan discharge;
  - .2 Sample 2: collect downstream of fan discharge and 1 metre maximum downstream in first horizontal branch;
  - .3 Sample 3: collect at junction of last horizontal branch and start of low-pressure duct;
  - .4 Sample 4: collect at junction each air terminal unit and supply duct.

### **3.4 DUCT CLEANING**

- .1 Do duct cleaning in accordance with NADCA ACR Standard.
- .2 Isolate and clean sections in zones to ensure that dirt deposits and debris from zone being cleaned does not pass through another zones which has already been cleaned.
  - .1 Isolate zone of duct before cleaning.
- .3 Ensure vacuum units and evacuation fans are securely in place before starting cleaning operation of isolated section of HVAC air duct system.
- .4 Clean HVAC supply air duct system and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.
- .5 Clean exhaust, return, transfer ductwork and plenums, equipment and components where particulate sample collected from surfaces is greater than 75 mg of particulate per 0.01 square metres.

- .6 Clean equipment, components and other features in isolated zone before moving to next zone of HVAC air duct system.
- .7 Clean diffusers, registers, louvers, and other terminal units.
- .8 Remove perforated supply diffusers from suspended tee-bar ceiling.
  - .1 Dismantle and clean perforated plates and supply diffuser duct collars.
  - .2 Re-assemble perforated plate diffusers and reconnect to HVAC system using supply diffuser duct collar after cleaning.
- .9 Advise 48 hours minimum before deactivation of fire alarm and smoke detectors duct cleaning operations.

### **3.5 ACOUSTICALLY LINED DUCTWORK CLEANING**

- .1 Clean glass fibre acoustically insulated ducts to NAIMA recommended practices.
  - .1 Use specifically designed robotic apparatus that has been demonstrated not to damage acoustic glass fibre lining.
  - .2 Monitor cleaning process progress by onboard camera.

### **3.6 COMPONENTS AND EQUIPMENT CLEANING**

- .1 Brush and vacuum coils, humidifiers, air handling unit enclosures, heat exchanger surfaces to achieve required cleanliness.
- .2 When cleaning equipment and components by brushing and vacuuming is inappropriate or insufficient, dismantle and remove equipment or component and move to area designated by Maintenance for cleaning.
  - .1 Pressure wash with water and cleaning solution until required cleanliness is achieved.
  - .2 Clean equipment and components in place only if there is no hazard to adjacent materials.
- .3 Proceed to next section in cleaning sequence only after written approval from Departmental Representative.
- .4 Compressed air and manual cleaning is acceptable only for cleaning individual components and small areas as follows and only after written approval from Departmental Representative :
  - .1 Fan blades;
  - .2 Dampers;
  - .3 Turning vanes;
  - .4 Controls;
  - .5 Sensor bulbs;
  - .6 Fire alarms;
  - .7 Smoke detectors;

### **3.7 FIELD QUALITY CONTROL/FINAL INSPECTIONS**

- .1 Post Cleaning Inspection: carry out final inspection using visual inspection methods after final cleaning has been completed.

- .1 Include in final survey areas inspected by contractor prior to cleaning.
- .2 Identify on HVAC system record drawings access points used for inspection and cleaning.
- .3 Re-collect and analyse particulates collected at same locations where original samples were collected before cleaning.
- .4 Reset components including dampers and sensors, which have been disturbed during cleaning operations.

### **3.8 SYSTEM STARTUP**

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

### **3.9 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Dispose of waste materials extracted from ductwork system .
  - .2 Dispose of existing HVAC filter materials.

**END OF SECTION**

## **Part 1 General**

### **1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for review and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba , Canada.
  - .2 Indicate on drawings:
    - .1 Mounting arrangements.
    - .2 Operating and maintenance clearances.
  - .3 Shop drawings and product data accompanied by:
    - .1 Detailed drawings of bases, supports, and anchor bolts.
    - .2 Acoustical sound power data, where applicable.
    - .3 Points of operation on performance curves.
    - .4 Manufacturer to certify current model production.
    - .5 Certification of compliance to applicable codes.
  - .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

### **1.2 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Operation and maintenance manual approved by, and final copies deposited with, Contract Administrator before final inspection.
  - .2 Operation data to include:
    - .1 Control schematics for systems including environmental controls.
    - .2 Description of systems and their controls.
    - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4 Operation instruction for systems and component.
    - .5 Description of actions to be taken in event of equipment failure.
    - .6 Valves schedule and flow diagram.
    - .7 Colour coding chart.
  - .3 Maintenance data to include:

- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
  - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
  - .2 Equipment performance verification test results.
  - .3 Special performance data as specified.
  - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
  - .1 Submit 2 copies of draft Operation and Maintenance Manual to .....  
... for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
  - .1 Contractor will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Contract Administrator for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

- .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One head gasket set for each heat exchanger.
  - .4 One glass for each gauge glass.
  - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials and equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MATERIALS**

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



### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

#### **3.3 SYSTEM CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

#### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

#### **3.5 DEMONSTRATION**

- .1 Contract Administrator and Commissioning Agent will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

- .4 Instruction duration time requirements as specified in appropriate sections.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.7 PROTECTION**

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

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 This Section includes requirements for selective demolition and removal of heating, ventilation and air conditioning systems, controls and automated automation components, and related mechanical components and incidentals required to complete work described in this Section ready for new construction.

### **1.2 RELATED REQUIREMENTS**

- .1 Section 02 41 13– Selective Site Demolition
- .2 Section 02 41 16– Structure Demolition
- .3 Section 02 41 19.13– Selective Building Demolition
- .4 Section 02 41 19.16– Selective Interior Demolition
- .5 Section 02 41 00.18– Demolition - Minor Works
- .6 Section 02 81 00– Transportation and disposal of hazardous materials
- .7 Section 02 82 10– Asbestos abatement -Type 1 ( Low Risk) Precaution
- .8 Section 02 82 12 - Asbestos Abatement - Glove Bag
- .9 Section 22 05 05– Selective Demolition for Plumbing
- .10 Section 26 00 90 Work in Existing Buildings .

### **1.3 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

### **1.4 DEFINITIONS**

- .1 Demolish: Detach items from existing construction and legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .2 Remove: Planned deconstruction and disassembly of electrical items from existing construction including removal of conduit, junction boxes, cabling and wiring from electrical component to panel taking care not to damage adjacent assemblies designated to remain; legally dispose of items off site, unless indicated as removed and salvaged, or removed and reinstalled.
- .3 Remove and Salvage: Detach items from existing construction and deliver them to City ready for reuse.
- .4 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- .5 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed and salvaged, or removed and reinstalled.
- .6 Hazardous Substances: Dangerous substances, dangerous goods, hazardous commodities and hazardous products may include asbestos, mercury and lead, PCB's, poisons, corrosive agents, flammable substances, radioactive substances, or other material that can

endanger human health or wellbeing or environment if handled improperly as defined by the Federal Hazardous Products Act (RSC 1985) including latest amendments.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Action Submittals: Provide the following in accordance with Section 01 33 00 – Submittal Procedures before starting work of this Section:
  - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 – Construction Waste Management and Disposal.

### **1.6 ADMINISTRATIVE REQUIREMENTS**

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Departmental Representative 's continued occupancy requirements during selective demolition with construction and schedule staged occupancy and worksite activities in accordance with Section 01 32 16.19– Construction Progress Schedule.

### **1.7 QUALITY ASSURANCE**

- .1 Regulatory Requirements: Perform work of this Section in accordance with the following

### **1.8 SITE CONDITIONS**

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering on date that tender is accepted.
- .2 Existing Hazardous Substances: has performed a hazardous substances assessment and identified materials requiring abatement as follows:
  - .1 Existing Hazardous Substances: Departmental Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
  - .2 Hazardous substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.
- .3 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Departmental Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
  - .1 Refer to Section 02 81 00 Hazardous Materials - General Provisions for directives associated with specific material types.
  - .2 Hazardous substances will be as defined in the Hazardous Products Act.
  - .3 Stop work in the area of the suspected hazardous substances.
  - .4 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.

- .5 Hazardous substances will be removed by contractor under a separate cash allowance
- .6 Proceed only after written instructions have been received from Departmental Representative.

### **1.9 SALVAGE AND DEBRIS MATERIALS**

- .1 Demolished items become Contractor 's property and will be removed from Project site; except for items indicated as being reused, salvaged, or otherwise indicated to remain City 's property.
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials in accordance with Section 02 42 00.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 General Patching and Repair Materials: Refer to Architectural for listing of patching and repair materials incidental to removal or demolition of components associated with work of this Section.
- .2 HVAC Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.
- .3 Fire stopping Repair Materials: Use fire stopping materials compatible with existing fire stopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; ..... will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

### **3.2 PREPARATION**

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
  - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
  - .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
  - .3 Prevent debris from blocking drainage inlets.
  - .4 Protect mechanical systems that must remain in operation.

- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Departmental Representative and users is minimized and as follows:
  - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
  - .2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

### **3.3 EXECUTION**

- .1 Coordinate requirements of this Section with information contained in 02 41 00.18 Demolition Minor Works and as follows:
  - .1 Disconnect and cap gas supply and electrical services in accordance with requirements of local Authority Having Jurisdiction.
  - .2 Do not disrupt active or energized utilities without approval of the Departmental Representative.
  - .3 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.
  - .4 Demolish parts of existing building to accommodate new construction and remedial work as indicated.
  - .5 At end of each day's work, leave worksite in safe condition.
  - .6 Perform demolition work in a neat and workmanlike manner:
    - .1 Remove any tools or equipment after completion of work, and leave site clean and ready for subsequent renovation work.
    - .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

### **3.4 CLOSEOUT ACTIVITIES**

- .1 Hazardous Substances Disposal: Arrange for disposal of hazardous substances in accordance with requirements of Section 02 81 00 Hazardous Materials General Provisions.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Electrical motors, drives and guards for mechanical equipment and systems.
  - .2 Supplier and installer responsibility indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
  - .3 Control wiring and conduit is specified in Division 26 except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 22 and 23. Refer to Division 26 for quality of materials and workmanship.

### **1.2 REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (SDS).

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Shop Drawings: submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 Contractor will make available 1 copy of systems supplier's installation instructions.
- .4 Closeout Submittals
  - .1 Provide maintenance data for motors, drives and guards for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

## **1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with applicable Manitoba regulations.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

## **1.5 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 and manufacturer's written instructions.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 Products**

### **2.1 GENERAL**

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

### **2.2 MOTORS**

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 1/2 HP: speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 1/2 HP and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, unless otherwise indicated.

### **2.3 TEMPORARY MOTORS**

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

### **2.4 BELT DRIVES**

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 1/2 HP: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 1/2 HP and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.



- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set installed in accordance with Section 01 78 00 - Closeout Submittals.

## **2.5 DRIVE GUARDS**

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
  - .1 Expanded metal screen welded to steel frame.
  - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
  - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
  - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
  - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
  - .2 Securely fasten in place.
  - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
  - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
  - .2 Net free area of guard: not less than 80% of fan openings.
  - .3 Securely fasten in place.
  - .4 Removable for servicing.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

### **3.3 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:

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

### **3.4 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - 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 REFERENCE STANDARDS**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 CSA Group (CSA)
  - .1 CAN/CSA B139-04, Installation Code for Oil Burning Equipment.
- .3 National Research Council Canada (NRC)
  - .1 National Fire Code of Canada 2015 (NFC).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets for piping and equipment and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 Paint: zinc-rich to CAN/CGSB-1.181.
  - .1 Primers, Paints and Coatings: in accordance with manufacturer's recommendations for surface conditions.
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .3 Adhesives: in accordance with Section 07 92 00 Joint Sealants
- .4 Fire Stopping: in accordance with Section 07 84 00 - Fire Stopping.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 CONNECTIONS TO EQUIPMENT**

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

### **3.3 CLEARANCES**

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

### **3.4 DRAINS**

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

### **3.5 AIR VENTS**

- .1 Install manual air vents to CAN/CSA B139 at high points in piping system.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

### **3.6 DIELECTRIC COUPLINGS**

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

### **3.7 PIPEWORK INSTALLATION**

- .1 Install pipework to CAN/CSA B139.
- .2 Screwed fittings jointed with Teflon tape.
- .3 Protect openings against entry of foreign material.
- .4 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .5 Assemble piping using fittings manufactured to ANSI standards.

- .6 Saddle type branch fittings may be used on mains if branch line is no larger than half size of main.
  - .1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to welding saddle.
- .7 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .8 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .9 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .10 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .11 Group piping wherever possible and as indicated.
- .12 Ream pipes, remove scale and other foreign material before assembly.
- .13 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .14 Provide for thermal expansion as indicated.
- .15 Valves:
  - .1 Install in accessible locations.
  - .2 Remove interior parts before soldering.
  - .3 Install with stems above horizontal position unless indicated.
  - .4 Valves accessible for maintenance without removing adjacent piping.
  - .5 Install globe valves in bypass around control valves.
  - .6 Use ball valves at branch take-offs for isolating purposes except where specified.
  - .7 Install butterfly valves on chilled water and related condenser water systems only.
  - .8 Install butterfly valves between weld neck flanges to ensure full compression of liner.
  - .9 Install ball valves for glycol service.
  - .10 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .16 Check Valves:
  - .1 Install silent check valves on discharge of pumps and as indicated.
  - .2 Install swing check valves in horizontal lines on discharge of pumps and as indicated.

### **3.8 SLEEVES**

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

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

### **3.9 ESCUTCHEONS**

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

### **3.10 PREPARATION FOR FIRE STOPPING**

- .1 Coordinate the installation of fire stopping around pipes, insulation and adjacent fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Pipes subject to movement: conform to fire stop system design listing to ensure pipe movement without damaging fire stopping material or installation.
- .3 Insulated pipes: ensure integrity of insulation and vapour barriers.

### **3.11 FLUSHING OUT OF PIPING SYSTEMS**

- .1 Flush system in accordance with Section 23 08 02 - Cleaning and start-up of HVAC piping systems.
- .2 Before start-up, clean interior of piping systems in accordance with requirements of Section 01 74 00 - Cleaning supplemented as specified in relevant mechanical sections.
- .3 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

### **3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK**

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

### **3.13 EXISTING SYSTEMS**

- .1 Connect into existing piping systems at times approved by Departmental Representative.
- .2 Request written approval by 7 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.

### **3.14 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM A53/A53M-07, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A105/A105M-05, Standard Specification for Carbon Steel Forgings, for Piping Applications.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for fixtures, and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Manufacturer, model number, line contents, pressure and temperature rating.
    - .2 Movement handled, axial, lateral, angular and the amounts of each.
    - .3 Nominal size and dimensions including details of construction and assembly.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance and operation data in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 Data to include:
    - .1 Servicing requirements, including special requirements, stuffing box packing, lubrication and recommended procedures.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions..
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 Products**

### **2.1 SLIP TYPE EXPANSION JOINTS**

- .1 Application: for axial pipe movement, as indicated.
- .2 Repacking: under full line pressure.
- .3 Body and packing housings: carbon steel pipe to ASTM A53/A53M, Grade B. Wall thickness to match pipe connecting to it.



- .4 Slip or traverse sleeves: carbon steel pipe to ASTM A53/A53M, Grade B, hard chrome plated.
- .5 Anchor base: construction steel, welded to body.
- .6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.
- .7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.
- .8 Packing rings: 6 minimum, impregnated non-asbestos.
- .9 Thermal plastic packing: impregnated non-asbestos slug supplied loose.
- .10 Lubricating fittings: pet cocks with grease nipple.
- .11 Plunger body and plunger:
  - .1 Plunger body: heavy wall carbon steel welded to body.
  - .2 Plunger: carbon steel with hex head for use with socket wrench.
- .12 Lubricant: to manufacturer's recommendations.
- .13 Lubricant gun: complete with hose assembly.
- .14 Drip connection: 20 MPa forged steel to ASTM A105/A105M. Include half coupling with drain plug.

## **2.2 BELLOWS TYPE EXPANSION JOINTS**

- .1 For axial, lateral or angular movements, as indicated.
- .2 Reinforcing or control rings:
  - .1 2 piece nickel iron.
- .3 Ends:
- .4 Liner:
  - .1 Austenitic stainless steel in direction of flow.
- .5 Shroud:
  - .1 Carbon steel, painted.

## **2.3 GROOVED END EXPANSION JOINTS**

- .1 Packless, Gasketed, Slip, Expansion Joints:
  - .1 2413 kPa maximum working pressure.
  - .2 Steel pipe fitting consisting of telescoping body and slip-pipe sections.
  - .3 PTFE modified polyphenylene sulfide coated slide section.
  - .4 Suitable for axial end movement to 75 mm.
- .2 Expansion joint consisting of series of grooved end pipe nipples joined in tandem with flexible couplings. Total joint movement dependent on number of couplings and nipples used.

## **2.4 FLEXIBLE CONNECTION**

- .1 Application: to suit motion as indicated.

- .2 Minimum length in accordance with manufacturer's recommendations to suit offset as indicated.
- .3 Inner hose: corrugated.
- .4 Braided wire mesh outer jacket.
- .5 Diameter and type of end connection: as indicated.
- .6 Operating conditions:
  - .1 Working pressure: 1034 kPa.
  - .2 Working temperature: 85 degrees C.
  - .3 To match system requirements.
- .7 Three flexible grooved couplings placed in close proximity to vibration source for vibration attenuation and stress relief.

## **2.5 ANCHORS AND GUIDES**

- .1 Anchors:
  - .1 Provide as indicated.
  - .2 Concrete: to Section 03 20 00 Concrete Reinforcing .
  - .3 Reinforcement: to Section 03 20 00 - Concrete Reinforcing.
- .2 Alignment guides:
  - .1 To accommodate specified thickness of insulation.
  - .2 Vapour barriers, jackets to remain uninterrupted.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 INSTALLATION**

- .1 Install expansion joints with cold setting. Make record of cold settings.
- .2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.
- .3 Install pipe anchors and guides as indicated. Anchors to withstand 150 % of axial thrust.
- .4 Do welding in accordance with section 23 05 17 - Pipe Welding.

### **3.3 PIPE CLEANING AND START-UP**

- .1 In accordance with Section 23 08 13 Performance Verification HVAC Systems & Section 23 08 16 Cleaning and Start Up of HVAC Piping Systems.

### **3.4 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 - Performance Verification: Mechanical Piping Systems.

### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  - .1 ANSI/ASME B31.1-2007, Power Piping.
  - .2 ANSI/ASME B31.3-2006, Process Piping.
  - .3 ANSI/ASME Boiler and Pressure Vessel Code-2007 :
    - .1 BPVC 2007 Section I: Power Boilers.
    - .2 BPVC 2007 Section V: Nondestructive Examination.
    - .3 BPVC 2007 Section IX: Welding and Brazing Qualifications.
- .2 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C206-03, Field Welding of Steel Water Pipe.
- .3 American Welding Society (AWS)
  - .1 AWS C1.1M/C1.1-2000 (R2006), Recommended Practices for Resistance Welding.
  - .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
  - .3 AWS W1-2000, Welding Inspection Handbook..
- .4 CSA Group (CSA)
  - .1 CSA W47.2-M1987 (R2008), Certification of Companies for Fusion Welding of Aluminum.
  - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .3 CSA B51-03 (R2007), Boiler, Pressure Vessel and Pressure Piping Code.
  - .4 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.
  - .5 CSA W178.1-2008, Certification of Welding Inspection Organizations.
  - .6 CSA W178.2-2008, Certification of Welding Inspectors.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

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

### **1.3 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Welders:
    - .1 Welding qualifications in accordance with CSA B51.
    - .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.
    - .3 Submit welder's qualifications to Departmental Representative.
    - .4 Each welder to possess identification symbol issued by authority having jurisdiction.

- .5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.
- .2 Inspectors:
  - .1 Inspectors qualified to CSA W178.2.
- .3 Certifications:
  - .1 Registration of welding procedures in accordance with CSA B51.
  - .2 Copy of welding procedures available for inspection.
  - .3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

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

#### **Part 2 Products**

##### **2.1 ELECTRODES**

- .1 Electrodes: in accordance with CSA W48 Series.

#### **Part 3 Execution**

##### **3.1 APPLICATION**

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

##### **3.2 QUALITY OF WORK**

- .1 Welding: in accordance with ANSI/ASME B31.1, B31.3, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and special procedures specified else where in Mechanical Sections, applicable requirements of provincial authority having jurisdiction.

##### **3.3 INSTALLATION REQUIREMENTS**

- .1 Identify each weld with welder's identification symbol.
- .2 Backing rings:
  - .1 Where used, fit to minimize gaps between ring and pipe bore.
  - .2 Do not install at orifice flanges.
- .3 Fittings:
  - .1 NPS 2 and smaller: install welding type sockets.
  - .2 Branch connections: install welding tees or forged branch outlet fittings.

### **3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS**

- .1 Review weld quality requirements and defect limits of applicable codes and standards with Contract Administrator and Departmental Representative before work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Contract Administrator and Departmental Representative.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

### **3.5 DEFECTS CAUSING REJECTION**

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

### **3.6 REPAIR OF WELDS WHICH FAILED TESTS**

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

### **3.7 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.
  - .2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
  - .2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.
- .3 Efficiency Valuation Organization (EVO)

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test and Evaluation Reports:
  - .1 Submit certified test reports for thermometers and pressure gauges from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store thermometers and pressure gauges original factory packaging, and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Design point to be at mid-point of scale or range.
- .2 Ranges: as indicated.

### **2.2 DIRECT READING THERMOMETERS**

- .1 Industrial, variable angle type, mercury-free, liquid filled, 125 mm scale length: to CAN/CGSB-14.4, ASME B40.200.
  - .1 Resistance to shock and vibration.

### **2.3 THERMOMETER WELLS**

- .1 Copper pipe: copper or bronze.

### **2.4 PRESSURE GAUGES**

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel phosphor bourdon tube having 0.5% accuracy full scale unless otherwise specified.
- .2 Provide:
  - .1 Snubber for pulsating operation.
  - .2 Diaphragm assembly for corrosive service.
  - .3 Gasketed pressure relief back with solid front.
  - .4 Bronze stop cock.
  - .5 Oil filled for high vibration applications.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 GENERAL**

- .1 Install thermometers and gauges so they can be easily read from floor or platform.
  - .1 If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.



### **3.3 THERMOMETERS**

- .1 Install in wells on piping. Include heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
  - .1 Heat exchangers.
  - .2 Water heating .
  - .3 Water boilers.
  - .4 DHW tanks.
- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

### **3.4 PRESSURE GAUGES**

- .1 Install in locations as follows:
  - .1 Suction and discharge of pumps.
  - .2 Upstream and downstream of PRV's.
  - .3 Upstream and downstream of control valves.
  - .4 Inlet and outlet of coils.
  - .5 Inlet and outlet of liquid side of heat exchangers.
  - .6 Outlet of boilers.
  - .7 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

### **3.5 NAMEPLATES**

- .1 Install engraved lamicoïd nameplates in accordance with Section 23 05 53 - Identification For HVAC Piping and Equipment, identifying medium. Languages of lamicoïds and nameplates to be in both English and French.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.7 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by thermometer and gauge installation.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1 ANSI/ASME B1.20.1-1983 (R2006), Pipe Threads, General Purpose (Inch).
  - .2 ANSI/ASME B16.18-2001, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 ASTM International (ASTM)
  - .1 ASTM A276-08, Standard Specification for Stainless Steel Bars and Shapes.
  - .2 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .3 ASTM B283-08a, Standard Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
  - .4 ASTM B505/B505M-08a, Standard Specification for Copper-Base Alloy Continuous Castings.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1 MSS-SP-25-1998, Standard Marking System for Valves, Fittings, Flanges and Unions.
  - .2 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
  - .3 MSS-SP-110-1996, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for equipment and systems and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit WHMIS SDS - Material Safety Data Sheets in accordance with Section 02 81 00 - Hazardous Materials General Provisions.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba of Canada.
  - .2 Submit data for valves specified in this Section.

### **1.3 CLOSEOUT SUBMITTALS**

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

### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials/Spare Parts:
  - .1 Furnish following spare parts:

- .1 Valve seats: one for every 10 valves each size, minimum 1.
- .2 Discs: one for every 10 valves, each size. Minimum 1.
- .3 Stem packing: one for every 10 valves, each size. Minimum 1.
- .4 Valve handles: 2 of each size.
- .5 Gaskets for flanges: one for every 10 flanged joints.
- .2 Tools:
  - .1 Furnish special tools for maintenance of systems and equipment.
  - .2 Include following:
    - .1 Lubricant gun for expansion joints.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove in accordance with Section 01 74 19 - Waste Management and Disposal.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Valves:
  - .1 Except for specialty valves, to be single manufacturer.
  - .2 Products to have CRN registration numbers.
- .2 End Connections:
  - .1 Connection into adjacent piping/tubing:
    - .1 Steel pipe systems: screwed ends to ANSI/ASME B1.20.1.
    - .2 Copper tube systems: to ANSI/ASME B16.18.
- .3 Lockshield Keys:
  - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.
- .4 Gate Valves:
  - .1 Requirements common to gate valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Bonnet: union with hexagonal shoulders.
    - .3 Connections: screwed with hexagonal shoulders.
    - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
    - .5 Packing: non-asbestos.
    - .6 Handwheel: non-ferrous.

- .7 Handwheel Nut: bronze to ASTM B62.
- .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
  - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
  - .2 Operator: Handwheel.
- .3 NPS 2 and under, non-rising stem, solid wedge disc, Class 150:
  - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
  - .2 Operator: handwheel.
- .4 NPS 2 and under, rising stem, split wedge disc, Class 125:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Disc: split wedge, bronze to ASTM B283, loosely secured to stem.
  - .3 Operator: handwheel.
- .5 NPS 2 and under, rising stem, solid wedge disc, Class 125:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Operator: handwheel.
- .6 NPS 2 and under, rising stem, solid wedge disc, Class 150:
  - .1 Body: with long disc guides, screwed bonnet.
  - .2 Operator: handwheel.
- .5 Globe Valves:
  - .1 Requirements common to globe valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Bonnet: union with hexagonal shoulders.
    - .3 Connections: screwed with hexagonal shoulders.
    - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
    - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
    - .6 Handwheel: non-ferrous.
    - .7 Handwheel Nut: bronze to ASTM B62.
  - .2 NPS 2 and under, composition disc, Class 125:
    - .1 Body and bonnet: screwed bonnet.
    - .2 Disc and seat: renewable rotating PTFE disc composition to suit service conditions, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
    - .3 Operator: handwheel.
  - .3 NPS 2 and under, composition disc, Class 150:
    - .1 Body and bonnet: union bonnet.
    - .2 Disc and seat: renewable rotating PTFE disc in easily removable disc holder, regrindable bronze seat, loosely secured to bronze stem to ASTM B505.
    - .3 Operator: handwheel.

- .4 NPS 2 and under, plug disc, Class 150, screwed ends:
  - .1 Body and bonnet: union bonnet.
  - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A276, loosely secured to stem.
  - .3 Operator: handwheel.
- .5 Angle valve, NPS 2 and under, composition disc, Class 150:
  - .1 Body and bonnet: union bonnet.
  - .2 Disc and seat: renewable rotating PTFE disc in slip-on easily removable disc holder having integral guides, regrindable bronze seat, loosely secured to stem.
  - .3 Operator: handwheel.
- .6 Check Valves:
  - .1 Requirements common to check valves, unless specified otherwise:
    - .1 Standard specification: MSS SP-80.
    - .2 Connections: screwed with hexagonal shoulders.
  - .2 NPS 2 and under, swing type, bronze disc, Class 125:
    - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
    - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
  - .3 NPS 2 and under, swing type, bronze disc:
    - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
    - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
  - .4 NPS 2 and under, swing type, composition disc, Class 200:
    - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
    - .2 Disc: renewable rotating disc of number 6 composition to suit service conditions, bronze two-piece hinge disc construction.
  - .5 NPS 2 and under, horizontal lift type, composition disc, Class 150:
    - .1 Body: with integral seat, union bonnet ring with hex shoulders, cap.
    - .2 Disc: renewable rotating disc in disc holder having guides top and bottom, of bronze to ASTM B62.
  - .6 NPS 2 and under, vertical lift type, bronze disc, Class 125:
    - .1 Disc: rotating disc having guides top and bottom, disc guides, retaining rings.
- .7 Silent Check Valves:
  - .1 NPS 2 and under:
    - .1 Body: cast high tensile bronze to ASTM B62 with integral seat.

- .2 Pressure rating: Class 125.
- .3 Connections: screwed ends to ANSI B1.20.1 and with hex. shoulders.
- .4 Disc and seat: renewable rotating disc.
- .5 Stainless steel spring, heavy duty.
- .6 Seat: regrindable.
- .8 Ball Valves:
  - .1 NPS 2 and under:
    - .1 Body and cap: cast high tensile bronze to ASTM B62.
    - .2 Stem: tamperproof ball drive.
    - .3 Stem packing nut: external to body.
    - .4 Ball and seat: replaceable solid ball and Teflon seats.
    - .5 Stem seal: TFE with external packing nut.
    - .6 Operator: removable lever handle.
- .9 Butterfly Valves:
  - .1 NPS 2 1/2 through NPS 6, 2068 kPa with grooved ends.
    - .1 Body: cast bronze, with copper-tube dimensioned grooved ends.
    - .2 Disc: elastomer coated ductile iron with integrally cast stem.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

#### **3.2 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.1-05, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ASTM International (ASTM).
  - .1 ASTM A49-01 (2006), Standard Specification for Heat-Treated Carbon Steel Joint Bars.
  - .2 ASTM A126-04, Standard Specification for Grey Iron Castings for Valves, Flanges, and Pipe Fittings.
  - .3 ASTM A536-84 (2004)e1, Standard Specification for Ductile Iron Castings.
  - .4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
  - .5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .6 ASTM B85/B85M-08, Standard Specification for Aluminum-Alloy Die Castings.
  - .7 ASTM B209-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .3 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)
  - .1 MSS SP-61-03, Pressure Testing of Steel Valves.
  - .2 MSS SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS SP-82-1992, Valve Pressure Testing Methods.
  - .5 MSS SP-85-2002, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheets for valves and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba , Canada.

### **1.3 CLOSEOUT SUBMITTALS**

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



#### **1.4 DELIVERY, STORAGE AND HANDLING**

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

#### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials/Spare Parts:
- .2 Furnish following spare parts:
  - .1 Valve seats: one for every 10 valves each size, minimum 1.
  - .2 Discs: one for every 10 valves, each size, minimum 1.
  - .3 Stem packing: one for every 10 valves, each size, minimum 1.
  - .4 Valve handles: 2 of each size.
  - .5 Gaskets for flanges: one for every 10 flanged joints.
- .3 Tools:
  - .1 Furnish special tools for maintenance of systems and equipment.
  - .2 Include following:
    - .1 Lubricant gun for expansion joints.

### **Part 2 Products**

#### **2.1 MATERIAL**

- .1 Valves:
  - .1 Except for specialty valves, to be of single manufacturer.
- .2 Standard specifications:
  - .1 Gate valves: MSS SP-70.
  - .2 Globe valves: MSS SP-85.
  - .3 Check valves: MSS SP-71.
- .3 Requirements common to valves, unless specified otherwise:
  - .1 Body, bonnet: cast iron to ASTM B209 Class B ductile iron to ASTM A536 Grade 65-45-12.
  - .2 Connections: flanged ends plain face to ANSI B16.1 to ANSI B16.1.
  - .3 Inspection and pressure testing: to MSS SP-82.
  - .4 Bonnet gasket: non-asbestos.
  - .5 Stem: to have precision-machined Acme or 60 degrees V threads, top screwed for handwheel nut.
  - .6 Stuffing box: non-galling two-piece ball-jointed packing gland, gland bolts and nuts.
  - .7 Gland packing: non-asbestos.

- .8 Handwheel: die-cast aluminum alloy to ASTM B85/B85M or malleable iron to ASTM A49. Nut of bronze to ASTM B62.
- .9 Identification tag: with catalogue number, size, other pertinent data.
- .4 All products to have CRN registration numbers.

## **2.2 GATE VALVES**

- .1 NPS 2 1/2 - 8, non rising stem, inside screw, bronze trim, solid wedge disc:
  - .1 Body and multiple-bolted bonnet: with bosses in body and bonnet for taps and drains, full length disc guides designed to ensure correct re-assembly, Class 125.
  - .2 Disc: solid offset taper wedge, bronze to ASTM B62.
  - .3 Seat rings: renewable bronze to ASTM B62, screwed into body.
  - .4 Stem: bronze to ASTM B62.
  - .5 Disc: solid offset taper wedge, cast iron to ASTM A126 Class B, secured to wrought steel stem.
  - .6 Seat: integral with body.
  - .7 Stem: wrought steel.
  - .8 Operator: handwheel.
  - .9 Bypass: complete with union as Section 23 05 23.01 - Valves - Bronze.

## **2.3 VALVE OPERATORS**

- .1 Install valve operators as follows:
  - .1 Handwheel: on valves except as specified.
  - .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install rising stem valves in upright position with stem above horizontal.

### **3.2 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Clean installed products in accordance to manufacturer's recommendation.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)
  - .1 ASME B16, Fittings and Valves Package.
  - .2 ASME B16.5-2009, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
  - .3 ANSI/ASME B16.10-2009, Face-to-Face and End-to-End Dimensions Valves.
  - .4 ANSI/ASME B16.25-2007, Buttwelding Ends.
  - .5 ANSI/ASME B16.34-2009, Valves Flanged, Threaded and Welding End. Includes Supplement (2010).
- .2 American Petroleum Institute (API)
  - .1 API STD 598-2009, Valve Inspection and Testing.
- .3 ASTM International (ASTM)
  - .1 ASTM A49-12, Standard Specification for Heat-Treated Carbon Steel Joint Bars, Micro Alloyed Joint Bars, and Forged Carbon Steel Comprise Joint Bars.
  - .2 ASTM A182/A182M-11 a, Standard Specification for Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valve Parts for High Temperature Service.
  - .3 ASTM A193/A193M-12, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.
  - .4 ASTM A194/A194M-2011, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both.
  - .5 ASTM A216/A216M-08, Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding for High-Temperature Service.
  - .6 ASTM B85/B85M-10, Standard Specification for Aluminum-Alloy Die Castings.
- .4 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
  - .1 MSS SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.
  - .2 MSS SP-61-2009, Pressure Testing of Valves.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for each valve and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for valves for incorporation into manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect valves from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Extra Stock Materials:
- .3 Furnish following spare parts:
  - .1 Valve seats: one for every 10 valves each size, minimum 1.
  - .2 Discs: one for every 10 valves, each size, minimum 1.
  - .3 Stem packing: one for every 10 valves, each size. Minimum 1.
  - .4 Valve handles: 2 of each size.
  - .5 Gaskets for flanges: one for every 10 flanged joints.

## **Part 2 Products**

### **2.1 MATERIAL**

- .1 Valves:
  - .1 To be of single manufacturer.
  - .2 Test valves individually.
- .2 Requirements common to valves, unless specified otherwise:
  - .1 Pressure-temperature ratings: to ANSI B16.34.
  - .2 Inspections and tests: to API 598.
  - .3 Pressure testing: to MSS SP-61.
  - .4 Flanged valves:

- .1 Face-to-face dimensions: to ANSI B16.10.
- .2 Flange dimensions: to ANSI B16.5 with 1.6 mm raised face.
- .5 Butt-weld valves:
  - .1 End-to-end dimensions: to ANSI B16.10.
  - .2 End dimensions: to ANSI B16.25 bored for standard pipe schedule.
- .6 Handwheel: non-heating type with raised rim of die-cast aluminum alloy to ASTM B85 or malleable iron to ASTM A49.
- .7 Markings: to MSS SP-25.
- .8 Identification:
  - .1 Plate showing catalogue number, size, material of body disc, stem seat, fluid, pressure-temperature rating.
  - .2 Body markings: manufacturer, size, primary service rating, material symbol.
- .9 CRN registration number required for all products.

## **2.2 VALVE OPERATORS**

- .1 Handwheel: on all valves.
- .2 Handwheel with chain operators: on valves installed more than 2400 mm above floor in mechanical equipment rooms.
- .3 Motors:
  - .1 Application: full open and full close applications.
  - .2 Position and precision control.
- .4 Hydraulic operators:
  - .1 Application: conveyor and feeder drives.
  - .2 Mixer and agitator drives.

## **2.3 SILENT CHECK VALVES**

- .1 Construction:
  - .1 Body: cast steel.
  - .2 Pressure rating: Class 125, 250.
  - .3 Connections: wafer flanged ends.
  - .4 Double bronze disc with SS seat and stem. Renewable disc, seat, stem and spring. Spring rating must match system design for silent operation and installation.
  - .5 Stainless steel spring, heavy duty.
  - .6 Seat: regrindable.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturer's recommendations in upright position with stem above horizontal.

### **3.3 COMMISSIONING**

- .1 As part of commissioning activities, develop schedule of valves and record thereon identifier, location, service, purchase order number and date, manufacturer, identification data specified above.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by cast steel valve installation.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B31.1-07, Power Piping.
- .2 ASTM International (ASTM)
  - .1 ASTM A125-1996 (2007), Standard Specification for Steel Springs, Helical, Heat-Treated.
  - .2 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - .3 ASTM A563-07a, Standard Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
  - .1 MSS SP58-2002, Pipe Hangers and Supports - Materials, Design and Manufacture.
  - .2 MSS SP69-2003, Pipe Hangers and Supports - Selection and Application.
  - .3 MSS SP89-2003, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .5 National Research Council Canada (NRC)
  - .1 National Plumbing Code of Canada 2015 (NPC).
- .6 Underwriter's Laboratories of Canada (ULC)

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba of Canada.
  - .2 Submit shop drawings for:
    - .1 Bases, hangers and supports.
    - .2 Connections to equipment and structure.
    - .3 Structural assemblies.
- .4 Certificates:
  - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Manufacturers' Instructions:

- .1 Provide manufacturer's installation instructions.
  - .1 Contractor will make available 1 copy of systems supplier's installation instructions.

### **1.3 CLOSEOUT SUBMITTALS**

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

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove f in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 Products**

### **2.1 SYSTEM DESCRIPTION**

- .1 Design Requirements:
  - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
  - .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP58.
  - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
  - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
  - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP58.

### **2.2 GENERAL**

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

### **2.3 PIPE HANGERS**

- .1 Finishes:
  - .1 Pipe hangers and supports: galvanized painted with zinc-rich paint after manufacture.
  - .2 Use electro-plating galvanizing process hot dipped galvanizing process.



- .3 Ensure steel hangers in contact with copper piping are copper plated epoxy coated.
- .2 Upper attachment structural: suspension from lower flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut carbon steel retaining clip.
    - .1 Rod: 9 mm UL listed.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed .
- .3 Upper attachment structural: suspension from upper flange of I-Beam:
  - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.
  - .2 Cold piping NPS 2 1/2 or greater, hot piping: malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nut UL listed.
- .4 Upper attachment to concrete:
  - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
  - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed to MSS SP69.
- .5 Hanger rods: threaded rod material to MSS SP58:
  - .1 Ensure that hanger rods are subject to tensile loading only.
  - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
  - .3 Do not use 22 mm or 28 mm rod.
- .6 Pipe attachments: material to MSS SP58:
  - .1 Attachments for steel piping: carbon steel black.
  - .2 Attachments for copper piping: copper plated black steel.
  - .3 Use insulation shields for hot pipework.
  - .4 Oversize pipe hangers and supports.
- .7 Adjustable clevis: material to MSS SP69 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
  - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .8 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP69.
- .9 U-bolts: carbon steel to MSS SP69 with 2 nuts at each end to ASTM A563.
  - .1 Finishes for steel pipework: black.
  - .2 Finishes for copper, glass, brass or aluminum pipework: black with formed portion plastic coated.
- .10 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP69.

## **2.4 RISER CLAMPS**

- .1 Steel or cast iron pipe: UL listed carbon steel to MSS SP58, type 42.
- .2 Copper pipe: carbon steel copper plated to MSS SP58, type 42.
- .3 Bolts: to ASTM A307.
- .4 Nuts: to ASTM A563.

## **2.5 INSULATION PROTECTION SHIELDS**

- .1 Insulated cold piping:
  - .1 64 kg/m<sup>3</sup> density insulation plus insulation protection shield to: MSS SP69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
  - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP69.

## **2.6 CONSTANT SUPPORT SPRING HANGERS**

- .1 Springs: alloy steel to ASTM A125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with Certified Mill Test Report (CMTR).
- .2 Load adjustability: 10 % minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

## **2.7 VARIABLE SUPPORT SPRING HANGERS**

- .1 Vertical movement: 13 mm minimum, 50 mm maximum, use single spring pre-compressed variable spring hangers.
- .2 Vertical movement greater than 50 mm: use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.
- .3 Variable spring hanger complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.
- .4 Steel alloy springs: to ASTM A125, shot peened, magnetic particle inspected, with +/-5 % spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

## **2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES**

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

## **2.9 PLATFORMS AND CATWALKS**

- .1 To Section 05 50 00 - Metal Fabrications.

## **2.10 HOUSE-KEEPING PADS**

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50 mm larger than equipment; chamfer pad edges.
- .2 Concrete: to Section 03 30 00 - Cast-in-Place Concrete.

## **2.11 OTHER EQUIPMENT SUPPORTS**

- .1 Submit structural calculations with shop drawings.

## **Part 3 Execution**

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

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

### **3.2 INSTALLATION**

- .1 Install in accordance with:
  - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
  - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, and as indicated.
- .3 Clamps on riser piping:
  - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
  - .2 Bolt-tightening torques to industry standards.
  - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
  - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
  - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.
- .6 Use approved constant support type hangers where:
  - .1 Vertical movement of pipework is 13 mm or more,
  - .2 Transfer of load to adjacent hangers or connected equipment is not permitted.
- .7 Use variable support spring hangers where:
  - .1 Transfer of load to adjacent piping or to connected equipment is not critical.
  - .2 Variation in supporting effect does not exceed 25 % of total load.

### **3.3 HANGER SPACING**

- .1 Plumbing piping: to Canadian Plumbing Code and Authority Having Jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Copper piping: up to NPS 1/2: every 1.5 m.
- .5 Flexible joint roll groove pipe: in accordance with table below for steel, but not less than one hanger at joints. Table listings for straight runs without concentrated loads and where full linear movement is not required.
- .6 Within 300 mm of each elbow.
- .7 Pipework greater than NPS 12: to MSS SP69.

### **3.4 HANGER INSTALLATION**

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

### **3.5 HORIZONTAL MOVEMENT**

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

### **3.6 FINAL ADJUSTMENT**

- .1 Adjust hangers and supports:
  - .1 Ensure that rod is vertical under operating conditions.
  - .2 Equalize loads.
- .2 Adjustable clevis:
  - .1 Tighten hanger load nut securely to ensure proper hanger performance.
  - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
  - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
  - .1 Hammer jaw firmly against underside of beam.

### **3.7 FIELD QUALITY CONTROL**

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Manufacturer's Field Services:

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

### **3.8 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
- .2 Related Requirements

### **1.2 REFERENCE STANDARDS**

- .1 Canadian Gas Association (CGA)
  - .1 CSA/CGA B149.1-05, Natural Gas and Propane Installation Code.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
  - .2 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 13-2002, Standard for the Installation of Sprinkler Systems.
  - .2 NFPA 14-2003, Standard for the Installation of Standpipe and Hose Systems.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

### **1.4 QUALITY ASSURANCE**

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

### **1.5 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 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Dispose of unused paint coating material at official hazardous material collections site approved by Departmental Representative.
- .3 Do not dispose of unused material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

## **Part 2 Products**

### **2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES**

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
  - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
  - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

### **2.2 SYSTEM NAMEPLATES**

- .1 Colours:
  - .1 Hazardous: red letters, white background.
  - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
  - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
  - .1 Conform to following table:
  - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
  - .1 Terminal cabinets, control panels: use size # 5.
  - .2 Equipment in Mechanical Rooms: use size # 9.
- .5 Identification for PSPC Preventive Maintenance Support System (PMSS):
  - .1 Use arrangement of Main identifier, Source identifier, Destination identifier.
  - .2 Equipment in Mechanical Room:
    - .1 Main identifier: size #9.
    - .2 Source and Destination identifiers: size #6.
    - .3 Terminal cabinets, control panels: size #5.
  - .3 Equipment elsewhere: sizes as appropriate.

### **2.3 EXISTING IDENTIFICATION SYSTEMS**

- .1 Apply existing identification system to new work.

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

## 2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
  - .1 Natural gas: to CSA/CGA B149.1.

## 2.5 IDENTIFICATION OF PIPING SYSTEMS

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

Background Colour	Legend, Arrows
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:



.1

Contents ** Add Design Temperature ++ Add Design Temperature and Pressure	Background Colour Marking	Legend
Domestic Cold Water	Green	DOMESTIC COLD WATER
Hot Water Heating Supply	Yellow	HEATING SUPPLY
Hot Water Heating Return	Yellow	HEATING RETURN
Make-Up Water	Yellow	MAKE UP WTR
Boiler Feed Water	Yellow	BLR FEED WTR
Sanitary	Green	SAN
Plumbing Vent	Green	SAN VENT
Natural Gas	To Codes	
Gas Regulator	To Codes	

## 2.6 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: back, or co-ordinated with base colour to ensure strong contrast.

## 2.7 VALVES, CONTROLLERS

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

## 2.8 CONTROLS COMPONENTS IDENTIFICATION

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

## 2.9 LANGUAGE

- .1 Identification in English and French .

## 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 TIMING**

- .1 Provide identification only after painting specified Section 09 91 23 - Interior Painting has been completed.

### **3.3 INSTALLATION**

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and /or CSA registration plates as required by respective agency.

### **3.4 NAMEPLATES**

- .1 Locations:
  - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
  - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection:
  - .1 Do not paint, insulate or cover.

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

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .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, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
  - .1 Position of identification 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.

### **3.6 VALVES, CONTROLLERS**

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

- .3 Number valves in each system consecutively.

### **3.7 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - 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 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

### **1.2 QUALIFICATIONS OF TAB PERSONNEL**

- .1 Submit names of personnel to perform TAB to Departmental Representative and Contract Administrator within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
  - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
  - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
  - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
  - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
  - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

### **1.3 PURPOSE OF TAB**

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

#### **1.4 EXCEPTIONS**

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

#### **1.5 CO-ORDINATION**

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

#### **1.6 PRE-TAB REVIEW**

- .1 Review Contract Documents before project construction is started confirm in writing to Departmental Representative and Contract Administrator adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative and Contract Administrator in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

#### **1.7 START-UP**

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

#### **1.8 OPERATION OF SYSTEMS DURING TAB**

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative and Contract Administrator for verification of TAB reports.

#### **1.9 START OF TAB**

- .1 Notify Departmental Representative and Contract Administrator 14 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:
- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, and caulking.
- .5 Pressure, leakage, other tests specified elsewhere Division 23.
- .6 Provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:

- .1 Proper thermal overload protection in place for electrical equipment.
- .2 Air systems:
  - .1 Filters in place, clean.
  - .2 Duct systems clean.
  - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
  - .4 Correct fan rotation.
  - .5 Fire, smoke, volume control dampers installed and open.
  - .6 Coil fins combed, clean.
  - .7 Access doors, installed, closed.
  - .8 Outlets installed, volume control dampers open.
- .3 Liquid systems:
  - .1 Flushed, filled, vented.
  - .2 Correct pump rotation.
  - .3 Strainers in place, baskets clean.
  - .4 Isolating and balancing valves installed, open.
  - .5 Calibrated balancing valves installed, at factory settings.
  - .6 Chemical treatment systems complete, operational.

#### **1.10 APPLICATION TOLERANCES**

- .1 Do TAB to following tolerances of design values:
  - .1 Laboratory HVAC systems: plus 10 %, minus 0 %.
  - .2 Other HVAC systems: plus 5 %, minus 5 %.
  - .3 Hydronic systems: plus or minus 10 %.

#### **1.11 ACCURACY TOLERANCES**

- .1 Measured values accurate to within plus or minus 2 % of actual values.

#### **1.12 INSTRUMENTS**

- .1 Prior to TAB, submit to Departmental Representative and Contract Administrator and Commissioning Agent list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative and Contract Administrator and Commissioning Agent.

#### **1.13 ACTION AND INFORMATIONAL SUBMITTALS**

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

#### **1.14 PRELIMINARY TAB REPORT**

- .1 Submit for checking and approval of Departmental Representative and Contract Administrator and Commissioning Agent, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
  - .1 Details of instruments used.
  - .2 Details of TAB procedures employed.
  - .3 Calculations procedures.
  - .4 Summaries.

#### **1.15 TAB REPORT**

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit electronic copie of TAB Report to Contract Administrator and Commissioning Agent for verification and approval.

#### **1.16 VERIFICATION**

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

#### **1.17 SETTINGS**

- .1 After TAB is completed to satisfaction of Departmental Representative and Contract Administrator and Commissioning Agent , replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

#### **1.18 COMPLETION OF TAB**

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative and Contract Administrator and Commissioning Agent .

#### **1.19 AIR SYSTEMS**

- .1 Standard: TAB to most stringent of this section TAB standards of ASHRAE, SMACNA, NEBB.
- .2 Do TAB of all HVAC equipment
- .3 Qualifications: personnel performing TAB qualified to standards of NEBB and AABC.

- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of NEBB, ABCC.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
  - .1 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
  - .2 At controllers, controlled device.
- .7 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not used.

**END OF SECTION**



## Part 1 General

### 1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM)
  - .1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
  - .2 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
  - .3 ASTM C411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
  - .6 ASTM C553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .7 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .8 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .9 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
- .4 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
- .5 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .6 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

### 1.2 DEFINITIONS

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - means "not concealed" as previously defined.
  - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:

- .1 CRD: Code Round Ductwork,
- .2 CRF: Code Rectangular Finish.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
    - .2 Details of operation, servicing and maintenance.
    - .3 Recommended spare parts list.
  - .3 Shop Drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .4 Samples:
    - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
    - .2 Mount sample on 12 mm plywood board.
    - .3 Affix typewritten label beneath sample indicating service.

### **1.4 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, member of TIAC.

### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.
- .3 Packaging Waste Management: remove for disposal in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 Products**

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

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

## 2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C553.

## 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.
- .2 Lagging adhesive: compatible with insulation.
- .3 Aluminum:
  - .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: smooth.
  - .4 Jacket banding and mechanical seals: 12 mm wide, 0.5 mm thick .

## 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449.
- .4 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup>cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .5 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .7 Contact adhesive: quick-setting
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.

- .11 Facing: 25 mm steel hexagonal wire mesh stitched on both faces of insulation
- .12 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.

### **Part 3 Execution**

#### **3.1 APPLICATION**

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

#### **3.2 PRE-INSTALLATION REQUIREMENTS**

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

#### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

#### **3.4 DUCTWORK INSULATION SCHEDULE**

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

#### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## Part 1 General

### 1.1 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE 90.1-04 -SI Edition, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 ASTM International (ASTM)
  - .1 ASTM C335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .2 ASTM C449/C449M-07, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .3 ASTM C533-07, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - .4 ASTM C547-07, Standard Specification for Mineral Fiber Pipe Insulation.
  - .5 ASTM C553-02, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
  - .6 ASTM C612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52MA-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB 51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (SDS).
- .5 Thermal Insulation Association of Canada (TIAC)
  - .1 National Insulation Standards 2005.
- .6 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Provide two copies WHMIS SDS - Material Safety Data Sheets in accordance with Section 02 81 00 Hazardous Materials - General Provisions.
- .3 Samples:
  - .1 Provide for review: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
    - .1 Mount sample on 12 mm plywood board.
    - .2 Affix typewritten label beneath sample indicating service.
- .4 Manufacturer's Instructions:
  - .1 Include procedures to be used and installation standards to be achieved.
- .5 Qualifications:
  - .1 Installer to be specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 Products**

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

- .1 Fire and smoke ratings to CAN/ULC-S102:
  - .1 Maximum flame spread rating: 25.
  - .2 Maximum smoke developed rating: 50.

### **2.2 INSULATION**

- .1 Mineral fibre: includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: ASTM C547.
  - .2 Maximum "k" factor: ASTM C547.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: ASTM C547.
  - .2 Jacket: to CGSB 51-GP-52MA.
  - .3 Maximum "k" factor: ASTM C547.
- .5 TIAC Code C-1: rigid mineral fibre board, unfaced.

- .1 Mineral fibre: ASTM C612.
- .2 Maximum "k" factor: ASTM C612.
- .6 TIAC Code C-4: rigid mineral fibre board faced with factory applied vapour retarder jacket.
  - .1 Mineral fibre: ASTM C612.
  - .2 Jacket: to CGSB 51-GP-52MA.
  - .3 Maximum "k" factor: ASTM C612.
- .7 TIAC Code C-2: mineral fibre blanket unfaced or faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: ASTM C553.
  - .2 Jacket: to CGSB 51-GP-52MA.
  - .3 Maximum "k" factor: ASTM C553.
- .8 TIAC Code A.6: flexible unicellular tubular elastomer.
  - .1 Insulation: with vapour retarder jacket.
  - .2 Jacket: to CGSB 51-GP-52MA.
  - .3 Maximum "k" factor.
  - .4 Certified by manufacturer free of potential stress corrosion cracking corrodents.
- .9 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
  - .1 Insulation: ASTM C533.
  - .2 Maximum "k" factor: ASTM C533.
  - .3 Design to permit periodic removal and re-installation.

### 2.3 CEMENT

- .1 Thermal insulating and finish
  - .1 To: ASTM C449/C449M.
  - .2 Hydraulic settings on mineral wool, to ASTM C449.

### 2.4 JACKETS

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CAN/CGSB 51.53 with pre-formed shapes as required.
  - .2 Colours: to match adjacent finish paint.
  - .3 Minimum service temperatures: -20 degrees C.
  - .4 Maximum service temperature: 65 degrees C.
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Thickness: 0.75 mm.
  - .7 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.

- .3 Pressure sensitive vinyl tape of matching colour.
- .8 Special requirements:
  - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .2 ABS Plastic:
  - .1 One-piece moulded type and sheet with pre-formed shapes as required.
  - .2 Colours: to match adjacent finish paint.
  - .3 Minimum service temperatures: -40 degrees C.
  - .4 Maximum service temperature: 82 degrees C.
  - .5 Moisture vapour transmission: 0.012 perm.
  - .6 Thickness: 0.75 mm.
  - .7 Fastenings:
    - .1 Solvent weld adhesive compatible with insulation to seal laps and joints
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
  - .8 Locations:
    - .1 For outdoor use ONLY.
- .3 Canvas:
  - .1 170 gm/m<sup>2</sup>cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
  - .2 Lagging adhesive: compatible with insulation.
- .4 Aluminum:
  - .1 To ASTM B209.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: smooth.
  - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

## **2.5 INSULATION SECUREMENTS**

- .1 Tape: self-adhesive, aluminum, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: Stainless steel, 19 mm wide, 0.5 mm thick.
- .6 Facing: 25 mm galvanized steel hexagonal wire mesh on one face of insulation with expanded metal lath on other face of insulation.
- .7 Fasteners: 4 mm diameter pins with 35 mm diameter clips. Length of pin to suit thickness of insulation.



## **2.6 VAPOUR RETARDER LAP ADHESIVE**

- .1 Water based, fire retardant type, compatible with insulation.

## **2.7 INDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.

## **2.8 OUTDOOR VAPOUR RETARDER MASTIC**

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.

## **Part 3 Execution**

### **3.1 APPLICATION**

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

### **3.2 PRE- INSTALLATION REQUIREMENTS**

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

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards
  - .1 Hot equipment: To TIAC code 1503-H.
  - .2 Cold equipment: to TIAC code 1503-C.
- .2 Elastomeric Insulation: to remain dry. Overlaps to manufacturer's instructions. Joints tight and sealed properly.
- .3 Provide vapour retarder as recommended by manufacturer.
- .4 Apply materials in accordance with insulation and equipment manufacturer's instructions and this specification.
- .5 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .6 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Hangers, supports outside vapour retarder jacket.
- .7 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

### **3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: At expansion joints, valves, flanges and unions at equipment and primary flow measuring elements..
- .2 Installation permit movement of expansion joint, to permit periodic removal and replacement without damage to adjacent insulation.

**3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

**END OF SECTION**

## Part 1 General

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Thermal insulation for piping and piping accessories in commercial type applications.

### 1.2 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 ASTM International (ASTM)
  - .1 ASTM B209M-04, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
  - .2 ASTM C335-04, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
  - .3 ASTM C411-04, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .4 ASTM C449/C449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
  - .5 ASTM C533-2004, Calcium Silicate Block and Pipe Thermal Insulation.
  - .6 ASTM C547-2003, Mineral Fiber Pipe Insulation.
  - .7 ASTM C795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
  - .8 ASTM C921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
  - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
  - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (SDS).
- .6 Manufacturer's Trade Associations
  - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC)

- .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
- .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

### **1.3 DEFINITIONS**

- .1 For purposes of this section:
  - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
  - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
  - .1 CRF: Code Rectangular Finish.
  - .2 CPF: Code Piping Finish.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
    - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (SDS) in accordance with Section 02 81 00 Hazardous Material General Provisions.
- .3 Shop Drawings:
  - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .4 Samples:
  - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed. Mount sample on 12 mm plywood board. Affix label beneath sample indicating service.
- .5 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
    - .1 Contractor will make available 1 copy of systems supplier's installation instructions.

## **1.5 QUALITY ASSURANCE**

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.
- .3 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 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
  - .1 Protect from weather, construction traffic.
  - .2 Protect against damage.
  - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:
  - .1 Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .2 Place excess or unused insulation and insulation accessory materials in designated containers.
  - .3 Divert unused metal materials from landfill to metal recycling facility approved by Departmental Representative.
  - .4 Dispose of unused adhesive material at official hazardous material collections site approved by Departmental Representative.

## **Part 2 Products**

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

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

### **2.2 INSULATION**

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702 ASTM C547.

- .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
  - .1 Mineral fibre: to CAN/ULC-S702.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to CAN/ULC-S702.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to CAN/ULC-S702.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
  - .1 Insulation: with vapour retarder jacket.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: CAN/ULC-702.
  - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
- .7 TIAC Code A-2: rigid moulded calcium silicate in sections and blocks, and with special shapes to suit project requirements.
  - .1 Insulation: to ASTM C533.
  - .2 Maximum "k" factor: to CAN/ULC-S702.
  - .3 Design to permit periodic removal and re-installation.

### **2.3 INSULATION SECUREMENT**

- .1 Tape: self-adhesive, aluminum, plain, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

### **2.4 CEMENT**

- .1 Thermal insulating and finishing cement:
  - .1 Hydraulic setting on mineral wool, to ASTM C449/C449M.

### **2.5 VAPOUR RETARDER LAP ADHESIVE**

- .1 Water based, fire retardant type, compatible with insulation.

### **2.6 INDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.

### **2.7 OUTDOOR VAPOUR RETARDER FINISH**

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m<sup>2</sup>.

## **2.8 JACKETS**

- .1 Polyvinyl Chloride (PVC):
  - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
  - .2 Colours: White.
  - .3 Minimum service temperatures: -20 degrees C.
  - .4 Maximum service temperature: 65 degrees C.
  - .5 Moisture vapour transmission: 0.02 perm.
  - .6 Thickness: 0.75 mm.
  - .7 Fastenings:
    - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
    - .2 Tacks.
    - .3 Pressure sensitive vinyl tape of matching colour.
- .2 Aluminum:
  - .1 To ASTM B209.
  - .2 Thickness: 0.50 mm sheet.
  - .3 Finish: smooth.
  - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
  - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
  - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

## **2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS**

- .1 Caulking to: Section 07 92 00 - Joint Sealants.

## **Part 3 Execution**

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

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

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

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

### **3.3 INSTALLATION**

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.

- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
  - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

### **3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES**

- .1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
  - .1 Insulation, fastenings and finishes: same as system.
  - .2 Jacket: aluminum.

### **3.5 INSTALLATION OF ELASTOMERIC INSULATION**

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

### **3.6 PIPING INSULATION SCHEDULES**

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
  - .1 Securements: Tape at 300 mm on centre.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
  - .1 Securements: Tape at 300 mm on centre.
  - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
  - .1 Insulation securements: Tape.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .5 TIAC Code: C-2 with vapour retarder jacket.
  - .1 Insulation securements: Tape.
  - .2 Seals: lap seal adhesive, lagging adhesive.
  - .3 Installation: TIAC Code: 1501-C.
- .6 TIAC Code: A-2.
  - .1 Insulation securements: Tape.



- .2 Seals: lap seal adhesive, lagging adhesive.
- .3 Installation: TIAC Code: 1501-H.
- .7 Thickness of insulation as listed in following table.
- .1

Application	Temp Degrees C	TIAC Code	Pipe Sizes (NPS) and Insulation Thickness (mm)								
Run Out	To 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8	up to 175	A-1	38	50	68	75
Hot Water Heating	60-94	A-1	25	38	38	38	38	38	25	25	38
Hot Water Heating	up to 59	A-1	25	25	25	25	38	38	25	25	38
Domestic HWS	A-1	25	25	25	38	38		25	25	28	38
Refrigerated Drinking Water	A-3	25	25	25	25	25	25				
Domestic CWS	A-3	25	25	25	25	25	25	25	25	25	25
Domestic CWS with Vapour Retarder	C-2	25	25	25	25	25	25	25	25	25	25
Refrigerant Hot Gas Liquid Suction	4-13	A-6	25	25	25	25	25	25			
Refrigerant Hot Gas Liquid Suction	Below 4	A-6	25	25	38	8	38	38			
RWL and RWP	C-2	25	25	25	25	25	25	25	25	25	25
Cooling Coil Cond. Drain	C-2	25	25	25	25	25	25				

- .2 Run-outs to individual units and equipment not exceeding 4000 mm long.
- .3 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.
- .8 Finishes:
  - .1 Exposed indoors: smooth.
  - .2 Exposed in mechanical rooms: smooth.
  - .3 Concealed, indoors: canvas on valves, fittings. No further finish.
  - .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
  - .5 Outdoors: water-proof smooth jacket.
  - .6 Finish attachments: , at 150 mm on centre. S
  - .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

### 3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - 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 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

### **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 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)**

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
  - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  - .2 Verify performance of hydronic system circulating pumps as specified, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    - .1 Pump operation.
    - .2 Boiler and/or chiller operation.
    - .3 Pressure bypass open/closed.
    - .4 Control pressure failure.
    - .5 Maximum heating demand.
    - .6 Maximum cooling demand.
    - .7 Boiler failure.
    - .8 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

### **1.4 HYDRONIC SYSTEM CAPACITY TEST**

- .1 Perform hydronic system capacity tests after:
  - .1 TAB has been completed
  - .2 Verification of operating, limit, safety controls.
  - .3 Verification of primary and secondary pump flow rates.
  - .4 Verification of accuracy of temperature and pressure sensors and gauges.
- .2 Calculate system capacity at test conditions.
- .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.

- .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
- .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
- .6 Heating system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
    - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger, heating coil and radiation control valves.
    - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
    - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

#### **1.5 CONDENSER WATER AND HUMIDIFICATION SYSTEMS**

- .1 In addition to procedures specified above, perform following:
  - .1 Add chemicals as required.
  - .2 Perform TAB as specified Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .3 Set up and adjust drip feeders, timer controls, pump strokes as required to maintain required chemical feed rates.

#### **1.6 GLYCOL SYSTEMS**

- .1 Test to prove concentration will prevent freezing to minus 40 degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

#### **1.7 GASEOUS FUEL SYSTEMS**

- .1 Operation tests:
  - .1 Measure gas pressure at gas metre outlet and at burner manifold.
  - .2 Verify details of temperature and pressure compensation at meter.
  - .3 Verify settings, operation, venting of high and low pressure cut-outs, alarms.
  - .4 Check terminals of vents for gas pressure regulators.

#### **1.8 SANITARY AND STORM DRAINAGE SYSTEMS**

- .1 Buried systems: perform tests prior to back-filling. Perform hydraulic tests to verify grades and freedom from obstructions.
- .2 Ensure that traps are fully and permanently primed.

- .3 Ensure that fixtures are properly anchored, connected to system.
- .4 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .5 Cleanouts: refer to Section 22 05 15 - Plumbing Specialties and Accessories.
- .6 Roof drains:
  - .1 Refer to Section 22 05 15 - Plumbing Specialties and Accessories.
  - .2 Remove caps as required.

### **1.9 REPORTS**

- .1 In accordance with Section 01 91 13 - General Commissioning Requirements: Reports, supplemented as specified herein.

### **1.10 TRAINING**

- .1 In accordance with Section 01 91 13 - Commissioning: Training of O&M Personnel, supplemented as specified herein.

### **Part 2 Products**

#### **2.1 NOT USED**

- .1 Not Used.

### **Part 3 Execution**

#### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

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

### **1.2 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (SDS).

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

### **1.4 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.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

## **Part 2 Products**

### **2.1 CLEANING SOLUTIONS**

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

## **Part 3 Execution**

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

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

### **3.2 CLEANING HYDRONIC AND STEAM SYSTEMS**

- .1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.
- .2 Cleaning Agency:
  - .1 Retain qualified water treatment specialist to perform system cleaning.
- .3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified as complete by water treatment specialist.
- .4 Cleaning procedures:
  - .1 Provide detailed report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:
    - .1 Cleaning procedures, flow rates, elapsed time.
    - .2 Chemicals and concentrations used.
    - .3 Inhibitors and concentrations.
    - .4 Specific requirements for completion of work.
    - .5 Special precautions for protecting piping system materials and components.
    - .6 Complete analysis of water used to ensure water will not damage systems or equipment.
- .5 Conditions at time of cleaning of systems:
  - .1 Systems: free from construction debris, dirt and other foreign material.
  - .2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.
  - .3 Strainers: clean prior to initial fill.
  - .4 Install temporary filters on pumps not equipped with permanent filters.
  - .5 Install pressure gauges on strainers to detect plugging.
- .6 Report on Completion of Cleaning:
  - .1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.
- .7 Hydronic Systems:
  - .1 Fill system with water, ensure air is vented from system.
  - .2 Fill expansion tanks 1/3 to 1/2 full, charge system with compressed air to at least 35 kPa (does not apply to diaphragm type expansion tanks).
  - .3 Use water metre to record volume of water in system to +/- 0.5%.
  - .4 Add chemicals under direct supervision of chemical treatment supplier.

- .5 Closed loop systems: circulate system cleaner at 60 degrees C for at least 36 h. Drain as quickly as possible. Refill with water and inhibitors. Test concentrations and adjust to recommended levels.
  - .6 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.
  - .7 Add chemical solution to system.
  - .8 Establish circulation, raise temperature slowly to design value. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C. Drain as quickly as possible. Refill with clean water. Circulate for 6 hours at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water adding to sodium sulphite (test for residual sulphite).
- .8 Glycol Systems:
- .1 In addition to procedures specified above perform specified procedures.
  - .2 Test to prove concentration will prevent freezing to minus 40 degrees C. Test inhibitor strength and include in procedural report. Refer to ASTM E202.

### **3.3 START-UP OF HYDRONIC SYSTEMS**

- .1 After cleaning is completed and system is filled:
  - .1 Establish circulation and expansion tank level, set pressure controls.
  - .2 Ensure air is removed.
  - .3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.
  - .4 Dismantle system pumps used for cleaning, inspect, replace worn parts, install new gaskets and new set of seals.
  - .5 Clean out strainers repeatedly until system is clean.
  - .6 Commission water treatment systems as specified in Section 23 25 00 - HVAC Water Treatment.
  - .7 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.
  - .8 Repeat with water at design temperature.
  - .9 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.
  - .10 Bring system up to design temperature and pressure.
  - .11 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
  - .12 Adjust pipe supports, hangers, springs as necessary.
  - .13 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.
  - .14 If issues arise, shut down system, re-align, repeat start-up procedures.
  - .15 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.



- .16 Check operation of drain valves.
- .17 Adjust valve stem packings as systems settle down.
- .18 Fully open balancing valves (except those that are factory-set).
- .19 Check operation of over-temperature protection devices on circulating pumps.
- .20 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

### **3.4 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 - 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 piping, valves and fittings for gas fired equipment.

### **1.2 REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.
  - .2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
  - .3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
  - .4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.
- .2 ASTM International (ASTM)
  - .1 ASTM A47/A47M-99 (2004), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
  - .3 ASTM B75M-99, Standard Specification for Seamless Copper Tube Metric.
  - .4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.
- .3 CSA Group (CSA)
  - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.
- .4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)
  - .1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (SDS).

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
  - .2 Indicate on manufacturers catalogue literature following: valves.
  - .3 Submit WHMIS SDS in accordance with Section 02 81 - Hazardous Materials.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .5 Instructions: submit manufacturer's installation instructions.
- .6 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

#### **1.4 QUALITY ASSURANCE**

- .1 Pre-Installation Meeting:
  - .1 Convene pre-installation meeting one week prior to beginning work of this Section in accordance with Section 01 31 19 Project Meetings.
    - .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.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Collect and separate for disposal and reuse packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).

### **Part 2 Products**

#### **2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
  - .1 NPS 1/2 to 2, screwed.
  - .2 NPS2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B837.

#### **2.2 JOINTING MATERIAL**

- .1 Screwed fittings: pulverized lead paste.
- .2 Welded fittings: to CSA W47.1.
- .3 Flange gaskets: nonmetallic flat.
- .4 Brazing: to ASTM B837.

#### **2.3 FITTINGS**

- .1 Steel pipe fittings, screwed, flanged or welded:
  - .1 Malleable iron: screwed, banded, Class 150.

- .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
- .3 Welding: butt-welding fittings.
- .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
- .5 Bolts and nuts: to ASME B18.2.1.
- .6 Nipples: schedule 40, to ASTM A53/A53M.
- .2 Copper pipe fittings, screwed, flanged or soldered:
  - .1 Cast copper fittings: to ASME B16.18.
  - .2 Wrought copper fittings: to ASME B16.22.

## **2.4 VALVES**

- .1 Provincial Code approved, lubricated plug ball type.

## **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 PIPING**

- .1 Install in accordance with Section 23 05 15 Common Installation Requirements for HVAC Pipework, applicable Provincial Standards, CAN/CSA B149.1, supplemented as specified.
- .2 Install drip points:
  - .1 At low points in piping system.
  - .2 At connections to equipment.

### **3.3 VALVES**

- .1 Install valves with stems upright or horizontal unless otherwise approved by Contract Administrator and Departmental Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.
- .2 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.
  - .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.

- .3 Schedule site visits to review work at stages listed:
  - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
  - .2 Twice during progress of work at 25% and 60% complete.
  - .3 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within 3 days of review and submit immediately to Contract Administrator and Departmental Representative.
- .4 Performance Verification:
  - .1 Refer to Section 23 08 01 - Performance Verification of Mechanical Piping Systems.
- .5 PV procedures:
  - .1 Test performance of components.

### **3.5 ADJUSTING**

- .1 Purging: purge after pressure test in accordance with CAN/CSA B149.1.
- .2 Pre-Start-Up Inspections:
  - .1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.
  - .2 Check gas trains, entire installation is approved by authority having jurisdiction.

### **3.6 CLEANING**

- .1 Cleaning: in accordance with Section 01 74 00 Cleaning , supplemented as specified.
- .2 Perform cleaning operations as specified in Section 01 74 00 Cleaning and in accordance with manufacturer's recommendations.
- .3 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 REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI)/American Welding Society (AWS)
  - .1 ANSI/AWS A5.8/A5.8M-11, AMD1 Specification Filler Metals for Brazing and Braze Welding.
- .2 ASME
  - .1 ANSI/ASME B16.4-06, Gray-Iron Threaded Fittings Classes 125 and 250.
  - .2 ANSI/ASME B16.15-11, Cast Copper Alloy Threaded Fittings Classes 125 and 250.
  - .3 ANSI B16.18-12, Cast Copper Alloy, Solder Joint Pressure Fittings.
  - .4 ANSI/ASME B16.22-12, Wrought Copper and Copper-Alloy Solder Joint Pressure Fittings.
- .3 ASTM International (ASTM)
  - .1 ASTM B32-08, Standard Specification for Solder Metal.
  - .2 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
  - .3 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .4 ASTM B88M-05 (2011), Standard Specification for Seamless Copper Water Tube Metric.
  - .5 ASTM E202-12, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (SDS).
- .5 Manufacturers Standardization Society (MSS)
  - .1 MSS SP67-2011, Butterfly Valves.
  - .2 MSS SP70-2011, Cast Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS SP71-2011, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
  - .4 MSS SP80-2008, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS SP85-2011, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS SDS in accordance with Section 02 81 00 Hazardous Materials - General Provisions.

- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate on manufacturers catalogue literature the following: valves.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
- .3 Submit three (3) copies of operation and maintenance manual.

### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Furnish following spare parts:
    - .1 Valve seats: one for every ten valves, each size. Minimum one.
    - .2 Discs: one for every ten valves, each size. Minimum one.
    - .3 Stem packing: one for every ten valves, each size. Minimum one.
    - .4 Valve handles: two of each size.
    - .5 Gaskets for flanges: one for every ten flanges.

### **1.5 QUALITY ASSURANCE**

- .1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial/Territorial regulations.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect hydronic systems from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 TUBING**

- .1 Type L hard drawn copper tubing: to ASTM B88M.

## 2.2 FITTINGS

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

## 2.3 FLANGES

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

## 2.4 JOINTS

- .1 Solder, tin-antimony, 95:5: to ASTM B32.
- .2 Silver solder BCUP: to ANSI/AWS A5.8.
- .3 Brazing: as indicated.

## 2.5 VALVES

- .1 Connections:
  - .1 NPS 2 and smaller: ends for soldering.
  - .2 NPS 2 1/2 and larger: grooved ends.
- .2 Gate Valves: application: isolating equipment, control valves, pipelines :
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: Class 125, rising stem split wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
    - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .3 Globe valves: application: throttling, flow control, emergency bypass :
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: withPTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
    - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .4 Balancing, for TAB:
  - .1 Sizes: calibrated balancing valves, as specified.
  - .2 NPS 2 and under:
    - .1 Mechanical rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
    - .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
- .5 Drain valves: gate, Class 125 . Section 23 05 23.01 Valves - Bronze
- .6 Swing check valves:



- .1 NPS 2 and under:
  - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .7 Silent check valves:
  - .1 NPS 2 and under:
    - .1 As specified Section 23 05 23.01 - Valves - Bronze.
- .8 Ball valves:
  - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.3 PIPING INSTALLATION**

- .1 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .2 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping where ever practical.
- .3 Slope piping in direction of drainage and for positive venting.
- .4 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .5 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .6 Assemble piping using fittings manufactured to ANSI standards.

#### **3.4 VALVE INSTALLATION**

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install butterfly valves on chilled water and condenser water lines only.

- .3 Install ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .4 Install globe valves for balancing and in by-pass around control valves as indicated.
- .5 Install silent check valves and as indicated.
- .6 Install swing check valves in horizontal lines on discharge of pumps and as indicated.
- .7 Install ball valves for glycol service.

### **3.5 CIRCUIT BALANCING VALVES**

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

### **3.6 FLUSHING AND CLEANING**

- .1 Flush and clean in presence of Contract Administrator and Departmental Representative and Commissioning Agent .
- .2 Flush after pressure test for a minimum of 4 hours.
- .3 Fill with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hours.
- .4 Refill system with clean water. Circulate for at least 4 hours. Clean out strainer screens/baskets regularly. Then drain.
- .5 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.
- .6 Drainage to include drain valves, dirt pockets, strainers, low points in system.
- .7 Re-install strainer screens/baskets only after obtaining Contract Administrator and Departmental Representative and Commissioning Agent approval.

### **3.7 FILLING OF SYSTEM**

- .1 Refill system with clean water adding water treatment as specified, glycol.

### **3.8 FIELD QUALITY CONTROL**

- .1 Testing:
  - .1 Test system in accordance with Section 23 05 00 - Common Work Results for HVAC.
  - .2 For glycol systems, retest with ethylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.
- .2 Balancing:
  - .1 Balance water systems to within plus or minus 5 % of design output.
  - .2 Refer to Section 23 05 93 Testing, Adjusting, and Balancing for HVAC for applicable procedures.
- .3 Glycol Charging:
  - .1 Provide mixing tank and positive displacement pump for glycol charging.
  - .2 Retest for concentration to ASTM E202 after cleaning.

- .3 Provide report to Contract Administrator for review.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## Part 1 General

### 1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C111/A21.11-06, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society of Mechanical Engineers (ASME)
  - .1 ASME B16.1-10, Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
  - .2 ASME B16.3-06, Malleable Iron Threaded Fittings: Classes 150 and 300.
  - .3 ASME B16.5-09, Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard.
  - .4 ASME B16.9-07, Factory-Made Wrought Butt welding Fittings.
  - .5 ASME B18.2.1-10, Square Hex, Heavy Hex and Askew Head Bolts and Hex, Heavy Hex, Hex Flange. Loded Head and Lag Screws (Inch Series).
  - .6 ASME B18.2.2-10, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
- .3 ASTM International (ASTM)
  - .1 ASTM A47/A47M-99 (2009), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - .3 ASTM A536-84 (2009), Standard Specification for Ductile Iron Castings.
  - .4 ASTM B61-08, Standard Specification for Steam or Valve Bronze Castings.
  - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
  - .6 ASTM E202-10, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.
- .4 CSA Group (CSA)
  - .1 CSA B242-05 (R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
  - .2 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
- .5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS)
  - .1 MSS-SP-67-2002a, Butterfly Valves.
  - .2 MSS-SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
  - .3 MSS-SP-71-05, Grey Iron Swing Check Valves Flanged and Threaded Ends.
  - .4 MSS-SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
  - .5 MSS-SP-85-02, Grey Iron Globe and Angle Valves, Flanged and Threaded Ends.

## **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for hydronic systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate on drawings:
    - .1 Components and accessories.

## **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic systems for incorporation into manual.
  - .1 Include special servicing requirements.

## **1.4 EXTRA STOCK MATERIALS**

- .1 Supply spare parts as follows:
  - .1 Valve seats: 1 minimum for every ten valves, each size. Minimum one.
  - .2 Discs: 1 minimum for every ten valves, each size. Minimum one.
  - .3 Stem packing: 1 minimum for every ten valves, each size. Minimum one.
  - .4 Valve handles: 2 minimum of each size.
  - .5 Gaskets for flanges: 1 minimum for every ten flanges.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect hydronic systems from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 PIPE**

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
  - .1 To NPS 6: Schedule 40.

## 2.2 PIPE JOINTS

- .1 NPS 2 and under: screwed fittings with PTFE tape.
- .2 NPS 2-1/2 and over: welding fittings and flanges to CSA W48.
- .3 Roll grooved: standard rigid coupling to CSA B242.
- .4 Flanges: plain, to ANSI/AWWA C111/A21.11.
- .5 Orifice flanges: slip-on raised face, 2100 kPa.
- .6 Flange gaskets: to AWWA C111.
- .7 Pipe thread: taper.
- .8 Bolts and nuts: to ASME B18.2.1.
- .9 Roll grooved coupling gaskets: type EPDM.

## 2.3 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.
- .5 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M.

## 2.4 VALVES

- .1 Connections:
  - .1 NPS 2 and smaller: screwed ends.
- .2 Gate valves: to MSS-SP-70 :
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: Class 125, rising stem, split wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
    - .2 Elsewhere: Class 125, non- rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .3 Globe valves: to MSS-SP-80 Application: Throttling, flow control, emergency bypass. :
  - .1 NPS 2 and under:
    - .1 Mechanical Rooms: withPTFE disc, as specified Section 23 05 23.01 - Valves - Bronze.
    - .2 Elsewhere: globe, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .4 Balancing, for TAB:
  - .1 Sizes: calibrated balancing valves, as specified this section.
  - .2 NPS 2 and under:
    - .1 Mechanical Rooms: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.

- .2 Elsewhere: globe, with plug disc as specified Section 23 05 23.01 - Valves - Bronze.
- .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .6 Bypass valves on gate and globe valves NPS 8 and larger: NPS 3/4, Globe, with PTFE disc as specified Section 23 05 23.01 - Valves - Bronze.
- .7 Swing check valves: to MSS-SP-71.
  - .1 NPS 2 and under:
    - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01 - Valves - Bronze.
- .8 Silent check valves:
  - .1 NPS 2 and under:
    - .1 As specified Section 23 05 23.01 - Valves - Bronze.
- .9 Ball valves:
  - .1 NPS 2 and under: as specified Section 23 05 23.01 - Valves - Bronze.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 PIPING INSTALLATION**

- .1 Install pipework in accordance with Section 23 05 15 - Common Installation Requirements for HVAC Pipework.

#### **3.3 CIRCUIT BALANCING VALVES**

- .1 Install flow measuring stations and flow balancing valves as indicated.
- .2 Remove handwheel after installation and when TAB is complete.
- .3 Tape joints in prefabricated insulation on valves installed in chilled water mains.

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

- .1 In accordance with Section 23 08 16 - Cleaning and Start-Up of HVAC Piping Systems.

#### **3.5 TESTING**

- .1 Test system in accordance with Section 23 05 00 - Common Work Results for HVAC.

- .2 For glycol systems, retest with glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

### **3.6 BALANCING**

- .1 Balance water systems to within plus or minus 5 % of design output.
- .2 In accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC for applicable procedures.

### **3.7 GLYCOL CHARGING**

- .1 Include mixing tank and positive displacement pump for glycol charging.
- .2 Retest for concentration to ASTM E202 after cleaning.

### **3.8 PERFORMANCE VERIFICATION**

- .1 In accordance with Section 23 08 01 - Performance Verification Mechanical Piping Systems.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.10 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by hydronic systems installation.

**END OF SECTION**



## **Part 1**

### **1.1 REFERENCE STANDARDS**

- .1 ASME
  - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .2 ASTM International (ASTM)
  - .1 ASTM A47/A47M-99 (2009), Standard Specification for Ferritic Malleable Iron Castings.
  - .2 ASTM A278/A278M-01 (2011), Standard Specification for Grey Iron Castings for Pressure-Containing Parts for Temperatures up to 650 degrees F (350 degrees C).
  - .3 ASTM A516/A516M-10, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.
  - .4 ASTM A536-84 (2009), Standard Specification for Ductile Iron Castings.
  - .5 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .3 CSA Group (CSA)
  - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for expansion tanks, air vents, separators, valves, and strainers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba , Canada.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic specialties for incorporation into manual.
- .3 Submit three (3) copies of operation and maintenance manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect hydronic specialties from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 DIAPHRAGM TYPE EXPANSION TANK**

- .1 Pressurized diaphragm type expansion tank.
- .2 Diaphragm sealed in container suitable for 115 degrees C operating temperature.
- .3 Air precharged to 84 kPa (initial fill pressure of system).
- .4 Renewable diaphragm.
- .5 Acceptable Manufacturers are: Amtrol, Wilo/Wessels, Armstrong, Westeel, Hamlett & Garneau

### **2.2 AUTOMATIC AIR VENT**

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 310 kPa working pressure.
- .2 Industrial float vent: cast iron body and NPS 1/2 connection and rated at 860 kPa working pressure.
- .3 Float: solid material suitable for 115 degrees C working temperature.
- .4 Acceptable Manufacturers are: Maid-O-Mist, Hoffman, Brauhkman, Bell & Gossett

### **2.3 AIR SEPARATOR - BOILER MOUNTED**

- .1 Complete with dip tube.
- .2 Working pressure: 860 kPa.
- .3 Acceptable Manufacturers are: Caleffi, Wilo/Wessels, Armstrong

### **2.4 AIR SEPARATOR - EXPANSION TANK FITTING**

- .1 Complete with adjustable vent tube and built-in manual vent valve.
- .2 Working pressure: 860 kPa.

### **2.5 AIR SEPARATOR - IN-LINE**

- .1 Working pressure: 860 kPa.

### **2.6 COMBINATION SEPARATORS/STRAINERS**

- .1 Steel, tested and stamped in accordance with ASME BPVC, for 860 kPa operating pressure, with galvanized steel integral strainer with 5 mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

### **2.7 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE**

- .1 Adjustable pressure setting: 206 kPa relief, 55 to 172 kPa reducing.
- .2 Low inlet pressure check valve.

- .3 Removable strainer.

## **2.8 PIPE LINE STRAINER**

- .1 NPS 1/2 to 2: bronze body to ASTM B62, solder end connections, Y pattern.
- .2 Blowdown connection: NPS 1.
- .3 Screen: stainless steel with 1.19 mm perforations.
- .4 Working pressure: 860 kPa.

## **2.9 SUCTION DIFFUSER**

- .1 Body: cast iron with flanged connections.
- .2 Strainer: with built-in, disposable 1.19 mm mesh, low pressure drop screen and NPS 1 blowdown connection.
- .3 Permanent magnet particle trap.
- .4 Full length straightening vanes.
- .5 Pressure Grey tappings.
- .6 Adjustable support leg.
- .7 Acceptable Manufacturers are: Bell & Gossett, Wilo/Wessels, Leitch, Armstrong

## **2.10 GLYCOL TANK AND FILL STATION**

- .1 Acceptable Manufacturers are: Axiom, Wilo/Wessels

## **2.11 TRIPLE DUTY VALVE**

- .1 Acceptable Manufacturers are: Bell & Gossett, Wilo/Wessels

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 APPLICATION**

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

### **3.3 GENERAL**

- .1 Run drain lines and blow off connections to terminate above nearest drain.

- .2 Maintain adequate clearance to permit service and maintenance.
- .3 Should deviations beyond allowable clearances arise, request and follow Contract Administrator's and Departmental Representative's directive.
- .4 Check shop drawings for conformance of tappings for ancillaries and for equipment operating weights.

### **3.4 STRAINERS**

- .1 Install in horizontal or down flow lines.
- .2 Ensure clearance for removal of basket.
- .3 Install ahead of each pump.
- .4 Install ahead of each automatic control valve as indicated.

### **3.5 AIR VENTS**

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest floor drain.

### **3.6 EXPANSION TANKS**

- .1 Adjust expansion tank pressure .
- .2 Install lockshield type valve at inlet to tank.

### **3.7 PRESSURE SAFETY RELIEF VALVES**

- .1 Run discharge pipe to terminate above nearest drain.

### **3.8 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE/IES Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 CSA Group (CSA)
  - .1 CAN/CSA-B214-12, Installation Code for Hydronic Heating Systems.
- .3 Electrical Equipment Manufacturers Association of Canada (EEMAC)
- .4 National Electrical Manufacturers' Association (NEMA)
  - .1 NEMA MG 1-2011, Motors and Generators.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for pump, circulator, and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation, and final location in field assembly.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for hydronic pumps for incorporation into manual.
- .3 Submit three (3) copies of operation and maintenance manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect hydronic pumps from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Size and select components to: CAN/CSA-B214.

### **2.2 IN-LINE CIRCULATORS**

- .1 Volute: cast iron radially split, with screwed or flanged design suction and discharge connections.
- .2 Shaft: alloy steel with bronze sleeve bearing, integral thrust collar.
- .3 Seal assembly: mechanical for service to 135 degrees C.
- .4 Coupling: flexible self-aligning.
- .5 Motor: to NEMA MG 1 resilient mounted drip proof, TEFC sleeve bearing.
- .6 Design pressure: 1200 kPa.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 APPLICATION**

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

### **3.3 INSTALLATION**

- .1 Install hydronic pumps to: CAN/CSA-B214.
- .2 In line circulators: install as indicated by flow arrows.
  - .1 Support at inlet and outlet flanges or unions.
  - .2 Install with bearing lubrication points accessible.
- .3 Base mounted type: supply templates for anchor bolt placement.
  - .1 Include anchor bolts with sleeves. Place level, shim unit and grout.
  - .2 Align coupling in accordance with manufacturer's recommended tolerance.
  - .3 Check oil level and lubricate. After run-in, tighten glands.
- .4 Ensure that pump body does not support piping or equipment.
  - .1 Provide stanchions or hangers for this purpose.

- .2 Refer to manufacturer's installation instructions for details.
- .5 Pipe drain tapping to floor drain.
- .6 Install volute venting pet cock in accessible location.
- .7 Check rotation prior to start-up.
- .8 Install pressure gauge test cocks.

### **3.4 START-UP**

- .1 General:
  - .1 In accordance with Section 01 91 13 - Commissioning : General Requirements; supplemented as specified herein.
  - .2 In accordance with manufacturer's recommendations.
- .2 Procedures:
  - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
  - .2 After starting pump, check for proper, safe operation.
  - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
  - .4 Check base for free-floating, no obstructions under base.
  - .5 Run-in pumps for 12 continuous hours minimum.
  - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.
  - .7 Eliminate air from scroll casing.
  - .8 Adjust water flow rate through water-cooled bearings.
  - .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
  - .10 Adjust alignment of piping and conduit to ensure true flexibility.
  - .11 Eliminate cavitation, flashing and air entrainment.
  - .12 Adjust pump shaft seals, stuffing boxes, glands.
  - .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
  - .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
  - .15 Verify lubricating oil levels.

### **3.5 PERFORMANCE VERIFICATION (PV)**

- .1 General:
  - .1 Verify performance in accordance with Section 01 91 13 - Commissioning : General Requirements, supplemented as specified herein.
- .2 Verify that manufacturer's performance curves are accurate.
- .3 Ensure valves on pump suction and discharge provide tight shut-off.
- .4 Net Positive Suction Head (NPSH):

- .1 Application: measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
- .2 Measure using procedures prescribed in Section 01 91 13 - General Commissioning Requirements.
- .3 Where procedures do not exist, discontinue PV, report to Departmental Representative and await instructions.
- .5 Multiple Pump Installations - Series and Parallel:
  - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .7 Commissioning Reports: in accordance with Section 01 91 13 - Commissioning reports supplemented as specified herein. Reports to include:
  - .1 Record of points of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
  - .2 Use Report Forms specified in Section 01 91 13 - General Commissioning Requirements: Report Forms and Schematics.
  - .3 Pump performance curves (family of curves).

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**



## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASME
  - .1 ASME B16.22-12, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.
  - .2 ASME B16.24-11, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 600, 900, 1500 and 2500.
  - .3 ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - .4 ASME B31.5-10, Refrigeration Piping and Heat Transfer Components.
- .2 ASTM International (ASTM)
  - .1 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - .2 ASTM B280-08, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 CSA Group (CSA)
  - .1 CSA B52-05 (R2009), B52 Package, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
  - .1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

### **1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-installation Meetings:
  - .1 Convene pre-installation meeting 1 week prior to beginning of construction in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building construction subtrades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS SDS in accordance with Section 02 81 00 Hazardous Materials General Provisions .

- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for refrigerant piping for incorporation into manual.
- .3 Submit three (3) copies of operation and maintenance manual.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect refrigerant piping, fittings and equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **Part 2 Products**

#### **2.1 TUBING**

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
  - .1 Hard copper: to ASTM B280, type B ACR.
  - .2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

#### **2.2 FITTINGS**

- .1 Service: design pressure 2070 kPa and temperature 121 degrees C.
- .2 Brazed:
  - .1 Fittings: wrought copper to ASME B16.22.
  - .2 Joints: silver solder, copper-phosphorous, 95% Cu-5%P 15% Ag-80% Cu-5%P and non-corrosive flux.
- .3 Flanged:
  - .1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.
  - .2 Gaskets: suitable for service.
  - .3 Bolts, nuts and washers: to ASTM A307, heavy series.
- .4 Flared:

- .1 Bronze or brass, for refrigeration, to ASME B16.26.

### **2.3 PIPE SLEEVES**

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

### **2.4 VALVES**

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 Mpa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 MANUFACTURER'S INSTRUCTIONS**

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

### **3.3 GENERAL**

- .1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 05 - Installation of Pipework.

### **3.4 BRAZING PROCEDURES**

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

### **3.5 PIPING INSTALLATION**

- .1 Hot gas lines:
  - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

- .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
- .3 Provide inverted deep trap at top of risers.
- .4 Provide double risers for compressors having capacity modulation.
  - .1 Large riser: install traps as specified.
  - .2 Small riser: size for 5.1 m<sup>3</sup>/s at minimum load. Connect upstream of traps on large riser.

### **3.6 PRESSURE AND LEAK TESTING**

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

### **3.7 FIELD QUALITY CONTROL**

- .1 Site Tests/Inspection:
  - .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13 degrees C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
  - .1 Twice to 14 Pa absolute and hold for 4 hours.
  - .2 Break vacuum with refrigerant to 14 kPa.
  - .3 Final to 5 Pa absolute and hold for at least 12 hours.
  - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
  - .5 Submit test results to Contract Administrator and Departmental Representative.
- .7 Charging:
  - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.
  - .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.

- .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
  - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
  - .2 Record and report measurements to Contract Administrator and Departmental Representative.
- .9 Manufacturer's Field Services:
  - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, at stages listed:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.
    - .3 Upon completion of the Work, after cleaning is carried out.
  - .4 Obtain reports, within 3 days of review, and submit, immediately, to Contract Administrator and Departmental Representative.

### **3.8 DEMONSTRATION**

- .1 Instructions:
  - .1 Post instructions in frame with glass cover in accordance with Section 01 78 00 - Closeout Submittals and CSA B52.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASME
  - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (SDS).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC water treatment systems and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit 2 copies of WHMIS SDS in accordance with Section 02 81 00 Hazardous Materials - General Provisions.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for HVAC water treatment systems for incorporation into manual.
- .3 Include following:
  - .1 Log sheets as recommended by manufacturer.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect HVAC water treatment systems from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MANUFACTURER**

- .1 Equipment, chemicals, and service provided by one supplier.

### **2.2 POT FEEDER**

- .1 Welded steel. Temperature rating: 90 degrees C.

### **2.3 CHEMICAL FEED PIPING**

- .1 Resistant to chemicals employed.

### **2.4 CHEMICAL FEED PUMPS**

- .1 Top-mounted electronic metering diaphragm type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with pressure relief valve, check valve, foot valve, injection fitting.
- .2 Piston type: flow range 0-100%, adjustable, plus or minus 1.0% accuracy (repetitive), on-off operation, with stainless steel piston, pressure relief valve, double ball and check valves.

### **2.5 SHIPPING/FEEDING CHEMICAL CONTAINERS**

- .1 High density moulded polyethylene, with liquid level graduations, cover.

### **2.6 CONDUCTIVITY CONTROLLER**

- .1 Fully transistorized, suitable for wall or flush panel mounting, linear over full measuring range of 0-5000 microhms.
- .2 Insensitive to phase angle shifts, capable of operating on 95-130 Volts without affecting accuracy, power, bleedoff status lights.

### **2.7 CONDUCTIVITY PROBES**

- .1 Dual carbon elements in PVC holder, quick disconnect, self-locking connection.

### **2.8 CHEMICALS**

- .1 Provide 2 years supply.
- .2 Obtain chemicals from manufacturer with existing valid contract with DND.

### **2.9 TEST EQUIPMENT**

- .1 Provide one set of test equipment for each system to verify performance.
- .2 Complete with carrying case, reagents for chemicals, specialized or supplementary equipment.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for HVAC water treatment systems installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### **3.2 MANUFACTURER'S INSTRUCTIONS**

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

### **3.3 INSTALLATION**

- .1 Install HVAC water treatment systems in accordance with ASME Boiler and Pressure Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

### **3.4 CHEMICAL FEED PIPING**

- .1 Install crosses at changes in direction. Install plugs in unused connections.

### **3.5 CLEANING OF MECHANICAL SYSTEM**

- .1 Provide copy of recommended cleaning procedures and chemicals for approval by Contract Administrator.
- .2 Flush mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Use chemicals to inhibit corrosion of various system materials that are safe to handle and use.
- .3 Examine and clean filters and screens, periodically during circulation of cleaning solution, and monitor changes in pressure drop across equipment.
- .4 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .5 Disposal of cleaning solutions approved by authority having jurisdiction.

### **3.6 WATER TREATMENT SERVICES**

- .1 Provide water treatment monitoring and consulting services for period of 1 year after system start-up. Service to include:
  - .1 Initial water analysis and treatment recommendations.
  - .2 System start-up assistance.
  - .3 Operating staff training.
  - .4 Visit plant every 5 days during period of operation and as required until system stabilizes, and advise on treatment system performance.
  - .5 Provide necessary recording charts and log sheets for 1 year operation.



- .6 Provide necessary laboratory and technical assistance.
- .7 Provide clear, concise, written instructions and advice to operating staff.

### **3.7 FIELD QUALITY CONTROL**

- .1 Start-up:
  - .1 Start up water treatment systems in accordance with manufacturer's instructions.
- .2 Commissioning:
  - .1 Timing:
    - .1 After start-up deficiencies rectified.
    - .2 After start-up and before TAB of connected systems.
  - .2 Pre-commissioning Inspections: verify:
    - .1 Presence of test equipment, reagents, chemicals, details of specific tests performed, and operating instructions.
    - .2 Suitability of log book.
    - .3 Required quality of treated water.
  - .3 Commissioning procedures - applicable to Water Treatment Systems:
    - .1 Establish, adjust as necessary and record automatic controls and chemical feed rates.
    - .2 Monitor performance continuously during commissioning of connected systems and until acceptance of project.
    - .3 Establish test intervals, regeneration intervals.
    - .4 Record on approved report forms commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
    - .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
    - .6 Visit project at specified intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
    - .7 Advise Contract Administrator and Departmental Representative in writing on matters regarding installed water treatment systems.
  - .4 Commissioning procedures - Water side of closed circuit coolers, Cooling Tower Systems:
    - .1 Verify operation of bleed-off system.
    - .2 Establish bleed-off flow rate.
    - .3 Establish rate of chemical feed - continual and periodic.
    - .4 Test system water for chlorides, TDS, suspended solids, algae, slime, inhibitor level, pH, alkalinity, hardness, other impurities and microbiological organisms.
    - .5 Compare with readings of total dissolved and suspended solids metre.

- .6 Read make-up water metre, compare with chiller load summation (ton-hours).
- .7 Test make-up water for chlorides, hardness.
- .8 Compare test results with readings from TDS metre.
- .9 Record quantity of make-up water, compare with summation of chiller load (in ton-hours).
- .10 Record types, quantities of chemicals applied.
- .5 Commissioning procedures - Closed Circuit Hydronic Systems:
  - .1 Analyze water in system.
  - .2 Based upon an assumed rate of loss approved by Contract Administrator and Departmental Representative, establish rate of chemical feed.
  - .3 Record types, quantities of chemicals applied.
- .6 Training:
  - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
  - .2 Train O&M personnel in softener regeneration procedures.
- .7 Certificates:
  - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .8 Commissioning Reports:
  - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, other data required by Commissioning Agent .
- .9 Demonstrations:
  - .1 Chemicals required and water treatment
  - .2 Chemical feed equipment operation
  - .3 Testing and water analysis
  - .4 Log book recording
- .10 Commissioning activities during Warranty Period:
  - .1 Check out water treatment systems on regular basis and submit written report to Commissioning Agent .

### **3.8 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International (ASTM)
  - .1 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
  - .2 ASTM A635/A635M-09b, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
  - .3 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .3 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air-Conditioning and Ventilating Systems.
  - .2 NFPA 90B-12, Standard for the 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, 2005.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
  - .3 IAQ Guideline for Occupied Buildings Under Construction 2007.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .4 Test and Evaluation Reports:
  - .1 Certification of Ratings:
    - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

### **1.3 DELIVERY, STORAGE AND HANDLING**

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

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 SEAL CLASSIFICATION**

- .1 Classification as follows:
- .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 and connections made airtight with sealant tape.
  - .3 Class C: transverse joints and connections made air tight with sealant. Longitudinal seams unsealed.
  - .4 Unsealed seams and joints.

### **2.2 SEALANT**

- .1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

### **2.3 TAPE**

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

### **2.4 DUCT LEAKAGE**

- .1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

### **2.5 FITTINGS**

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
  - .1 Rectangular: short radius with single thickness turning vanes.
  - .2 Round: centreline radius: 1.5 times diameter.
- .3 Mitred elbows, rectangular:
  - .1 To 407 mm: with single thickness turning vanes.
  - .2 Over 407 mm: with double thickness turning vanes.
- .4 Branches:
  - .1 Rectangular main and branch: with 45 degrees entry on branch 1.5 times width of duct .
  - .2 Round main and branch: enter main duct at 45 degrees with conical connection.

- .3 Provide volume control damper in branch duct near connection to main duct.
- .4 Main duct branches: with splitter damper.
- .5 Transitions:
  - .1 Diverging: 20 degrees maximum included angle.
  - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
- .7 Obstruction deflectors: maintain full cross-sectional area.
  - .1 Maximum included angles: as for transitions.

## **2.6 FIRE STOPPING**

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Fire Stopping.
- .2 Coordinate with 07 84 00 - Fire Stopping to ensure fire stopping materials and installation does not distort duct.

## **2.7 GALVANIZED STEEL**

- .1 Lock forming quality: to ASTM A653/A653M, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to ASHRAE, SMACNA.
- .3 Joints: to ASHRAE ,SMACNA. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

## **2.8 ALUMINUM**

- .1 To ASHRAE, SMACNA. Aluminum type: 3003-H-14.
- .2 Thickness, fabrication and reinforcement: to ASHRAE, SMACNA.
- .3 Joints: to ASHRAE, SMACNA.

## **2.9 BLACK STEEL**

- .1 To ASTM A635/A635M.
- .2 Thickness: 1.2 mm or as indicated.
- .3 Fabrication: ducts and fittings to ASHRAE, SMACNA.
- .4 Reinforcement: as indicated.
- .5 Joints: continuous weld.

## **2.10 HANGERS AND SUPPORTS**

- .1 Hangers and Supports: in accordance with Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
  - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
    - .1 Maximum size duct supported by strap hanger: 500.
  - .2 Hangers: galvanized steel angle with galvanized steel rods to SMACNA to following table :

.1

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50x50x6	10

.3 Upper hanger attachments:

- .1 For concrete: manufactured concrete inserts.
- .2 For steel joist: manufactured joist clamp, steel plate washer.
- .3 For steel beams: manufactured beam clamps:

### Part 3 Execution

#### 3.1 EXAMINATION

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

#### 3.2 GENERAL

- .1 Do work in accordance with ASHRAE and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Ensure diffuser is fully seated.
- .3 Support risers to SMACNA, ASHRAE.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

#### 3.3 HANGERS

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

### **3.4 WATERTIGHT DUCT**

- .1 Provide watertight duct for:
  - .1 Fresh air intake.
  - .2 Minimum 3000 mm from duct mounted humidifier in all directions.
  - .3 As indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
  - .1 Weld joints of bottom and side sheets.
  - .2 Seal other joints with duct sealer.

### **3.5 SEALING AND TAPING**

- .1 Apply sealant in accordance with SMACNA.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

### **3.6 LEAKAGE TESTS**

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**



## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- .2 ASTM International (ASTM)
  - .1 ASTM A653/A653M-09b, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. (Metric).
- .3 Sheet Metal Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2005.
  - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012.
  - .3 SMACNA IAQ Guideline for Occupied Buildings Under Construction, 2007.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal ducts and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .4 Test and Evaluation Reports:
  - .1 Certification of Ratings:
    - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect metal ducts from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove in accordance with Section 01 74 19 - Waste Management and Disposal

## Part 2 Products

### 2.1 DUCTWORK

- .1 Material:
  - .1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.
  - .2 Thickness: to SMACNA.
- .2 Construction: round and oval.
  - .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
  - .2 Transverse joints up to 900 mm: slip type with tape and sealants.
  - .3 Transverse joints over 900 mm: Vanstone.
  - .4 Fittings:
    - .1 Elbows: smooth radius 5 piece ( for 90 degrees), 3 piece ( for 45 degrees). Centreline radius: 1.5 x diameter.
    - .2 Branches: conical transition with conical branch at 45 degrees and 45 degrees elbow.
- .3 Construction: rectangular:
  - .1 Ducts: to SMACNA.
  - .2 Transverse joints: SMACNA seal Class A and B.
  - .3 Fittings:
    - .1 Elbows: smooth radius; centreline radius 1.5 x width of duct. No vanes.
    - .2 Branches: with conical branch at 45 degrees and 45 degrees elbow.
- .4 Fire stopping:
  - .1 Retaining angles around duct, on both sides of fire separation in accordance with Section.
  - .2 Coordinate with Section 07 84 00 - Fire Stopping to ensure fire stopping materials and installation does not distort duct.

### 2.2 SEAL CLASSIFICATION

- .1 Classification as follows:
  - .1

Maximum Pressure Pa	SMACNA Seal Class
2500	[A]
1500	[A]
100	[A]
750	[B]

- .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 and connections made airtight with gaskets, tape, sealant or combination thereof.

## 2.3 SEALANT

- .1 Oil resistant, water-borne polymer type flame resistant high velocity duct sealing compound.
  - .1 Temperature range of minus 30 degrees C to plus 93 degrees C.

## 2.4 TAPE

- .1 Tape: polyvinyl treated, open weave fibre glass, 50 mm wide.

## 2.5 HANGERS AND SUPPORTS

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

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25x25x3	6
751 to 1050	40x40x3	6
1051 to 1500	40x40x3	10
1501 to 2100	50x50x3	10
2101 to 2400	50x50x5	10
2401 and over	50x50x6	10

- .4 Upper hanger attachments:
  - .1 For concrete: manufactured concrete inserts
  - .2 For steel joists: manufactured joist clamp or steel plate washer
  - .3 For steel beams: manufactured beam clamps

## Part 3 Execution

### 3.1 EXAMINATION

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

### 3.2 GENERAL

- .1 Do work as indicated to SMACNA, ASHRAE.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
  - .1 Ensure diffuser is fully sealed.
- .3 Support risers in accordance iwth SMACNA, ASHRAE.
- .4 Install breakaway joints in ductwork on sides of fire separation.

### 3.3 HANGERS

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

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

### 3.4 SEALING AND TAPING

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

### 3.5 LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Perform leakage tests in sections.
- .4 Perform trial leakage tests, as instructed to demonstrate quality of work.
- .5 Do not install additional ductwork until trial tests have been achieved.
- .6 Test section minimum of 30 m long with not less than 3 branch takeoffs and two 90 degrees elbows.
- .7 Complete tests before performing insulation or concealment Work.

### 3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 GENERAL**

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

### **2.2 FLEXIBLE CONNECTIONS**

- .1 Frame: galvanized sheet metal frame .
- .2 Material:
  - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m<sup>2</sup>.

### **2.3 ACCESS DOORS IN DUCTS**

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene foam rubber.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2 301 to 450 mm: four sash locks complete with safety chain.
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
  - .5 Hold open devices.
  - .6 300 mm x 300mm glass viewing panels.

### **2.4 TURNING VANES**

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

### **2.5 INSTRUMENT TEST**

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

### **2.6 SPIN-IN COLLARS**

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

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### 3.2 INSTALLATION

- .1 Flexible Connections:
  - .1 Install in following locations:
    - .1 Inlets and outlets to supply air units and fans.
    - .2 Inlets and outlets of exhaust and return air fans.
    - .3 As indicated.
  - .2 Length of connection: 100 mm.
  - .3 Minimum distance between metal parts when system in operation: 75 mm.
  - .4 Install in accordance with recommendations of SMACNA.
  - .5 When fan is running:
    - .1 Ducting on sides of flexible connection to be in alignment.
    - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
  - .1 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat coils.
    - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
  - .1 General:
    - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
    - .2 Locate to permit easy manipulation of instruments.
    - .3 Install insulation port extensions as required.
    - .4 Locations:
      - .1 For traverse readings:
        - .1 Ducted inlets to roof and wall exhausters.
        - .2 Inlets and outlets of other fan systems.
        - .3 Main and sub-main ducts.
        - .4 And as indicated.
      - .2 For temperature readings:
        - .1 At outside air intakes.
        - .2 In mixed air applications in locations as approved by supplier.
        - .3 At inlet and outlet of coils.
        - .4 Downstream of junctions of two converging air streams of different temperatures.



.5 And as indicated.

.4 Turning Vanes:

.1 Install in accordance with recommendations of SMACNA and as indicated.

### **3.3 CLEANING**

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

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

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
  - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible-2013.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect dampers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Manufacture to SMACNA standards.

### **2.2 SPLITTER DAMPERS**

- .1 Fabricate from same material as duct but one sheet metal thickness heavier, with appropriate stiffening.
- .2 Single thickness construction.
- .3 Control rod with locking device and position indicator.
- .4 Rod configuration to prevent end from entering duct.
- .5 Pivot: piano hinge.
- .6 Folded leading edge.

### **2.3 SINGLE BLADE DAMPERS**

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height as indicated.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside bronze nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

### **2.4 MULTI-BLADED DAMPERS**

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: as indicated.
- .4 Bearings: self-lubricating nylon pin in bronze bushings.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 Dampers: vibration free.
- .6 Ensure damper operators are observable and accessible.
- .7 Corrections and adjustments conducted by Contractor as requested by Contract Administrator.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for dampers and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dampers for incorporation into manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect dampers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 MULTI-LEAF DAMPERS**

- .1 Opposed parallel blade type as indicated.
- .2 Structurally formed steel Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Insulated aluminum dampers:
  - .1 Frames: insulated with extruded polystyrene foam with RSI 0.88.

- .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

## **2.2 DISC TYPE DAMPERS**

- .1 Frame: insulated brake formed, welded, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
- .2 Disc: insulated spin formed, 1.6 mm thick, galvanized steel to ASTM A653/A653M.
- .3 Gasket: extruded neoprene, field replaceable, with 10 year warranty.
- .4 Bearings: roller self lubricated and sealed.
- .5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.

## **2.3 BACK DRAFT DAMPERS**

- .1 Automatic gravity operated, single leaf, aluminum construction with nylon bearings.

## **2.4 RELIEF DAMPERS**

- .1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights .

## **2.5 ACCEPTABLE MANUFACTURERS:**

- .1 All dampers to be from one manufacturer.
- .2 Acceptable Manufacturers are: Tamco, Alumavent/Nailor, Ruskin, Ventex, Greenheck, Westvent

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

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

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S112-10, Standard Test Method of Fire Test of Fire Damper Assemblies.
  - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
  - .3 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for fire and smoke dampers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate the following:
    - .1 Fire dampers.
    - .2 Smoke dampers.
    - .3 Fire stop flaps.
    - .4 Operators.
    - .5 Fusible links.
    - .6 Design details of break-away joints.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire and smoke dampers for incorporation into manual.

### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

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



## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect fire and smoke dampers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## Part 2 Products

### 2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type A C B , listed bear label of UL ULC Warnock Hersey , meet requirements of authorities having jurisdiction CFFM Fire Commissioner of Canada (FCC) provincial fire authority and NFPA 90A . Fire damper assemblies fire tested in accordance with CAN/ULC-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
  - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
  - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper , round or square; interlocking type; guillotine type; multi-blade hinged roll door type; sized to maintain full duct cross section as indicated .
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.
- .11 Acceptable Manufacturers are: Nailor, Price, Ruskin.

## **2.2 SMOKE DAMPERS**

- .1 Smoke Dampers: to be ULC or UL listed and labelled.
- .2 Normally closed reverse action smoke vent (S/D-RASV): folding blade type, opening by gravity upon detection of smoke, and/or as indicated from remote alarm signaling device actuated by an electro thermal link . . Two flexible stainless steel blade edge seals to provide required constant sealing pressure.
- .3 Normally open smoke/seal (S/D-SSSD): folding blade type, closing when actuated by means of electro thermal link from remote alarm signaling device and/or. Blade edge seals of flexible stainless steel to provide required constant sealing pressure. Provide stainless steel negator springs with locking devices to ensure positive closure for units mounted horizontally in vertical ducts.
- .4 Motorized (S/D-M): folding blade type, normally open with power on. When power is interrupted damper shall close automatically. Both damper and damper operator shall be ULC listed and labelled.
- .5 Electro thermal link (S/D-ETL): dual responsive fusible link which melts when subjected to local heat of 74 degrees C and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.
- .6 Acceptable Manufacturers are: Nailor, Price, Ruskin.

## **2.3 COMBINATION FIRE AND SMOKE DAMPERS**

- .1 Damper: similar to smoke dampers specified above.
- .2 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.
- .3 Acceptable Manufacturers are: Nailor, Price, Ruskin.

## **2.4 FIRE STOP FLAPS**

- .1 Fire smoke flaps: ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.2.
- .2 Construct of minimum 1.5 mm thick sheet steel with 1.6 mm thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps held open with fusible link conforming to ULC-S505 and close at 74 degrees C or as indicated.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with NFPA 90A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Coordinate installation of fire stopping with Section 07 84 00 - Fire Stopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM C423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - .2 ASTM C916-85 (2007), Standard Specification for Adhesives for Duct Thermal Insulation.
  - .3 ASTM C1071-12, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - .4 ASTM C1338-08, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
  - .5 ASTM G21-09, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
  - .2 NFPA 90B-12, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- .3 North American Insulation Manufacturers Association (NAIMA)
  - .1 NAIMA AH116-2002, Fibrous Glass Duct Construction Standards.
- .4 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
  - .1 SMACNA, HVAC Duct Construction Standards, Metal and Flexible-2005.
  - .2 SMACNA IAQ Guideline for Occupied Buildings Under Construction-2007.
- .5 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for duct liners and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for duct liners for incorporation into manual.

## 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect duct liners from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## Part 2 Products

### 2.1 DUCT LINER

- .1 General:
  - .1 Mineral Fibre duct liner: air surface coated mat facing.
  - .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with NFPA 90A, CAN/ULC-S102, NFPA 90B.
- .2 Rigid:
  - .1 Use on flat surfaces where indicated.
  - .2 25 mm thick, to ASTM C1071 Type 2, fibrous glass rigid board duct liner.
  - .3 Density: 48 kg/m<sup>3</sup>minimum.
  - .4 Thermal resistance to be minimum 0.76 (m<sup>2</sup>.degrees C)/W for 25 mm thickness 1.53 (m<sup>2</sup>.degrees C)/W for 50 mm thickness 1.15 (m<sup>2</sup>.degrees C)/W for 38 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
  - .5 Maximum velocity on faced air side: ??? m/s.
  - .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.
- .3 Flexible:
  - .1 Use on surfaces indicated round or oval surfaces.
  - .2 25 mm thick, to ASTM C1071 Type 1, fibrous glass blanket duct liner.
  - .3 Density: 24 kg/m<sup>3</sup>minimum.
  - .4 Thermal resistance to be minimum 1.11 (m<sup>2</sup>.degrees C)/W for 38 mm thickness 1.41 (m<sup>2</sup>.degrees C)/W to 50 mm thickness 0.37 (m<sup>2</sup>.degrees C)/W for 12 mm thickness 0.74 (m<sup>2</sup>.degrees C)/W for 25 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
  - .5 Maximum velocity on coated air side: 25.4 m/s.
  - .6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C423.

## **2.2 ADHESIVE**

- .1 Adhesive: to NFPA 90A and NFPA 90B, ASTM C916.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 29 degrees C to plus 93 degrees C.
- .3 Water-based fire retardant type.

## **2.3 FASTENERS**

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Metal Nylon Polymer retaining clips, 32 mm square.

## **2.4 JOINT TAPE**

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

## **2.5 SEALER**

- .1 Meet requirements of NFPA 90A NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 GENERAL**

- .1 Do work in accordance with as indicated NIMA AH116 AMACNA HVAC duct construction standard except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

### **3.3 DUCT LINER**

- .1 Install in accordance with manufacturer's recommendations, and as follows:
  - .1 Fasten to interior sheet metal surface with 90 % coverage of adhesive to ASTM C916.
    - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.

- .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.
  - .1 Spacing of mechanical fasteners in accordance with SMAC HVAC duct construction standard NAIMA AH116.
- .2 In systems, where air velocities exceeds 20.3 m/s, install galvanized sheet metal nosing to leading edges of duct liner.

### **3.4 JOINTS**

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
  - .1 Bed tape in sealer.
  - .2 Apply 2 coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Contract Administrator.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air Movement and Control Association (ANSI/AMCA)
  - .1 ANSI/AMCA Standard 99-2010, Standards Handbook.
  - .2 ANSI/ASHRAE 51-07 (ANSI/AMCA 210-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - .3 ANSI/AMCA Standard 300-2008, Reverberant Room Method for Sound Testing of Fans.
  - .4 ANSI/AMCA Standard 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - current edition.
    - .1 MPI #18, Primer, Zinc Rich, Organic.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC fans and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba , Canada.
  - .2 Provide:
    - .1 Fan performance curves showing point of operation, bhp kW and efficiency.
    - .2 Sound rating data at point of operation.
  - .3 Indicate:
    - .1 Motors, sheaves, bearings, shaft details .
    - .2 Minimum performance achievable with with variable speed controllers , variable inlet vanes as appropriate..

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
    - .1 Provide:
      - .1 Matched sets of belts.
      - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, include:



- .1 Bearings and seals.
- .2 Addresses of suppliers.
- .3 List of specialized tools necessary for adjusting, repairing or replacing.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect HVAC fans from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **Part 2 Products**

#### **2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.
  - .2 Capacity: flow rate, static total pressure, W bhp, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.
  - .3 Fans: statically and dynamically balanced, constructed in conformity with ANSI/AMCA Standard 99.
  - .4 Sound ratings: comply with ANSI/AMCA Standard 301, tested to ANSI/AMCA Standard 300. Supply unit with ANSI/AMCA certified sound rating seal.
  - .5 Performance ratings: based on tests performed in accordance with ANSI/AMCA Standard 210. Supply unit with ANSI/AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.

#### **2.2 FANS GENERAL**

- .1 Motors:
  - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
  - .2 For use with variable speed controllers.
  - .3 Sizes as indicated on equipment schedules.
  - .4 Two speed with two windings and speeds of approximately as indicated.
  - .5 Two speed with split winding, constant horsepower constant or variable torque and speeds as indicated.

- .2 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan outlet inlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment, inlet outlet dampers and vanes and as indicated.
- .3 Factory primed before assembly in colour standard to manufacturer.
- .4 Scroll casing drains: as indicated.
- .5 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .6 Flexible connections: to Section 23 33 00 - Air Duct Accessories.
- .7 Acceptable Manufacturers are: Greenheck, Loren Cook, Penn, Twin City

### **2.3 CABINET FANS - GENERAL PURPOSE**

- .1 Fan characteristics and construction: as centrifugal fans.
- .2 Cabinet hung casing floor mounted single or multiple wheel with DWDI centrifugal fans in factory fabricated casing complete with vibration isolators and seismic control measures, motor, variable speed V-belt drive and guard outside inside casing.
- .3 Fabricate casing of zinc coated or phosphate treated steel of reinforced and braced for rigidity. Provide removable panels for access to interior. Paint uncoated, steel parts with corrosion resistant paint to MPI #18. Finish inside and out, over prime coat, with rust resistant enamel. Internally line cabinet .
- .4 Acceptable Manufacturers are: Greenheck, Loren Cook, Penn, Twin City

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 FAN INSTALLATION**

- .1 Install fans as indicated, complete with resilient mountings specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.

### **3.3 ANCHOR BOLTS AND TEMPLATES**

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified
- .2 Size anchor bolts to withstand seismic acceleration and velocity forces as specified.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.
- .3 Samples:
  - .1 Samples are required for following:
    - .1 Submit duplicate 300 x 300 mm samples of each type.

### **1.2 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Include:
    - .1 Keys for volume control adjustment.
    - .2 Keys for air flow pattern adjustment.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect diffuser, registers and grilles from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

### **2.2 GENERAL**

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board and as specified.
  - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.

### **2.3 MANUFACTURED UNITS**

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.
- .2 Acceptable Manufacturers are: Price, Nailor, Titus.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturers instructions.
- .2 Install with oval head cadmium plated flat head screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.
- .4 Provide concealed safety chain on each grille, register and diffuser in gymnasium and similar game rooms and elsewhere as indicated.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 ASTM International (ASTM)
  - .1 ASTM E90-09, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .2 National Research Council Canada (NRC)
  - .1 National Building Code of Canada 2015 (NBC).
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .4 Society of Automotive Engineers (SAE)

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for louvers, intakes and vents and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate following:
    - .1 Pressure drop.
    - .2 Face area.
    - .3 Free area.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Test Reports: submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect louvers, intakes and vents from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 SYSTEM DESCRIPTION**

- .1 Performance Requirements:

- .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

## **2.2 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS**

- .1 Factory manufactured ss frp aluminum hinged at curb line galvanized steel pvc.
  - .1 Complete with integral birdscreen of 2.7 mm diameter SS wire.
  - .2 Maximum throat velocity: 3.3 m/s intake.
  - .3 Maximum loss through unit: 15 Pa exhaust static pressure.
  - .4 Maximum velocity through damper area: 1.5 m/s.
  - .5 Shape: as indicated.
- .2 Birdscreens:
  - .1 Complete with integral birdscreen of 2.7 mm diameter wire. Use 12mm mesh on exhaust 19mm mesh on intake

## **2.3 GOOSENECK HOODS**

- .1 Thickness: to SMACNA ASHRAE.
- .2 Fabrication: to SMACNA ASHRAE.
- .3 Joints: to SMACNA ASHRAE. Proprietary manufactured flanged duct joint considered class A seal.
- .4 Supports: as indicated.
- .5 Complete with integral birdscreen of 2.7 mm diameter wire. Use 12mm mesh on exhaust and 19mm mesh on intake

## **2.4 FIXED LOUVRES - ALUMINUM**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12mm exhaust and 19mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: anodized factory applied enamel, prime coated. Colour: to to be coordinated and specified by architect approval.

## **2.5 FIXED LOUVRES**

- .1 General: copper in welded steel frame, complete with anchors.



- .2 Blades:
  - .1 24 ounce cold rolled copper set at 45 degrees, Z-shaped with drip lips.
  - .2 Stormproof design for outside air intakes.
  - .3 Maximum length without mullions of same material: 1250 mm.
- .3 Frame: galvanized structural steel, welded construction. Paint welds after construction to Section 09 91 13 - Exterior Painting.
- .4 Screen: 12mm exhaust 19mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .5 Finish: factory applied enamel, anodized prime coated. Colour: to be coordinated and specified by architect approval.

## **2.6 ADJUSTABLE LOUVRES**

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12mm exhaust 19mm intake mesh, 2 mm diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied enamel, anodized prime coated. Colour: to Departmental Representative's approval.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.

- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standard Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
  - .1 ANSI/ASHRAE 52.2-12, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size (ANSI approved).
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.
  - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.
  - .4 CAN/CGSB-115.13-85, Filter Media, Automatic Roll.
  - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
  - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
  - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odor Removal from Ventilating Systems.
  - .8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
  - .9 CAN/CGSB-115.20-95, Polarized Media Air Filter.
- .3 International Organization of Standardization (ISO)
  - .1 ISO 14644-1-99, Clean Rooms and Associated Controlled Environments - Part 1: Classification of Air Cleanliness.
- .4 Underwriters' Laboratories of Canada (ULC)
  - .1 ULC -S111-07, Standard Method of Fire Tests for Air Filter Units.
- .5 US Department of Defense - Test Method Standard
  - .1 MIL-STS-282-95, Filter Units, Protective Clothing, Gas-Mask Components and Related Products; Performance Test Methods.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for HVAC filters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
  - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
  - .3 Spare filters: in addition to filters installed immediately prior to acceptance by City, supply 1 complete set of filters for each.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect HVAC filters from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Media: suitable for air at 100% RH and air temperatures between -40 and 50 degrees C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: as indicated on schedule.

### **2.2 ACCESSORIES**

- .1 Holding frames: permanent channel section "T" section construction of extruded aluminum same material as casing / hood galvanized steel, 1.6 mm thick, except where specified.
- .2 Seals: to ensure leakproof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: and/or through doors/panels on each side from upstram, downstream face of filter bank..

### **2.3 FIBROUS GLASS PANEL FILTERS**

- .1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.

- .2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.
- .3 Performance: to ANSI/ASHRAE 52.2 minimum average synthetic dust weight arrestance 70 %.
- .4 Fire rated: to ULC -S111.

## **2.4 COTTON PANEL FILTERS**

- .1 Disposable pleated reinforced cotton dry media: to CAN/CGSB 115.18.
- .2 Holding frame: galvanized steel, or slide in channel for side access.
- .3 Performance:
  - .1 Average atmospheric dust spot efficiency 30 % to ANSI/ASHRAE 52.2.
  - .2 Average synthetic dust weight arrestance 90 % to ANSI/ASHRAE 52.2.
- .4 Fire Rated: to ULC -S111.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION GENERAL**

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

### **3.3 ACTIVATED CARBON TYPE FILTERS**

- .1 During testing, adjusting and balancing, install substitute media.
- .2 Install permanent media only after painting is completed.

### **3.4 REPLACEMENT MEDIA**

- .1 Replace media with new upon acceptance.
- .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

### **3.5 FILTER GAUGES**

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- .2 Underwriters' Laboratories of Canada (ULC)

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for chimneys and stacks and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba , Canada.
  - .2 Indicate following:
    - .1 Methods of sealing sections.
    - .2 Methods of expansion.
    - .3 Details of thimbles.
    - .4 Bases/Foundations.
    - .5 Supports.
    - .6 Guy details.
    - .7 Rain caps.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with applicable Provincial/Territorial regulations CEAA, CEPA, TDGA,.
- .2 Certifications:
  - .1 Catalogued or published ratings: obtained from tests carried out by independent testing agency or manufacturer signifying adherence to codes and standards.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect chimneys and stacks from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove in accordance with Section 01 74 19 Waste Management and Disposal

## **Part 2 Products**

### **2.1 BREECHINGS**

- .1 Shop fabricated 3.5 mm thick mild steel, welded, stainless steel galvanized steel with sweep bends from boiler outlet to thimble or chimney as indicated.

### **2.2 FUELS: PRESSURE CHIMNEY AND BREECHING**

- .1 ULC labelled, 760 degrees C rated.
- .2 Sectional, prefabricated, double wall with mineral wool insulation air space with mated fittings and couplings.
  - .1 Outer seals between sections: to suit application.
  - .2 Inner seals between sections: to suit application.

### **2.3 TYPE B GAS VENT**

- .1 ULC labelled, 288 degrees C rating maximum, atmospheric gas vent only.
- .2 Sectional, prefabricated, double wall with 13 mm air space. Aluminum inner wall. Galvanized steel outer wall. Mated fittings and couplings.

### **2.4 STEEL CHIMNEY REFRACTORY LINED**

- .1 Material:
  - .1 Prefabricated sections with 90 mm thick high temperature impervious insulating refractory lining, centrifugally spun into 3.5 mm thick circular casing.
- .2 Construction:
  - .1 Prefabricated sections, welded at factory on site . Use high temperature insulating cement at joints in refractory lining.
- .3 Welding:
  - .1 To full thickness; grind welds smooth.
- .4 Supports:
  - .1 Welded gussets, cleats and bolts for installation on concrete base.
  - .2 Chimney self cupping laterally braced, as indicated vertically.
  - .3 Concrete base by Section 03 30 00 - Cast-in-Place Concrete.
- .5 Breeching entry:
  - .1 Tee section with 150 mm minimum refractory lined projection.
- .6 Access door: in bottom section.
- .7 Drain connection: at base of stack.
- .8 Dimensions: as indicated.



## **2.5 ACCESSORIES**

- .1 Cleanouts: bolted, gasketed type, full size of breeching, as indicated.
- .2 Barometric dampers: double acting, 70% of full size of breeching area.
- .3 Hangers and supports: in accordance with recommendations SMACNA as indicated.
- .4 Rain cap.
- .5 Expansion sleeves with heat resistant caulking, held in place as indicated.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION - GENERAL**

- .1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.
- .2 Suspend breeching at 1.5 m centres and at each joint.
- .3 Support chimneys at bottom, roof and intermediate levels as indicated.
- .4 Install thimbles where penetrating roof, floor, ceiling and where breeching enters masonry chimney. Pack annular space with heat resistant caulking.
- .5 Install flashings on chimneys penetrating roofs, as indicated.
- .6 Install rain caps and cleanouts, as indicated.

### **3.3 INSTALLATION - REFRACTORY LINED STEEL CHIMNEY**

- .1 Grind welds smooth to form appearance of single tube.
- .2 Seal insulating refractory at top of stack.
- .3 Pack annular space around breeching at entry tee with heat resistant caulking.
- .4 Run drain line from drain connection to .....
- .5 On completion, paint one coat of rust inhibitive primer and two coats of heat resisting paint of colour, make and quality approved by .....

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Boiler Manufacturers Association (ABMA)
- .2 ASME
  - .1 ASME Boiler and Pressure Vessel Code (BPVC), Section VII-2013.
- .3 CSA Group (CSA)
  - .1 CAN1-3.1-77 (R2011), Industrial and Commercial Gas-Fired Package Boilers.
  - .2 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.
  - .3 CSA B139-09, Installation Code for Oil Burning Equipment.
  - .4 CSA B140.7-05 (R2010), Oil Burning Equipment: Steam and Hot-Water Boilers.
  - .5 CSA B149.1-10, Natural Gas and Propane Installation Code.
  - .6 ANSI Z21.13-10 /CSA 4.9-10, Gas-Fired Low-Pressure Steam and Hot Water Boilers.
- .4 Electrical and Electronic Manufacturers Association of Canada (EEMAC)

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for heating boilers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate on drawings:
    - .1 General arrangement showing terminal points, instrumentation test connections.
    - .2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.
    - .3 Foundations with loadings, anchor bolt arrangements.
    - .4 Piping hook-ups.
    - .5 Equipment electrical drawings.
    - .6 Burners and controls.
    - .7 All miscellaneous equipment.
    - .8 Flame safety control system.
    - .9 Breeching and stack configuration.
    - .10 Stack emission continuous monitoring system to measure CO, O, NOx, SO, stack temperature and smoke density of flue gases.
  - .3 Engineering data to include:

- .1 Boiler efficiency at 25%, 50%, 75%, 100%, and 110% of design capacity.
- .2 Radiant heat loss at 100% design capacity.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for heating boilers for incorporation into manual.

### **1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, TDGA and applicable Provincial/Territorial regulations.

### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra materials:
  - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
    - .1 Special tools for burners, access opening, handholes and Operation and Maintenance.
    - .2 Spare parts for 1 year of operation.
    - .3 Spare gaskets.
    - .4 Spare gauge glass inserts.
    - .5 Probes and sealants for electronic indication.
    - .6 Spare burner tips.
    - .7 Spare burner gun.
    - .8 Safety valve test gauge.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect boiler and equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## Part 2 Products

### 2.1 GENERAL

- .1 Packaged boiler:
  - .1 Complete with burner and necessary accessories and controls.
  - .2 Laboratory factory tested at rated capacity to, and bearing seal or nameplate certifying compliance with, CAN1-31, CSA B1407, witnessed and certified by Contract Administrator.
  - .3 Ready for attachment to piping, electrical power, controls, flue gases exhaust.
  - .4 Designed and constructed to ASME Boiler and Pressure vessel Code.
  - .5 CRN (Canadian Registration Number), to CSA B51.
  - .6 Boiler/burner package to bear CGA ULC label.
- .2 Performance:
  - .1 In accordance with American Boiler Manufacturers Association (ABMA), or ANSI Z21.13/CSA 4.9 (gas burning) testing procedures.
  - .2 Firing rate: as per equipment schedule
  - .3 Boiler efficiency: 80 % minimum at 30% to 100% firing rates.
  - .4 Flue gas temperature leaving boiler:
    - .1 Not to exceed 260 degrees C.
    - .2 Above dewpoint conditions at minimum firing rate.
- .3 Electrical:
  - .1 Power: as per equipment schedule
  - .2 Controls: 120 V, 1 phase, 60 Hz.
  - .3 Electrical components: CSA approved.
- .4 Controls: factory wired. Enclosed in EEMAC 1 steel cabinet.
- .5 Thermal insulation:
  - .1 50 mm thick mineral fibre. Seal insulation at handholes, access opening, mudholes, piping connections with insulating cement or asphaltic paint. Finish with heat resisting paint.
- .6 Jackets: heavy gauge metal, finished with heat resisting paint.
- .7 Mounting:
  - .1 Structural steel base, lifting lugs.
- .8 Start-up, instruction, on-site performance tests: 3 days per boiler.
- .9 Trial usage:
  - .1 Departmental Representative, Contract Administrator and Commissioning Agent may use boilers for test purposes prior to acceptance and commencement of warranty period.
  - .2 Supply labour, materials and instruments required for tests.
- .10 Temporary use by contractor:
  - .1 Contractor may use boilers only after written approval from .....

- .2 Monitor and record performance continuously. Keep log of maintenance activities carried out.
- .3 Refurbish to as-new condition before final inspection and acceptance.

## **2.2 MODULAR HOT WATER BOILER, NATURAL GAS PULSE FIRED, CONDENSING TYPE**

- .1 Heating boiler seasonal efficiency rating: 90 %. Flue gas exhaust temperature: 45 to 55 degrees C, when operating in condensing mode.
- .2 Flue gas: individually direct vented. Combustion air: individually drawn from outdoors through plastic pipes as indicated and as recommended by manufacturer.
- .3 Factory-assemble each module to include:
  - .1 Combustion air inlet chamber.
  - .2 Pre-purge blower assembly.
  - .3 Air-gas fuel control valve.
  - .4 Cast pulse combustion chamber.
  - .5 Welded absorption chamber with spiralled fire tubes and exhaust chamber.
  - .6 House assembly in insulated jacket which includes boiler mounted electrical control panel enclosure with operation sequence indicator lights.
  - .7 Provide coupling on combustion air inlet and exhaust chambers for connections of plastic piping, PVC for outside air intake and CPVC for outside exhaust.
  - .8 Provide condensate drain fitting on exhaust chamber.
  - .9 Boiler materials will enable operation with flue gas temperature below dewpoint without corrosion.
- .4 Absorption unit: constructed in accordance with ASME Boiler and Pressure Vessel Code for Low Pressure Heating Boilers for 207 kPa working pressure.
- .5 Controls for each module to include:
  - .1 Solid state controller with auxiliary relay.
  - .2 Fan prove pressure switch and pressure sensing flame safeguard system.
  - .3 Provide combination gas control with:
    - .1 Manual shut off valve.
    - .2 System pressure controlled regulator.
    - .3 Automatic redundant shut off valves.
    - .4 High limit water temperature control with adjustable differential.
    - .5 ASME approved pressure relief valve and temperature/pressure indicator.
- .6 Factory wire each module and operationally test.
  - .1 Each module suitable for individual firing.
  - .2 Step firing accomplished by firing individual modules without reducing their thermal efficiency.
  - .3 Control system: designed and provided for heating plant by manufacturer.
- .7 Acceptable Manufacturers are: Raypak, Buderus, Camus, Patterson Kelly, Aerco, Viessmann

## 2.3 AUXILIARIES

- .1 Provide auxiliaries for each boiler and to meet ASME requirements.
- .2 Hot water boilers:
  - .1 Relief valves: ASME rated, to release entire boiler capacity.
  - .2 Pressure gauge: 90 mm diameter complete with shut-off cock.
  - .3 Thermometer: 115 mm diameter range 10 to 150 degrees C.
  - .4 Low water cut-off: with visual and audible alarms.
  - .5 Auxiliary low water cut-off: with separate cold water connection to boiler.
  - .6 Isolating gate valves: on supply and return connections.
  - .7 Drain valve: NPS 2.
  - .8 Stack thermometer: range 65 to 400 degrees C.
  - .9 Outdoor controller: to reset operating temperature controller.
  - .10 1 set of cleaning tools.
- .3 Pot type chemical feeder.

## 2.4 GAS BURNERS

- .1 General:
  - .1 Forced draft with:
    - .1 Built-in blower to supply combustion air, complete with motor, silencer and damper.
    - .2 High voltage ignition transformer.
    - .3 Flame observation port.
    - .4 Easy access to nozzles and electrodes.
- .2 Gas pilot:
  - .1 To building code and provincial regulations including solenoid gas valve, pressure regulator, pressure gauge, manual shut-off valve.
- .3 Main gas train:
  - .1 To building code and provincial regulations including main shut-off valve, pressure regulator, motorized electric shut-off valve, downstream block-test valve with test connection and pressure gauge.
- .4 Controls:
  - .1 Electronic combustion control relay with flame detector for combustion control and flame supervision.
  - .2 Control to shut off fuel within 5 seconds upon pilot flame or main flame failure or upon signal of safety interlock and to ensure, when restarted, in sequence:
    - .1 Pre-purge.
    - .2 Pilot ignition and supervision.
    - .3 Main gas valve opening.
    - .4 Pilot cut-off. Pilot-proving period not to exceed 10 seconds.
    - .5 Burner operation.

- .6 Post-purge burner shut-down.
- .3 Static pressure interlock. To shut off burner upon loss of combustion air pressure.
- .4 Fuel-air mixture: control through:
  - .1 2-position motor with end switch to provide for low-fire start and high fire run.
  - .2 2-position motor with linkage to control fuel and air and with end switches to prove low-fire start and energize high fire solenoid valve for high-low fire operation.
  - .3 Modulating motor with end switch to provide for low-fire start and fully modulating operation down to 20 % of design capacity.
- .5 Immersion controllers:
  - .1 Operating: to start and stop burner, and operating between adjustable setpoints.
  - .2 High-low: to shift burner operation to high or low fire.
  - .3 Modulating: to modulate burner output.
- .6 Visual and audible alarms: to indicate burner shutdown due to flame failure, low water level, low air pressure, low gas pressure.
- .7 Selector switch: to permit manual and automatic firing at any rate between low and high fire.
- .8 Pilot lights: to indicate:
  - .1 Normal burner operation.
  - .2 All stages of burner operation.
- .9 Burner to start up in low fire position.

## 2.5 EMISSION CONTROL

- .1 Rate of discharge of air contaminants from boiler not to exceed:
  - .1 For nitrogen oxides expressed as nitrogen dioxide:
    - .1 150 ng/J of heat input when fired with solid fossil fuel.
    - .2 110 ng/J of heat input when fired with oil specified as type 4, 5, or 6, according to CGSB classification.
    - .3 43 ng/J of heat input when fired with oil specified as type 1 or 2, according to CGSB classification.
    - .4 22 ng/J of heat input when fired with gaseous fuel.
  - .2 For sulphur dioxide:
    - .1 500 ng/J of heat input when fired with solid fossil fuel.
    - .2 500 ng/J of heat input when fired with oil specified as type 4, 5, or 6, according to CGSB classification.
    - .3 25 ng/J of heat input when fired with oil specified as type 1 or 2, according to CGSB classification.
  - .3 For particulate matter measured undiluted, 160 mg/m<sup>3</sup>, when fired with solid fossil fuel.



- .4 For carbon monoxide, 125 ng/J of heat input.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.3 INSTALLATION**

- .1 Install in accordance with ASME Boiler and Pressure Vessels Code, regulations and authorities having jurisdiction, except where specified otherwise, and manufacturers recommendations.
- .2 Make required piping connections to inlets and outlets recommended by boiler manufacturer.
- .3 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.
- .4 Pipe hot water relief valves full size to nearest drain.
- .5 Pipe blowdown/drain to blowdown tank/floor drain.
- .6 Natural gas fired installations: in accordance with CSA B149.1.

#### **3.4 MOUNTINGS AND ACCESSORIES**

- .1 Safety valves and relief valves:
  - .1 Run separate discharge from each valve.
  - .2 Terminate discharge pipe as indicated.
  - .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.
- .2 Blowdown valves:
  - .1 Run discharge to terminate as indicated.

#### **3.5 FIELD QUALITY CONTROL**

- .1 Commissioning:
  - .1 Manufacturer to:

- .1 Certify installation.
  - .2 Start up and commission installation.
  - .3 Carry out on-site performance verification tests.
  - .4 Demonstrate operation and maintenance.
- .2 Provide Departmental Representative and Contract Administrator at least 24 hours notice prior to inspections, tests, and demonstrations. Submit written report of inspections and test results.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Society of Mechanical Engineers (ASME)
  - .1 ASME Boiler and Pressure Vessel Code, 2010.
- .2 CSA Group (CSA)
  - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

### **1.2 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-Installation Meetings:
  - .1 Convene pre-installation meeting 1 week prior to beginning of construction in accordance with Section 01 31 19 - Project Meetings to:
    - .1 Verify project requirements.
    - .2 Review installation and substrate conditions.
    - .3 Co-ordination with other building subtrades.
    - .4 Review manufacturer's written installation instructions and warranty requirements.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for heat exchangers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Shop drawings to indicate project layout, including layout and dimensions of heat exchangers and system.
    - .1 Indicate manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.
- .4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .7 Manufacturers Reports:
  - .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for heat exchangers for incorporation into manual.

#### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Stock Materials:
  - .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
    - .1 Supply following spare parts:
      - .1 Head gaskets: one.

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

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect heat exchangers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **Part 2 Products**

#### **2.1 EQUIPMENT**

- .1 As indicated on mechanical drawings:
- .2 Acceptable Manufacturers: Bell & Gossett, Wilo/Wessels, SEC Heat Exchangers, Armstrong

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 General: install level and firmly anchored to supports in accordance with manufacturer's recommendations.
- .3 Tube in shell heat exchangers: arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.
- .4 Plate exchangers: install in accordance with manufacturer's recommendations.

### **3.3 APPURTENANCES**

- .1 Install with hose bib drain valve safety relief valve piped to drain.
- .2 Install thermometer wells with thermometers on inlet and outlet of primary and secondary side.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site Tests and Inspections:
  - .1 Perform tests as directed by Manufacturer/Supplier and Contract Administrator to ensure heat exchangers are functional.
  - .2 Obtain reports within 3 days of review and submit immediately to Contract Administrator.
- .2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
- .3 Manufacturer's Field Services:
  - .1 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .2 Ensure manufacturer's representative is present before and during start up .
  - .3 Schedule site visits:
    - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
    - .2 Twice during progress of Work at 25% and 60% complete.

### **3.5 SYSTEM START-UP**

- .1 General: perform start-up operations in accordance with Section 01 91 13 - 1 Commissioning : General Requirements, supplemented as specified herein.
- .2 Check heater for cleanliness on primary and secondary sides.
- .3 Check water treatment system is complete, operational and correct treatment is being applied.
- .4 Check installation, settings, operation of relief valves and safety valves.
- .5 Check installation, location, settings and operation of operating, limit and safety controls.

- .6 General: perform performance verification in accordance with Section 01 91 13 - Commissioning : General Requirements, supplemented as specified.
- .7 Timing: only after TAB of hydronic systems have been successfully completed.
- .8 Primary side:
  - .1 Measure flow rate, pressure drop, pressure and temperature at heater inlet or 2 water temperature at heater inlet and outlet.
    - .1 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.
  - .2 Control valve: verify proper operation without binding, slack in components. Measure either steam pressure and temperature at control valve inlet or 2 if control is three-port type, pressure drop across inlet to common, bypass to common, inlet to bypass.
  - .3 Secondary side:
    - .1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.
    - .2 Verify installation and operation of air elimination devices.
  - .4 Calculate heat transfer from primary and secondary sides.
  - .5 Simulate heating water temperature schedule and repeat above procedures.
  - .6 Verify settings, operation, safe discharge from safety valves and relief valves.
  - .7 Verify settings, operation of operating, limit and safety controls and alarms.
  - .8 Reports:
    - .1 In accordance with Section 01 91 13 - Commissioning: Reports, supplemented as specified herein.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.7 DEMONSTRATION**

- .1 Training: provide training in accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel, supplemented as follows:

### **3.8 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by heat exchanger installation.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 84-2013 , Method of Testing Air-to-Air Heat/Energy Exchangers (ANSI approved).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for energy recovery equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba , Canada.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test Reports:
  - .1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
  - .2 Provide confirmation of testing.
- .6 Manufacturers' Instructions: submit manufacturer's installation instructions.
  - .1 The City of Winnipeg will make available [1] copy of systems supplier's installation instructions.

**1.3 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit maintenance materials in accordance with Section 01 78 00- Closeout Submittals.
- .2 Extra Materials:
  - .1 Furnish list of individual manufacturer's recommended spare parts for equipment include:
    - .1 Bearings and seals.
    - .2 Addresses of suppliers.
  - .2 List of specialized tools necessary for adjusting, repairing or replacing.

**1.4 DELIVERY, STORAGE AND HANDLING**

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

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect energy recovery equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

**Part 2 Products**

**2.1 GENERAL**

- .1 Comply with ASHRAE 84.

**2.2 AIR TO AIR FIXED PLATE EXCHANGER**

- .1 Casing: pre-painted galvanized steel.
- .2 Heat transfer surfaces: corrugated aluminum, edge sealed and bonded to casing.
- .3 Cross contamination: not permitted.
- .4 Condensate drain: NPS 2.
- .5 Removable access panels.
- .6 Performance characteristics: as indicated.
- .7 Acceptable Manufacturers are : Lifebreath, VenMar, Renewaire, Vanee, Nu-Air, Fantech

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for energy recovery equipment installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of the City of Winnipeg.
  - .2 Inform the City of Winnipeg, of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the City of Winnipeg. .

**3.2 INSTALLATION**

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of adjacent ductwork with flexible connections.



- .3 Install access doors in accordance with Section 23 33 00- Air Duct Accessories for access to coils and dampers.

### **3.3 FIELD QUALITY CONTROL**

- .1 Tests:
  - .1 Perform tests in accordance with Section 26 05 00- Common Work Results for Electrical.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00- Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00- Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19- Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
  - .1 ANSI/AHRI 430-10, Performance Rating of Central Station Air-Handling Units.
- .2 American National Standards Institute/American Society of Heating, Refrigeration and Air Condition Engineers/Illuminating Engineering Society (ANSI/ASHRAE/IES)
  - .1 ANSI/ASHRAE 52.2-2012, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
  - .2 ANSI/ASHRAE/IES 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .3 Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual - current edition.
    - .1 MPI #18.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for insulation, filters, adhesives, and paints and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate on drawings ; include performance data.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air handling equipment for incorporation into manual.

### **1.4 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide 1 spare sets of filters.
- .3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .4 Spare filters: in addition to filters installed immediately prior to acceptance by City, supply 1 complete set of filters for each filter unit or filter bank.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect air handling equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated.
- .2 Certify ratings: to ANSI/AHRI 430 with AHRI seal.
- .3 Units to consist of cabinet and frame, supply fan, heat exchanger, burner with integral induced draft fan, heater control, air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper.
- .4 Acceptable Manufacturers are: Daikin, Trane, Carrier, Lennox, Engineered Air, York, Johnson Controls.

### **2.2 CABINET**

- .1 Cabinets: weatherproofing tested and certified to AGA rain test standards and soundproofing tested to ARI 270.
- .2 Framing and supports: 2 mm thick welded steel, galvanized after manufacture, with lifting lugs at base of unit.
- .3 Outer casing: weathertight 1.2mm thick galvanized steel with baked enamel finish, complete with flashing.
- .4 Access: removable gasketed hinged doors or panels with quick locking door handle type fasteners.
- .5 Insulation: neoprene coated glass fiber on surfaces where conditioned air is handled, 50mm thick, 32kg/m<sup>3</sup> density.
- .6 Line casing with steel liner.

### **2.3 ACOUSTIC LINER**

- .1 Ensure that expanded polystyrene and polyurethane insulation materials were not produced with ozone depleting substances.
- .2 Insulate internal surface of panels with 50 mm neoprene coated rigid duct liner of 72 kg/m<sup>3</sup> density.
  - .1 Apply with 100% coverage of adhesive with clip pins.
  - .2 Cover with 0.8 mm thick perforated galvanized sheet metal.

- .3 Cover leading and trailing edges with sheet metal nosing and at edges around access doors and panels complete with 15 mm overlap.

## **2.4 DRAIN PANS**

- .1 Construction: rounded corners.
- .2 Construction: rounded corners.
- .3 Insulation: external foam type, minimum 13 mm thick.
- .4 Drain connection: in bottom at low point.
- .5 Installation: slope without sag minimum 1% to ensure no standing water at any time or at any point.
- .6 Dimensions: minimum 75 mm from upstream face of coil to 150 mm beyond downstream face of coil or eliminator and to include return bends and headers.

## **2.5 FANS**

- .1 Centrifugal, forward curved impellers, statically and dynamically balanced. Multi V belt drive with adjustable variable pitch motor pulley, spring isolated hinge mounted motor fan and motor integrally mounted on isolation base, separated from unit casing with flexible connections and spring isolators. Vibration isolators: 95% efficiency.

## **2.6 VIBRATION ISOLATION**

- .1 Flexible connections at inlet and outlet of fan: to Section 23 33 00 - Air Duct Accessories.

## **2.7 FILTER BOX**

- .1 Material to match casing. .
  - .1 Provide access to filter through access door with suitable hardware.
- .2 Provide blank-off plates and gaskets to prevent air bypass.
- .3 Filters: in accordance with Section 23 44 00 - HVAC Air Filtration.
  - .1 Immediately prior to occupancy, replace filtration media with new filtration media with Minimum Efficiency Reporting Value (MERV) of 13 in accordance with ANSI/ASHRAE 52.2.
- .4 Filters:
  - .1 Minimum Efficiency Reporting Value (MERV) value 8 filtration media to ANSI/ASHRAE 52.2, to be used on return air section of air handling unit.
  - .2 Immediately prior to occupancy, replace filtration media with new filtration media with Minimum Efficiency Reporting Value (MERV) of 13 in accordance with ANSI/ASHRAE 52.2.

## **2.8 MIXING BOX**

- .1 Material to match casing and produce uniformly mixed air temperature within plus or minus 5 degrees C of design across face of outlet.
- .2 Dampers for mixing boxes: Section 23 33 15 - Dampers - Operating.

## 2.9 COILS

- .1 Capacity: as indicated.
- .2 Ratings: AHRI certified.
- .3 Construction:
  - .1 Casings: 1.5 mm thick galvanized sheet steel.
    - .1 Supports of galvanized steel .....
    - .2 Supports of galvanized steel
    - .3 Blank-off plates. Insulated sandwich construction.
  - .2 Direct expansion refrigerant coils:
    - .1 Arranged to prevent trapping of oil.
      - .1 Liquid distributors to ensure even distribution of liquid refrigerant to all circuits.
      - .2 Silver solder or braze joints in refrigerant tubing.
      - .3 Evacuate and charge coil with nitrogen and seal before sending to site.
    - .2 Tubes: copper.
    - .3 Headers: copper.
    - .4 Pressure tests: to Canadian Refrigeration Code. Dehydrated. Sealed with nitrogen charge.

## Part 3 Execution

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.

### 3.3 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

### **3.4 DRIP PANS**

- .1 Install deep seal P-traps and trap seal primer on drip lines.
  - .1 Depth of water seal to be 1.5 times static pressure at this point.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American Gas Association (AGA)
- .2 American National Standards Institute/Air-Conditioning, Heating and Refrigeration Institute (ANSI/AHRI)
  - .1 ANSI/AHRI 210/240-08, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - .2 ANSI/AHRI 270-08, Sound Rating of Outdoor Unitary Equipment.
- .3 CSA Group (CSA)
  - .1 CSA B52-05, Mechanical Refrigeration Code.
  - .2 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
- .4 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 Underwriters Laboratories (UL)
  - .1 UL 1995-11, Standard for Heating and Cooling Equipment.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for outdoor HVAC equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Drawings to indicate project layout and dimensions; indicate:
    - .1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.
    - .2 Piping, valves, fitting shipped loose showing final location in assembly.
    - .3 Control equipment shipped loose, showing final location in assembly.
    - .4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

- .5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.
- .6 Pump and fan performance curves.
- .7 Details of vibration isolation.
- .8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.
- .9 Type of refrigerant used.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturer's Field Reports:
  - .1 Submit manufacturer's field reports specified.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for outdoor HVAC equipment for incorporation into manual.
  - .1 Indicate: brief description of unit, indexed, with details of function, operation, control, and service for components.
  - .2 Provide for units, manufacturer's name, type, year, number of units, and capacity.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect outdoor HVAC equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### **1.5 WARRANTY**

- .1 For Work of this Section 23 74 00 - Packaged Outdoor HVAC Equipment, 12 months warranty period is extended to 60 months.
- .2 Contractor hereby warrants that packaged rooftop HVAC units and refrigeration compressors will function and operate in accordance with the City's requirements, but for 5 years (provide separate price for shorter warranty period).



## **Part 2 Products**

### **2.1 GENERAL**

- .1 Self-contained and bear label of CSA, CGA.
- .2 Units to consist of cabinet and frame, supply fan, exhaust fan, heat exchanger, burner with integral induced draft fan, heater control, air filter, refrigerant cooling coil, compressor, condenser coil and fans, motorized outside air damper, return damper, exhaust damper.
- .3 Prefabricated base rails to sit on grade level concrete pad.
- .4 Conform to ANSI/AHRI 210/240, rating for unit larger than 40 kW nominal.

### **2.2 SCOPE**

- .1 Furnish and install, where indicated, a factory assembled fully enclosed packaged environmental control system with energy recovery feature(s) designed for natatorium environmental control. Features shall include:
  - .1 Dehumidification by means for a direct expansion evaporator coil
  - .2 Space heating by means of a packaged indirect-fired natural gas duct furnace module.
  - .3 Cooling mode with heat rejection to a packaged outdoor air cooled fluid cooler (dry-cooler)
  - .4 Packaged minimum exhaust fan
  - .5 Integral minimum outdoor air connection
  - .6 Heat recovery by means of a glycol run around loop between the minimum exhaust and minimum outdoor air streams.
  - .7 Convenience outlet and light included factory mounted in control cabinet, powered and wired separately.
  - .8 Internet connectivity for 2 years via cell based technology.

### **2.3 QUALITY AND SAFETY ASSURANCE**

- .1 The system shall be ETL listed
- .2 The system shall be completely assembled, wired, piped, and test-run at the factory prior to shipping. All controls shall be factory adjusted to satisfy the design conditions.
- .3 Manufacturer shall have a minimum of ten-plus years prior experience making similar equipment as described in this specification.
- .4 Where possible, the system shall have a mechanical vestibule where the electrical panel, compressor (s), pool water heat exchanger (s), receiver(s) and most of the refrigeration controls are out of the process air stream.
- .5 Warranty: The entire system shall have a 24 month limited parts warranty from the factory ship date
  - .1 A 1 year labour warranty shall be provided by the manufacturer when the system is connected to the factory via an internet monitoring system from the date of initial commissioning.

- .6 When connected to a network with internet access, the system shall have remote service capability with the ability for field service technicians to receive service and trouble alerts by email and make parameter adjustments via a browser interface on any internet capable device .

## 2.4 GENERAL

- .1 The natatorium control system shall include:
  - .1 Mechanical process dehumidification
  - .2 Outdoor cabinet configuration
  - .3 packaged outdoor air cooled fluid cooler (dry cooler) for AC heat rejection
  - .4 A packaged indirect fired natural gas duct furnace module installed downstream of the blower, sized as specified by the design engineer to meeting the skin losses and outdoor air heating loads.
  - .5 Pool heating via pool water to fluid titanium heat exchanger providing premium unmatched chemical resistance for saltwater and chlorine pool water.
  - .6 Air filtration via MERV-13 pleated panel filters for return.
  - .7 Minimum exhaust fan (s)
  - .8 Heat recovery between the minimum exhaust air and outdoor streams and via a glycol run around loop.
  - .9 A service vestibule where the compressor, refrigeration specialties, control valves and all electronics are outside of process air stream.
  - .10 Convenience outlet and light included factory mounted in control cabinet, powered and wired separately.

## 2.5 SEQUENCE OF OPERATION

- .1 The system shall be designed and sized to maintain the specified space conditions.
  - .1 System Start Up
    - .1 Power is turned on or the system is restarted
    - .2 After a short initial delay to allow the sensors to stabilize, the blower starts and operates continuously
    - .3 Based on sensor feedback, the system shall begin or resume operation based on the sequence below
  - .2 Airside Configuration
    - .1 The system continuously delivers the specified supply air volume to the natatorium
    - .2 The minimum exhaust air volume is set to meet the engineer's schedule
    - .3 The minimum outdoor air volume is set to meet the engineer's schedule
  - .3 Dehumidification Mode
    - .1 The return air relative humidity is above the humidity set point.
    - .2 Return air dewpoint is above dewpoint setpoint
    - .3 The compressor enters the Compressor Start sequence

- .4 If the system cannot maintain the relative humidity below setpoint, the second compressor circuit will start cooled heat exchanger in parallel.
  - .5 The reheat coils are fully modulating (0-100%). The reheat output will modulate to maintain the space temperature at set point year-round. Reheat coils are on off or only give heat from one circuit are not acceptable since they do not closely match the requirement of the space and cause swings in space conditions.
- .4 Air Conditioning Mode
- .1 The return air temperature is above room temperature set point
  - .2 The compressor starts, if not already operating Dehumidification Mode
  - .3 Excess compressor hot gas is diverted to a fluid-cooled heat exchanger. Up to 100% compressor heat is rejected into the glycol fluid loop which is pumped outdoors to an outdoor air cooled heat exchanger for 100% heat rejection at summer design ambient conditions.
  - .4 100% of compressor heat is rejected at the outdoor air cooled heat exchanger on a summer design day. On off peak days, the air reheat output will modulate to maintain the space temperature at the set point .
  - .5 If the system cannot maintain the return air temperature setpoint, the second compressor will start.
- .5 Space Heating Mode
- .1 The return air temperature is below the room temperature setpoint
  - .2 The microprocessor space heating output signal (0-10 volts) is sent to the heating coil controller. The signal output will regulate based on the return air temperature.
- .6 Pool Water Heating Mode
- .1 The return pool water temperature is below the pool water setpoint and the pool water flow switch or minimum temperature differential is satisfied.
  - .2 if the compressor is already operating due to a Dehumidification or Air Conditioning demand, the fluid control valve will divert fluid to the Titanium pool water heat exchanger to modulate the heating of the pool water. Pool water heating that does not use a titanium pool water heater or modulation
  - .3 If there is no preexisting demand for the compressor to operate, the microprocessor sends a signal to the auxiliary pool water heater ( remote by others) to operate. The compressor will not operate solely for a pool water heating demand unless specifically configured to do so at the controller. Aux Pool Heat contact will be closed with insufficient flow. In order to prevent the pool from overheating, it is recommended that a field-installed aquastat (provided by others) be installed in series with these wires.
  - .4 Factory installed relay (s) and factory furnished, field-installed pool water temperature sensor(s) are provided to enable the smart pool feature. This feature provides the ability to activate booster pool water pump (s) feeding the unit when pool water heating is in demand.

- .7 Exhaust Air Heat Recovery Mode
  - .1 The minimum outdoor air damper and minimum exhaust fan (s) are tied to the system's occupancy schedule and will operate as programmed.
  - .2 Once the outdoor air temperature falls below the heat recovery setpoint (65 degrees F by default; field - adjustable) the glycol pump shall circulate a glycol mixture between the exhaust air and the outdoor air heat recovery coils, recovering heat from the space condition exhaust air and using it to preheat the incoming outside
- .8 Freeze Protection
  - .1 The supply air temperature falls below the freeze setpoint
  - .2 Exhaust fan (s) are stopped and outdoor air damper (s) are fully closed
  - .3 When the freeze alarm is tripped, it must be manually cleared by the operator.

## 2.6 CABINET

- .1 Cabinet Construction: All cabinet 16, 20 and 24 gauge sheet metal shall be galvanized G90 steel or Galvalume™ alloy with mill-applied zinc phosphate primer followed by an exterior grade white silicone modified polyester top coat. The sheet metal is engineered to form a cabinet with maximum strength and rigidity. All seams shall be caulked with silicone to prevent air and water leakage or infiltration
  - .1 Base Rails: The cabinet shall have a base frame comprised of 2 layers of 10 gauge mill galvanized G90 steel. Lifting lugs shall be provided on the base frame for rigging the system
  - .2 The cabinet walls shall be of double-wall construction using 20 gauge pre-painted steel with a fully painted inner metal liner and 2 inches of fiberglass insulation.
  - .3 The cabinet floor shall be comprised of a 16 gauge galvanized steel panel with a 20 gauge pre-painted steel inner liner, 2 inch double wall engineered with structural bending for a maximum rigidity and be mechanically fastened to the base frame of the unit .
  - .4 The cabinet roof shall be 20 gauge pre-painted steel, 2 inch double wall engineered with structural bending for maximum rigidity and be mechanically fastened to the base walls of the unit.
  - .5 The cabinets shall be mechanically assembled with stainless steel 5/32 inches sealed blind rivets. where bolts are required bright zinc plated bolts shall be used
  - .6 Access doors shall be supported on multiple hinges, held shut by compression latches for quick access. Doors shall be provided for entrance to all sections housing components requiring routine maintenance. Full height access doors shall have "hold back" latches to prevent door closure during the performance of service procedures.
  - .7 The unit shall have non-corroding protective mesh screens on all air intake openings.
  - .8 The system shall have non-corroding protective mesh screens covering internal fan blades, protective grates covering all floor access ports.

- .2 Outdoor Air Intake
- .3 Insulation: The unit shall be insulated per the following standards:
  - .1 All exterior cabinet sections shall be insulated with two (2) inch thick fibreglass inside the double walled cabinet
  - .2 Fire resistant rating to conform to NFPA Standard 90A and 90B
  - .3 Sound attenuation coefficient shall not be less than 1.02 at a frequency of 1,000Hz as per ASTM Standard C423
- .4 Cabinet configuration shall include:
  - .1 A filter rack with separate access doors shall be provided for the return air and minimum outdoor streams
  - .2 Mechanical vestibule: The unit shall have the compressor , receiver, solenoid valves and the electrical panel in a separate compartment out of the processed air stream. All components shall be serviceable while the unit is in operation without disturbing the airflow.
  - .3 Electrical panel: The unit shall have a built-in in a separate compartment in order not to disturb the airflow within the dehumidifier during electrical servicing. All electrical components shall be mounted on a 16 gauge galvanized sub-panel.

## **2.7 FILTERS**

- .1 Wherever possible, air filters shall be standard sized, replaceable, off-the-shelf filters including:
  - .1 Exhaust Air: 2 inch MERV 8, 30% pleated filters with rust free non metallic structure
  - .2 Return Air: 2 inch MERV 13 90% pleated filters with rust free non metallic structure on a slide in or face loading rack
  - .3 Outside Air: 2 inch MERV 13 90% pleated filters with rust free non metallic structure
  - .4 Dirty air filter switches included on the return air filter for indicating an alarm when pressure drop exceeds a set point.

## **2.8 COILS**

- .1 Evaporator/dehumidifies coils shall be designed for maximum moisture removal capacity
  - .1 Coils shall be fully dipped and coated with a polyester/enamel coating for maximum corrosion protection. coating shall comply with ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salt and gases.
  - .2 Coil shall have galvanized casing and end plates
  - .3 Aluminum fin and copper tubes mechanically bonded to assure high heat transfer
- .2 Air reheat coils shall be sized for variable heat transfer into the air with a capacity of 100% of the compressors total required heat of rejection. Air reheat coils that are on off will cause unstable space conditions and are not acceptable.
  - .1 Coils shall be fully dipped and coated with polyester/enamel coating for maximum corrosion protection. Coating shall comply ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salt and gases

- .2 Coil shall have galvanized casing and end plates
- .3 Aluminum fin and copper tubes mechanically bonded to assure high heat transfer
- .3 Heat recovery Coils
  - .1 The unit shall have heat recovery between the minimum exhaust and outdoor air streams per specifications:
    - .1 The heat recovery coils shall be sized for heat transfer between the two air streams
    - .2 The heat recovery fluid circulating between coils shall be glycol . The module shall be a complete package and independent circuit that includes a circulating pump, fill valves and expansion tank.
  - .2 Coils shall be fully dipped and coated with a polyester/enamel coating for maximum corrosion Aluminum fin and copper tubes mechanically bonded to assure high heat transfer protection. Coating shall comply with ASTM B117 and ASTM D2126 for corrosion resistance against common acids, salt and gases.
  - .3 Aluminum fin and copper tube joints mechanically bonded to assure high heat transfer
  - .4 Plate heat recovery that will add fan horsepower and therefore have a negative effect on energy saving are not acceptable. Strategies that use the main compressors to cool exhaust air to try and act as heat recovery cannot be used in place of full time heat recovery because the compressors will not be running in the coldest months requiring heat recovery the most

## **2.9 DRAIN PANS**

- .1 Each evaporator coil shall be provided with a positive draining , compound sloped baked powder paint coated aluminum drain pan with fully welded corners to ensure zero water retention. In no way will stainless steel or galvanized drain pans be acceptable.

## **2.10 BLOWERS AND BLOWER MOTORS**

- .1 Supply blowers
  - .1 The multiple direct driven supply air blower wheels shall be a parallel mounted array. Blowers shall be a single width/single inlet airfoil plenum type, secured a machined, ground and polished solid steel shaft. The wheel shall be G90 galvanized steel with baked powder paint coating. The shaft shall be coated with a rust inhibitor.
  - .2 The complete blower assembly shall be statically and dynamically balanced on precision electronic balancers
  - .3 The blower assembly shall be mounted on a 1 inch deflection spring isolated rack.
  - .4 The fan inlets shall be equipped with accidental contact protection screen
  - .5 Motor(s) shall be Premium efficiency painted cast iron construction TEFC, NEMA MG1-PART 3 inverter Duty 15:1 Constant Torque Severe Duty with a service factor 1.25. Motors shall be 6 Pole 1200RPM synchronous speed with HOA switch with motor safeties against overloading at 60 Hz operation directly on mains. Motors shall have double lip seals on both ends with re-greaseable bearings 254T frame and larger with Polyurea grease.

- .6 At least on motor shall be provided with a low motor noise starting torque VFD for air balancing purposes. The VFD shall have a drive efficiency of 96 to 98% with displacement power factor of 0.98, output maximum frequency of 400Hz with torque boost. The VFD shall have protective features including: torque limit, heat sink over temperature, current limiting DC bus fuse, electronic motor overload with phase to phase and ground fault short circuit protection; current limit, over/under torque protection, over/under voltage protection, short circuit current rating of 30kA rms symmetrical and 100kA rms symmetrical.
- .2 Exhaust blower
  - .1 The packaged exhaust blower (EF1) shall be sized to maintain negative pressure requirement in the space during normal operation and its operation tied to the systems occupancy scheduler.
  - .2 The blower shall be impeller plenum fan complete with backward curved, three - dimensional, profiled blades made of high performance composite material. The blower shall be completely corrosion resistant and be maintenance free a direct drive via a direct current (DC) electronic commuted (EC) motor. the EC\_Motor shall have zero slippage design and have continuously variable speed control when connected to the unit's controller.
  - .3 The fan assembly shall be balanced in Class G6.3 acc DIN ISO 1940, Dynamic on two levels.
  - .4 The fan assembly shall be suitable for ambient temperatures of -40 degrees C to a max of + 70 degrees C.
  - .5 Thermal contacts installed in the windings compliant with THCL 155
  - .6 Drive motor in external rotor principle, sealed in protection class IP154 with moisture protection impregnation of the windings, topical protection
  - .7 High corrosion resistance design with high quality and reliability
  - .8 The exhaust fan shall be controlled from an end switch on the power open of the exhaust air damper. The exhaust dampers shall be protected by louvers to divert rain from the face of the dampers
  - .9 Shall be packaged with the heat recovery module.

## **2.11 DAMPERS**

- .1 Internal dampers shall be made from extruded anodized aluminum with a parallel blade configuration and neoprene double-seal tips to minimize leakage. Damper blades shall be mounted on steel rods which rotate on nylon bushings. All damper hardware shall be corrosion resistant
  - .1 The system shall be provided with normally closed outside air and exhaust air dampers equipped with spring-return actuators. The dampers adjust between 0% and 100% to open position.
  - .2 The outdoor air and exhaust air dampers shall be of opposed blade configuration. Dampers shall have 0.750 inch insulated blades made from extruded anodized aluminum with neoprene double-seal tips to minimize leakage. Damper leakage shall be less than 10% maximum flow at 4 inch water column differential. damper blades shall be mounted on steel rods which rotate on nylon bushings. All damper hardware shall be corrosion resistant.

## **2.12 POOL WATER HEATER**

- .1 The pool water heater shall be Titanium Gasketed Flt Plate heat exchanger. Heat exchanger that are not titanium are not acceptable since they increase the City's liability .
- .2 The pool water heater shall be Titanium Flat Plate heat exchanger
- .3 Heat exchanger will be modulating. On/off pool water heaters are not acceptable.
- .4 Pool heaters that when breached allow water into the refrigeration system are not allowed.
- .5 Terminating connections are PVC schedule 40 NPT fittings located at the cabinet wall for easy connection
- .6 The maximum circuit pressure rating is 100psi

## **2.13 COMPRESSORS**

- .1 Hermetic, scroll action compressor , suction gas cooled, suitable for refrigerant R-410A
- .2 The compressor (s) shall be mounted on rubber-in-shear isolators to limit the transmission of noise and vibration
- .3 The compressor(s) shall be equipped with removable crankcase heater (s) for liquid migration protection
- .4 The compressor (s) shall be located outside the conditioned air stream in the system's service vestibule
- .5 The compressor manufacturer must have a wholesale outlet for replacement parts in the nearest major city.

## **2.14 REFRIGERATION CIRCUIT**

- .1 The system shall consist of two factory sealed circuits for dehumidification and sensible cooling. No site refrigeration work shall be required.
- .2 Each refrigeration circuit shall have pressure transducers monitoring the refrigeration discharge (high) and suction (low) pressures. The refrigeration circuit shall be accessible for diagnostics, adjustment and servicing without the need for service manifold gauges.
- .3 All refrigeration circuits shall have solenoid control valves, check valves, a liquid line filter-drier, liquid and moisture indicator, thermostatic expansion valve and a pump solenoid valve.
- .4 The system shall have an externally adjustable balanced port design mechanical thermostatic expansion valve, The valve shall have a removable power head
- .5 Tamper proof, hermetically sealed non adjustable high and low pressure switches and refrigeration service valves shall be installed using Schrader type valves. refrigeration service valves shall be located outside the airstream.
- .6 The receiver shall have two refrigeration level ( maximum and minimum) indicating sight glasses
- .7 The suction line shall be fully insulated with 0.500 inch closed cell insulation
- .8 The maximum operating pressure for glycol loop is 100 psi. The glycol loop temperature should not exceed 134 degrees F.



## 2.15 CONTROL PANEL

- .1 The Electrical Subcontractor shall be responsible for external power wiring and disconnect switch fusing. Power block terminals shall be provided.
- .2 The system shall include a factory installed fused disconnect
- .3 Main control panel shall be mounted inside the service vestibule outside of the process air stream
- .4 Blower motors shall be protected with thermal trip overloads.
- .5 The system shall have a voltage monitor with phase protection
- .6 Available dry contacts include
  - .1 Alarm
  - .2 Blower interlock
  - .3 Stage 1 and 2 heating
  - .4 Outdoor air damper control
  - .5 Remote exhaust fan #1
  - .6 Remote exhaust fan #2
  - .7 Outdoor air cooled equipment
  - .8 System on
  - .9 Auxiliary pool heater 1
  - .10 Heat recovery
- .7 Terminals shall be provided to send 24 volt power to the outdoor air cooled condenser or fluid cooler fan contactor
- .8 All wiring shall be installed in accordance with UL or CSA safety electrical code regulations and shall be in accordance with the NFPA. All components used in the system shall be UL or CSA listed.
- .9 Wiring diagrams shall be located near the electrical panel (s) on the system. These diagrams shall provide colour coding and wire numbering for easy troubleshooting. All wires shall be contained in a wire duct.
- .10 The compressor (s) shall have a time delay on start to prevent short cycling
- .11 An airflow switch and a dry contact for alarm (s) shall be provided and factory mounted.
- .12 Convenience outlet and light included factory mounted in control cabinet, powered and wired separately.

## 2.16 AIR HEATING

- .1 The packaged indirect fired natural gas duct furnace module shall be sized to meet the scheduled heating capacity and have the following characteristics
  - .1 Modulating (0-10V) auxiliary air heat control
  - .2 The duct furnace module shall be a natural gas indirect- fired type using spark ignition with a heating capacity as shown in this submittal and is installed in a 'blow through' configuration downstream from the blower . The heat exchanger tubes are constructed of formed and welded 16 gauge series 4098 stainless steel suitable for installation downstream of the cooling coil and satisfactory for air

- inlet temperatures below 40 degrees F. Th burner is the power firing type and incorporates a primary combustion air blower and spark ignition transformer
- .3 Standard controls shall include a modulating gas valve, intermittent spark ignition, overheat control, rollout flame supervision, combustion air flow proving switch, positive burner safety switch, pilot cock, main gas cock, with 100% shut off, adjustable main and pilot pressure regulators.
  - .4 The natural gas duct furnace module shall be an ETL recognized component. The gas train shall be complete with all controls factory mounted to comply with requirements of ETL. The gas train is complete with a modulating main gas valve and is ready for connection to a natural gas supply with pressure between 7 in and 14 in WC.
  - .5 The complete system shall be test fired and preliminary adjustments made prior to leaving the factory

## **2.17 AIR CONDITIONING**

- .1 Air cooled air conditioning via a fluid cooler
  - .1 The system shall be equipped with an air conditioning mode where excess compressor heat is rejected to a factory packaged integral outdoor air cooled heat exchanger (aka Dry Cooler) via a single glycol fluid loop. No site refrigeration work shall be required. The packaged fluid cooled condenser and outdoor air cooled heat exchanger shall both be capable of rejecting 100% of the compressor heat rejection with an air on temperature at summer design conditions.
  - .2 The system shall be provided with a dry contact rated for 24VAC/5A to operate the remote outdoor fluid cooler control
  - .3 Each refrigeration circuit shall include refrigeration valves, a receiver with pressure relief valve set at 650 psig, a pressure control valve and a pressure differential valve, and two manual shutoff valves to isolate the outdoor fluid cooler .
  - .4 Coils shall be tested at 425PSIG and mounted vertically for complete surface utilization. Coils shall be counter flow and have adequate capacity to dissipate the total heat rejection of the system at design conditions.

## **2.18 FACTORY PERFORMANCE TESTING**

- .1 The system shall be thoroughly tested under factory test conditions.

## **2.19 PRODUCT DELIVERY, ACCEPTANCE, STORAGE AND HANDLING**

- .1 Perform a thorough physical inspection of the system upon delivery from the shipment carrier
- .2 Identify and immediately report any physical damage to manufacturer
- .3 If the system is to be stored prior to installation, store in a clean , dry place protected from weather, dirt , fumes, water, construction and physical damage
- .4 Handle the system carefully during installation to prevent damage
- .5 Damaged systems or components shall not be installed. Contact the manufacturer for RMA instructions.

- .6 Comply with the manufacturers rigging and installation instructions for unloading the system and moving it into position.

## **2.20 CONNECTIONS**

- .1 Where installing piping adjacent to the system, allow space for service and maintenance
- .2 Duct connections: drawings indicate the general arrangements of the ducts. Connect the system to ducts with flexible duct connectors. Comply with code requirements for flexible connectors.
- .3 Electrical connections: comply with code requirements for power wiring, switches and motor controls in electrical sections.

## **2.21 INSTALLATION**

- .1 The agency responsible for start-up should work in accordance with the specifications and in accordance with the manufacturer's instructions and only by workers experienced in this type of work.

## **2.22 START UP**

- .1 Detailed instructions for start up as provided by the manufacturer
- .2 Installing contractor must contact the manufacturer prior to start up to confirm start up procedures.
- .3 Remote internet access and control must be initiated and confirmed by the factory prior to start up for extended labour warranty to be in effect.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Install as per manufacturers' instructions on roof curbs.
- .2 Manufacturer to certify installation, supervise start-up and commission unit.
- .3 Run drain line from cooling coil condensate drain pan to discharge over roof drain.

### **3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and

- submit written reports, in acceptable format, to verify compliance of work with Contract.
- .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
  - .3 Schedule site visits to review work at stages listed:
    - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
    - .2 Twice during progress of work at 25% and 60% complete.
    - .3 Upon completion of work, after cleaning is carried out.
  - .2 Obtain reports within 3 days of review and submit immediately to Contract Administrator.
  - .3 Performance Verification:
    - .1 General:
      - .1 In accordance with Section 23 08 16- Cleaning and Start-up of HVAC Piping Systems, supplemented as specified herein.
    - .2 Air Handling Units:
      - .1 Set zone mixing dampers for full cooling, except that where diversity factor forms part of design set that percentage of zone dampers to full heating.
      - .2 Set outside air and return air dampers for minimum outside air.
      - .3 Check for smooth, vibration less correct rotation of supply fan impeller.
      - .4 Measure supply fan capacity.
      - .5 Adjust impeller speed as necessary and repeat measurement of fan capacity.
      - .6 Measure pressure drop each component of air handling unit.
      - .7 Set outside air and return air dampers for the percentage of outside air required by design and repeat measurements of fan capacity.
      - .8 Reduce differences between fan capacity at minimum and maximum outside air less than 5 %.
      - .9 Reduce difference between fan capacity at full cooling and fan capacity at full heating to less than 5 %.
      - .10 OAD: verify for proper stroking, interlock with RAD.
      - .11 Measure DBT, WBT of SA, RA, EA.
      - .12 Measure air cooled condenser discharge DBT.
      - .13 Measure flow rates (minimum and maximum) of SA, RA, EA, relief air.
      - .14 Simulate maximum cooling load and measure refrigerant hot gas and suction temperatures and pressures.
      - .15 Simulate maximum heating load and:
        - .1 Verify temperature rise across heat exchanger.

- .2 Perform flue gas analysis. Adjust for peak efficiency.
- .3 Verify combustion air flow to heat exchanger.
- .4 Simulate minimum heating load and repeat measurements.
- .16 Measure radiated and discharge sound power levels under maximum heating demand and under maximum cooling demand with compressors running.
- .17 Verify operating control strategies, including:
  - .1 Heat exchanger operating and high limit.
  - .2 Early morning warm-up cycle.
  - .3 Freeze protection.
  - .4 Economizer cycle operation, temperature of change-over.
  - .5 Alarms.
  - .6 Voltage drop across thermostat wiring.
  - .7 Operation of remote panel including pilot lights, failure modes.
- .18 Set zone mixing dampers for full heating and repeat measurements.
- .19 Measure leakage past zone mixing dampers by taking temperature measurements. Reduce leakage to less than 5 %.
- .20 Measure exhaust fan capacity
- .21 Adjust impeller speed as necessary and repeat measurement of exhaust fan capacity.
- .22 Check capacity of heating unit.
- .23 Measure DX refrigeration system performance .
- .24 Refer to other sections of these specifications for PV procedures for other components.
- .3 Start-Up:
  - .1 General: in accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.
- .4 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.
- .5 Verify accessibility, clean ability, drainage of drain pans for coils, humidifiers.
- .4 Commissioning Reports:
  - .1 In accordance with Section 01 91 13 - Commissioning: reports supplemented as specified herein. Include:
    - .1 Report forms as specified Section 01 91 13 - Commissioning: Report Forms and Schematics.

### **3.4 DEMONSTRATION**

- .1 Training: in accordance with Section 01 91 13 - General Commissioning Requirements: Training of O&M Personnel, supplemented as specified.

### **3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Perform cleaning operations in accordance with manufacturer's recommendations.
- .4 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)
  - .1 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particulate Size.
  - .2 ANSI/ASHRAE 127-2007, Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners.
- .2 ASTM International (ASTM)
  - .1 ASTM C547-11, Specification for Mineral Fiber Pipe Insulation.
- .3 CSA Group (CSA)
  - .1 CSA B52-05 (R2009), Mechanical Refrigeration Code.
  - .2 CAN/CSA-C656-05 (R2010), Performance Standard for Single Package Central Air-Conditioners and Heat Pumps.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for air conditioning components and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2 Indicate on drawings:
    - .1 Major components and accessories including sound power levels of units.
    - .2 Type of refrigerant used.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for air conditioning components for incorporation into manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect air conditioning components from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

## **1.5 WARRANTY**

- .1 For computer room air conditioning 12 months warranty period is extended to 60 months.
- .2 Contractor hereby warrants that computer room air conditioning will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with the City's requirements, but for 5 years.
- .3 Contractor hereby warrants that computer room air conditioning will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with contract, but for 5 years.

## **Part 2 Products**

### **2.1 DESCRIPTION**

- .1 Integrated package: to CAN/CSA-C656.
- .2 Cooling and dehumidifying capacity, with fan heat extracted: based on computer room environment of 22 degrees C dry bulb and 50 % R.H. (plus or minus 1 degree C and 5% R.H.), with minimum supply air temperature of 14 degrees C and minimum control dead-band of 3 % R.H. separating humidification and dehumidification.
- .3 Unit controls not to permit dehumidification and humidification to occur simultaneously.
- .4 Fan capacity to provide for dry coil operation at 22 degrees C and 50% R.H..

### **2.2 CABINET**

- .1 Free standing, welded steel, unit construction, corrosion protected, 20 mm thick acoustic insulation, factory baked on external finish aesthetically compatible with typical computer and peripheral cabinets. Colour as selected from manufacturer's standard range by Departmental Representative.
- .2 Cabinet to house: compressors, condensers, liquid receiver, cooling coil, reheat coil, fans, filters, humidifier, unit environmental control system, motor starters or contactors and electrical disconnect switch.
- .3 Include adequate access to components for servicing.
- .4 Corrosion protected welded structural steel floor stand with adjustable feet and locking device on corners, vibration isolators and compatible with raised floor system.

### **2.3 DISCHARGE PLENUM**

- .1 Welded steel, unit construction, corrosion protected, 20 mm thick acoustic insulation, factory baked on external finish aesthetically compatible with typical computer and peripheral cabinets with double deflection grille on front and both sides as indicated.
  - .1 Colour: coordinate with departmental representative.
- .2 Plenum suitable for connecting to supply ducting as indicated.



- .3 Welded steel, unit construction, corrosion protected, 20 mm thick acoustic insulation, constructed to assure proper air distribution to space under raised floor.

#### **2.4 RETURN PLENUM AND FILTER HOUSING**

- .1 Welded steel, unit construction, corrosion protected, 20 mm thick acoustic insulation, factory baked on external finish aesthetically compatible with typical computer and peripheral cabinets with single deflection return grille on front .

#### **2.5 FANS**

- .1 DWDI centrifugal, statically and dynamically balanced, variable speed drive, with self-aligning, permanently lubricated, 100,000 hours minimum life ball or roller bearings.
- .2 If V-belt driven include 2 belt adjustable pitch pulleys with belts sized for 200 % minimum of motor capacity.

#### **2.6 FAN MOTORS**

- .1 Drip-proof permanently lubricated bearings for continuous duty, 40 degrees C maximum rise and variable pitch sheaves on belt driven systems.

#### **2.7 COMPRESSORS**

- .1 Minimum 2 required, with:
  - .1 Vibration isolators.
  - .2 Adjustable high and low pressure switches.
  - .3 Anti-slug device.
  - .4 Motor overload and over temperature protection pump down controls.
  - .5 Crank case heater.
  - .6 Compressor lead/lag switch.
  - .7 Refrigerant service valves.
  - .8 Capacity controls.

#### **2.8 COOLING COIL**

- .1 Aluminum fins, mechanically bonded to copper tubes, tested to 1.7 MPa, maximum face velocity 2.8 m/s, with stainless steel insulated condensate tray and drain connections.
- .2 Direct expansion: with separate refrigerant circuit for each compressor.
- .3 Cooling coil condensate drain pans: designed to avoid standing water, easily cleaned or removable for cleaning.
  - .1 Drain connection with deep seal trap complete with trap seal primer.

#### **2.9 HEATING COIL**

- .1 Hot water: aluminum or copper fins mechanically bonded to copper tubes, complete with Y-strainer, modulating control valve, tested to 1.7 MPa,
- .2 Coils: located down-stream of cooling coil.

## **2.10 FILTERS**

- .1 Prefilters: 25 mm flat, disposable type: MERV 8.
- .2 Final filters: pleated type: MERV 14.
- .3 Mounting: in corrosion resistant racks with service access.

## **2.11 CONDENSER**

- .1 Air cooled: coaxial or shell and tube type, sized for each compressor/evaporator combination; complete with head pressure actuated water regulating valve for each refrigerant circuit.
- .2 Air cooled: free standing, welded steel unit construction, corrosion protected.
  - .1 Circuited to provide separate refrigerant circuit for each compressor/evaporator combination.
  - .2 Aluminum fins, mechanically bonded to copper tubes, tested to 3.1 MPa.
  - .3 Electrical and control components housed in weather-tight access panels with electrical disconnect switch and control cable for control interconnection and designed for year round operation.
  - .4 Vibration isolation: providing at least 95 % isolation efficiency.
  - .5 Capacity: to heat rejection capacity.
  - .6 Head pressure control for low outdoor ambient operation.

## **2.12 HEAT EXCHANGER**

- .1 Packaged, glycol to air: free standing, welded steel unit construction, corrosion protected.
- .2 Coil: aluminum fins mechanically bonded to copper tubes, tested to 1.7 MPa.
- .3 Control systems to:
  - .1 Regulate glycol condenser coolant temperature.
  - .2 Divert chilled glycol flow from chiller circuits to heat exchanger circuits during periods of low ambient temperatures.
- .4 Electric disconnect switch and control cables for control interconnection and designed for year round operation.

## **2.13 REFRIGERANT PIPING, VALVES, FITTINGS AND ACCESSORIES WITHIN UNIT**

- .1 To CSA B52.
- .2 Include for each refrigerant circuit:
  - .1 Thermal expansion valve, external equalizing type.
  - .2 Combination filter-dryer.
  - .3 Solenoid valves.
  - .4 Liquid sight glass with moisture indicator.
  - .5 Suction line insulation: flexible elastomeric unicellar to ASTM C547, 12 mm minimum thickness.
  - .6 Liquid refrigerant receiver.

## **2.14 ENVIRONMENTAL CONTROLS**

- .1 Solid state electronic control system.
- .2 Front mounted operating panel with visual display.
- .3 Panel to include following:
  - .1 Manual operation and adjustment:
    - .1 On-Off air conditioning system control.
    - .2 Room temperature set point, indicator and sensitivity adjustment controller.
    - .3 Room humidity set point, indicator and sensitivity adjustment controller.
    - .4 Alarm silencing switch for each alarm point.
    - .5 Lead-lag selection switch.
    - .6 Alarm circuits test switch.
  - .2 Operational: Visual and Audible Alarm:
    - .1 Loss of air flow.
    - .2 Loss of liquid flow.
    - .3 High room temperature.
    - .4 Low room temperature.
    - .5 High humidity.
    - .6 Low humidity.
    - .7 High head pressure No.1 chiller.
    - .8 High head pressure No.2 chiller
  - .3 Operational: Visual display:
    - .1 Cooling each stage.
    - .2 Reheat stage 1 and 2.
    - .3 Humidification
    - .4 Dehumidification.
    - .5 Glycol to Air Heat Exchanger Operating.
    - .6 Change filter.

## **2.15 REFRIGERANT CHARGE**

- .1 Charge refrigerant system at factory, seal and test.
- .2 Holding charge of refrigerant applied at factory.

## **2.16 ACCEPTABLE MANUFACTURERS**

- .1 As per Mechanical / Electrical Schedules on drawings
- .2 Acceptable Manufacturer are: Daikin, Samsung, Mitsubishi, Carrier, LG, Hitachi

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 GENERAL**

- .1 Install as indicated, to manufacturer's recommendations, and to EPS 1/RA/2.
- .2 Manufacturer to certify installation.
- .3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

#### **3.3 EQUIPMENT PREPARATION**

- .1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

#### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

#### **3.5 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by computer room air conditioning installation.

**END OF SECTION**

**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1     Institute of Boiler and Radiator Manufacturers (IBR)
- .2     US Department of Commerce
  - .1        CS 140-47, Commercial Standard.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1     Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2     Product Data:
  - .1        Submit manufacturer's instructions, printed product literature and data sheets for finned tube radiation heaters and include product characteristics, performance criteria, physical size, finish and limitations.
- .3     Shop Drawings:
  - .1        Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
  - .2        Indicate on drawings:
    - .1            Equipment, capacity, piping, and connections.
    - .2            Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
    - .3            Special enclosures.
- .4     Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

**1.3                CLOSEOUT SUBMITTALS**

- .1     Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2     Operation and Maintenance Data: submit operation and maintenance data for finned tube radiation heaters for incorporation into manual.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1     Deliver, store and handle materials in accordance with Section with manufacturer's written instructions 01 61 00- Common Product Requirements .
- .2     Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3     Storage and Handling Requirements:
  - .1        Store materials indoors, in dry location, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2        Store and protect finned tube radiation heaters from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 DAMPERS**

- .1 Factory built, internal damper, at enclosure air outlet grille for each convection type heating unit not thermostatically controlled. Refer to schedules on drawings.

**2.2 CAPACITY**

- .1 As indicated, based on 52 degrees C average water temperature, 11 degrees C temperature drop.

**2.3 BASEBOARD RADIATION**

- .1 Heating elements: NPS copper tubing sized as specified, mechanically expanded into flanged collars of evenly spaced aluminum fins, one tube end belled.
- .2 Enclosure: minimum 1.0 mm thick steel surface mounted prefinished with 1.0 mm thick back and top of one piece construction. Front panel removable. Run wall to wall unless otherwise indicated. Provide panel corners joiner pieces end caps as required. Assemble with stainless steel oval head sheet metal screws. Finish factory applied baked on enamel.
- .3 Element brackets: 1.2 mm thick galvanized steel to support front panel and element cradle. Space brackets 900 mm centres maximum.
- .4 Provide for noiseless expansion of components.
- .5 Acceptable Manufacturers are: Sigma, Vulcan, Rittling, Engineered Air, Slant Fin

**2.4 FINNED TUBE RADIATION**

- .1 Heating elements: NPS seamless copper tubing sized as specified, mechanically expanded into flanged collars of evenly spaced aluminum fins
- .2 Element hangers: cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm centres maximum.
- .3 Standard enclosures: 1.2 mm thick steel complete with components for wall-to-wall or complete with die formed end caps having no knock-outs, with inside corners, outside corners, as indicated. Provide full length channel and sealer strip at top of wall edge. Height as indicated. Joints and filler pieces flush with cabinet. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces clear of grilles located to provide easy access to valves and vents. Provide access doors for valves, traps, and vents. Finish cabinet with factory applied baked primer coat.
- .4 Special enclosures: as indicated.
- .5 Dimensions for enclosures: measure site conditions. Do not scale from drawing.
- .6 Provide for noiseless expansion of components.
- .7 Acceptable Manufacturers are: Sigma, Vulcan, Rittling, Engineered Air, Slant Fin

## **2.5 CABINET CONVECTORS**

- .1 Heating element: seamless copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins and cast iron headers, steel side plates and supports.
- .2 Cabinet: type as indicated, 1.6 mm thick steel back and ends, exposed corners rounded, secured removable front panel, braced and reinforced for stiffness. Provide access doors for traps, vents and valves.
- .3 Acceptable Manufacturers are: Daikin, Sigma, Trane, Rittling, Engineered Air, Slant Fin, Vulcan, Carrier

## **2.6 HYDRONIC HEATING COILS**

- .1 Heating element: Seamless copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins and cast iron headers, steel side plates and supports.
- .2 Connection: Copper wrot male NPT. Same side supply and return.
- .3 Case: Slip & drive or flanged.
- .4 Acceptable Manufacturers: Daikin, Trane, Madok, Cancoil, Carrier, Engineered Air, Johnson Controls.

## **2.7 RADIANT PANELS**

- .1 Pipework: 16mm O.D. copper tubing.
- .2 Panels: Extruded aluminum planks.
- .3 Suspension, Joint, and Pipework Clips: Cadmium or zinc-plated steel springs.
- .4 Finish: White Polyester Powder Coating.
- .5 Suspension system: T-bar or drywall installation as specified.
- .6 Insulate above panel as indicated on drawings.
- .7 Acceptable Manufacturers: TWA, Sigma, Price

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for finned tube radiation convector heater installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of City of Winnipeg.
  - .2 Inform the City of Winnipeg of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from the City of Winnipeg.

### **3.2 INSTALLATION**

- .1 Install in accordance with manufacturer's instructions.

- .2 Install in accordance with piping layout and approved shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with the City of Winnipeg, if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow the City of Winnipeg's directive.
- .6 Valves:
  - .1 Install valves with stems upright or horizontal unless approved otherwise.
  - .2 Install isolating gate valves on inlet and lockshield globe balancing valves on outlet of each unit.
- .7 Venting:
  - .1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.
  - .2 Install standard air vent with cock on continuous finned tube radiation.
- .8 Clean finned tubes and comb straight.
- .9 Install flexible expansion compensators as indicated.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00- Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00- Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19- Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**



## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI)/CSA Group
  - .1 ANSI Z83.19a/CSA 2.35a-2011, Gas-Fired High-Intensity Infrared Heaters.
- .2 CSA Group (CSA)
  - .1 CSA B149.1-10, Natural Gas and Propane Installation Code.
  - .2 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for radiant heating units and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for radiant heating units for incorporation into manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect radiant heating units from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 GENERAL**

- .1 Provide CGA CSA approved, packaged factory assembled components consisting of heat exchangers, burners, controls, air filters, vacuum generators, reflectors, fans.

## **2.2 BURNERS**

- .1 Burners to include following features:
  - .1 Manufactured to ANSI Z83.19/CSA 2.35 vented infrared heater standards.
  - .2 CGA CSA certified for use with natural gas .
  - .3 Air-fuel mixture controlled combustion system designed for compatibility with remote-generated and controlled vacuum.
  - .4 Fail-safe design to shut off supply of fuel in following situations:
    - .1 Power failure.
    - .2 Inadequate pilot flame.
    - .3 Inadequate vacuum in combustion chamber.
    - .4 Failure of main fuel valve in open position.
  - .5 Electrical control system isolated from combustion air system.
  - .6 Pre-wired burner control system with electric ignition.
  - .7 Suitable for operation with 115 V AC, single phase, 60 Hz electrical service.
  - .8 Enamel-finished steel enclosure complete with removable access panels.
  - .9 Heating output capacity compatible with associated downstream radiant tube.
- .2 Burners to include following features:
  - .1 Manufactured to ANSI Z83.19/CSA 2.35 vented infrared heater standards.
  - .2 CGA CSA certified for use with natural gas.
  - .3 Air-fuel mixture controlled combustion system designed for compatibility with combustion supply air blower.
  - .4 Fail-safe design to shut off supply of fuel in following situations:
    - .1 Blower motor failure.
    - .2 Main flame failure.
    - .3 Inadequate inlet air.
    - .4 Excessive flue back pressure.
  - .5 Combustion air terminal suitable for connection of outside air duct.
  - .6 Electrical control system isolated from combustion air system.
  - .7 Combustion process operational status indicator lights observation windows.
  - .8 Pre-wired burner control system with electric ignition.
  - .9 Suitable for operation with 120 V AC, single phase, 60 Hz electrical service.
  - .10 Enamel-finished steel enclosure complete with removable access panels.
  - .11 Heating output capacity compatible with associated downstream radiant tube.
  - .12 Centrifugal, direct-drive blower with adequate air flow capacity to accommodate ducted inlet and exhaust air requirements.

## **2.3 VACUUM GENERATORS**

- .1 Vacuum generators to include following features:

- .1 Corrosion-resistant construction with capacity to accommodate total upstream output of burners.
- .2 Direct-drive via 115/230 V, 60 Hz, totally-enclosed, thermally protected, ball-bearing motor.
- .3 Dynamically-balanced impeller.
- .4 Flexible inlet connection.
- .5 Temperature and pressure rated for maximum conditions which could be encountered.
- .6 Common support bracket for vacuum generator and motor.
- .7 Exhaust duct terminal complete with exhaust duct and exterior terminal with bird screen.
- .8 Removable acoustic enclosure.
- .9 Condensate terminal complete with trap and drain line connection.

#### **2.4 HEAT EXCHANGER**

- .1 Heat exchanger to consist of radiant piping with following features:
  - .1 Nominal 102 mm O.D., 1.519 mm thick, steel tubing 89 mm O.D., 0.607 mm thick, aluminized steel spiral pipe ..
  - .2 Removable, heat and corrosion-resistant joint connections designed to accommodate system expansion/contraction.
  - .3 Length compatible with upstream burner output capacity.

#### **2.5 REFLECTORS**

- .1 Reflectors to include following features:
  - .1 Polished aluminum construction complete with corrugations and configuration to maximize radiant heat directed toward floor.
  - .2 Standard lengths to facilitate installation complete with overlaps at joints to accommodate expansion and contraction.
  - .3 Hangers/supports at spacing recommended by system manufacturer to maintain maximum reflector efficiency.
  - .4 Side extension reflector complete with supports, retainers, and brackets, to prevent radiant heat from striking adjacent surfaces.
  - .5 Barrier reflector shield complete with supports, retainers, and brackets, to prevent radiant heat from striking objects beneath radiant piping.
  - .6 Factory fabricated corners, joints, tees, end caps, and related accessories.
  - .7 Egg-crate style aluminum grille beneath reflectors complete with supports, shields, as required, to improve aesthetics of radiant heating system and complement reflector design efficiency.

#### **2.6 OUTSIDE AIR SUPPLY**

- .1 Outside air supply to include following features:
  - .1 Ducted outside air supply to each burner to provide sealed-combustion system.

- .2 Insulation and vapour retarder on duct to prevent condensation.
- .3 Duct size to ensure adequate air supply to each burner.
- .4 Exterior air inlet terminal complete with bird screen and weatherproof hood.
- .5 Flexible duct connector adjacent to burner complete with removable joint clamp at burner.

## **2.7 CONTROLS**

- .1 System controls to include following features:
  - .1 Pre-wired control panel complete with transformers, relays, terminal blocks, wiring, circuits, hinged door, visible door-mounted system status lights, steel cabinet complete with baked enamel finish and keyed access.
  - .2 24 V heating thermostat control of burners complete with radiant heat shields where shown.
  - .3 Integral prepurge and post purge cycles for combustion chambers and heat exchanger pipes.
  - .4 Thermostat radiant heat reflector shields, if exposed to radiant heat.
  - .5 Vacuum switch interlock with vacuum generator.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Install infrared radiant system in accordance with CSA B149.1, as recommended by manufacturer and as indicated.
- .2 Provide grading of radiant pipe as required.
- .3 Make provision for pipe movement caused by normal operation and expansion.
- .4 Maintain required clearances from combustibles.
- .5 Follow manufacturer's detailed installation, testing, operation and maintenance instructions.
- .6 Install thermostats where indicated. Supply heat shields where recommended by manufacturer.
- .7 Test radiant system as recommended by manufacturer and required by authorities having jurisdiction. Air test piping for leaks. Check burner safety controls.

- .8 Arrange equipment, including burners, vacuum generators, to facilitate removal without dismantling pipe, reflectors, or associated apparatus.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### **3.4 EQUIPMENT SCHEDULE**

- .1 As per drawings.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes.
  - .1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
    - .1 Start-up testing and verification of systems.
    - .2 Check out demonstration or proper operation of components.
    - .3 On-site operational tests.

### **1.2 DEFINITIONS**

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
  - .1 Outage of main power supply in excess of back-up power sources, provided that:
    - .1 Automatic initiation of back-up was accomplished.
    - .2 Automatic shut-down and re-start of components was as specified.
  - .2 Failure of communications link, provided that:
    - .1 Controller automatically and correctly operated in stand-alone mode.
    - .2 Failure was not due to failure of any specified EMCS equipment.
  - .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
    - .1 System recorded said fault.
    - .2 Equipment defaulted to fail-safe mode.
    - .3 AEL of total of all input sensors and output devices is at least 99 % during test period.

### **1.3 DESIGN REQUIREMENTS**

- .1 Confirm with Departmental Representative and Contract Administrator that Design Criteria and Design Intents are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Final Report: submit report to Departmental Representative, Contract Administrator and Commissioning Agent.
  - .1 Include measurements, final settings and certified test results.
  - .2 Bear signature of commissioning technician and supervisor
  - .3 Report format to be approved by Departmental Representative before commissioning is started.
  - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative and Contract Administrator in accordance with Section 01 78 00 - Closeout Submittals.
  - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

#### **1.5 CLOSEOUT SUBMITTALS**

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of documents before interim acceptance in accordance with Section 01 78 00 - Closeout Submittals.

#### **1.6 COMMISSIONING**

- .1 Do commissioning in accordance with Section 01 91 13 - COMMISSIONING.
- .2 Carry out commissioning under direction of Commissioning Agent and in presence of Commissioning Agent .
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:
  - .1 Location and part of system to be tested or commissioned.
  - .2 Testing/commissioning procedures, anticipated results.
  - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of Contract Administrator, Departmental Representative and Commissioning Agent until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

#### **1.7 COMPLETION OF COMMISSIONING**

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Commissioning Agent .

## **1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION**

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

## **Part 3 Execution**

### **3.1 PROCEDURES**

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the commissioning agent.
- .3 Commission integrated systems using procedures prescribed by commissioning agent.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

### **3.2 FIELD QUALITY CONTROL**

- .1 Pre-Installation Testing.
  - .1 Not Applicable
- .2 Completion Testing.
  - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
  - .2 Include following activities:
    - .1 Test and calibrate field hardware including stand-alone capability of each controller.
    - .2 Verify each A-to-D convertor.
    - .3 Test and calibrate each AI using calibrated digital instruments.



- .4 Test each DI to ensure proper settings and switching contacts.
- .5 Test each DO to ensure proper operation and lag time.
- .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
- .7 Test operating software.
- .8 Test application software and provide samples of logs and commands.
- .9 Verify each CDL including energy optimization programs.
- .10 Debug software.
- .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
- .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Contract Administrator. This document will be used in final startup testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Contract Administrator and provide:
  - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
  - .2 Detailed daily schedule showing items to be tested and personnel available.
  - .3 Contract Administrator's acceptance signature to be on executive and applications programs.
  - .4 Commissioning to commence during final startup testing.
  - .5 O&M personnel to assist in commissioning procedures as part of training.
  - .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
  - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
  - .8 Operate systems as long as necessary to commission entire project.
  - .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
  - .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.

- .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
- .2 Test to last at least 30 consecutive 24 hour days.
- .3 Tests to include:
  - .1 Demonstration of correct operation of monitored and controlled points.
  - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
- .4 System will be accepted when:
  - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
  - .2 Requirements of Contract have been met.
- .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
- .6 Correct defects when they occur and before resuming tests.
- .5 Contract Administrator and Commissioning Agent to verify reported results.

### **3.3 ADJUSTING**

- .1 Final adjusting: upon completion of commissioning as reviewed by Commissioning Agent, set and lock devices in final position and permanently mark settings.

### **3.4 DEMONSTRATION**

- .1 Demonstrate to Commissioning Agent and Contract Administrator operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 79 00 - Demonstration and Training.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes.
  - .1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.

### **1.2 DEFINITIONS**

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to departmental representative, Contract Administrator and commissioning agent prior to anticipated date of beginning of training.
  - .1 List name of trainer, and type of visual and audio aids to be used.
  - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of maintenance training program that training has been satisfactorily completed.

### **1.4 QUALITY ASSURANCE**

- .1 Provide bilingual, competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 Departmental Representative and Contract Administrator reserves right to approve instructors.

### **1.5 INSTRUCTIONS**

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

### **1.6 TIME FOR TRAINING**

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

### **1.7 TRAINING MATERIALS**

- .1 Provide equipment, visual and audio aids, and materials for classroom training.

- .2 Supply manual for each trainee, describing in detail data included in each training program.
  - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

### **1.8 TRAINING PROGRAM**

- .1 To be in 2 phases over 6 month period.
- .2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Contract Administrator.
  - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
  - .2 Supplement with on-the-job training during 30 day test period.
  - .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
  - .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3 Phase 2: 5 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
  - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
    - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
    - .2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
    - .3 Programmers: provide personnel with 2 days training within 5 day period in following subjects in approximate percentages of total course shown:

### **1.9 ADDITIONAL TRAINING**

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

### **1.10 MONITORING OF TRAINING**

- .1 Departmental Representative and Contract Administrator to monitor training program and may modify schedule and content.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

### **1.2 REFERENCE STANDARDS**

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
  - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE).
  - .1 ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA Group).
  - .1 CAN/CSA-Z234.1-89 (R1995), Canadian Metric Practice Guide.
- .5 Consumer Electronics Association (CEA).
  - .1 CEA-709.1-B-2002, Control Network Protocol Specification.
- .6 Department of Justice Canada (Jus).
  - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .7 Electrical and Electronic Manufacturers Association (EEMAC).
  - .1 EEMAC 2Y-1-1958, Light Grey Colour for Indoor Switch Gear.
- .8 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1 Material Safety Data Sheets (SDS).
- .9 Transport Canada (TC).
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

### **1.3 ABBREVIATIONS AND ACRONYMS**

- .1 Acronyms used in EMCS:
  - .1 AEL - Average Effectiveness Level
  - .2 AI - Analog Input
  - .3 AIT - Agreement on International Trade

- .4 AO - Analog Output
- .5 BACnet - Building Automation and Control Network.
- .6 BC(s) - Building Controller(s).
- .7 BECC - Building Environmental Control Centre.
- .8 CAD - Computer Aided Design.
- .9 CDL - Control Description Logic.
- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.

- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

#### **1.4 DEFINITIONS**

- .1 Point: may be logical or physical.
  - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
  - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
  - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
    - .1 Area descriptor: building or part of building where point is located.
    - .2 System descriptor: system that point is located on.
    - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or acronyms. Database must provide 25 character field for each point identifier.
  - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
  - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
    - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: points fall into following object types:
  - .1 AI (analog input).
  - .2 AO (analog output).
  - .3 DI (digital input).
  - .4 DO (digital output).
  - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
  - .1 Printouts: to ANSI/IEEE 260.1.
  - .2 Refer also to Section 25 05 54 - EMCS: Identification.



## 1.5 SYSTEM DESCRIPTION

- .1 Refer to control schematics for system architecture.
  - .1 There is an existing central monitoring system in place. All DDC points are identified as centrally monitored points. The contractor shall provide and install required hardware and software to interface the existing SNE-XX on site using either BACnet/IP controller or MS/TP Remote Field Bus. All monitoring and control points to be viewed and adjusted through the City of Winnipeg ADX server. All new controls shall be provided by the manufacturer of the existing control system. The contractor is required to meet with the City for additional direction.
  - .2 The entire existing N2 system is to be removed and replaced. All existing control sensors and actuators may be used if they are compatible with the new control system. The existing MS/TP system can remain providing it can be interfaced seamlessly into the new DDC system provided under this contract.
  - .3 Contractor to supply all drawings/graphics/ sequence of operations in both hard and soft copy. Drawings and graphics to be able to be read and modified by the City. User interface graphics to be completed using MUI Software Tool. Graphics must use the City of Winnipeg graphic templates. Contractor to supply As-Built drawings in an editable format, able to be easily edited by the City. Contractor to create user views to match existing structure.
  - .4 BACnet Communication protocol shall be provided. All control panels shall be located within the basement mechanical rooms.
  - .5 A complete list of setpoints for all controlled equipment shall be provided.
  - .6 A points list is to be provided for all controlled objects.
  - .7 Alarm Messages: All objects that must be alarmed will have in the alarm message text the following information as per the included example. Alarm Message: Building Address, what in in alarm, see graphic for Instruction. Example: 241 Donald SF-1 VFD Common Alarm, see graphic for Instruction.
  - .8 All controllers/ hardware shall be the latest models used by the City of Winnipeg. The use of controllers that are obsolete / to be discontinued or those that are below standard used by the City are not acceptable.
  - .9 All existing controllers and devices that require removal, are to be kept undamaged and turned over to the City Representative for future use in other buildings. The contractor is responsible to cover the cost for any damaged/missing controllers. At the beginning of the project, provide a record of all the controllers through out the building, including pictures.
  - .10 Existing controls are by METASYS by Johnson Controls. New controls to match/be compatible with existing. City of Winnipeg uses METASYS by Johnson controls in all their projects.
- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
  - .1 Building Controllers.
  - .2 Control devices as listed in I/O point summary tables.

- .3 OWS(s).
- .4 Data communications equipment necessary to effect EMCS data transmission system.
- .5 Field control devices.
- .6 Software/Hardware complete with full documentation.
- .7 Complete operating and maintenance manuals.
- .8 Training of personnel.
- .9 Acceptance tests, technical support during commissioning, full documentation.
- .10 Wiring interface co-ordination of equipment supplied by others.
- .11 Miscellaneous work as specified in these sections and as indicated.
- .3 Design Requirements:
  - .1 Design and provide conduit and wiring linking elements of system.
  - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Contract Administrator prior to installation.
  - .3 Location of controllers as reviewed by Contract Administrator prior to installation.
  - .4 Provide utility power to EMCS and emergency power to EMCS as indicated.
  - .5 Metric references: in accordance with CAN/CSA Z234.1.
- .4 Language Operating Requirements:
  - .1 Provide English and French operator selectable access codes.
  - .2 Use non-linguistic symbols for displays on graphic terminals wherever possible. Other information to be in English and French .
  - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in English and French.
  - .4 System manager software: include in English and French system definition point database, additions, deletions or modifications, control loop statements, use of high level programming languages, report generator utility and other OS utilities used for maintaining optimal operating efficiency.
  - .5 Include, in English and French :
    - .1 Input and output commands and messages from operator-initiated functions alarms as defined in CDL's or assigned limits (i.e. commands relating to day-to-day operating functions and not related to system modifications, additions, or logic re-definitions).
    - .2 Graphic "display" functions, point commands to turn systems on or off, manually override automatic control of specified hardware points. To be in French and English at specified OWS and to be able to operate one terminal in English and second in French. Point name expansions in both languages.

- .3 Reporting function such as trend log, trend graphics, alarm report logs, energy report logs, maintenance generated logs.

#### **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for review:
  - .1 Shop drawings within 48 hours within 10 days after award of contract.
  - .2 List existing field control devices to be re-used included in shop drawings, along with unit price.
- .3 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
  - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.
  - .4 In lieu of such evidence, submit certificate from testing organization, approved by Contract Administrator and Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
  - .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
  - .6 Permits and fees: in accordance with general conditions of contract.
  - .7 Submit certificate of acceptance from authority having jurisdiction to departmental representative and Contract Administrator.
  - .8 Existing devices intended for re-use: submit test report.

#### **1.7 QUALITY ASSURANCE**

- .1 Have local office within 100 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .5 Health and Safety:

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

### **1.8 DELIVERY, STORAGE AND HANDLING**

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Place materials defined as hazardous or toxic in designated containers.
  - .4 Handle and dispose of hazardous materials in accordance with local regulations.
  - .5 Label location of salvaged material's storage areas and provide barriers and security devices.
  - .6 Ensure emptied containers are sealed and stored safely.

### **1.9 EXISTING- CONTROL COMPONENTS**

- .1 Utilize existing controls as indicated.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
  - .1 Do not modify original design of existing devices without written permission from Contract Administrator.
  - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
  - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Contractor.
  - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
  - .1 Provide with report specification sheets or written functional requirements to support findings.
  - .2 Contract Administrator and Department representative will review to determine if will repair or replace existing items judged defective yet deemed necessary for EMCS.
- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.

- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Contract Administrator.
  - .1 Be responsible for items repaired or replaced by Contractor.
  - .2 Be responsible for repair costs due to negligence or abuse of equipment.
  - .3 Responsibility for existing devices terminates Contractor.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

## **Part 2 Products**

### **2.1 EQUIPMENT**

- .1 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

### **2.2 ADAPTORS**

- .1 Provide adaptors between metric and imperial components.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S RECOMMENDATIONS**

- .1 Installation: to manufacturer's recommendations.

### **3.2 PAINTING**

- .1 Painting: in accordance with Section 09 91 23 - Interior Painting, supplemented as follows:
  - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
  - .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
  - .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
  - .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes.
  - .1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

### **1.2 DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

### **1.3 DESIGN REQUIREMENTS**

- .1 Preliminary Design Review: to contain following contractor and systems information.
  - .1 Location of local office.
  - .2 Description and location of installing and servicing technical staff.
  - .3 Location and qualifications of programming design and programming support staff.
  - .4 List of spare parts.
  - .5 Location of spare parts stock.
  - .6 Names of sub-contractors and site-specific key personnel.
  - .7 Sketch of site-specific system architecture.
  - .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
  - .9 Descriptive brochures.
  - .10 Sample CDL and graphics (systems schematics).
  - .11 Response time for each type of command and report.
  - .12 Item-by-item statement of compliance.
  - .13 Proof of demonstrated ability of system to communicate utilizing BACnet.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.
- .2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by Departmental Representative.
- .3 Shop Drawings to consist of 3 hard copies and 1 soft copy of design documents, shop drawings, product data and software.
- .4 Hard copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.

- .5 Soft copy to be in Autocad - latest version and Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

### **1.5 PRELIMINARY SHOP DRAWING REVIEW**

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
  - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
  - .2 Detailed system architecture showing all points associated with each controller .
  - .3 Spare point capacity of each controller by number and type.
  - .4 Controller locations.
  - .5 Auxiliary control cabinet locations.
  - .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
  - .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
  - .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
  - .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
  - .10 Compressor schematic and sizing data.

### **1.6 DETAILED SHOP DRAWING REVIEW**

- .1 Submit detailed shop drawings within 60 working days after award of contract and before start of installation and include following:
  - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
  - .2 Wiring diagrams.
  - .3 Piping diagrams and hook-ups.
  - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
  - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
    - .1 Sensing element type and location.
    - .2 Transmitter type and range.

- .3 Associated field wiring schematics, schedules and terminations.
- .4 Complete Point Name Lists.
- .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
- .6 Software and programming details associated with each point.
- .7 Manufacturer's recommended installation instructions and procedures.
- .8 Input and output signal levels or pressures where new system ties into existing control equipment.
- .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- .7 Graphic system schematic displays of water and air systems with point identifiers and textual description of system, and typical floor plans as specified.
- .8 Complete system CDL's including companion English and French language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .12 Type and size of memory with statement of spare memory capacity.
- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

## **1.7 QUALITY ASSURANCE**

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
  - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
  - .2 Resolve conflicts between Contract Document requirements and actual items (e.g.: points list inconsistencies).
  - .3 Review interface requirements of materials supplied by others.
  - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 Contract Administrator retains right to revise sequence or subsequent CDL prior to software finalization without cost to Contractor.



**Part 2 Products**

**2.1 NOT USED**

.1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

.1 Not Used.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes.
  - .1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.

### **1.2 DEFINITIONS**

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 78 00 - Closeout Procedures, supplemented and modified by requirements of this Section.
- .2 Submit Operation and Maintenance Manual and As-built drawings to Contract Administrator and Department Representative in English. Refer to section 01 78 00 for O&M Manual requirements as well as Commissioning General Requirements (01 91 13).
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
  - .1 Binders to be 2/3 maximum full.
  - .2 Provide index to full volume in each binder.
  - .3 Identify contents of each manual on cover and spine.
  - .4 Provide Table of Contents in each manual.
  - .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

### **1.4 AS-BUILTS**

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
  - .1 Changes to Contract Documents as well as addenda and contract extras.
  - .2 Changes to interface wiring.
  - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
  - .4 Locations of obscure devices to be indicated on drawings.
  - .5 Listing of alarm messages.
  - .6 Panel/circuit breaker number for sources of normal/emergency power.
  - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.

- .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Contract Administrator and Departmental Representative.
- .3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

### **1.5 O&M MANUALS**

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.
- .4 Functional description to include:
  - .1 Functional description of theory of operation.
  - .2 Design philosophy.
  - .3 Specific functions of design philosophy and system.
  - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
  - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
  - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
  - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
  - .2 Operation of computer peripherals, input and output formats.
  - .3 Emergency, alarm and failure recovery.
  - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
  - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.

- .2 Detailed descriptions of program requirements and capabilities.
- .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
- .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
- .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
- .6 Software for each Controller and single section referencing Controller common parameters and functions.
- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
  - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
  - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes.
  - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

### **1.2 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA Group).
  - .1 CSA C22.1-02, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

### **1.3 DEFINITIONS**

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.4 SYSTEM DESCRIPTION**

- .1 Language Operating Requirements: provide identification for control items in English and French.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.
- .2 Submit to Contract Administrator for approval samples of nameplates, identification tags and list of proposed wording.

## **Part 2 Products**

### **2.1 NAMEPLATES FOR PANELS**

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

### **2.2 NAMEPLATES FOR FIELD DEVICES**

- .1 Identify by plastic encased cards attached by Contractor.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

### **2.3 NAMEPLATES FOR ROOM SENSORS**

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by Departmental Representative.
- .3 Letter size: to suit, clearly legible.

### **2.4 WARNING SIGNS**

- .1 Equipment including motors, starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Contract Administrator and Departmental Representative's.

### **2.5 WIRING**

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

### **2.6 CONDUIT**

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

## **Part 3 Execution**

### **3.1 NAMEPLATES AND LABELS**

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

### **3.2 EXISTING PANELS**

- .1 Correct existing nameplates and legends to reflect changes made during Work.

**END OF SECTION**

## Part 1

### 1.1 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
  - .1 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressures Fittings.
  - .2 ANSI C2-1990, National Electrical Safety Code.
  - .3 ANSI/NFPA 70-1990, National Electrical Code.
- .2 CSA Group (CSA)
  - .1 CSA C22.1-12,
  - .2 CAN/CSA-C22.3 No. 7-10, Underground Systems.
  - .3 CAN/CSA C22.2 No. 45.1-07 (R2012), Electrical Rigid Metal Conduit.
  - .4 CAN/CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .5 CAN/CSA C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.
  - .6 CAN/CSA-C22.3 No. 1-10, Overhead Systems.

### 1.2 SYSTEM DESCRIPTION

- .1 Electrical:
  - .1 Provide power wiring from existing emergency power panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
  - .2 Hard wiring between field control devices and EMCS field panels.
  - .3 Communication wiring between EMCS field panels and OWS's including main control centre BECC.
  - .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .5 Refer to Electrical and Mechanical equipment schedules.
- .2 Mechanical:
  - .1 Pipe Taps Required For EMCS equipment will be supplied and installed by Mechanical Contractor.
  - .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Mechanical Contractor.
  - .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Mechanical Contractor. Costs to be carried by designated trade.
- .3 Structural:
  - .1 Special steelwork as required for installation of work.

### **1.3 PERSONNEL QUALIFICATIONS**

- .1 Qualified supervisory personnel to:
  - .1 Continuously direct and monitor all work.
  - .2 Attend site meetings.

### **1.4 EXISTING CONDITIONS**

- .1 Cutting and Patching: refer to Section 01 73 29 Cutting and Patching supplemented as specified herein.
- .2 Repair all surfaces damaged during execution of work.
- .3 Turn over to Departmental Representative existing materials removed from work not identified for re-use.

## **Part 2 Products**

### **2.1 PIPING**

- .1 Insulation: Replacement of any insulation disturbed by replacement of existing valves shall be by the Mechanical Contractor.

### **2.2 SPECIAL SUPPORTS**

- .1 Structural grade steel, primed and painted after construction and before installation.

### **2.3 WIRING**

- .1 As per requirements of Division 26.
- .2 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.
- .3 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.
- .4 Sizes:
  - .1 120V Power supply: to match or exceed breaker, size #12 minimum.
  - .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
  - .3 Field wiring to digital device: #18 AWG or 20 AWG stranded twisted pair, per EMCS manufacturer's requirements. .
  - .4 Analog input and output: shielded shielded #18 minimum solid copper or #20 minimum stranded twisted pair, per EMCS manufacturer's requirements. Wiring must be continuous without joints.
  - .5 More than 4 conductors: #22 minimum solid copper.
- .5 Terminations:
  - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.



## **2.4 CONDUIT**

- .1 As per requirements of Division 26.
- .2 Electrical metallic tubing to CAN/CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CAN/CSA C22.2 No. 56. Rigid steel threaded conduit to CAN/CSA C22.2 No. 45.1.
- .3 Junction and pull boxes: welded steel.
  - .1 Surface mounting cast FS: screw-on flat covers.
  - .2 Flush mounting: covers with 25 mm minimum extension all round.
- .4 Cabinets: sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire contract as approved.
- .5 Outlet boxes: 100 mm minimum, square.
- .6 Conduit boxes, fittings:
  - .1 Bushings and connectors: with nylon insulated throats.
  - .2 With push pennies to prevent entry of foreign materials.
- .7 Fittings for rigid conduit:
  - .1 Couplings and fittings: threaded type steel.
  - .2 Double locknuts and insulated bushings: use on sheet metal boxes.
  - .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.
- .8 Fittings for thin wall conduit:
  - .1 Connectors and couplings: steel, set screw type.

## **2.5 WIRING DEVICES, COVER PLATES**

- .1 Conform to CSA.
- .2 Receptacles:
  - .1 Duplex: CSA type 5-15R.
  - .2 Single: CSA type 5-15R.
  - .3 Cover plates and blank plates: finish to match other plates in area.

## **2.6 STARTERS, CONTROL DEVICES**

- .1 Across-the-line magnetic starters:
  - .1 Enclosures: CSA Type 1, except where otherwise specified.
  - .2 Size, type and rating: to suit motors.
- .2 Starter diagrams:
  - .1 Provide copy of wiring and schematic diagrams - mount one copy in each starter with additional copies for operation and maintenance manual.
- .3 Auxiliary Control Devices:

- .1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.
- .2 Auxiliary contacts: one "Normally Open" and one "Normally Closed" spare auxiliary contact in addition to maintained auxiliary contacts as indicated.
- .3 Hand-Off-Automatic switch: heavy duty type, knob lever operator.
- .4 Double voltage relays: with barrier to separate relay contacts from operating magnet. Operating coil voltage and contact rating as indicated.

## **2.7 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT**

- .1 Solid masonry, tile and plastic surfaces: lead anchors or nylon shields.
  - .1 Hollow masonry walls, suspended drywall ceilings: toggle bolts.
- .2 Exposed conduits or cables:
  - .1 50 mm diameter and smaller: one-hole steel straps.
  - .2 Larger than 50 mm diameter: two-hole steel straps.
- .3 Suspended support systems:
  - .1 Individual cable or conduit runs: support with 6 mm diameter threaded rods and support clips.
  - .2 Two or more suspended cables or conduits: support channels supported by 6 mm diameter threaded rod hangers.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.

### **3.2 PIPING**

- .1 Domestic H&CWS: refer to Section 22 11 16 - Domestic Water Piping .
- .2 Sanitary: refer to Section 22 13 16.13 Sanitary Waste and Vent Piping Cast Iron and Copper and Section 22 13 16.16 Sanitary Waste and Vent Piping Plastic
- .3 Hot water heating: refer to Section 23 05 15 Common Installation Requirements f for HVAC Pipework and Section 23 21 16 Hydronic Piping Specialties.
- .4 Refrigeration: refer to Section 23 23 00 - Refrigerant Piping .
- .5 Insulation: refer to Section 23 07 19 - HVAC Piping Insulation.

### **3.3 MECHANICAL PIPING**

- .1 Install piping straight, parallel and close to building structure with required grades for drainage and venting.
- .2 Ream ends of pipes before assembly.
- .3 Copper tubing not to come into contact with dissimilar metal.
- .4 Use non-corrosive lubricant or Teflon tape on male screwed threads.

- .5 Clean ends of pipes, tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.
- .6 Install di-electric couplings where dissimilar metals joined.
- .7 Sleeves:
  - .1 Installation:
    - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
    - .2 Other floors: terminate 25 mm above finished floor.
    - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint.
  - .2 Caulking:
    - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
    - .2 Elsewhere: provide space for fire stopping by Section 07 84 00– Fire Stopping. Maintain the fire-resistance rating integrity of the fire separation.
    - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
    - .4 Ensure no contact between copper pipe or tube and sleeve.
- .8 Pressure tests:
  - .1 Isolate equipment, components, not designed to withstand test pressure.
- .9 Introduce system pressure carefully into new piping.

### **3.4 SUPPORTS**

- .1 Install special supports as required and as indicated.

### **3.5 ELECTRICAL GENERAL**

- .1 Do complete installation in accordance with requirements of:
  - .1 Division 26, this specification.
  - .2 CSA 22.1 Canadian Electrical Code.
  - .3 ANSI/NFPA 70.
  - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.
- .3 Do underground installation to CAN/CSA-C22.3 No.7, except where otherwise specified.
- .4 Conform to manufacturer's recommendations for storage, handling and installation.
- .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .6 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.

- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

### **3.6 CONDUIT SYSTEM**

- .1 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
- .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Contract Administrator and Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .4 Locate conduits at least 150 mm from parallel hot water pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.
- .8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .9 Fastenings and supports for conduits, cables, and equipment:
  - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.
  - .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
  - .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Contract Administrator and Departmental Representative.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of Contract Administrator and Departmental Representative's written approval.

- .13 Conduits may be run in flanged portion of structural steel.
- .14 Group conduits wherever possible on suspended or surface channels.
- .15 Pull boxes:
  - .1 Install in inconspicuous but accessible locations.
  - .2 Support boxes independently of connecting conduits.
  - .3 Fill boxes with paper or foam to prevent entry of construction material.
  - .4 Provide correct size of openings. Reducing washers not permitted.
  - .5 Mark location of pull boxes on record drawings.
  - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .16 Install bonding conductor for 120 volt and above in conduit.

### **3.7 WIRING**

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
  - .1 Circuits are continuous, free from shorts, unspecified grounds.
  - .2 Resistance to ground of all circuits is greater than 50 Megohms.
- .5 Provide Contract Administrator and Departmental Representative with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

### **3.8 WIRING DEVICES, COVER PLATES**

- .1 Receptacles:
  - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
  - .2 Cover plates:
    - .1 Install suitable common cover plate where wiring devices are grouped.
    - .2 Use flush type cover plates only on flush type outlet boxes.

### 3.9 STARTERS, CONTROL DEVICES

- .1 Install and make power and control connections as indicated.
- .2 Install correct over-current devices.
- .3 Identify each wire, terminal for external connections with permanent number marking identical to diagram.
- .4 Performance Verification:
  - .1 Operate switches and controls to verify functioning.
  - .2 Perform start and stop sequences of contactors and relays.
  - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

### 3.10 GROUNDING

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors and accessories.
- .2 Install separate grounding conductors in conduit within building.
- .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
- .4 Tests: perform ground continuity and resistance tests, using approved method appropriate to site conditions.

### 3.11 TESTS

- .1 General:
  - .1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.
  - .2 Give 14 days written notice of intention to test.
  - .3 Conduct in presence of Contract Administrator and Departmental Representative and authority having jurisdiction.
  - .4 Conceal work only after tests satisfactorily completed.
  - .5 Report results of tests to Contract Administrator and Departmental Representative in writing.
  - .6 Preliminary tests:
    - .1 Conduct as directed to verify compliance with specified requirements.
    - .2 Make needed changes, adjustments, replacements.
    - .3 Insulation resistance tests:
      - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V instrument. Resistance to ground to be more than required by Code before energizing.
      - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Contract Administrator and Department Representative and authority having jurisdiction.

### **3.12 IDENTIFICATION**

- .1 Refer to Section 25 05 54 - EMCS: Identification.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes.
  - .1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).
- .2 References.
  - .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
  - .2 Canadian Standards Association (CSA Group).
    - .1 CSA Z204-94 (R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

### **1.2 DEFINITIONS**

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit detailed preventative maintenance schedule for system components to Contract Administrator and Departmental Representative.
- .3 Submit detailed inspection reports to Contract Administrator and Departmental Representative.
- .4 Submit dated, maintenance task lists to Contract Administrator and Departmental Representative and include the following sensor and output point detail, as proof of system verification:
  - .1 Point name and location.
  - .2 Device type and range.
  - .3 Measured value.
  - .4 System displayed value.
  - .5 Calibration detail
  - .6 Indication if adjustment required,
  - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 Maintain records and logs of each maintenance task on site.



- .2 Organize cumulative records for each major component and for entire EMCS chronologically.
- .3 Submit records to Contract Administrator, after inspection indicating that planned and systematic maintenance have been accomplished.
- .7 Revise and submit to Contract Administrator in accordance with Section 01 78 00 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

#### **1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD**

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
  - .1 Initiate service calls when EMCS is not functioning correctly.
  - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
  - .3 Furnish Contract Administrator and Departmental Representative with telephone number where service personnel may be reached at any time.
  - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
  - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
  - .1 Serial number identifying component involved.
  - .2 Location, date and time call received.
  - .3 Nature of trouble.
  - .4 Names of personnel assigned.
  - .5 Instructions of work to be done.
  - .6 Amount and nature of materials used.
  - .7 Time and date work started.
  - .8 Time and date of completion.
- .5 Provide system modifications in writing.
  - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Contract Administrator and Departmental Representative.

## **1.5 SERVICE CONTRACTS**

- .1 Provide in-depth technical expertise and assistance to Contract Administrator and Departmental Representative and Commissioning Manager in preparation and implementation of service contracts and in-house preventive maintenance procedures.
- .2 Service Contracts to include:
  - .1 Annual verification of field points for operation and calibration.
  - .2 OWS Software updates and controller Firmware updates.
  - .3 DDC firmware upgrades available during the warranty period.
  - .4 Silent hours defined as 1700 to 0700 h.
  - .5 Complete inventory of installed system.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 FIELD QUALITY CONTROL**

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Contract Administrator and Departmental Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
  - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
  - .2 Check and Calibrate each field input/output device in accordance with CSA Z204 Canada Labour Code - Part I.
  - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
  - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
  - .2 Check equipment cooling fans as required.
  - .3 Review system performance with Operations Supervisor to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
  - .1 Minor inspection.

- .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
- .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
- .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
- .5 Provide mechanical adjustments, and necessary maintenance on printers.
- .6 Run system software diagnostics as required.
- .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
  - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
  - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 System requirements for Local Area Network (LAN) for Building Energy Monitoring and Control System (EMCS).

### **1.2 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA Group).
  - .1 CSA T529-95 (R2000), Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/TIA/EIA-568-A with modifications).
  - .2 CSA T530-99 (R2004), Commercial Building Standard for Telecommunications Pathways and Spaces (Adopted ANSI/TIA/EIA-569-A with modifications).
- .2 Institute of Electrical and Electronics Engineers (IEEE)/Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements.
  - .1 IEEE Std 802.3<sup>TM</sup>-, Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
- .3 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
  - .1 TIA/EIA-568-March 2004, Commercial Building Telecommunications Cabling Standards Set, Part 1 General Requirements Part 2 Balanced Twisted-Pair Cabling Components Part 3 Optical Fiber Cabling Components Standard.
  - .2 TIA/EIA-569-A-December 2001, Commercial Building Standard for Telecommunications Pathways and Spaces.
- .4 Treasury Board Information Technology Standard (TBITS).
  - .1 TBITS 6.9-2000, Profile for the Telecommunications Wiring System in Government Owned and Leased Buildings - Technical Specifications.

### **1.3 DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS - General Requirements.

### **1.4 SYSTEM DESCRIPTION**

- .1 Data communication network to link Operator Workstations and Master Control Units (MCU) in accordance with CSA T530/TBITS 6.9, TIA/EIA-568, TIA/EIA-569-A and CSA T529.
  - .1 Provide reliable and secure connectivity of adequate performance between different sections (segments) of network.
  - .2 Allow for future expansion of network, with selection of networking technology and communication protocols.
- .2 Data communication network to include, but not limited to:
  - .1 EMCS-LAN.

- .2 Modems.
- .3 Network interface cards.
- .4 Network management hardware and software.
- .5 Network components necessary for complete network.

## **1.5 DESIGN REQUIREMENTS**

- .1 EMCS Local Area Network (EMCS-LAN).
  - .1 High speed, high performance, local area network over which MCUs and OWSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
  - .2 EMCS-LAN to: BACnet Protocol.
  - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
  - .4 Support of combination of MCUs and OWSs directly connected to EMCS-LAN.
  - .5 High speed data transfer rates for alarm reporting, quick report generation from multiple controllers, upload/download information between network devices. Bit rate to be 10 Megabits per second minimum.
  - .6 Detection and accommodation of single or multiple failures of either OWSs, MCUs or network media. Operational equipment to continue to perform designated functions effectively in event of single or multiple failures.
  - .7 Commonly available, multiple sourced, networking components and protocols to allow system to co-exist with other networking applications including office automation.
- .2 Dynamic Data Access.
  - .1 LAN to provide capabilities for OWSs, either network resident or connected remotely, to access point status and application report data or execute control functions for other devices via LAN.
  - .2 Access to data to be based upon logical identification of building equipment.
- .3 Network Medium.
  - .1 Network medium: shielded twisted cable, or as per EMCS manufacturer's requirements and compatible with network protocol to be used within buildings. Fibre optic cable to be used between buildings.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Hardware and software requirements for an Operator Work Station (OWS) in a Building Energy Monitoring and Control System (EMCS), including primary, secondary, portable and remote OWS's.

### **1.2 DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.
- .2 Secondary OWS: serves as backup to primary OWS, is storage and retrieval facility of soft copy of as-built contractor supplied data as described in Section 25 05 03 - EMCS: Project Record Documents.
- .3 Portable OWS: used as remote dial-up OWS with same capabilities as primary OWS including graphic display.
- .4 Remote Auxiliary OWS: performs identical user interface functions as primary OWS.

### **1.3 OWS SYSTEM DESCRIPTION**

- .1 Consists of commercially available personal computer in current production, with sufficient memory and processor capacity to perform functions specified.
- .2 Primary OWS to include:
  - .1 Report printer.
  - .2 Colour graphics printer.
  - .3 Modem Router
  - .4 Desks, furniture.
- .3 Remote auxiliary OWS.
- .4 Portable Laptop.

### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

### **1.5 ENVIRONMENTAL CONDITIONS**

- .1 OWS to operate in conditions of 10 degrees C to 32 degrees C and 20 % to 90 % non-condensing RH.

### **1.6 MAINTENANCE**

- .1 Provide maintenance in accordance with Section 25 05 03 - EMCS: Project Record Documents.

## Part 2 Products

### 2.1 OWS HARDWARE

- .1 PC system to include:
  - .1 Processor: 8th Generation Intel® Core™ i7-8700 6-Core Processor (12M Cache, up to 4.6 GHz).
  - .2 Internal clock.
    - .1 Uninterruptible clock: accuracy of plus or minus 5 seconds/month, capable of deriving year/month/day/hour/minute/second.
    - .2 Rechargeable batteries: to provide minimum 48 hours clock operation in event of power failure.
  - .3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.
- .2 Power supply unit to accept 120 V 60 Hz source and include line surge and low voltage protection for processor and its peripherals.
- .3 Include UPS to provide 5 minutes minimum operation of PC, LCD and communication and peripheral devices; applies to fixed (non portable) OWS and peripherals.

### 2.2 OWS PC COMPONENTS

- .1 Primary OWS: MS Windows based PC compatible with following as minimum:
  - .1 IDE Disk drive controller to support 4 drives.
    - .1 TB hard disk drive, 3.5" Serial ATA 7200 RPM. 8x DVD+/-RW 9.5mm Optical Disk Drive 8GB, 2666MHz, DDR4 minimum.
  - .2 256 MB RAM minimum.
  - .3 Enhanced 101 key keyboard.
  - .4 USB Button Laser mouse.
  - .5 Colour monitor: 17". Flat panel display TFT, resolution 1920 x 1080,
  - .6 Video card with CPU.
  - .7 6 USB ports or 2 serial ports.
  - .8 Include two 2 spare expansion slots in system
  - .9 PCI Ethernet LAN Adapter to connect to local Ethernet LAN network.
  - .10 290 W minimum power supply.
- .2 Portable OWS: IBM compatible personal laptop computer, with following as minimum:
  - .1 8th Gen Intel® Core™ i5-8250U (Quad Core, 6M Cache, 1.6GHz, 15W)
  - .2 4GB, 1x4GB, 2400MHz DDR4 Non-ECC
  - .3 2.5" 500G 7200RPM 7mm HD
  - .4 3 USB Ports
  - .5 1 HDMI port
  - .6 Enhanced 101-key keyboard.

- .7 Ethernet LAN adapter to connect to local Ethernet Network.
- .8 Protective case with serviceable carrying straps.
- .9 CPU and peripherals: IBM compatible.
- .10 Operating system: same as primary OWS and include licensed OWS software as installed on primary OWS.
- .11 Operating system: same as primary OWS and include licensed OWS software as installed on primary OWS.
- .12 Install licensed OWS software as installed on primary OWS.
- .3 Remote Auxiliary OWS:
  - .1 Not Applicable

### **2.3 PRINTERS**

- .1 Report printer: Include following features:
  - .1 Laser printer.
  - .2 Accommodate 8.5 X 14" and 8.5 X 11" paper.
  - .3 Minimum 1200 by 1200 dpi resolution.
  - .4 Minimum 256 MB RAM.
  - .5 Minimum 18 pages per minute print speed.
  - .6 266 MHz Processor
  - .7 LCD Control Panel
  - .8 Connectivity: USB, GIGABIT Ethernet, Wireless 80211b/g/n
  - .9 Duplex Printing
  - .10 Minimum 20 pages per minute print speed.
- .2 Include one box of 8.5 X 11" and one box of 8.5 X 14" paper.
- .3 Include one box of 8.5 X 11" and one box of 8.5 X 14" paper.

### **2.4 CONTROL DESK CONSOLE**

- .1 Reuse existing furniture. Mount UPS where directed by the Contract Administrator and Department Representative.

### **2.5 OPERATING SYSTEM (OS) OR EXECUTIVE**

- .1 OS to support complement of hardware terminals and software programs specified.
- .2 OS to be true multitasking operating environment.
- .3 OWS software to operate in "Windows" based operating environment: Windows 10 PRO 64 Bit.

### **2.6 OWS CONTROL SOFTWARE**

- .1 OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.



- .2 Time Synchronization Module.
  - .1 System to provide Time Synchronization of real-time clocks in controllers.
  - .2 System to perform this feature on regular scheduled basis and on operator request.
- .3 User Display Interface Module.
  - .1 OWS software to support "Point Names" as defined in Section 25 05 01 - EMCS: General Requirements.
  - .2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. For systems supporting COSV, refresh rate of screen data not to exceed 5 seconds from time of field change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up to 30 active points), including presentation of associated dynamic data not to exceed 8 seconds.
- .4 General Event Log Module: to record system activities occurring at OWS or elsewhere in system including:
  - .1 Operator Log-in from user interface device.
  - .2 Communication messages: errors, failures and recovery.
  - .3 Event notifications and alarms by category.
  - .4 Record of operator initiated commands.
- .5 General Event Log:
  - .1 Hold minimum of 4 months information and be readily accessible to operator.
  - .2 Able to be archived as necessary to prevent loss of information.
- .6 Operator Control Software Module: to support entry of information into system from keyboard and mouse, disk, or from another network device. Display of information to user; dynamic displays, textual displays, and graphic displays to display logging and trending of system information and following tasks:
  - .1 Automatic logging of digital alarms and change of status messages.
  - .2 Automatic logging of analog alarms.
  - .3 System changes: alarm limits, set-points, alarm lockouts.
  - .4 Display specific point values, states as selected.
  - .5 Provide reports as requested and on scheduled basis when required.
  - .6 Display graphics as requested, and on alarm receptions (user's option).
  - .7 Display list of points within system.
  - .8 Display list of systems within building.

- .9 Direct output of information to selected peripheral device.
- .10 On-line changes:
  - .1 Alarm limits.
  - .2 Setpoints.
  - .3 Deadbands.
  - .4 Control and change of state changes.
  - .5 Time, day, month, year.
  - .6 Control loop configuration changes for controller-based CDLs.
  - .7 Control loop tuning changes.
  - .8 Schedule changes.
  - .9 Changes, additions, or deletions, of points, graphics, for installed and future systems.
- .11 According to assigned user privileges (password definition) following functions are to be supported:
  - .1 Permit operator to terminate automatic (logic based) control and set value of field point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.
  - .2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.
- .12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.
- .7 Dial-up host Module for off site OWSs.
  - .1 Operators at dial-up OWS to be able to perform control functions, report functions, data base generation and modification functions as described for OWS's connected via LAN. Provide routines to automatically answer calls and either file or display information sent from remote panels.
  - .2 Operator to be able to access remote buildings by selection of facility by its logical name. Dial-up module to maintain user-definable cross-reference of buildings and associated telephone numbers without manual dialing.
  - .3 Local OWS may serve as dial-up host for remotely connecting OWSs, remote controllers or networks. Alarms and data file transfers handled via dial-up transactions must not interfere with local LAN activity. LAN activity not to prevent work-station from handling incoming calls.
- .8 Message Handling Module - and Error Messages: to provide message handling for following conditions:
  - .1 Message and alarm buffering to prevent loss of information.
  - .2 Error detection correction and retransmission to guarantee data integrity.
  - .3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to requests or commands and failure of communications between EMCS devices.

- .4 Default device definition to be implemented to ensure alarms are reported as quickly as possible in event of faulty designated OWS.
- .9 Access ControlModule.
  - .1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:
    - .1 Guest: no password data access and display only.
    - .2 Operator Level: full operational commands including automatic override.
    - .3 Technician: data base modifications.
    - .4 Programmer: data base generation.
    - .5 Highest Level: system administration - password assignment addition, modification.
  - .2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 3 minutes.
- .10 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.
  - .1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 6 month capacity.
  - .2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable rate of 05 seconds to 3600 seconds, individually selectable for selected value, or use of COSV detection. Collected trend data to be stored on minimum 96 hours basis in temporary storage until removed from trend data list by operator. Option to archive data before overwriting to be available.
  - .3 Control loop plot utility: for AO Points provide for concurrent plotting of Measured value input - present value, present value of output, and AO setpoint. Operator selectable sampling interval to be selectable between 1 second to 20 seconds. Plotting utility to scroll to left as plot reaches right side of display window. Systems not supporting control loop plot as separate function must provide predefined groups of values. Each group to include values for one control loop display.
  - .4 Trend data Module to include display of historical or trend data to OWS screen in X Y plot presentation. Plot utility to display minimum of 6 historical points or 6 trend points concurrently or 1 Control Loop Plot. For display output of real time trend data, display to automatically index to left when window becomes full.

- Provide plotting capabilities to display collected data based on range of selected value for (Y) component against time/date stamp of collected data for (X) component.
- .5 Provide separate reports for each trend utility. Provide operator feature to specify report type, by point name and for output device. Reports to include time, day, month, year, report title, and operator's initials. Implement reports using report module. Ensure trend data is exportable to third party spreadsheet or database applications for PCs.
  - .11 Report Module: reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at MCU level. Refer also to Section 25 30 01 - EMCS: Building Controllers.
    - .1 Reports to include time, day, month, year, report title, operator's initials.
    - .2 Software to provide capability to:
      - .1 Generate and format reports for graphical and numerical display from real time and stored data.
      - .2 Print and store reports as selected by operator.
      - .3 Select and assign points used in such reports.
      - .4 Sort output by area, system, as minimum.
    - .3 Periodic/automatic report:
      - .1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.
      - .2 Reports to include:
        - .1 Power demand and duty cycle summary: see application program for same.
        - .2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.
        - .3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.
        - .4 Summary of run time alarms: include point name, run time to date, alarm limit.
        - .5 Summary of start/stop schedules: include start/stop times and days, point name.
        - .6 Motor status summary.
    - .4 Report types:
      - .1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for

- operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:
- .2 Points in accessible from this OWS (total connected for this location), multiple "areas".
  - .3 Area (points and systems in Area).
  - .4 Area, system (points in system).
  - .5 System (points by system type).
  - .6 System point (points by system and point object type).
  - .7 Area point (points by system and point object type).
  - .8 Point (points by point object type).
- .5 Summary report: printout or display of point object data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.
- .6 Include preformatted reports as listed in Event/Alarm Module.
- .12 Graphics Display Module: graphics software utility to permit user to create, modify, delete, file, and recall graphics required by Section 25 90 01 - EMCS: Site Requirements, Applications and Systems Sequences of Operation.
- .1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlaid with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of mouse or similar pointing device.
  - .2 Display specific system graphics: provide for manual and/or automatic activation (on occurrence of an alarm). Include capability to call up and cancel display of graphic picture.
  - .3 Library of pre-engineered screens and symbols depicting standard air handling components (fans, coils, filters, dampers, VAV), complete mechanical system components (chillers, boilers, pumps), electrical symbols.
  - .4 Graphic development, creation, modification package to use mouse and drawing utility to permit user to:
    - .1 Modify portion of graphic picture/schematic background.
    - .2 Delete graphic picture.
    - .3 Call up and cancel display of graphic picture.
    - .4 Define symbols.
    - .5 Position and size symbols.
    - .6 Define background screens.
    - .7 Define connecting lines, curves.
    - .8 Locate, orient, size descriptive text.

- .9 Define, display colours of elements.
- .10 Establish co-relation between symbols or text and associated system points or other graphic displays.
- .5 User to be able to build graphic displays showing on-line point data from multiple MCU panels. Graphic displays to represent logical grouping of system points or calculated data based upon building function, mechanical system, building layout, other logical grouping of points which aids operator in analysis of facility operation. Data to be refreshed on screen as "changed data" without redrawing of entire screen or row on screen.
- .6 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.
- .7 Windowing environment to allow user to view several graphics simultaneously to permit analysis of building operation, system performance, display of graphic associated with alarm to be viewed without interrupting work in progress. If interface is unable to display several different types of display at same time, provide at minimum 2 OWS's.
- .8 Utilize graphics package to generate system schematic diagrams as required in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation, and as directed by Contract Administrator and Department Representative. In addition provide graphics for schematic depicted on mechanical plan flow diagrams, point lists and system graphics. Provide graphic for floor depicting room sensors and control devices located in their actual location. For floor graphic include secondary diagram to show TCU-VAV box actuator and, flow sensor. Diagram to be single line schematic of ductwork as well as associated heating coil or radiation valve. Contract Administrator and Department Representative to provide CAD floor layouts. Provide display of TCU -VAV's in table form, include following values as minimum; space temp, setpoint, mode, actual flow, min flow setpoint, max flow setpoint, cooling signal value, and heating signal value. Organize table by rooms and floor groupings.
- .9 Provide complete directory of system graphics, including other pertinent system information. Utilize mouse or pointing device to "point and click" to activate selected graphic.
- .10 Provide unique sequence of operation graphic or pop-up window for each graphic that is depicted on OWS. Provide access to sequence of operation graphic by link button on each system graphic. Provide translation of sequence of operation, a concise explanation of systems operation, from control descriptive logic into plain English and French language.
- .13 Event/Alarm Module: displays in window alarms as received and stored in General Event Log.
  - .1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.
  - .2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.

- .3 Alarm reports.
  - .1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.
  - .2 Analog alarm limit summary: include point name, alarm limits, deviation limits.
  - .3 Summary of alarm messages: include associated point name, alarm description.
- .4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.
- .5 EMCS to notify operator of occurrence of alarms originating at field device within following time periods of detection:
  - .1 Critical - 5 seconds.
  - .2 Cautionary - 10 seconds.
  - .3 Maintenance - 10 seconds.
- .6 Display alarm messages in English and French .
- .7 Primary alarm message to include as minimum: point identifier, alarm classification, time of occurrence, type of alarm. Provide for initial message to be automatically presented to operator whenever associated alarm is reported. Assignment of secondary messages to point to be operator-editable function. Provide secondary messages giving further information (telephone lists, maintenance functions) on per point basis.
- .8 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgment of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgement of one alarm as acknowledgement of other alarms.
- .9 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:
  - .1 Controller not responding - where possible delineate between controller and communication line failure.
  - .2 Controller responding - return to normal.
  - .3 Controller communications bad - high error rate or loss of communication.
  - .4 Controller communications normal - return to normal.

- .10 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV). Annunciate each non-expected status with alarm message.
- .14 Archiving and Restoration Module.
  - .1 Primary OWS to include services to store back-up copies of controller databases. Perform complete backup of OWS software and data files at time of system installation and at time of final acceptance. Provide backup copies before and after Controller's revisions or major modifications.
  - .2 Provide continuous integrity supervision of controller data bases. When controller encounters database integrity problems with its data base, system to notify operator of need to download copy data base to restore proper operation.
  - .3 Ensure data base back-up and downloading occurs over LAN without specialized operator technical knowledge. Provide operator with ability to manually download entire controller data base, or parts thereof as required.
- .15 CDL Generator and Modifier Module.
  - .1 CDL Generator module to permit generation and modification of CDLs.
  - .2 Provide standard reference modules for text based systems module that will permit modification to suit site specific applications. Module to include cut, paste, search and compare utilities to permit easy CDL modification and verification.
  - .3 Provide full library of symbols used by manufacturer for system product installed accessible to operators for systems using graphical environment for creation of CDLs. Module to include graphic tools required to generate and create new object code for downloading to building controllers.
  - .4 Module to permit testing of code before downloading to building controllers.

## **2.7 ADDITIONAL UTILITY SOFTWARE**

- .1 Supply and install on primary OWS, following CAD software products by Autodesk Inc. and include:
  - .1 AutoCAD LT latest version.
  - .2 Include special drivers, fonts, to ensure complete and proper functioning of software packages specified. Deliver system complete with full set of User Manuals.
  - .3 Enter soft copy submissions, including "Record" drawings specified in Section 25 05 03 - EMCS: Project Record Documents in OWS.
  - .4 Enter soft copy of Architectural, Electrical, Mechanical systems plans and "Record" drawings in OWS.

## **Part 3 Execution**

### **3.1 INSTALLATION REQUIREMENTS**

- .1 Provide necessary power as required from local 120 V emergency power branch circuit panels for OWS's and peripheral equipment.



- .1 Install tamper locks on breakers of circuit panels.
- .2 Refer to UPS requirements stated under OWS Hardware in PART 2.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 Materials and installation for building automation controllers including:
    - .1 Master Control Unit (MCU).
    - .2 Local Control Unit (LCU).
    - .3 Equipment Control Unit (ECU).
    - .4 Terminal Control Unit (TCU).

### **1.2 REFERENCE STANDARDS**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1 ASHRAE 2003, Applications Handbook, SI Edition.
- .2 Canadian Standards Association (CSA Group).
  - .1 C22.2 No.205-M1983 (R1999), Signal Equipment.
- .3 Institute of Electrical and Electronics Engineers (IEEE).
  - .1 IEEE C37.90.1-02, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.

### **1.3 DEFINITIONS**

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

### **1.4 DESCRIPTION**

- .1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided as indicated in System Architecture Diagram to support building systems and associated sequence(s) of operations as detailed in these specifications.
  - .1 Provide sufficient controllers to meet intents and requirements of this section.
  - .2 Controller quantity, and point contents to be approved by Contract Administrator and Departmental Representative at time of preliminary design review.
- .2 Controllers: stand-alone intelligent Control Units.
  - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
  - .2 Incorporate communication interface ports for communication to LANs to exchange information with other Controllers.
  - .3 Capable of interfacing with operator interface device.
  - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

- .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
- .3 Interface to include provisions for use of dial-up modem for interconnection with remote modem.
  - .1 Dial-up communications to use 56 Kbit modems and voice grade telephone lines.
  - .2 Each stand-alone panel may have its own modem or group of stand-alone panels may share modem.

### **1.5 DESIGN REQUIREMENTS**

- .1 To include:
  - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.
  - .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
  - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
  - .4 Control of systems as described in sequence of operations.
  - .5 Execution of optimization routines as listed in this section.
- .2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.
- .3 Field Termination and Interface Devices:
  - .1 To: CSA C22.2 No.205.
  - .2 Electronically interface sensors and control devices to processor unit.
  - .3 Include, but not be limited to, following:
    - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
    - .2 Power supplies for operation of logics devices and associated field equipment.
    - .3 Lockable wall cabinet.
    - .4 Required communications equipment and wiring (if remote units).
    - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
    - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
    - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
  - .4 AI interface equipment to:
    - .1 Convert analog signals to digital format with 10 bit analog-to-digital resolution.
    - .2 Provide for following input signal types and ranges:

- .1 4 - 20 mA;
- .2 0 - 10 V DC;
- .3 100/1000 ohm RTD input;
- .3 Meet IEEE C37.90.1 surge withstand capability.
- .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
- .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
  - .1 Convert digital data from controller processor to acceptable analog output signals using 8 bit digital-to-analog resolution.
  - .2 Provide for following output signal types and ranges:
    - .1 4 - 20 mA.
    - .2 0 - 10 V DC.
  - .3 Meet IEEE C37.90.1 surge withstand capability.
- .6 DI interface equipment:
  - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
  - .2 Meet IEEE C37.90.1 surge withstand capability.
  - .3 Accept pulsed inputs up to 2 kHz.
- .7 DO interface equipment:
  - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
  - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.
- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
  - .1 Provide for conduit entrance from top, bottom or sides of panel.
  - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
  - .3 Mounting details as approved by Contract Administrator for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

#### **1.6 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
  - .1 Submit product data sheets for each product item proposed for this project.

## 1.7 MAINTENANCE

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

## Part 2 Products

### 2.1 MASTER CONTROL UNIT (MCU)

- .1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
- .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
  - .1 MCU must support BACnet Protocol.
- .3 MCU local I/O capacity as follows:
  - .1 MCU I/O points as allocated in I/O Summary Table referenced in MD13800.
  - .2 LCUs may be added to support system functions.
- .4 Central Processing Unit (CPU).
  - .1 Processor to consist of minimum 16 bit microprocessor capable of supporting software to meet specified requirements.
  - .2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.
  - .3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
    - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.
    - .2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
  - .4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.
- .5 Local Operator Terminal (OT): Not required

### 2.2 LOCAL CONTROL UNIT (LCU)

- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.

- .3 Points integral to one Building System to be resident on only one controller.
- .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
  - .1 Include minimum 2 interface ports for connection of local computer terminal.
  - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.
  - .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
  - .4 Include power supplies for operation of LCU and associated field equipment.
  - .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
  - .6 Provide conveniently located screw type or spade lug terminals for field wiring.

### **2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)**

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
  - .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.
- .2 Controller to communicate directly with EMCS through EMCS LAN and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.
- .3 VAV Terminal Controller.
  - .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer and measure temperatures as per I/O Summary required inputs. Sequence of operation to ASHRAE HVAC Applications Handbook.
  - .2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.
  - .3 Controller to operate independent of network in case of communication failure.
  - .4 Controller to include damper actuator and terminations for input and output sensors and devices.

### **2.4 SOFTWARE**

- .1 General.
  - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
  - .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
  - .3 Include initial programming of Controllers, for entire system.

- .2 Program and data storage.
  - .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
  - .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
- .3 Programming languages.
  - .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
  - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental Representative.
- .4 Operator Terminal interface.
  - .1 Operating and control functions include:
    - .1 Multi-level password access protection to allow user/manager to limit workstation control.
    - .2 Alarm management: processing and messages.
    - .3 Operator commands.
    - .4 Reports.
    - .5 Displays.
    - .6 Point identification.
- .5 Pseudo or calculated points.
  - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
  - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
- .6 Control Description Logic (CDL):
  - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. City must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.
  - .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from OWS and BC(s) to tune control loops.
  - .3 Perform changes to CDL on-line.

- .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or inter-locking control.
- .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
- .6 MCU to be able to perform following pre-tested control algorithms:
  - .1 Two position control.
  - .2 Proportional Integral and Derivative (PID) control.
- .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
- .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
- .9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyse controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyse status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.
- .7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
- .8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.
  - .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
    - .1 Time of day scheduling.
    - .2 Calendar based scheduling.
    - .3 Holiday scheduling.
    - .4 Temporary schedule overrides.
    - .5 Optimal start stop.
    - .6 Night setback control.
    - .7 Enthalpy (economizer) switchover.
    - .8 Peak demand limiting.



- .9 Temperature compensated load rolling.
- .10 Fan speed/flow rate control.
- .11 Hot water reset.
- .12 Night purge.
- .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
- .3 Apply programs to equipment and systems as specified or requested by the Contract Administrator and Departmental Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
  - .1 MCUs to accumulate and store automatically run-time for binary input and output points.
  - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
  - .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
  - .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
  - .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWh, litres, tonnes, etc.).
  - .6 Store event totalization records with minimum of 9,999,999 events before reset.
  - .7 User to be able to define warning limit and generate user-specified messages when limit reached.

## **2.5 LEVELS OF ADDRESS**

- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
  - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
  - .2 Update displayed analog values and status when new values received.
  - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
  - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

## **Part 3 Execution**

### **3.1 LOCATION**

- .1 Location of Controllers to be approved by Departmental Representative and Contract Administrator.

### **3.2 INSTALLATION**

- .1 Install Controllers in secure locking enclosures.
- .2 Provide necessary power from local 120 V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.

**END OF SECTION**

## Part 1 General

### 1.1 SUMMARY

- .1 Section Includes:
  - .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, switches, damper operators, transducers, valves, low voltage current transformers, sensors, valve actuators, controls..
  - .2 Related Sections:
    - .1 Section 01 73 00 - Execution.
    - .2 Section 07 84 00 - Fire stopping.
    - .3 Section 23 33 15 - Dampers - Operating.
    - .4 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
    - .5 Section 25 05 01 - EMCS: General Requirements.
    - .6 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
    - .7 Section 25 05 54 - EMCS: Identification.
    - .8 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
    - .9 Section 26 00 10 Basic Electrical Materials and Methods.
    - .10 Section 26 27 26 - Wiring Devices.

### 1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C12.7-1993 (R1999), Requirements for Watthour Meter Sockets.
  - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM B148-97 (03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
  - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
  - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.
- .5 CSA Group CSA Group
  - .1 CSA-C22.1-02, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

### 1.3 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
  - .1 Not Applicable
- .3 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation instructions for specified equipment and devices.

#### **1.5 EXISTING CONDITIONS**

- .1 Cutting and Patching: in accordance with Section 01 73 29 - Cutting and Patching supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to City of Winnipeg Representative existing materials removed from Work not identified for re-use.

### **Part 2 Products**

#### **2.1 GENERAL**

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

#### **2.2 TEMPERATURE SENSORS**

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
  - .1 Thermocouples: limit to temperature range of 200 degrees C and over.

- .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored lead wires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.
- .3 Sensing element: hermetically sealed.
- .4 Stem and tip construction: copper or type 304 stainless steel.
- .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
- .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities..
- .2 Room temperature sensors and display wall modules.
  - .1 Temperature sensing and display wall module.
    - .1 LCD display to show space temperature and temperature setpoint.
    - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
    - .3 Jack connection for plugging in laptop personal computer .
    - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
    - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
    - .6 Stability 0.02 degrees C drift per year.
    - .7 Separate mounting base for ease of installation.
  - .2 Room temperature sensors.
    - .1 Wall mounting, in slotted type covers having white finish, with guard as indicated.
    - .2 Element 10-50 mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000 ohm, accuracy of plus or minus 0.2 degrees C.
- .3 Duct temperature sensors:
  - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm as indicated.
  - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6096 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.
- .4 Outdoor air temperature sensors:
  - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

## 2.3 TEMPERATURE TRANSMITTERS

- .1 Requirements:

- .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
- .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
- .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .4 Input and output short circuit and open circuit protection.
- .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
- .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
- .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
- .8 Integral zero and span adjustments.
- .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/50 degrees C.
- .10 Long term output drift: not to exceed 0.25 % of full scale/6 months.
- .11 Transmitter ranges: select narrowest range to suit application from following:
  - .1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
  - .2 0 to 100 degrees C, plus or minus 0.5 degrees C.
  - .3 0 to 50 degrees C, plus or minus 0.25 degrees C.
  - .4 0 to 25 degrees C, plus or minus 0.1 degrees C.
  - .5 10 to 35 degrees C, plus or minus 0.25 degrees C.

## 2.4 HUMIDITY SENSORS

- .1 Room and Duct Requirements:
  - .1 Range: 5 - 90 % RH minimum.
  - .2 Operating temperature range: 0 - 60 degrees C.
  - .3 Absolute accuracy:
    - .1 Duct sensors: plus or minus 3 %.
    - .2 Room sensors: plus or minus 2 %.
  - .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
  - .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
  - .6 New Room sensors: For AHU-1 and AHU-2 locate next to room temperature sensor and as approved by the Contract Administrator and Department representative.
  - .7 Duct mounted sensors: locate so that sensing element is in air flow in duct.
- .2 Outdoor Humidity Requirements:
  - .1 Range: 0 - 100 % RH minimum.
  - .2 Operating temperature range: -40 - 50 degrees C.

- .3 Absolute accuracy: plus or minus 2 %.
- .4 Temperature coefficient: plus or minus 0.03%RH/degrees C over 0 to 50 degrees C.
- .5 Must be unaffected by condensation or 100% saturation.
- .6 No routine maintenance or calibration is required.

## **2.5 HUMIDITY TRANSMITTERS**

- .1 Requirements:
  - .1 Input signal: from RH sensor.
  - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
  - .3 Input and output short circuit and open circuit protection.
  - .4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
  - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
  - .6 Integral zero and span adjustment.
  - .7 Temperature effect: plus or minus 1.0 % full scale/6 months.
  - .8 Long term output drift: not to exceed 0.25 % of full scale output/6 months.

## **2.6 PRESSURE TRANSDUCERS**

- .1 Requirements:
  - .1 Combined sensor and transmitter measuring pressure.
    - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
  - .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
  - .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
  - .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/50 degrees C.
  - .6 Over-pressure input protection to at least twice rated input pressure.
  - .7 Output short circuit and open circuit protection.
  - .8 Accuracy: plus or minus 1 % of Full Scale.

## **2.7 DIFFERENTIAL PRESSURE TRANSMITTERS**

- .1 Requirements:
  - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
  - .2 Output signal: 4 - 20 mA into 500 ohm maximum load.

- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/50 degrees C.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.
- .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

## **2.8 STATIC PRESSURE SENSORS**

- .1 Requirements:
  - .1 Multipoint element with self-averaging manifold.
    - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
  - .2 Accuracy: plus or minus 1 % of actual duct static pressure.

## **2.9 STATIC PRESSURE TRANSMITTERS**

- .1 Requirements:
  - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
  - .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
  - .3 Accuracy: 0.4 % of span.
  - .4 Repeatability: within 0.5 % of output.
  - .5 Linearity: within 1.5 % of span.
  - .6 Deadband or hysteresis: 0.1 % of span.
  - .7 External exposed zero and span adjustment.
  - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

## **2.10 VELOCITY PRESSURE SENSORS**

- .1 Requirements:
  - .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
  - .2 Maximum pressure loss: 37 Pa at 1000 m/s.
  - .3 Accuracy: plus or minus 1 % of actual duct velocity.

## **2.11 VELOCITY PRESSURE TRANSMITTERS**

- .1 Requirements:
  - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.



- .2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
- .3 Accuracy: 0.4 % of span.
- .4 Repeatability: within 0.1 % of output.
- .5 Linearity: within 0.5 % of span.
- .6 Deadband or hysteresis: 0.1 % of span.
- .7 External exposed zero and span adjustment.
- .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

## 2.12 WATER FLOW METERS

- .1 Requirements:
  - .1 Electromagnetic meters are spool piece in-line flow sensors.
  - .2 For Domestic water flow measurement, Meters are to be ACS Drinking Water Approved, provided with Teflon liner.
- .2 Communications:
  - .1 The water flow meter shall be capable of communicating to the new EMCS via BACnet or MODBUS. MODBUS is the standard protocol but BACnet is also acceptable if available.
- .3 Electromagnetic Flow Sensor:
  - .1 Design Details:
    - .1 The water flow sensor shall be inline, flanged, and electromagnetic.
    - .2 All circuits for inputs, outputs and power supply shall galvanically isolated from each other.
    - .3 The flow sensor shall be available for pipes of nominal diameter 1” to 12”.
    - .4 The flow sensor flanges shall be available in ASME class 150 and 300.
  - .2 Accuracy
    - .1 The flow sensor shall have the following maximum measured error within the sensor application ranges:
      - .1 Current output: +/- 5  $\mu$ A
      - Pulse output: +/- 0.5% o.r.
  - .3 Application Ranges
    - .1 Fluid velocity: 0.01 to 10m/s
    - .2 Fluid Temperature up to 180°C (356°F)
    - .3 Process pressures up to 40bar (580 psi)
    - .4 Conductivity  $\geq$  5 $\mu$ S/cm
  - .4 Measurements
    - .1 Volume Flow
    - .2 Volume Totalizer

- .3 Measurements shall be available in the following units:
  - .1 ft<sup>3</sup>
    - US gallons
    - million US gallons
    - lbs
    - cubic meters
    - liters
    - million liters
    - kg
- .5 Communications
  - .1 The flow sensor shall communicate to the EMCS via any of the following communications protocols:
    - .1 Current output
    - Pulse/Frequency output
    - PROFIBUS DP
    - PROFIBUS PA
    - MODBUS
    - HART
- .6 Data Logging
  - .1 The flow computer shall be able to store in non-volatile memory at minimum the following
    - .1 1750 entries of 1-minute interval data; or
    - 260 Days of data; or
    - 1600 events; or
    - 27 operating variables over 128 periods.
- .7 Alarming
  - .1 The energy calculator shall have a fault mode where error values are transmitted over the communications bus if measurement error conditions exist.
- .8 Communications:
  - .1 Ethernet TCP/IP via RJ-45 port

## **2.13 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES**

- .1 Requirements:
  - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
  - .2 Adjustable setpoint and differential.
  - .3 Switch: snap action type, rated at .....
  - .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
  - .5 Accuracy: within 2 % repetitive switching.

- .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.
- .7 Switches on steam and high temperature hot water service: provide pigtail syphon.

## **2.14 TEMPERATURE SWITCHES**

- .1 Requirements:
  - .1 Operate automatically. Reset automatically, except as follows:
    - .1 Low temperature detection: manual reset.
    - .2 High temperature detection: manual reset.
  - .2 Adjustable setpoint and differential.
  - .3 Accuracy: plus or minus 120 V 15 amps 24V DC degrees C.
  - .4 Snap action rating: 120V as required. Switch to be DPST for hardwire and EMCS connections.
  - .5 Type as follows:
    - .1 Room: for wall mounting on standard electrical box with protective guard as indicated. protective guard as indicated.
    - .2 Duct, general purpose: insertion length = 460 mm.
    - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
    - .4 Low temperature detection: continuous element with 6096 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
    - .5 Strap-on: with helical screw stainless steel clamp.

## **2.15 TANK LEVEL SWITCHES**

- .1 Requirements:
  - .1 Indicate high/low water level and to alarm.
  - .2 For mounting on top of tank.
  - .3 Maximum operating temperature: 120 degrees C.
  - .4 Snap action contacts rated 15 amp at 120 V.
  - .5 Adjustable setpoint and differential.

## **2.16 ELECTROMECHANICAL RELAYS**

- .1 Requirements:
  - .1 Double voltage, DPDT, plug-in type with termination base.
  - .2 Coils: rated for 24V DC 120V AC. Other voltage: provide transformer.
  - .3 Contacts: rated at 5 amps at 120 V AC.
  - .4 Relay to have visual status indication

## **2.17 SOLID STATE RELAYS**

- .1 General:
  - .1 Relays to be socket or rail mounted.
  - .2 Relays to have LED Indicator
  - .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
  - .4 Operating temperature range to be -20 degrees C to 70 degrees C.
  - .5 Relays to be CSA Certified.
  - .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
  - .7 Operational frequency range, 45 to 65 HZ.
- .2 Input:
  - .1 Control voltage, 3 to 32 VDC.
  - .2 Drop out voltage, 1.2 VDC.
  - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output:
  - .1 AC or DC Output Model to suit application.

## **2.18 CURRENT TRANSDUCERS**

- .1 Requirements:
- .2 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
  - .1 4-20 mA DC.
  - .2 0-1 volt DC.
  - .3 0-10 volts DC.
  - .4 0-20 volts DC.
- .3 Frequency insensitive from 10 - 80 hz.
- .4 Accuracy to 0.5% full scale.
- .5 Zero and span adjustments. Field adjustable range to suit motor applications.
- .6 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

## **2.19 CURRENT SENSING RELAYS**

- .1 Requirements:
  - .1 Suitable to detect belt loss or motor failure.
  - .2 Trip point adjustment, output status LED.
  - .3 Split core for easy mounting.
  - .4 Induced sensor power.
  - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC/DC. Output to be NO solid state.

- .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
- .7 Adjustable latch level.

## 2.20 CONTROL DAMPERS

- .1 Construction: blades, 152 mm wide, 1219 mm long, maximum. Modular maximum size, 1219 mm wide x 1219 mm high. Three or more sections to be operated by jack shafts.
- .2 Materials:
  - .1 Frame: 2.03 mm minimum thickness extruded aluminum. For outdoor air and exhaust air applications, frames to be insulated.
  - .2 Blades: extruded aluminum. For outdoor air/exhaust air applications, blades to be internally insulated.
  - .3 Bearings: maintenance free, synthetic type of material.
  - .4 Linkage and shafts: aluminum, zinc and nickel plated steel.
  - .5 Seals: synthetic type, mechanically locked into blade edges.
    - .1 Frame seals: synthetic type, mechanically locked into frame sides.
- .3 Performance: minimum damper leakage meet or exceed AMCA Standard 500-D ratings.
  - .1 Size/Capacity: refer to damper schedule
  - .2 25 L/s/m<sup>2</sup> maximum allowable leakage against 1000 Pa static pressure for outdoor air and exhaust air applications.
  - .3 Temperature range: minus 40 degrees C to plus 100 degrees C.
- .4 Arrangements: dampers mixing warm and cold air to be parallel blade, mounted at right angles to each other, with blades opening to mix air stream.
- .5 Jack shafts:
  - .1 25 mm diameter solid shaft, constructed of corrosion resistant metal complete with required number of pillow block bearings to support jack shaft and operate dampers throughout their range.
  - .2 Include corrosion resistant connecting hardware to accommodate connection to damper actuating device.
  - .3 Install using manufacturer's installation guidelines.
  - .4 Use same manufacturer as damper sections.

## 2.21 ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
  - .1 Direct mount proportional type as indicated.
  - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
  - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
  - .4 Power requirements: 5 VA maximum at 24 V AC.

- .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
- .6 For VAV box applications floating control type actuators may be used.
- .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

## **2.22 CONTROL VALVES**

- .1 Body: globe style, characterized ball.
  - .1 Flow characteristic, equal percentage, quick opening, as applicable.
  - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
  - .3 Normally open and Normally closed, as indicated.
  - .4 Two port, as indicated.
  - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
  - .6 Packing easily replaceable.
  - .7 Stem, stainless steel.
  - .8 Plug and seat, stainless steel, brass, bronze.
  - .9 Disc, replaceable, material to suit application.
  - .10 NPS 2 and under:
    - .1 Screwed National Pipe Thread (NPT) tapered female connections.
    - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
    - .3 Rangeability 50:1 minimum.
  - .11 NPS 2½ and larger:
    - .1 Flanged connections.
    - .2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.
    - .3 Rangeability 100:1 minimum.

## **2.23 ELECTRONIC/ELECTRIC VALVE ACTUATORS**

- .1 Requirements:
  - .1 Construction: steel, cast iron, aluminum.
  - .2 Control signal: 0-10V DC 4-20 mA DC..
  - .3 Positioning time: to suit application. 90 sec maximum.
  - .4 Fail to normal position as indicated.
  - .5 Scale or dial indication of actual control valve position.
  - .6 Size actuator to meet requirements and performance of control valve specifications.
  - .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
  - .8 Minimum shut-off pressure: refer to control valve schedule.

## **2.24 WATTHOUR METERS AND CURRENT TRANSFORMERS**

- .1 Requirements:
  - .1 Include three phases, test and terminal blocks for watthour metre connections and connections for monitoring of current. Provide two transformers for 600 V 3 wire systems for watthour metre use. Accuracy: plus or minus 0.25 % of full scale. For chiller applications: to have instantaneous indicator with analog or digital display.
  - .2 Watthour metre sockets: to ANSI C12.7.
  - .3 Potential and current transformers: to ANSI/IEEE C57.13.
  - .4 Potential transformers: provide two primary fuses.
  - .5 Demand meters: configure to measure demand at 15 minute intervals.

## **2.25 SURFACE WATER DETECTORS**

- .1 Requirements:
  - .1 Provide alarm on presence of water on floor.
  - .2 Expendable cartridge sensor.
  - .3 Internal waterproof switch.
  - .4 One set of dry contacts 2 amps at 24 V.
  - .5 Unaffected by moisture in air.
  - .6 Self-powered.

## **2.26 PANELS**

- .1 Wall mounted enameled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Contract Administrator and Department Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

## **2.27 WIRING**

- .1 In accordance with Section 26 27 26- Wiring Device 26 27 10- Modular Wiring System..
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
  - .1 Field wiring to digital device: 20AWG stranded twisted pair #18AWG or as required by EMCS manufacturer..
  - .2 Analog input and output: shielded #20 minimum stranded twisted pair or #18 minimum solid copper 18AWG or as required by EMCS manufacturer..

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Fire stopping. Maintain the fire-resistance rating integrity of the fire separation.
- .6 Electrical:
  - .1 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .2 Refer to control schematics included as part of control design schematics in Section 25 90 01- EMCS: Site Requirements Applications and Systems Sequences of Operation. Trace existing control wiring installation and provide updated wiring schematics including additions, deletions to control circuits for review by Contract Administrator and Department Representative before beginning Work.
  - .3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
  - .4 Install communication wiring in conduit.
    - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
    - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
    - .3 Maximum conduit fill not to exceed 40%.
    - .4 Design drawings do not show conduit layout.
  - .5 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Contract Administrator and Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .7 VAV Terminal Units: supply, install and adjust as required.
  - .1 Air probe, actuator and associated vav controls.
  - .2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.



- .3 Co-ordinate air flow adjustments with balancing trade.

### **3.2 TEMPERATURE AND HUMIDITY SENSORS**

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
  - .1 Protect from solar radiation and wind effects by non-corroding shields.
  - .2 Install in NEMA 4 enclosures.
- .4 Duct installations:
  - .1 Do not mount in dead air space.
  - .2 Locate within sensor vibration and velocity limits.
  - .3 Securely mount extended surface sensor used to sense average temperature.
  - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
  - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
  - .1 Install averaging element horizontally across the ductwork starting 305 mm from top of ductwork. Each additional horizontal run to be no more than 305 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
  - .2 Wire multiple sensors in series for low temperature protection applications.
  - .3 Wire multiple sensors separately for temperature measurement.
  - .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
  - .1 Locate well in elbow where pipe diameter is less than well insertion length.
  - .2 Thermowell to restrict flow by less than 30%.
  - .3 Use thermal conducting paste inside wells.

### **3.3 PANELS**

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

### **3.4 IDENTIFICATION**

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

### **3.5 AIR FLOW MEASURING STATIONS**

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

### **3.6 TESTING AND COMMISSIONING**

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

**END OF SECTION**

## **Part 1 General**

### **1.1 SUMMARY**

- .1 Section Includes:
  - .1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.
    - .1 Control Description Logic (CDL) for each system.
    - .2 Input/Output Point Summary Tables for each system.
    - .3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

### **1.2 REFERENCE STANDARDS**

- .1 ASHRAE Guideline 36 ( High Performance Sequences of Operation for HVAC Systems)
- .2 Refer to the control schematics and refer to the Input/Output Summary Table
- .3 In general, all existing sensors and controllers shall be replaced with new devices, except as noted on the control schematics and in this document.
- .4 All existing damper and valve actuators shall be replaced.
- .5 All existing reheat valves and radiation valves shall be replaced with new fully modulating, normally open valves, as noted on the control schematics.

### **1.3 SEQUENCING**

- .1 General
  - .1 These sequences are intended to be performance based. Implementations that provide the same functional result using different underlying detailed logic will be acceptable.
  - .2 Unless otherwise indicated, control loops shall be enabled and disabled based on the status of the system being controlled to prevent windup.
  - .3 When a control loop is enabled or re-enabled, it and all its constituents (such as the proportional and integral terms shall be set initially to a neutral value.
  - .4 A control loop in neutral shall correspond to a condition that applies the minimum control effect, i.e., valves/dampers closed, VFDs at minimum speed, etc.
  - .5 All set points, timers, deadbands, PID gains, etc. listed in sequences shall be adjustable by the user with appropriate access level whether indicated as adjustable in sequences or not. Software points shall be used for these variables. Fixed scalar numbers shall not be embedded in programs except for physical constants and conversion factors.
  - .6 Values for all points, including real (hardware) points used in control sequences shall be capable of being overridden by the user with appropriate access level

- (e.g., for testing and commissioning). If hardware design prevents this for hardware points, they shall be equated to a software point, and the software point shall be used in all sequences. Exceptions shall be made for machine or life safety.
- .7 All existing controls, including associated reheat and radiation valves and damper actuators shall be replaced with new devices.
- .2 Alarms
    - .1 There shall be 4 levels of alarm:
      - .1 Level 1: Life-safety message
      - .2 Level 2: Critical equipment message
      - .3 Level 3: Urgent message
      - .4 Level 4: Normal message
    - .2 Maintenance Mode. Operators shall have the ability to put any device (e.g. AHU) in/out of maintenance mode.
      - .1 All alarms associated with a device in maintenance mode will be suppressed. Exception: Life safety alarms shall not be suppressed.
      - .2 If a device is in maintenance mode, issue a daily Level 3 alarm at a scheduled time indicating that the device is still in maintenance mode.
    - .3 Entry Delays. All alarms shall have an adjustable delay time such that the alarm is not triggered unless the alarm condition is TRUE for the delay time. Default entry delays are as follows:
      - .1 Level 1 alarms: 1 seconds
      - .2 Level 2 alarms: 10 seconds
      - .3 Level 3 alarms: 1 minute
      - .4 Level 4 alarms: 5 minutes
    - .4 Exit Hysteresis
      - .1 Each alarm shall have an adjustable time-based hysteresis (default: 5 seconds) to exit the alarm. Once set, the alarm does not return to normal until the alarm conditions have ceased for the duration of the hysteresis.
      - .2 Each analog alarm shall have an adjustable percent –of-limit-based hysteresis (default: 0% of the alarm threshold, i.e., no hysteresis; alarm exits at the same value as the alarm threshold) the alarmed variable required to exit the alarm. Alarm conditions have ceased when the alarmed variable is below the triggering threshold by the amount of the hysteresis.
  - .3 VFD Speed Points
    - .1 The speed AO sent to VFDs shall be configured such that 0% speed corresponds to 0 Hz, and 100% speed corresponds to maximum speed configured in the VFD.
    - .2 For each piece of equipment, the minimum speed shall be stored in a single software point. The value shall be written to the VFD’s minimum speed set point

- every 15 minutes via the drive's network interface; in the case of a hard-wired VFD interface, the minimum speed shall be the lowest speed command sent to the drive by the BAS.
- .3 The VFD shall be connected via BACnet to the EMCS. All relevant data shall be mapped to the EMCS and shall be available on the system graphics for pertinent data, such as setpoints Frequency, Amperage, Energy consumption in kWh and alarms. All data shall also be available on the graphics in table format.
  - .4 Trim and Response Set-Point Reset Logic
    - .1 T & R set-point reset logic and zone/system reset requests, where referenced in sequences, shall be implemented as described below.
    - .2 A "request" is a call to reset a static pressure or temperature set point generated by downstream zones or air handling systems. These requests are sent up stream to the plant or system that serves the zone or air handler that generated the request.
    - .3 For each upstream system or plant set point being controlled by a T & R loop, define the following variables. Initial values are defined in the system /plant sequences below. Values for trim, respond, time step, etc. shall be tuned to provide stable control.  
Trim & Respond logic shall reset the set point within the range SPmin to SPmax. When the associated device is OFF< the set point shall be the initial setpoint. The reset logic shall be active while the associated device is proven ON. When active, every time step T, trim the set point by SPmin
  - .5 Duct Heating Coil
    - .1 When the zone state is cooling the heating coil is disabled
    - .2 When the zone state is deadband, the heating coil is disabled.
    - .3 When the zone state is heating, the heating loop shall modulate to maintain space temperature at the heating set point as follows:
      - .1 The heating – loop shall reset the discharge temperature set point from the current AHU SAT set point to a maximum of Max $\Delta$ T above space temperature set point.
      - .2 The heating coil shall be modulated to maintain the discharge temperature at set point (Directly controlling heating off the zone temperature control loop is not acceptable).
    - .4 Alarms
      - .1 Low –Discharge Air Temperature
        - .1 If hot-water plant is proven ON, and the heating coil DAT is 3°C (5°F) less than set point for 10 minutes, generate a Level 3 alarm.
        - .2 If heating hot-water plant is proven ON, and the DAT is 5°C (9°F) less than set point for 10 minutes, generate a Level 2 alarm.

- .2 Leaking Valve, if the valve position is 0% for 15 minutes, DAT is above AHU SAT by 3°C (5°F) and the fan serving the zone is proven On, generate a Level 4 alarm.
- .5 Testing /Commissioning Overrides. Provide software switches that interlock at a system level point to:
  - .1 Force heating to OFF/closed,
  - .2 Force heating to full ON/open.
- .6 Heating Water System Requests
  - .1 If the DAT is 3°C (5°F) less than set point for 5 minutes, send request to raise Boiler LWT by 3C.
  - .2 Else if the DAT 5°C (9°F) less than set point for 5 minutes, send request to raise Boiler LWT by 5C.
  - .3 Else if HW valve position is greater than 95% send request to raise Boiler LWT by 3C, every 5 minutes until the HW valve position is less than 85%
- .6 AHU -1 NATATORIUM
  - .1 The System shall be designed and sized to maintain the specified conditions. The unit is a packaged unit generally, and it is to be included on the graphics, and the controls illustrated in Detail 12 on drawing M9.0 are to be added by this Division.
  - .2 Refer to the manufacturer's literature for the packaged unit sequence of operations. Allow to assist the commissioning agent and the Contract Administrators with both the packaged controls and the controls provided by this division.
  - .3 The packaged system is complete with integral controls that are BACnet Compatible. Allow to read and manipulate the following BACnet variables into the system and include on graphics:
    - .1 System Status
    - .2 System Start/Stop
    - .3 Exhaust Fan Status
    - .4 Return, outside, purge and exhaust air damper positions
    - .5 General fault alarm
    - .6 Purge mode
    - .7 Number of compressors operating
    - .8 Number of condenser fans operating
    - .9 Communication fault
    - .10 Pool heating mode
    - .11 Discharge Air Temperature reset
  - .4 Allow to install and commission control components supplied by the AHU-1 supplier that are shipped loose.

- .5 Provide the following additional controls in the packaged AHU:
  - .1 Return air humidity
  - .2 Return air temperature
  - .3 Filter pressure drop and change filter alarm
  - .4 Supply fan status as determined by a CSR or CT.
  - .5 Mixed air temperature
  - .6 Low temperature alarm to stop supply fan and annunciate an alarm.
  - .7 Discharge air temperature
  - .8 Supply air humidity
- .7 Air Handling Unit - AHU 2
  - .1 Run Conditions – Occupied/Unoccupied

The system shall run continuously during occupied hours. Occupied hours will be determined by the City.

The system shall be off during the unoccupied hours. The system may also be returned to the occupied status by selecting the temporary override function on the Operator Workstation.

Alarms shall be provided as follows:

    - High Supply Air Temp: If the supply air temperature is 2°C greater than the supply air setpoint.
    - Low Supply Air Temp: If the supply air temperature is 2°C less than the supply air setpoint.
  - .2 Optimal Start
    - .1 The unit shall start prior to scheduled occupancy based on the time necessary for the zones to reach their occupied setpoints. The start time shall automatically adjust based on changes in outside air temperature and zone temperatures. The lead time for the start up mode shall be based on the spaces inertia. In the Heating mode, the OAD shall remain fully closed prior to occupancy. In the Free Cooling mode (OAT<RAT), the economizer is enabled.
  - .3 Night Cycle Program
    - .1 The unit shall start and operate when any room temperature drops below the night setpoint (15°C). The outdoor air damper shall remain closed. When the temperature has risen 2°C above the night setpoint the unit shall shut down.
  - .4 Freeze Protection
    - .1 The unit shall shut down and generate a critical alarm upon receiving a low supply air temperature status from the Low temperature device (Freezestat). On system shutdown the supply and return fans shall stop, the outdoor and exhaust dampers shall close, the humidifier shall be disabled, the heating coil valve shall go to the full-heat position and the

heating coil pump shall remain on. The low temperature device must be reset manually by the operator.

.5 Supply Air Temperature Control

.1 In heating mode:

- .1 the heating coil pump shall start if it is not already running and the heating control valve shall modulate towards open until the DAT temperature set point is achieved.
- .2 The DAT temperature shall be reset by the space temperature.
- .3 If the heating coil control valve reaches 95% open then the boiler LWT shall be reset 3 degrees C (5F) upwards. After 10 minutes if the heating valve is still 95% open or more, reset the LWT an additional 3C (5F) every 10 minutes until the heating control valve is open less than 95%, or the DAT set point is achieved.
- .4 When the heating coil drops to 80% open, and the boiler LWT is not held above 52 C (125F), by another heating appliance, drop the boiler LWT in 3C (5F) increments every 10 minutes until the boiler LWT again reaches 52C (125F).
- .5 When the heating valve is open any percentage, the cooling system shall be locked out, and the outside air damper shall be in minimum position.

.2 Free Cooling Mode:

- .1 When the  $OAT < RAT$  and the heating valve is fully closed then the system can free cool.
- .2 The outside and return air dampers shall modulate to maintain the desired MAT, which in this case would be the same as the SAT, or as close as they can get to it.
- .3 If the economizer cannot maintain the MAT equal to the SAT, and the MAT is warmer than the SAT, then mechanical cooling will be energized and run until either the minimum cooling run time has elapsed, or the SAT is satisfied, whichever occurs first.

.3 Cooling Mode:

- .1 When the  $OAT > RAT$ , and cooling is required, the economizer shall close the outside air damper to the minimum position and the mechanical cooling shall be energized. The mechanical cooling shall run until the minimum run time is reached, or the SAT is satisfied, whichever occurs first.

.6 Heating Coil Pump

- .1 The circulation pump shall run whenever:
  - The OAT is less than 12C (55F) or the heating coil valve is enabled.
  - OR the freezestat is on.Alarms shall be provided as follows:
  - Heating Coil Pump Failure: Commanded on, but the status is off.



- Heating Coil Pump in Hand: Commanded off, but the status is on.
- .2 During the heating season, if the heating pump fails, the outside air damper will be closed The EMCS will initiate a critical alarm.
- .7 Economizer
  - .1 The controller shall measure the mixed air temperature and modulate the economizer dampers in sequence to maintain a setpoint 1°C (adj.) less than the supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position as determined by the balancing contractor (adj.) whenever the system is in the occupied mode. The economizer will modulate between the Minimum outside air setpoint (set by the Balancing Contractor) and 100% open in response to the mixed air temperature setpoint.
  - .2 The economizer shall close whenever:
    - Mixed air temperature drops below 4.5°C (adj.)
    - OR the low supply air temperature status is on.
    - OR on loss of supply fan status.The outside air and exhaust dampers shall close and the return air damper shall open when the unit is off.
- .8 Wall Fin Radiation
  - .1 Each new and existing section of wall fin radiation shall have a dedicated room temperature sensor, except where indicated otherwise on the floor plans. The controller shall modulate the new control valve to maintain temperature at set point. Implement Night setback to match occupancy time frames. Night setback setpoint shall be 15°C.
  - .2 The BACnet thermostat shall be connected to the EMCS, for control and monitoring access.
  - .3 When any air conditioning system that serves the room containing the wall fin radiation is on, the heating control valve shall be fully closed.
- .9 Radiant Panels
  - .1 All the radiant panels located in a single room shall have a dedicated room temperature sensor except where indicated otherwise on the floor plans. The controller shall modulate the new control valve to maintain the room temperature at set point. Implement Night setback to match occupancy time frames. Night setback setpoint shall be 15°C.
  - .2 The BACnet thermostat shall be connected to the EMCS, for control and monitoring access.
  - .3 When any air conditioning system that serves the room containing the radiant panels is on, the heating control valve shall be fully closed.
- .10 Hydronic Force Flow Heater Control
  - .1 Each new and existing hydronic force flow heater shall be provided with a new wall mounted DDC BACnet temperature sensor. The controller shall modulate the new control valve to maintain the room temperature at set point. The new

- aquastat shall cycle the Force Flow fan when detecting hot water is supplied to the force flow. Implement Night setback to match occupancy time frames. Night setback setpoint shall be 15°C.
- .2 The BACnet thermostat shall be connected to the EMCS, for control and monitoring access.
  - .3 Provide a low temperature alarm to the DDC system if the space temperature is more than 5C (9F) below set point for 5 minutes.
  - .4 Provide a very low temperature alarm to the DDC system if the space temperature is more than 10C (18F) below boiler LWT set point for 2 minutes.
- .11 Packaged AC Unit AC-1
- .1 The unit is a self-contained air conditioner.
  - .2 The EMCS shall monitor room temperature via a dedicated temperature sensor.
  - .3 Provide a high temperature alarm if the room temperature rises above 27C (80F).
- .12 Heating Plant
- .1 The Heating Plant is controlled by the boiler plant Master Controller (supplied with the boiler). The DDC system shall allow adjusting the hot water supply temperature setpoint via BACnet.
  - .2 The Boilers are controlled in sequence by the Master Controller to achieve the required hot water supply setpoint. The individual boiler pumps are also controlled by the Master Controller.
  - .3 The Heating Plant Master Controller controls the plant heating water supply temperature, The HWS temperature is reset from the controller's outdoor air temperature sensor
  - .4 Boiler shall only fire if airflow from MUA-1 is proved and combustion air is being provided. Boiler operation shall be interlocked with MUA-1.
  - .5 Boiler Plant Master Controller Interface to EMCS.
    - .1 The master controller shall be connected via BACnet to the EMCS. All relevant data shall be mapped to the EMCS and shall be available on the system graphics for pertinent data, such as temperatures, setpoints and alarms. All data shall also be available on the graphics in table format, arranged in logical sections, such as all data for each boiler, etc.
  - .6 The controls contractor shall provide the following sensors, which shall be indicated on the controls graphics (refer also to Detail 8 on drawing M9.0).
    - .1 Boiler B1, Pump P6A Pump Status
    - .2 Boiler B2, Pump P6B Pump Status
    - .3 Boiler B1 EWT
    - .4 Boiler B2 EWT
    - .5 Boiler B1 LWT
    - .6 Boiler B2 LWT
    - .7 Combined Boiler B1/B2 LWT

- .7 Collect and display the following BACnet Variables:
  - .1 Boiler B1 Fault
  - .2 Boiler B2 Fault
  - .3 Pump P6A Fault
  - .4 Pump P6B Fault
  - .5 Boiler B1 Temperature Setpoint
  - .6 Boiler B2 Temperature Setpoint
- .8 Boiler Operation:
  - .1 Enable the boilers when the outdoor ambient drops below 12C or when there is a call for heat from the building. Once the boilers are enabled, they shall remain enabled until the outdoor ambient temperature rises to 14C (57F).
  - .2 When there is a call for heat, open the boiler control valves on the boiler discharge fully and start the duty pumps, P1A/P1B and P2A/P2B as well as the duty glycol pump, P3A/P3B. The pumps shall continue to run for 8 hours after the last call for heat, or until the outside air temperature rises 2C (4F), which ever occurs first – providing the duty pumps have run for a minimum of 30 minutes.
  - .3 Ten minutes after a boiler turns off, close the two position control valve on the entering water piping. Before the boiler is enabled to fire, open the valve fully.
- .9 Pumps P1A and P1B:
  - .1 Pumps P1A and P1B shall operate as duty/standby. The duty pump shall alternate every 14 days.
  - .2 If the duty pump fails, annunciate an alarm and automatically start the standby pump.
  - .3 When the duty pump starts, the VSD shall control the pump so it accelerates to 20 Hz which shall be it's minimum speed. The pump shall modulate between 20Hz and 60 Hz.
  - .4 The pump discharge water pressure shall be monitored approximately 2/3's of the way to the end of the longest pipe run. The pump VSD shall be used to maintain a constant pressure in the pipe system.
  - .5 If the pump VSD falls to 20 Hz, then the pump speed will be held at 20 Hz and the bypass valve shall modulate open to maintain the pump pressure at 20 Hz. When the bypass valve returns to closed and the duty pump shall again start to modulate, but it cannot fall below 20 Hz.
- .10 Pumps P2A and P2B:
  - .1 Pumps P2A and P2B shall operate as duty/standby. The duty pump shall alternate every 14 days.
  - .2 If the duty pump fails, annunciate an alarm and automatically start the standby pump.

**EMCS SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS  
SEQUENCES OF OPERATION**

- .3 When the duty pump starts, the VSD shall control the pump so it accelerates to 20 Hz which shall be its minimum speed. The pump shall modulate between 20Hz and 60 Hz.
  - .4 The pump discharge water pressure shall be monitored approximately 2/3's of the way to the end of the longest pipe run. The pump VSD shall be used to maintain a constant pressure in the pipe system.
  - .5 If the pump VSD falls to 20 Hz, then the pump speed will be held at 20 Hz and the bypass valve shall modulate open to maintain the pump pressure at 20 Hz. When the bypass valve returns to closed and the duty pump shall again start to modulate, but it cannot fall below 20 Hz.
- .11 Pumps P3A and P3B:
- .1 Pumps P3A and P3B shall operate as duty/standby. The duty pump shall alternate every 14 days.
  - .2 If the duty pump fails, annunciate an alarm and automatically start the standby pump.
  - .3 When the duty pump starts, the VSD shall control the pump so it accelerates to 20 Hz which shall be its minimum speed. The pump shall modulate between 20Hz and 60 Hz.
  - .4 The pump discharge water pressure shall be monitored approximately 2/3's of the way to the end of the longest pipe run. The pump VSD shall be used to maintain a constant pressure in the pipe system.
  - .5 If the pump VSD falls to 20 Hz, then the pump speed will be held at 20 Hz and the bypass valve shall modulate open to maintain the pump pressure at 20 Hz. When the bypass valve returns to closed and the duty pump shall again start to modulate, but it cannot fall below 20 Hz.
- .12 Pump P-8, Pool Water Pre-Heat
- .1 Pump P-8 shall run continuously.
  - .2 Annunciate an alarm if P-8 fails.
  - .3 Annunciate an alarm if P-8 is turned off when the outdoor ambient air temperature is below 0C (32F).
  - .4 Provide a temperature sensor in the pool water piping upstream of the pool heater. This sensor shall monitor the pool water temperature and modulate two 3 way mixing valves, one for each pool to maintain the pool water temperature set point. The two tee way mixing valves shall function as injection valves into each pool water system, piped to ensure there is full flow through pump P-8 at all times.
- .13 Water to Glycol Heat Exchange HX-1
- .1 The glycol supply temperature shall be maintained by the modulating control valve in the HWS upstream of the heat exchanger.
  - .2 The glycol temperature shall be set at the lowest temperature possible and still satisfy the needs of MUA-1, AHU-2 and HRV-2, CUH-1A/B, 2, 3 and HC-17.

- .3 Annunciate an alarm if the glycol temperature is 3C (5F) above set point for 5 minutes.
- .4 Annunciate an alarm if the glycol temperature is 3C (5F) below set point for 5 minutes.
- .14 Pumped Heating Coils, MUA-1, AHU-2, HRV-2, and HC-17:
  - .1 When MUA-1, AHU-2, HRV-2, or HC-17 call for heat, the two way injection modulating control valve shall modulate towards open.
  - .2 The glycol system HGS temperature shall be set to maintain the heating control valve with the largest demand at 85% open.
  - .3 If a heating control valve exceeds 85% open for more than 10 minutes, annunciate an alarm.
  - .4 If the SAT in MUA-1, AHU-2, HRV-2, or HC-17 falls more than 3C (5F) below set point for more than 5 minutes annunciate an alarm.
  - .5 If the SAT in MUA-1, AHU-2, HRV-2, or HC-17 falls more than 5C (9F) below set point for more than 2 minutes annunciate an alarm and turn off the associated air movement fan. Associated pumps to continue operation.
  - .6 Pumps P11A and P11B shall operate as duty/standby. The duty pump shall alternate every 14 days.
    - .1 If the duty pump fails, annunciate an alarm and automatically start the standby pump.
- .15 Electrical Room Ventilation
  - .1 The room temperature loop shall cycle the electrical room exhaust fan to maintain the desired room temperature.
  - .2 When the exhaust fan is on the intake and exhaust dampers shall be open, else they are closed.
  - .3 The EMCS monitors the damper positions and the exhaust fan status.
  - .4 Alarms shall be generated if the fan fails or the room temperature exceeds an operator selected value.
- .16 Washroom Exhaust
  - .1 The EMCS provides a timer function for the exhaust fan. The fans shall run when the building is occupied and shall be off when the building is unoccupied.
  - .2 If a new or existing fan is off, when it is scheduled to be on, annunciate an alarm.
- .17 Domestic Hot Water System
  - .1 The recirc pump shall be controlled by a time schedule, in accordance with the building occupancy times.
- .18 HRV-1, Natatorium
  - .1 HRV-1 shall be upgraded to the new control system, the operating sequence shall remain the same except as noted below.
  - .2 HRV-1 shall operate whenever AHU-1 is operating.
  - .3 The existing 'free cooling' mode on HRV-1 shall be disabled.

- .19 Existing Exhaust fans:
  - .1 The controls for the existing exhaust fans shall be upgraded to the new control system, the operating sequence shall remain the same except the exhaust fans shall operating during operating hours unless noted otherwise in these specifications.
- .20 Existing Air Conditioning Units:
  - .1 The controls for the existing air conditioning units shall be upgraded to the new control system, the operating sequence shall remain the same except the air conditioning units shall be locked out during unoccupied periods.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not Used.

## **Part 3 Execution**

### **3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED WORK**

- .1    Division 0 – Bidding & Contract Requirements
- .2    General Requirements
- .3    All Electrical Drawings and Division 26, 2,7 28 Series Specification Sections.

**1.2                QUALITY ASSURANCE**

- .1    Do complete installations in accordance with CSA C22.1.
- .2    While not identified and specified by number in this Division, comply with CSA Electrical Bulletins in force at time of tender submission. Comply with the requirements of all Provincial and loc Reviewed
- .3    Electrical installation shall be in accordance with the current edition of the Canadian Electrical Code, Provincial and other codes, rules and regulations. Supply material and labour required to meet the requirements of these codes, rules and regulations even though the work is not shown on the drawings or mentioned in the specifications. Where the electrical installation calls for better quality materials or construction than the minimum requirements of these codes, rules and regulations, the electrical installation shall be as shown on the drawings and as specified.
- .4    Electrical installation shall be in accordance with the requirements of the electrical supply authority and local inspection authority.

**1.3                PERMITS, FEES**

- .1    Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2    Obtain all necessary permits required for the electrical installation.
- .3    Pay all fees for permits and inspections as required for the electrical installation.

**1.4                MATERIALS AND EQUIPMENT**

- .1    Provide labour, materials, transportation, equipment and facilities, etc., required for the complete electrical installation as indicated or implied on the drawings and specifications.
- .2    Electrical equipment shall be new and of type and quality specified.
- .3    Equipment and material shall be CSA certified, and manufactured to standards described. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the appropriate Inspection Departments.
- .4    Request for approval of material, as equal, shall conform to Section 26 00 10.1.16.4 herein.

**1.5                SUBMITTALS**

- .1 Submit shop drawings and product data for review by the Contract Administrator. All drawings shall be in English and Imperial dimensions or in metric where indicated. Manufacture of equipment shall not commence until shop drawings have been reviewed. Shop drawings shall be submitted electronically. The MCW shop drawing email address for electrical submission is [wpg.shopdrawings@mcw.com](mailto:wpg.shopdrawings@mcw.com). Shop drawings shall be reviewed prior to submittal to Contract Administrator, confirming that they meet all the design requirements. Mark up and sign Contractor approval on the drawings.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing inter-connection with work of other sections.
- .5 Submit samples in accordance with General Conditions. Samples shall be forwarded to the Contract Administrator's office. Approved samples will be retained until after tender closing, then all samples will be returned except for the sample submitted by the Manufacturer who has been listed by the successful Contractor in the tender documents. This sample will be used for comparison with the actual production run of successful manufacturer.
- .6 Submit shop drawings of service entrance equipment to utilities.
- .7 Material submitted for Contract Administrator's review shall bear Contractor's, and where applicable, Utility reviewed stamp.

#### **1.6 OPERATIONS AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into Maintenance Manuals.
- .2 Include details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- .3 Include technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
- .4 Include wiring and schematic diagrams and performance curves.
- .5 Include names and addresses of local suppliers for items included in Maintenance Manuals.
- .6 Submit Maintenance Manuals electronically to the Contract Administrator for review. Manuals that are incomplete shall be returned to the Electrical Sub-Contractor for completion. Completed manuals shall be submitted, to the satisfaction of the Contract Administrator, before final payment may be considered to be due.

#### **1.7 MAINTENANCE MANUALS**

- .1 Provide maintenance materials as specified.
- .2 Turn materials over to the City in an orderly fashion upon completion of installation.
- .3 Include electronic pdf copy, one (1) USB flash drive and three (3) hard copy binders.



**1.8 VOLTAGE RATINGS**

- .1 Operating voltages: to CAN3-C235-83.
- .2 Motors, electrical heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment shall operate in extreme operating conditions established in above standard without damage to equipment.

**1.9 INSPECTION**

- .1 Furnish a Certificate of Acceptance from the Inspection Authorities on completion of work. Copies of certificate shall be included in Maintenance Manuals.
- .2 Certificate of Inspection of Approval shall be submitted before final payment may be considered to be due.
- .3 During the course of the project construction, the Contract Administrator will carry out periodic site reviews and prepare a deficiency list for remedial action by the Electrical Subcontractor. The Contractor shall respond in writing to the Contract Administrator, stating corrective action and completion date for each item listed as deficient. This response shall be in the hands of the Contract Administrator within three working days of receipt of the Inspection Report.

**1.10 CARE, OPERATION AND START-UP**

- .1 Instruct the City's operating personnel in the operation, care and maintenance of equipment. Arrangement of such instructional sessions shall be done at a time convenient to the City.
- .2 Arrange and pay for services of Manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these services for such a period, and for as many visits as necessary to put equipment into operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

**1.11 FINISHES**

- .1 Finish outdoor electrical equipment such as parking lot panels, to match light standards.
- .2 Paint indoor switchgear and distribution enclosures light grey to EEMAC-2Y-1. Outdoor electrical equipment enclosures shall be painted "equipment green" to EEMAC 2Y-1.
- .3 Clean and touch up surfaces of shop-painted equipment, scratched or marred during shipment or installation, to match original paint.
- .4 Clean, prime and paint exposed hangers, racks, fastenings to prevent rusting.

**1.12 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with lamacoid nameplates.
- .2 Provide lamacoid nameplates, 1/8" (3mm) thick plastic engraving sheet, black or red face, white core, mechanically attached (screwed or riveted) unless specified otherwise. Sizes as follows:

Size 0 3.8" x 1 1/2"(10 x 38 mm) 1 line 1/8" (3mm) high letters

Size 1	3/8" x 4"	(10 x 100mm)	1 line	1/8"	(3 mm) high letters
Size 2	1/2" x 3"	(13 x 75mm)	1 line	3/16"	(5 mm) high letters
Size 3	1/2" x 3"	(13 x 75mm)	2 lines	1/8"	(3 mm) high letters
Size 4	3/4" x 3"	(19 x 75mm)	1 line	3/8"	(10mm) high letters
Size 5	3/4" x 4"	(19 x 100mm)	2 lines	3/16"	(5 mm) high letters
Size 6	1" x 4" (25 x 100mm)		1 line	1/2"	(13mm) high letters
Size 7	1" x 4" (25 x 100mm)		2 lines	1/4"	(6 mm) high letters

- .3 Wording on nameplates shall be approved prior to manufacture. Submit schedule of nameplates and wording.
- .4 Allow for average of twenty-five (25) letters per nameplate.
- .5 Identification shall be English.
- .6 Nameplates for terminal cabinets and junction boxes shall indicate system and/or voltage characteristics.
- .7 Use black nameplates with white lettering for normal power and communications equipment. Use red nameplates with white lettering for emergency power and fire alarm equipment.

### **1.13 PROJECT RECORD DOCUMENTS**

- .1 Contractor shall maintain accurate Project Record Drawings (Red-Line Markups) on site while project is under construction. These documents shall be available and presented for review at any time during the Contract Administrators site review.
- .2 Project Record Drawings shall include all changes in the contract documents as per Change order (CO), Change Directive (CD) Supplemental or Job Instructions (SI)(JI) and all changes to mechanical, electrical, architectural, structural floor plans and civil drawings as well as all addenda items.
- .3 The Contractor shall be responsible for the production of the Project Record Drawings which shall provide a complete and accurate detailed record of the actual Electrical installation. Record "as-built" information in red ink, accurately and concurrently with construction progress.  
Electrical Record Drawings shall include:
  1. Circuiting of all new and existing equipment to remain
  2. Location of all feeder cables, conduit routing, conduit sizes, junction box locations and branch wiring drops
  3. Dimensions and locations of all underground or in or under slab conduits/feeders
  4. Distribution and Panel identification labels
  5. Fire alarm device addresses
  6. ME Schedules shall include updates to all equipment, motors, wiring, breaker sizes based on final equipment selections
- .4 Any relocated or added equipment shall be identified.
- .5 The use of white out (liquid or tape) shall only be used for correcting contractor red line errors only. Do not use white out to delete original contract drawings deleted items shall be crossed out in red ink

- .6 The Contractor shall neatly transfer all “as-built” notations to a clean set of drawings, affix their company name, contact information, signed, dated and the words “Project Record Drawings” on each page of the drawing set.
- .7 Submit electronic copy to Contract Administrators for preliminary review prior to request for Substantial Performance.
- .8 Record Drawings that are incomplete shall be returned to the Contractor for remedial measures. The Contract Administrator shall recommend a suitable deficiency holdback until such time as the Record Drawings are submitted in the acceptable form.
- .9 A minimum of \$1,000.00 per drawing may be held back until all Project Record Drawings are submitted and deemed complete.
- .10 Project Record Drawings shall be transferred to electronic AutoCAD file in latest version and labelled as “Project Record Drawings”.
- .11 Upon review and acceptance of preliminary Project Record Drawings by the Contract Administrator, final Record Document Package shall consist of one (1) complete set of AutoCAD and PDF Record Documents submitted electronically to Contract Administrator. In addition submittal shall include one (1) USB drive, one (1) set of Project Record Drawing prints and one (1) set of the contractor's on site Red-Line Drawing Markups. These documents will be reviewed and submitted to the City for their use.
- .12 MCW Contract Administrators Ltd. can complete the Auto Cad Project Record Document reproduction from the contractor's red-lined markups for a fee of \$350.00 per drawing sheet with a project minimum of \$1,000.00
- .13 Substantial Performance will not be attained until the Project Record Drawings are received and accepted as complete by the Contract Administrator.

#### **1.14 DEFINITIONS**

- .1 The following are definitions of terms and expressions used in the specification:
  - .1 CONTRACT ADMINISTRATOR means Electrical Engineering Contract Administrator: MCW Contract Administrators Ltd
  - .2 INSPECTION AUTHORITY means agent of any authority having jurisdiction over construction standards associated with any part of electrical work on site.
  - .3 SUPPLY AUTHORITY means electrical power utility company responsible for delivery of electrical power to project.
  - .4 ELECTRICAL CODE means as shown on contract drawings or noted in Contract Documents.
  - .5 TYPE TESTED means that each piece of equipment produced by Manufacturer is not fully tested. An original piece with similar arrangement has been fully tested and results of that test are available.
  - .6 PROVIDE means to supply, install and leave in working order all materials and necessary wiring, supports, access panels, etc., as necessary for equipment indicated.

#### **1.15 LABELS AND WARNING SIGNS**

- .1 Manufacturer's nameplates and CSA labels shall be visible and legible after equipment is installed.
- .2 Provide warning signs on equipment, as required, to meet the requirements of the Inspection Authorities, including indication of multiple power sources.

**1.16 EQUIVALENT MATERIALS AND EQUIPMENT**

- .1 Bidders shall submit a tender based on the specified materials and equipment only.
- .2 Bidders may submit a tender based on equivalent materials and equipment only if such items have been approved as equals by the Contract Administrator.
- .3 Bidders may submit, with their tender, an alternate price based on alternate materials and equipment only if such items have been approved as alternates by the Contract Administrator.
- .4 Submissions for equals or alternates shall be received by the Contract Administrator five (5) working days prior to tender closing. Submissions shall include sufficient Manufacturer's data to clearly show equivalency, as well as an itemized list of equal or alternate items, the items for which they were submitted and a space for the Contract Administrator to indicate 'approved equal', 'approved alternate', or 'not approved'.
- .5 All submissions shall include the following phrase "We have reviewed all contract documents, contract drawings and specifications relating to the equipment presented herein" and must bear the name and signature of the Manufacturer or his agent.

**1.17 LOCATION OF OUTLETS**

- .1 Locate outlets as indicated
- .2 Do not install outlets back-to-back in wall; allow minimum 16" (400 mm) horizontal clearance between boxes.
- .3 Drawings are schematic only and do not indicate all architectural or structural elements.
- .4 Change location of outlets at no extra cost or credit, providing distance does not exceed 10'-0" (3 m) and information is provided before installation.
- .5 Locate light switches on latch side of doors.
- .6 Vertically align outlets of different systems when shown in close proximity to each other and occurring at different mounting heights.
- .7 Coordinate mounting heights and location of all equipment with Architectural, Mechanical and Structural Drawings prior to installation of rough-in boxes.
- .8 Cut in and recess outlet boxes in existing walls including cutting into block walls for flush finish.

**1.18 MOUNTING**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicate otherwise.
- .2 Mounting height of equipment shall be as per Architectural clarifications. Where elevations are not indicated, the following shall apply:

- .1 Outlets above counters: (6") 150mm; splashbacks: 100mm.
- .2 General receptacles, telephone and television outlets: 500mm.
- .3 Receptacles in mechanical and shop areas: 1025mm.
- .4 Switches, dimmers, push buttons, Luxo bracket: (45") 1150mm.
- .5 Fire alarm pullstations: (45") 1150mm.
- .6 End of line resistors: (64") 1625mm.
- .7 Fire alarm visual, audible, and combination devices:
  - .1 (92") 2350mm or,
  - .2 (6) 150mm below ceiling measured from top edge of device where mounting height will be lower than (92") 2350mm.
- .8 Intercom stations, keypads: (45") 1150mm (LCD/Video display T.B.C.).
- .9 Electric hand driers: (42") 1075mm. (Confirm with Architect and Manufacturer recommendations).
- .10 Card readers, panic switches: (45") 1150mm.
- .11 Branch circuit panels, control panels, annunciators, etc.: (72") 1825mm. To top of panel.
- .12 Clock outlets: (92") 2350mm.
- .13 Emergency battery units: (98") 2500mm.
- .14 Emergency remote heads: (92") 2350mm.
- .15 Exit signage: (92") 2350mm.
- .16 Accessibility suite switches, dimmers, pushbuttons: (35") 900mm.
- .17 Accessibility suite thermostats: (35") 900mm.
- .18 Accessibility suite receptacles, telephone, television (24") 600mm.
- .4 Refer to accessibility design standards.
- .5 All transformers, motor control centres and floor-mounted distribution panels shall be mounted on 4" (100 mm) concrete housekeeping pads. The Contractor shall be responsible for provision of these pads. Where ceiling heights will not allow housekeeping pads to be installed below distributions, and where pre-approved by the Contract Administrator, 1 ½" (38mm) galvanized cantruss shall be provided in place of the pad.

#### **1.19 PROTECTION**

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE ( ) VOLTS", with appropriate voltage in English.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision.
- .4 Provide wire guards for all electrical equipment in Gymnasium or areas subject to damage.

#### **1.20 LOAD BALANCE**

- .1 Measure phase current to panelboards with normal loads operating at time of measurement. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, a report listing phase and neutral currents on panelboards, transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.
- .4 Include load balance and voltage test results as per Form 26 00 10.2.1.5.

**1.21 CONDUIT SLEEVES AND HOLES**

- .1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete shall be sized for free passage of conduit.
- .2 Holes through exterior walls and roof shall be flashed and made weatherproof.
- .3 Make necessary arrangements for cutting of chases, drilling of holes and other structural work required to install electrical conduits, cables, pullboxes and outlet boxes.
- .4 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .5 Contractor shall scan structure before making openings and advise general contractor and Contract Administrator of any obstructions found prior to cutting or coring. Scan shall be completed prior to ordering material to be installed in or through concrete to ensure proper fit.

**1.22 FIREPROOFING**

- .1 Where cables or conduits pass through floors, block or concrete walls and fire-rated walls, seal openings with fire-stopping material with intumescent properties.
- .2 Fire proofing of electrical cables, conduits, trays, etc, passing through fire barriers shall conform to local codes and inspection authorities.
- .3 Fire stop materials shall be asbestos free and have been tested in accordance with ASTM E-84, E-136 and E-814 and UC-1479.
- .4 Fire stop and smoke seals shall be done in accordance with Section 07 84 00.
- .5 Seal all penetrations upon completion of demolition
- .6 Approved Manufacturer Spec seal

**1.23 TESTS**

- .1 Conduct and pay for tests including, but not limited to, the following systems:
  - .1 Distribution system.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: Fire alarm, voice communication, intercom, P.A., etc. as applicable.
  - .6 Grounding systems.
  - .7 Local area network systems.
- .2 Furnish Manufacturer's Certificate or letter confirming that entire installation, as it pertains to each system, has been installed to Manufacturer's instructions. Submit letter in accordance with Section 26 00 10.1.40.3.
- .3 Carry out tests in presence of Contract Administrator where directed.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results in Maintenance Manuals.

**1.24 INSULATION RESISTANCE TESTING**

- .1 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
- .2 Megger 350-600V circuits, feeders and equipment with a 1000V instrument.
- .3 Check resistance to ground before energizing.

**1.25 COORDINATION/SHORT CIRCUIT STUDY OF PROTECTIVE DEVICES**

- .1 Provide under professional Engineer seal, registered in applicable jurisdiction a Coordination/Short Circuit/Arc Flash Study for service entrance equipment, main distribution switchboard breakers and first level of sub-distribution (including 120/208V

transformers) to ensure proper short circuit capacity and proper selective coordination. Submit a copy of the Coordination/Short Circuit Study to the Contract Administrator with distribution shop drawings and include one copy in each Maintenance Manual.

- .2 Ensure circuit protective devices such as overcurrent trips, relays, fuses, are installed to values and settings as recommended in Study.

#### **1.26 CLEANING**

- .1 Do final cleaning in accordance with Section 01 74 00.
- .2 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.

#### **1.27 DELIVERY STORAGE AND HANDLING**

- .1 Deliver all materials to site in an orderly fashion.
- .2 Store all materials in a clean and dry place, secure from vandalism or theft. All materials shall be left in shipping containers until required for use.
- .3 Provide additional protection such as tarps, padding, wood skids, etc., where such is required to ensure protection of equipment and as directed by the Architect.

#### **1.28 COORDINATION WITH OTHER TRADES**

- .1 Refer to Mechanical, Structural, Architectural and Interior Design drawings and specifications for additional electrical work in connection with other Divisions. Where such work is included in other sections of the specifications, provide equipment, conduit, wiring, etc. (in accordance with the Manufacturer's approved shop drawings), as required, for operation of the specified equipment.
- .2 Schedule execution of electrical work with associated work specified in other Divisions.
- .3 Coordinate electrical work with work of other trades to avoid conflicts with pipes, air ducts or other equipment. Provide additional supports, wiring, etc. to relocate electrical equipment, as required, where structural members, air ducts, piping or other equipment interferes with the electrical installation.

#### **1.29 EXAMINATION OF SITE AND CONSTRUCTION DOCUMENTS**

- .1 Prior to submitting a tender, examine the site and local conditions which will affect the work. Refer to the Architectural, Mechanical and Structural drawings, schedules and specifications for construction details to be certain that the electrical work can be satisfactorily carried out as specified. Claims for extra payments, resulting from conditions, which could reasonably be foreseen during an examination of the documents and/or site, will not be recognized.
- .2 Ensure that all equipment designated as "Existing to Remain" or "Existing to be Relocated" is suitable for its intended re-use, including panelboards and circuits. Report any discrepancies to the Contract Administrator BEFORE close.
- .3 Refer to General Conditions for instructions regarding a pre-arranged site visit during the tender period.

#### **1.30 EXCAVATION AND BACKFILLING**



- .1 Excavate and backfill as required for underground electrical services as indicated. Provide protective materials around and over services and be present at all times during excavation and backfilling to supervise work. Backfilling shall restore the excavated area to the original condition and shall include sodding where required.
- .2 Work shall be in accordance with the current CSA Bulletin.
- .3 Include all costs for excavation and backfilling, for any underground electrical installation, unless otherwise indicated.

**1.31 CUTTING AND PATCHING**

- .1 Pay the costs of all cutting and patching required for the installation of electrical work. Payment for cutting and patching shall be made through the General Contractor.
- .2 Cutting and patching required for the installation of electrical work shall be done by the particular trade whose work is involved. No cutting or patching shall be carried out by the tradesman employed on the electrical work.
- .3 Obtain the approval of the Architect and/or the City before arranging for any cutting. Patching shall restore the affected area to the original condition; materials and methods used for patching shall be in accordance with the requirements of the corresponding Divisions of the specification.

**1.32 WORKMANSHIP**

- .1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Contract Administrator. Install conduit and cable runs parallel and perpendicular to building lines in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are shall be exposed, install neatly and group in a tidy appearance.
- .2 Include, in the work, all requirements shown on the shop drawings or Manufacturer's installation instructions.
- .3 Replace work unsatisfactory to the Contract Administrator without extra cost.

**1.33 ACCESS DOORS**

- .1 Access doors shall be a minimum #12 gauge prime coat painted bonderized steel. Each shall be complete with a heavy flush frame and anchor, concealed hinges, positive locking screwdriver lock, and mounting and finishing provisions to suit the finish material for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc. shall be U.L.C. listed and labelled and of a rating to maintain the fire separation integrity.
- .2 Where access doors are located in surfaces where special finishes are required, they shall be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the fire separation integrity.
- .3 Supply access doors in inaccessible construction shall give access to all concealed junction boxes, pullboxes, conductor joints and other similar electrical work which may need maintenance or repair.

- .4 Before commencing installation of electrical work submit, to the Architect for approval, a list of required access doors showing the exact sizes and locations of such access doors. Locate access doors in walls and partitions to the Architect's approval, and arrange electrical work to suit. Access doors shall be, wherever possible, of a standard size for all application. Confirm exact dimensions with the Architect, prior to ordering.
- .5 Access doors shall be installed by the Division responsible for the particular type of construction in which access doors are required. Supply the access doors to the Division installing same at the proper time to avoid construction delays.

**1.34 SPARE PARTS**

- .1 Assemble spare parts as specified:
- .2 Include the following:
  - .1 Part number.
  - .2 Identification of equipment or system for which parts applicable.
  - .3 Installation instructions as applicable.
- .3 Provide a written list complete with the City's signature assuring that spare parts have been received by the the City.

**1.35 CASH ALLOWANCES**

- .1 Provide for a cash allowance of \$3,500.00 for a Short Circuit and Coordination study by the Contract Administrator prior to providing distribution shop drawings.
- .2 Refer to General Conditions for any further requirements under this heading.

**1.36 PRICING OF CHANGES AFTER TENDER**

- .1 The Contractor shall submit, with his tender, an hourly rate for:
  - .1 Foreman
  - .2 Journeyman
- .2 For changes made after award of contract. This shall include all overhead, vacation pay, contributions, etc. for a complete hourly rate. The General Contractor shall sign and date this submission, and a copy shall be submitted to the Contract Administrator; attached to Form 26 00 10.2.1.1.2; in accordance with Section 26 00 10.2.1.2.
- .3 The rates submitted in Item 1.37.1 will be considered in evaluating the overall tender.
- .4 MCW Contract Administrators Ltd. reserves the right to review costing using accepted Contractor's Pricing Standards.

**1.37 SUBSTANTIAL PERFORMANCE**

- .1 The Contract Administrator shall make a Representative available for one substantial performance inspection within one week of receipt of the following:
  - .1 Verification Certificate and complete report for fire alarm and life safety system by the fire alarm manufacturer and emergency generator manufacturer indicating that the system is complete, tested and in conformance with the specification and local jurisdiction requirements. Refer to Fire Alarm System Section .

- .2 A letter from the Contractor stating that the fire alarm and life safety system, complete, tested and fully operational as per the plans and specifications, including all formal changes to the Contract. The letter shall further state that all deficiencies cited by the Contract Administrator or local Electrical or Building Inspector have been completed and accepted.
- .3 A letter from each system supplier indicating that the following systems are complete and tested as per the specifications and ready for operation:
  - .1 P.A. system
  - .2 Intercom system
  - .3 Local area network (LAN)
  - .4 Security system
  - .5 Emergency call
  - .6 Voice/Data Communication
  - .7 Telephone system
  - .8 Energy management system
  - .9 Demand control systems
- .2 Before or during the substantial performance inspection, the Contractor shall prove the proper performance of all fire alarm and life safety systems, in the presence of and to the satisfaction of the Contract Administrator, local inspection authorities and the City (or his representative).

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1    Section 26 00 10 – Basic Electrical Materials and Methods
- .2    Section 26 05 34 – Conduit
- .3    Section 26 05 29 – Fastenings and Supports
- .4    Section 26 27 16 – Cabinets, Splitters, Junction Boxes
- .5    Section 26 05 35 – Outlet Boxes and Fittings
- .6    Section 26 27 26 – Wiring Devices

**1.2                COORDINATION**

- .1    The building shall remain open and in normal operation during the construction period.
- .2    Where existing services, such as electrical power, fire alarm system, sound system, etc., are required to be disrupted and/or shut-down, coordinate the shut-downs with the The City and carry out the work at a time and in a manner acceptable to them. Carefully schedule all disruption and/or shut-downs and ensure that the duration of same is kept to the absolute minimum. Submit for approval a written, concise schedule of each disruption at least 120 hours in advance of performing work and obtain The City's written consent prior to implementing.
- .3    Should any temporary connections be required to maintain services during work in the existing building, supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing system be damaged, make full repairs without extra cost, and to the satisfaction of the The City and Contract Administrator.
- .4    Refer to general conditions for phasing and staging of work and adhere to that schedule. Comply with instructions regarding working hours necessary to maintain the building in operation.
- .5    Coordinate complete installation of relocated utility services, if required, with utilities to ensure minimum interruption of service. Coordinate the transfer of the existing Hydro service point to the new service point with the Hydro utility in order to keep power interruptions to a minimum.

**1.3                EXISTING DEVICES IN NEW CONSTRUCTION**

- .1    Where existing devices (receptacles, switches, etc.) presently mounted on a wall which will be covered with a new finish, provide an extension ring, coverplate, etc., as required to mount the device to the new wall.
- .2    Where existing conduits pass vertically through a floor area, relocate those conduits to be installed concealed in a new wall or surface-mounted in a service area. Extend conduit, wiring, etc., as required.
- .3    Existing junction boxes in walls and ceiling spaces required to maintain existing circuits shall remain accessible.

**1.4 SCHEDULE OF WORK**

- .1 Carefully note and refer to the Architect's general schedule of work and include for all requirements to conform to it.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Provide all materials required for the complete interface and reconnection installation as herein described and as indicated on the drawings.
- .2 New fire alarm devices, speakers, starters, panelboards, etc., required to be tied into existing systems shall match the existing devices.
- .3 New wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturer's requirements and instructions.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install boxes, conduit and wiring through existing areas as required for the new installation.
- .2 Add modules, switches, etc., in existing control panels, as required, to extend existing systems to new or renovated areas.
- .3 Patch and repair walls and ceilings in existing areas that have been damaged to cut open due to the new electrical installation.
- .4 Where new cables or conduits have been installed through existing fire rated walls, seal opening around cables and conduit to maintain fire rating.

END OF SECTION

**Part 1 General**

**1.1 RELATED WORK**

- .1 Section 26 00 10 - Basic Electrical Material and Methods
- .2 Section 26 05 34 – Conduit
- .3 Section 27 05 28 - Communication Cabling Raceways
- .4 Section 26 05 29 - Fastenings and Support

**Part 2 Products**

**2.1 MATERIALS**

- .1 Conductors in Conduit (R-90):
  - Type: RW-90
  - Conductors: Solid copper #10 AWG and smaller.  
Stranded copper #8 AWG and larger.  
Sized as indicated (minimum #12 AWG)
  - Insulation: Cross link polyethylene (XLPE), 90°C. (194°F)
  - Configuration: Single conductor
  - Voltage Rating: 1000V
  - Certification: CSA C22.22 No.38 or latest revision
- .2 Armored Cable:
  - Type: AC-90
  - Conductors: Solid copper #10 AWG and smaller.  
Stranded copper #8 AWG and larger.  
Sized as indicated (minimum #12 AWG).
  - Insulation: Cross link polyethylene (XLPE), 90°C. (194°F)
  - Configuration: Multi-conductor, as required, complete with a separate bare CU ground wire.
  - Voltage Rating: 600V
  - Armor: Bare interlocked aluminium.
  - Certification: CSA C22.22 No.38 or latest revision
- .3 Armored Cable (Teck):
  - Type: Teck 90.
  - Conductors: Solid copper #10 AWG and smaller.  
Stranded copper #8 AWG and larger.  
Sized as indicated (minimum #12 AWG).
  - Insulation: Cross link polyethylene (XLPE), 90°C. (194°F).
  - Configuration: Multi-conductor, as required, complete with a separate bare CU ground wire.
  - Color Code: Black, red, blue and white in 4/c cable. Cables of more than 4/c to be number coded.

- 
- |  |                 |  |
|--|-----------------|--|
|  | Voltage Rating: | 1 kV or 5 kV as indicated.*  |
|  | Inner Jacket:   | Black polyvinyl chloride (PVC)<br>Low flame spread (LFS).<br>Low gas emission (LGE).                 |
|  | Armor:          | Interlocked aluminium.   |
|  | Outer Jacket:   | Black polyvinyl chloride (PVC), -40°C. (-40°F)<br>Low flame spread (LFS).<br>Low gas emission (LGE). |
|  | Fire Rated:     | FT4.   |
|  | Certification:  | CSA C22.22 No. 131 or latest revision.   |
- .4 Aluminium Sheathed Cables:
- |  |                   |  |
|--|-------------------|--|
|  | Type:             | RA-90.   |
|  | Conductors:       | Solid copper #10 AWG and smaller.<br>Stranded copper #8 AWG and larger.<br>Sized as indicated (minimum #12 AWG). |
|  | Insulation:       | Cross link polyethylene (XLPE), 90°C. (194°F)  |
|  | Configuration:    | Single conductor.  |
|  | Voltage Rating:   | 1000V.   |
|  | Aluminium Sheath: | Liquid and vapour tight solid corrugation.   |
|  | Outer Jacket:     | Polyvinyl chloride (PVC), -40°C. (-40°F)<br>Low flame spread (LFS).<br>Low gas emission (LGE).                   |
|  | Fire Rating:      | FT4.   |
|  | Certification :   | CSA C22.22 No. 123 or latest revision.   |
|  | Ground:           | Provide bare bond sized to Table 16 C.E.C.   |
- .5 Fire Alarm
- |  |                 |  |
|--|-----------------|--|
|  | Conductor:      | Solid copper #18 AWG.  |
|  | Insulation:     | 105°C (221°F) flame retardant PVC.   |
|  | Configuration:  | Multi-conductor (minimum 4 conductors per cable).                                      |
|  | Voltage Rating: | 300V   |
|  | Conductor:      | Color coded.   |
|  | Identification: |  |
|  | Shielding:      | Aluminium mylar foil.  |
|  | Outer Jacket:   | 105°C (221°F) red PVC jacket.  |
|  | Certification:  | CSA Class #5851-01 File #LR41741.<br>UL subject 1424 File #E-83163. Or latest revision |
- .6 FAS Fire Alarm Armoured Cable
- |  |                |                                 |
|--|----------------|---------------------------------|
|  | Conductor:     | Solid bare copper               |
|  | Inner Jacket:  | Red PVC                         |
|  | Armour:        | Red tinted aluminum interlocked |
|  | Temperature:   | -30°C bend to 105°C.            |
|  | Configuration: | 3 cond, 5 cond.                 |
|  | Shield:        | Aluminum Polyester Shield       |
|  | Certification: | CSA, FAS, FT4, SR               |
- .7 Pressure type connectors, fixture type splicing connectors, cable clamps and lugs, as required.

**Part 3 Execution**

**3.1 INSTALLATION IN RACEWAYS**

- .1 Install wiring as follows:
  1. In conduit systems in accordance with Section 26 05 34.
  2. In underground ducts in accordance with Section 26 05 44.
  3. Ensure conduits are dry and free of debris before pulling cables.
  4. Color coding and identification as per this Section.
  5. Wires in outlet, junction and switch boxes, not having a connection within the box shall not be spliced, but shall continue unbroken through the box.

**3.2 INSTALLATION SINGLE CONDUCTOR CABLES**

- .1 Single conductor cables shall be installed one cable diameter apart on suspended cable tray or channel supports and shall be clamped with aluminium cable clamps. Cables shall be terminated using non-magnetic connectors. Cable armour shall be grounded via an aluminium plate at the supply end and isolated via an insulating plate, at the load end of the cable. A #3/0 AWG bare (unless otherwise noted) copper ground wire shall be installed with each set of feeder cables. Cable bending radius shall be at least twelve times the overall cable diameter and bend shall not damage or distort the outer sheath.
- .2 Install cables in trenches as per Section 26 05 45.
- .3 Do not install PVC jacketed cables in circulating air plenums.
- .4 Provide pressure tight connectors when aluminum cable is utilized.

**3.3 INSTALLATION OF FLEXIBLE ARMOURED CABLE**

- .1 Type AC-90 armoured cable (BX) shall be used for connections from conduit systems to recessed luminaires in accessible ceilings. Cable shall be of sufficient length to allow the lighting fixture to be relocated to any location within a 6' (1.83 mm) radius. Cable shall be clamped before entering the lighting fixture and shall be clipped before entering the conduit system junction box. (Minimum requirements)
- .2 Type AC-90 armoured cable may be used for connections from conduit systems to wiring devices in steel stud partitions and for interconnection of wiring devices within steel stud partitions, cable shall be clipped before entering junction or outlet boxes.
- .3 Type AC-90 ISO-BX as supplied by Alcatel shall be used for isolated ground receptacles.

**3.4 INSTALLATION IN EQUIPMENT**

- .1 Group and lace-in neatly, wire and cable installed in switchboards, panelboards, cabinets, wireways and other such enclosures.

**3.5 TERMINATIONS**

- .1 Terminate wires and cables with appropriate connectors in an approved manner.



**3.6 MOTOR CONNECTIONS**

- .1 Flexible connections to motors shall not exceed 78” (2 m) unless authorized in writing by Contract Administrator. Utilize liquid-tight flexible metal conduit or Teck cable with approved Teck connectors.

**3.7 IDENTIFICATION**

- .1 Wire in conduit #2 AWG and smaller shall have solid coloured insulation, color coded as listed below.
- .2 Wire in conduit #1 AWG and larger and single conductor cables for normal power feeders shall be identified at each outlet box and termination with a 6” (150 mm) band of coloured vinyl tape of the appropriate color. Emergency power feeders shall be provided with an additional 3” (75 mm) band of red vinyl tape installed adjacent to the 6” (150 mm) band of the coloured phase identification tape, as listed below. Neutral and ground conductors shall be identified. Paint or other means of coloring the insulation shall not be used.

- .3 Color code wire in conduit and single conductor cables as follows:

Phase A	red
Phase B	black
Phase C	blue
Neutral	white
Ground	green

Unless shown otherwise on the drawings.

- .4 Maintain phase sequence and color coding throughout project.
- .5 Use color coded wires in communication cables, matched throughout system.
- .6 Identify control conductors in motor equipment, contactors, fire alarm panels, etc. with Mylar / cloth wire markers.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1      Section 26 00 10 - Basic Electrical Material and Methods.
- .2      Section 26 05 19 - Wire and Cable
- .3      Section 26 24 14 - Main Distribution Switchboard

**1.2                REFERENCES**

- .1      Ground equipment to: CSA C22.2 No. 41, or latest revision
- .2      Copper grounding conductors to: CSA G7.1 or latest revision.

**Part 2            Products**

**2.1                EQUIPMENT**

- .1      Grounding conductors system, circuit and equipment, grounding to be bare stranded copper, sized in accordance with the Canadian Electrical Code.
- .2      Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1      grounding and bonding bushings
  - .2      protective type clamps
  - .3      bolted type conductor connectors
  - .4      thermit welded type conductor connectors
  - .5      bonding jumpers, straps
  - .6      pressure wire connectors

**Part 3            Execution**

**3.1                INSTALLATION GENERAL**

- .1      Install complete permanent, continuous, system and circuit, grounding systems including electrodes, conductors, connectors and accessories to conform to requirements of local authority having jurisdiction over installation.
- .2      Install connectors to manufacturer's instructions.
- .3      Protect exposed grounding conductors from mechanical injury.
- .4      Make buried connections using copper welding by thermit process.
- .5      Use mechanical connectors for grounding connections to equipment provided with lugs. Soldered joints not permitted.

- .6 The main public metallic water service to a building shall be utilized as the main ground electrode. Where such a service does not exist, then an artificial grounding electrode shall be provided to suit the requirements of the local inspection authorities.
- .7 Install bonding wire for flexible conduit, connected to both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate ground conductor, to exterior pole mounted luminaires.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end and run separate ground conductor.
- .11 Provide separate ground conductors in PVC conduit, plastic or fibreglass raceways.

### **3.2 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral points of 600V and 208V systems.

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to: service equipment, transformers, frame of motors, motor control centres, starters, control panels, building steel work, generators, elevators distribution panels, outdoor lighting.

### **3.4 COMMUNICATION SYSTEMS**

- .1 Install grounding connections for telephone, sound, fire alarm, intercommunication systems as follows:
  - .1 Provide minimum #6 AWG ground from voice/data rooms to main building ground as indicated.
  - .2 Sound, fire alarm, intercommunication system, as indicated.

### **3.5 PADMOUNTED TRANSFORMER**

- .1 Provide grounding connections to the padmounted transformer in conformance with requirements of the supply authority.

### **3.6 TESTS**

- .1 Perform tests in accordance with Section 26 00 10.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the local inspection authority. A report shall be submitted to the Contract Administrator from the testing agency.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator, if provided, during tests.

- .5 A ground electrode with an unsatisfactory resistance test result shall be altered as necessary until the required resistance reading is achieved.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1        Section 26 00 10 – Basic Electrical Materials and Methods
- .2        Section 26 05 19 – Wire and Cable
- .3        Section 26 05 34 – Conduit
- .4        Section 26 05 36 – Cable Tray

**Part 2            Products**

**2.1                SUPPORT CHANNELS**

- .1        U-shape galvanized steel uni-strut, size 1.6” x 1.6” (40 x 40mm), 0.1” (2.5mm) thick, surface-mounted, suspended or set in poured concrete walls and ceilings as required.

**2.2                MANUFACTURERS**

- .1        Acceptable manufacturers: Burndy, Electrovert, Unistrut, Pilgrim, Pursley.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2        Secure equipment to poured concrete with cast-in or 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. Provide additional support where required.
- .5        Support equipment, conduit or cables on support channels 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.
  - .1        One-hole steel straps to secure surface conduits and cables 1 ¼” (32mm) and smaller.
  - .2        Two-hole steel straps for conduits and cables larger than 1 ¼” (32mm).
  - .3        Beam clamps to secure conduit to exposed steel work.
- .7        Suspended support systems.
  - .1        Support individual cable or conduit runs with ¼” (6mm) dia. Threaded rods and spring clips.
  - .2        Support 2 or more cables or conduits on channels supported by 3/8” (10mm) diameter threaded rod hangers where direct fastenings to building construction is impractical.
- .8        For surface-mounting of two or more conduits use channels at 60” (1.52m) o.c.
- .9        Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

- .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 pipe straps to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except when otherwise approved by the Contract Administrator.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, in accordance with manufacturer's installation recommendations.
- .14 Where conduit and cable runs are installed on support systems, they shall be run so as to be as inconspicuous as possible. Coordinate support system path with equipment, of other trades, to ensure proper installation of electrical equipment. Run support system path perpendicular or parallel to building lines.
- .15 Cut off all excess threaded rod on support systems.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1        Section 26 00 10 – Basic Electrical Materials and Methods.
- .2        Section 26 05 29 – Fastenings and Supports

**1.2                LOCATION OF CONDUIT**

- .1        Drawings do not show all conduits. Those shown are diagrammatic form only.
- .2        Electrical Subcontractor shall produce layout sketches of conduit runs through mechanical and electrical service areas in order to pre-avoid any conflict with other construction elements and to determine the most efficient route to run conduit.

**Part 2            Products**

**2.1                CONDUITS**

- .1        Rigid galvanized steel threaded conduit: size as indicated.
- .2        Electrical metallic tubing (EMT), size as indicated.
- .3        Rigid PVC conduit: size as indicated.
- .4        Flexible metal conduit and liquid-tight flexible metal conduit: size as indicated.
- .5        FRE duct: size 2" (53mm) and above as indicated.
- .6        Electrical non-metallic tubing (ENT) only as indicated.

**2.2                CONDUIT FASTENINGS**

- .1        One hole steel straps to secure surface conduits 1 ¼" (35mm) and smaller. Two hole steel straps for conduits larger than 1 ¼" (35mm).
- .2        Beam clamps to secure conduits to exposed steel work.
- .3        U-channel type supports as specified in Section 26 05 29.2.1.1 for two or more conduits at 60" (1.52m) intervals (surface-mounted or suspended).
- .4        3/8" (10mm) diameter threaded rods to support suspended channels.

**2.3                CONDUIT FITTINGS**

- .1        Fittings manufactured for use with conduit specified.
- .2        Manufacturer elbows where 90° bends are required for 2 ½" (63mm) and larger conduits.
- .3        Steel set screw connectors and couplings. Insulated throat liners on connectors.
- .4        Raintight connector fittings complete with O-rings, for use on weatherproof or sprinklerproof enclosures.

- .5 Raintight connectors shall be used for all top entries to panels, disconnects, contactors and motor control centres.
- .6 Raintight couplings and connectors shall be used for surface conduit installations exposed to moisture, attic spaces, crawlspaces and exterior.

## **2.4 EXPANSION FITTINGS FOR RIGID AND PVC CONDUIT**

- .1 Weatherproof expansion fittings with internal bonding assembly, suitable for 4" (100mm) or 8" (200mm) linear expansion, as required.
- .2 Watertight expansion fittings suitable for linear expansion, and 3/4" (21mm) deflection in all directions, as required.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel as required.
- .4 O-ring type expansion fittings for PVC conduit.
- .5 Flexible watertight conduit between junction boxes with integral bonding jumper suitable for linear and lateral movement greater than 3/4" (21mm).

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use electrical metallic tubing (EMT) except where noted otherwise.
- .4 Wiring home runs to panels and main branch wiring runs in ceiling spaces shall be run in conduit. Wiring drops from conduit systems into boxes for wiring devices in steel stud partitions may be wired with AC-90. AC-90 drops to light fixtures shall not run horizontally more than 6' (1.83m) from conduit system junction boxes in ceiling space. AC-90 drops from conduit system in the ceiling space to feed outlets in steel stud partitions shall not run more than 6' (1.83m) horizontally from the ceiling outlet box to the point where the AC-90 drops vertically into the partition.
- .5 Use rigid PVC conduit for underground installations.
- .6 The use of electrical non-metallic tubing (ENT) shall be limited to in-slab installations only and must be approved by Contract Administrator prior to installation.
- .7 Use flexible metal conduit for connection to fluorescent fixtures recessed in T-bar ceilings, suspended fixtures, and equipment subject to movement or vibration. Provide a separate insulated grounding conductor within flexible conduit.
- .8 Use liquid-tight flexible metal conduit for connection to motors and transformers. Provide a separate insulating ground conductor within conduit.
- .9 All wiring under computer floors shall be in liquid-tight flexible metal conduit, or teck cable, where indicated.



- .10 Use threaded rigid conduit and fittings in hazardous areas, concrete encased duct banks or where conduit is exposed to mechanical injury. Install conduit sealing fittings in hazardous areas and fill with compound. Field threads on rigid conduit shall be sufficient length to draw conduits up tight. Mechanically bend rigid steel conduit over  $\frac{3}{4}$ " (21mm) diameter.
- .11 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Install polypropylene fish cord in empty conduits.
- .13 Install two 1" (27mm) spare conduits up to ceiling space and two 1" (27mm) spare conduits down to ceiling space below from each recessed panelboard, cabinet, annunciator, etc. Terminate these conduits in 6" x 6" x 4" (150 x 150 x 100mm) junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in a flush concrete-type box with extension ring.
- .14 Where conduits become blocked, remove and replace blocked section.
- .15 Dry conduits out before installing wire.
- .16 The length of any conduit run shall not exceed 100' (33m) and no conduit run shall have more than two 90° bends (or equivalent) before a pullbox is installed. Pullboxes shall be installed in accessible ceiling spaces. Conduits shall be supported within 12" (300mm) of entering any junction box, pullbox, cabinet, or panelboard.
- .17 Conduit shall be sized as per Canadian Electrical Code or as shown on drawings. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and shall be increased as required to suit length of run and voltage drop in accordance with Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the conduit size to suit at no extra cost.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Do not locate conduits within 78" (2m) of infrared or gas-fired heaters.
- .3 Group conduits wherever possible on suspended or surface channels.
- .4 Do not pass conduits through structural members, except as indicated.
- .5 Do not locate conduits less than 6" (150mm) to steam or hot water lines.

### **3.3 CONCEALED CONDUITS**

- .1 Do not install conduit home runs horizontally in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings, unless otherwise indicated.

### **3.4 CONDUITS UNDERGROUND**

- .1 Use PVC conduits or FRE duct underground. Provide a separate ground wire in non-metallic conduits.
- .2 All fittings shall be waterproof.

- .3 Slope conduits to provide drainage.

### 3.5 CONDUIT IDENTIFICATION

- .1 Colour code coverplates of junction boxes in conduit systems as per the colour code list below.
- .2 Colour code by spray painting the coverplate on each junction box in the conduit run.
- .3 In addition to colour coding coverplates on junction boxes with power wiring, the circuits being run in the box shall be identified on the inside of coverplate with permanent felt marker.

120/208V Normal Power	yellow
120/208V Emergency Power	fluorescent red
347/600V Normal	orange
347/600V Emergency Power	fluorescent orange
Fire Alarm	red
Telephone	purple
Security	royal blue
CCTV	black
Ground	green
PA/Sound	brown
Nurse Call	sky blue
Controls	white
Satellite or Cable TV	fluorescent green

- .4 Provide pre-manufactured peel and stick labels for each system on every conduit penetrating a wall or floor and at each junction box location.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1        Section 26 00 10 – Basic Electrical Materials and Methods
- .2        Section 26 05 34 – Conduits

**1.2                SYSTEM DESCRIPTION**

- .1        Provide boxes to suit each specified application. Locate as indicated.

**Part 2            Products**

**2.1                OUTLET AND CONDUIT BOXES – GENERAL**

- .1        Size boxes in accordance with CSA C22.1, Section 12.
- .2        Multi-gang boxes where wiring devices are grouped.
- .3        Blank coverplates for boxes without wiring devices.
- .4        347V outlet boxes for 347V switching devices.
- .5        Combination boxes with barriers where outlets for more than one system are grouped.

**2.2                SHEET STEEL OUTLET BOXES**

- .1        Electro-galvanized steel device boxes for flush installation, minimum size 4” (100mm) square with extension and plaster rings, as required.
- .2        Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit.
- .3        4” (100mm) square or octagonal outlet boxes for lighting fixture outlets.
- .4        4” (100mm) square outlet boxes with extension and plaster rings flush-mounting devices in finished plaster and tile walls.

**2.3                MASONRY BOXES**

- .1        Electro-galvanized steel masonry single and multi-gang boxes for devices flush-mounted in exposed block or brick walls.

**2.4                CONCRETE BOXES**

- .1        Electro-galvanized sheet steel concrete-type boxes for flush-mount in concrete with matching extension and plaster rings as required.

**2.5                CONDUIT BOXES**

- .1        Cast FS or FD ferrous boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles where exposed to moisture.

**2.6 FITTINGS – GENERAL**

- .1 Bushings and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Conduit outlet bodies for conduit up to 1 ¼” (35mm) and pullboxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

**2.7 SECTIONAL BOXES**

- .1 Do not utilize sectional boxes.

**Part 3 Execution**

**3.1 INSTALLATION OF 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 ¼” (6mm) of opening.
- .4 Cut in and recess outlet boxes in existing walls including cutting into block walls for flush finish.
- .5 Surface mounted outlet boxes accessible to public spaces shall be completely sealed free of knock outs. Use of surface mounted outlet boxes must be approved by contract administrator prior to installation.
- .6 Provide correct size of openings in boxes for conduit and cable connections. Reducing washers not allowed.
- .7 Maintain continuity of vapour barrier where boxes are installed in exterior walls.
- .8 Boxes shall be mounted plumb and square with building lines.
- .9 Co-ordinate boxes in masonry with brick or block configuration. Boxes shall be sawcut in of appropriate brick or block.
- .10 Co-ordinate locations with millwork.
- .11 Verify exact location of floor boxes with Architect. Adjust floor boxes level with finished floor.
- .12 Verify exact location of service fittings with furniture drawings and/or Architect. Service fittings shall be installed parallel and perpendicular to building lines.
- .13 Contractor shall scan structure before making openings and advise general contractor and contract administrator of any obstructions found prior to cutting or coring. Scan shall be completed prior to ordering material to be installed in or through concrete to ensure proper fit.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1      Section 26 00 10 – Basic Electrical Materials and Methods
- .2      Section 26 05 34 – Conduits
- .3      Section 26 05 19 – Wire and Cable

**1.2                SUBMITTALS**

- .1      Submit shop drawings in accordance with Section 26 00 10.

**Part 2            Products**

**2.1                CONDUIT**

- .1      Heavy wall rigid PVC conduits, size as indicated.
- .2      FRE duct, size as indicated.

**2.2                FITTINGS**

- .1      Rigid PVC opaque solvent welded type watertight couplings, bell end fittings, plugs, caps, adaptors, as required to make complete installation.
- .2      Expansion joints as required.
- .3      FRE duct couplings, bends, adapters, caps, etc., as required.

**2.3                GROUNDING**

- .1      Provide a separate insulated ground wire in each PVC or FRE conduit run.

**2.4                DIRECT BURIED SINGLE AND MULTI-CONDUCTOR CABLES**

- .1      Single conductor and multi-conductor direct buried cables to Section 26 05 19.

**2.5                WIRE**

- .1      Wire in conduit to Section 26 05 19.

**Part 3            Execution**

**3.1                INSTALLATION OF DIRECT BURIED CABLES AND CONDUITS**

- .1      Conduits and multi-conductor cables shall be laid out and spaced appropriately.
- .2      Single conductor cables shall be spaced 7 ½” (190mm) apart.
- .3      Install sand 6” (150mm) below and 6” (150mm) above cables and conduits.

- .4 Install conduit with watertight couplings. Make transitions, offsets and changes in direction using 5° bend sections. Do not exceed a total of 20° with conduit offset. Clean conduits before laying. Cap ends of conduits during construction and after installation to prevent entrance of foreign materials. Install pull cords in empty conduits
- .5 Install continuous overlapping cuprinol-treated planking 6" (150mm) above cables and conduits before backfilling. Install continuous yellow marker tapes 6" (150mm) above treated planking.

### **3.2 INSPECTIONS**

- .1 Advise Contract Administrator that they may inspect cable installation prior to backfilling.

### **3.3 RECORD DRAWINGS**

- .1 Include on Record Drawings, exact dimensioned position and routing of all underground cable feeders, etc.

### **3.4 COORDINATION**

- .1 Coordinate underground installation with utilities and underground work of other trades.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1      Mechanical Specifications
- .2      Section 26 00 10 – Basic Electrical Materials & Methods
- .3      Section 26 05 34 – Conduit
- .4      Section 26 05 19 – Wire and Cable
- .5      Section 26 05 35 – Outlet Boxes and Fittings

**1.2                SYSTEM DESCRIPTION**

- .1      Provide complete electrical power and control connections for mechanical equipment, except as noted herein, or as noted on the drawings.

**Part 2            Products**

**2.1                MATERIALS**

- .1      Include motor starters, disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.
- .2      Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices, and fittings required to provide control wiring for mechanical equipment, except for temperature/humidity control systems.
- .3      Unless otherwise noted, motors and control devices shall be supplied by Division 21, 22 23, 25. Motor horsepower ratings shall be as shown in the Division 21, 22 23, 25 specifications. Motor voltage and phase ratings shall be as shown on the Division 21, 22 23, 25 drawings.

**2.2                EXTERIOR EQUIPMENT**

- .1      All equipment, mounted on the exterior of the building, shall be weatherproof.
- .2      Exterior disconnect switches shall be weatherproof and mounted a minimum of 750mm above roof independent of equipment.

**Part 3            Execution**

**3.1                POWER WIRING**

- .1      Install power feeders, starters, disconnects, and associated equipment and make connections to all mechanical equipment.
- .2      Install branch circuit wiring for mechanical system control panels, time clocks, and control transformers.



- .3 Conduit, wire, devices and fittings required to wire and connect low voltage temperature control systems, shall be supplied and installed by the trade supplying the temperature control system. Control wiring shall be installed in conduit.
- .4 Wire and connect electrical interlocks for starters supplied by Division 21, 22 23, 25
- .5 Wire and connect hi-limit cut-outs for remotely mounted electric heating coils provided by Division 21, 22 23, 25
- .6 Wire and connect thermistor control devices, built-in to large motors, to motor starters, as per wiring diagrams provided by Division 21, 22 23, 25.
- .7 Provide boiler power disconnect switch at Boiler Room exit doors for each boiler. Coverplate for switches shall be red with lamacoid nameplate (Boiler #1, Boiler #2, etc.).

### **3.2 CONTROLS**

- .1 Install all electrical controls, except low voltage temperature controls, unless otherwise noted herein. Controls which have both electrical and mechanical connections shall be installed by the trade supplying the control.
- .2 Wire and connect line voltage remote thermostats and P/E switches for furnaces, condensing units, force flows, gas-fired unit heaters, electric heaters and rooftop units.
- .3 Wire and connect float switches, pressure switches, alternators, alarms, etc. for sump pumps, sewage pumps, domestic hot water re-circulating pumps, booster pumps, jockey pumps and compressors.
- .4 Conduit, wire, devices and fittings required to wire and connect low voltage controls, which are an integral part of a packaged unit, shall be supplied by the trade supplying the packaged unit, unless otherwise indicated. Control wiring shall be installed in conduit.
- .5 Wire and connect electrical interlocks for starters supplied by Division 21, 22 23, 25.
- .6 Wire and connect hi-limit cut-outs for remotely mounted electric heating coils provided by Division 21, 22 23, 25.
- .7 Wire and connect thermistor control devices, built-in to large motors, to motor starters, as per wiring diagrams provided by Division 21, 22 23, 25.

### **3.3 CO-ORDINATION**

- .1 Refer to mechanical drawings for the exact location of motor control devices, and other mechanical equipment requiring an electrical connection.
- .2 Obtain full information from Division 21, 22 23, 25, regarding wiring controls, overload heaters, equipment ratings and over-current protection. Notify the Division 21, 22 23, 25, at once, if any information provided is incorrect or unsatisfactory.
- .3 Refer to Division 21, 22 23, 25 specifications for any further electrical requirements.
- .4 Review both electrical and mechanical drawings and specifications and co-ordinate all controls with Mechanical Subtrades through General Contractor. Report all discrepancies to both mechanical and electrical contract administrator before close of tender. No additional money will be justified for assumptions made on any duplication of information.

- .5 Submit to General Contractor, as part of the tender submission, a list of controls and wiring to be provided in the Electrical Contract.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1      Section 26 00 10 – Basic Electrical Materials and Methods
- .2      Section 26 05 34 – Conduit
- .3      Section 26 05 19 – Wire and Cables
- .4      Section 26 05 35 – Outlet Boxes and Fittings
- .5      Section 26 27 26 – Wiring Devices

**1.2                SYSTEM DESCRIPTION**

- .1      Make all required electrical connections to devices, equipment, appliances, etc., furnished by other trades or The City, as indicated or implied on the drawings or in the specifications.
- .2      Provide and install miscellaneous electrical components where required.

**1.3                COORDINATION**

- .1      Verify electrical supply characteristics of all equipment prior to rough-in. Report any discrepancies immediately. Revise wire sizing, device type, connection type, breaker size, etc., as required, to accommodate the electrical supply characteristics of the equipment supplied by other trades.

**Part 2            Products**

**2.1                GENERAL**

- .1      Provide all required electrical devices, components, conduits, fittings, wiring, disconnects, and miscellaneous equipment to make all connections to equipment.
- .2      Be familiar with the apparatus being supplied and carefully coordinate and cooperate with the supplier/installer to ensure a proper and complete installation.

**2.2                RECEPTACLES**

- .1      Where equipment has line cord and plug, ensure cap is compatible with receptacle. Provide cord sets to equipment where required.

**2.3                ELECTRIC HAND-DRYERS**

- .1      World Dryer
  - .1      Electric hand-dryers shall have the following features:
    - .1      High power 80 second drying cycle
    - .2      Quiet operation for sound sensitive areas
    - .3      Durable and vandal resistant
    - .4      Designed for use in health clubs, locker rooms and schools

- .5 Push-button operation
- .6 Surface or recess mounted
- .7 Classic style design
- .2 Equipment shall be equal to World Dryer B-974, 120V, 2300A, 20A.
- .3 Provide stainless Steel model as base unit.
- .4 Equipment shall be complete with 5 year limited warranty.

**Part 3 Execution**

**3.1 BARRIER FREE DOOR OPERATIONS AND CONTROLS**

- .1 Wire and connect operator motors, and safety controls for the motorized entrance/exit doors as per the equipment supplier requirements.
- .2 Wire and connect associated controls including, but not limited to entry pushbuttons, kick buttons, power supplies, motion sensors, panic hardware switches, powered hinges, electric strikes, key switches etc.
- .3 Refer to architectural door hardware schedules and/or electrical door hardware schedule for further requirements.

**3.2 EQUIPMENT SUPPLIED BY OTHER TRADES OR THE CITY**

- .1 Wire and connect all equipment requiring an electrical connection. Install disconnect switches where required.
- .2 Provide a direct connection or receptacle and cord set to suit hook-up requirements of each piece of equipment. Confirm connection method with The City or General Contractor.

**3.3 TUB LIFTS, WHIRLPOOLS, ETC.**

- .1 Wire and connect all components and controls.
- .2 Supply and install ground fault circuit interrupters for all branch circuits.

**3.4 ELECTRIC HAND-DRYERS**

- .1 Install, wire and connect equipment as shown on drawings. Refer to circuiting for voltage requirements.
- .2 Mount recessed mounting kit for all recessed units.
- .3 Provide adequate support for secure mounting including blocking where required.

END OF SECTION

**Part 1            General**

**1.1                WORK INCLUDED**

- .1        Permanent electric service shall be provided from the utility company primary electrical system, to the Customer Service Termination Equipment.

**1.2                WORK RELATED**

- .1        Connection cabinets, pullboxes, special enclosures, etc. shall be provided as indicated on the drawings and as required for a complete installation.

**1.3                REQUIREMENTS OF REGULATORY AGENCIES**

- .1        All electrical service components shall, as a minimum, be in compliance with the Canadian Electrical Code and all utility company requirements.

**Part 2            Products**

**2.1                SERVICE ENTRANCE COMPONENTS**

- .1        The service entrance configuration and the electrical characteristics shall be as indicated on the drawings.
- .2        Underground service entrance conduits shall be located a minimum of 36” below grade.
- .3        Connection cabinets (where indicated and required) shall be pad mounted galvanized steel, painted grey and constructed to the utility company requirements.
- .4        Current transformer cabinets (where indicated and required), shall be galvanized steel painted grey, with a continuous piano hinge, and a sealing clasp integral with the main switchboard installation.
- .5        Metering system configuration(s) shall be as indicated on the drawings.
- .6        All service transformers shall be provided by the utility company.

**Part 3 Execution**

**3.1 COORDINATION**

- .1 Contractor shall initiate, co-ordinate, and schedule all utility company associated work.
- .2 Co-ordinate scheduling of service installation with the project construction schedule.

**3.2 INSTALLATION**

- .1 The electrical service and all components shall, as a minimum, be in compliance with all utility company requirements.

END OF SECTION

**Part 1        General**

**1.1            RELATED WORK**

- .1        Section 26 00 10 – Basic Electrical Materials and Methods
- .2        Section 26 05 25 – Grounding

**1.2            SUBMITTALS**

- .1        Submit product data in accordance with Section 26 00 10.

**Part 2        Products**

**2.1            MATERIALS**

- .1        Dry-type transformers: to CSA C9-M1981 and CAN/CSAC-802.2-00 and USA NEMA TP-1, or latest revision.
- .2        Use distribution transformers of one manufacturer throughout project.

**2.2            TRANSFORMERS – VENTILATED**

- .1        Type: ANN.
- .2        3-phase, 600V Delta, primary 120/280V “Y”, secondary 60 Hz.
- .3        kVA capacities as indicated.
- .4        150°C (302°F) temperature rise insulation system.
- .5        Basic Impulse Level (BIL): standard.
- .6        Hi-pot: standard.
- .7        Average sound level: standard.
- .8        Impedance at 170°C (338°F): standard.
- .9        Enclosure: air ventilated sprinklerproof NEMA/CSA (type 3R enclosures and labelled accordingly), removable metal front panel. Rear panel shall be unremovable.
- .10      Mounting: floor, wall or ceiling suspended as indicated.
- .11      Finish: in accordance with Section 26 00 10.
- .12      Primary taps: two 2 ½% FCAN and two 2 ½% FCBN.
- .13      Windings: copper.

**2.3            TRANSFORMERS – NON-VENTILATED**

- .1        Epoxy potted.
- .2        3-phase, 600V Delta, primary 120/208V “Y”, secondary 60 Hz.
- .3        115° temperature rise insulation system.
- .4        Basic Impulse Level (BIL): standard.

- .5 Hi-pot: standard.
- .6 Average sound level: 45 dB.
- .7 Impedance at 170°C [338°F]: standard.
- .8 Enclosure: sealed.
- .9 Mounting: floor or wall as indicated.
- .10 Finish: in accordance with Section 26 00 10.
- .11 Windings: copper.

#### **2.4 MANUFACTURERS**

- .1 Acceptable manufacturers: Westinghouse, Federal Pioneer, Square D, Hammond, Delta, REX and BEMAG.

### **Part 3 Execution**

#### **3.1 MOUNTING**

- .1 Mount dry-type transformers on floor with a 4” (100 mm) high concrete housekeeping pad, unless otherwise indicated.
- .2 Suspend dry-type transformers from structure on a U-channel and threaded rod support system complete with insulation springs, as indicated. Maximum size shall be 75kVA. Submit installation detail to structural Contract Administrator for review.
- .3 Allow 6” (150 mm) of clearance from walls and 4” (100 mm) from adjacent equipment for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Mount transformers with vibration isolators.
- .8 Install epoxy potted transformers on wall, unless otherwise indicated.

#### **3.2 CONNECTIONS**

- .1 Make final connections with liquid tight flexible conduit to mitigate vibration.
- .2 Energize transformers immediately after installation is completed, where practicable.
- .3 Provide grounding as per Section 26 05 25.

#### **3.3 EQUIPMENT IDENTIFICATION**

- .1 Size 7 label in accordance with Section 26 00 10.

END OF SECTION



**Part 1            General**

**1.1                RELATED WORK**

- .1        Section 26 00 10 – Basic Electrical Materials and Methods
- .2        Section 26 28 17 – Circuit Breakers
- .3        Section 26 05 34 – Conduit
- .4        Section 26 05 19 – Wire and Cable

**1.2                DESCRIPTION OF EQUIPMENT**

- .1        Main distribution board incorporates service entrance cable connection section, main breaker complete with built-in ground fault, utility metering transformer compartment, sub-feeder distribution section and customer metering section, factory assembled in one enclosure.

**1.3                SUBMITTALS**

- .1        Submit shop drawings and product data in accordance with Section 26 00 10.
- .2        Indicate:
  - .1        Floor anchoring method and foundation template.
  - .2        Dimensioned cable entry and exit locations.
  - .3        Dimensioned position and size of bus.
  - .4        Overall length, height and depth.
  - .5        Dimensioned layout of internal and front panel mounted components.
  - .6        Shipping sections and weights.

**1.4                MAINTENANCE DATA**

- .1        Provide data for incorporation into Maintenance Manual specified in Section 26 00 10.

**1.5                MAINTENANCE MATERIALS**

- .1        One set of spare parts as recommended by manufacturer.
- .2        Fuses:
  - .1        3 fuses for each type above 600A.
  - .2        6 fuses for each type up to and including 600A.

**1.6                SOURCE QUALITY CONTROL**

- .1        Refer to Section 26 00 10.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Service entrance board: to CSA C22.2 No. 31.
- .2 Molded case circuit breakers: to CSA C22.2 No. 5.
- .3 Fuse holder assemblies: to CSA C22.2 No. 39.
- .4 HRC Fuses: to CSA C22.2 No. 106.
- .5 Meters: to CSA C17.
- .6 Meter mounting devices: to CSA C22.2 No. 115.
- .7 Digital instruments: to ANSI C39.1 and UL508.
- .8 Instrument transformers: to CSA C13.

**2.2 POWER SUPPLY**

- .1 Power supply: 3 phase, 4 wire, grounded neutral, 60 Hz, short circuit current rated at 42 KA RMS symmetrical, voltage as indicated on the drawings.

**2.3 SERVICE ENTRANCE SWITCHBOARD**

- .1 Ampere rating: as indicated on the drawings.
- .2 Enclosure:
  - .1 Free-standing, totally enclosed sheet steel, ‘sprinklerproof’ enclosure with steel frame.
  - .2 Sheet steel barriers to separate adjoining sections.
  - .3 Provision for installation of supply authority metering transformers.
  - .4 Customer metering instruments, transformers and selector switches.
  - .5 Distribution section.
  - .6 Hinged access panels with captive knurled thumbscrews. Utility metering section to have provision for utility seals.
  - .7 High conductivity aluminum bus.
  - .8 Bus from load terminals of main
  - .9 Identify phases with colour coding.

**2.4 MAIN BREAKER SECTION**

- .1 The main circuit breaker shall be a manually operable, fixed mounted molded case circuit breaker. Breaker shall be constructed in accordance with the following standards: UL489, NEMA AB1-1986, CSA 22.5 No. 5.
- .2 Breaker shall be complete with a microprocessor based, RMS sensing trip system or the breaker shall be equipped with an independent of any external power source and shall be LI, LIG, LS or LSG (as indicated) to provide time/current curve shaping adjustments. Local visual indication for overload, short circuit and ground fault trip occurrences.
  - .1 ( ) LI - Adjustable Long Time Ampere Rating and Delay

- .1 Adjustable Instantaneous Pickup.
- .2 Fixed Selective Override
- .2 ( ) LIG - Adjustable Long Time Ampere Rating and Delay
  - .1 Adjustable Instantaneous Pickup.
  - .2 Adjustable Ground Fault Pickup and Delay
  - .3 (delay includes I2t IN and I2t OUT)
  - .4 Fixed Selective Override
- .3 ( ) LS - Adjustable Long Time Ampere Rating and Delay
  - .1 Adjustable Short Time Pickup and Delay
  - .2 (delay includes I2t IN and I2t OUT)
  - .3 Adjustable Defeatable Instantaneous Pickup
  - .4 Fixed Selective Override
- .4 ( ) LSG - Adjustable Long Time Ampere Rating and Delay
  - .1 Adjustable Short Time Pickup and Delay
  - .2 (delay includes I2t IN and I2t OUT)
  - .3 Adjustable Defeatable Instantaneous Pickup
  - .4 (delay includes I2t IN and I2t OUT)
  - .5 Fixed Selective Override
- .3 Breaker shall be equipped with test port for use with manufacturer's test set enabling testing of all trip functions (without actual tripping of breaker) and without disassembly of breaker.

## 2.5 GROUNDING

- .1 Copper ground bus extending full width of cubicles and located at bottom.
- .2 Lugs at each end sized for grounding cable.
- .3 Bond non-current carrying metal parts to ground bus.

## 2.6 HYDRO UTILITY METERING SECTION

- .1 Separate compartment for exclusive use of utility company metering transformers.
- .2 Provide mounting and wiring for the following:
  - .1 potential transformers
  - .2 current transformers
- .3 Hydro utility metering transformers shall be supplied by the Hydro utility and factory installed by the switchboard manufacturer.

## 2.7 CUSTOMER METERING SECTION

- .1 The Circuit Monitor vendor shall be ISO 9000 registered to demonstrate quality compliance.

- .2 The current and voltage signals shall be digitally sampled at a rate high enough to provide valid data for waveform analysis and true-RMS metering accurate beyond the 30th harmonic (fundamental of 60Hz).
- .3 The Circuit Monitors shall be listed to UL508, industrially rated for an operating temperature range of  $-25^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  and have an overcurrent withstand rating of 500 amps for one second.
- .4 The Circuit Monitor shall be accurate to .15% of reading plus .05% of full scale for voltage and current metering, and .3% for all power and energy functions.
  - .1 These accuracies shall be maintained for both light and full loads and for power factors from .5 – 1.
  - .2 No annual recalibration by users shall be required to maintain these accuracies.
  - .3 Voltage and current for all phases shall be sampled simultaneously to assure high accuracy in conditions of low power factor or large waveform distortions (harmonics).
  - .4 The Circuit Monitor shall be capable of being applied without modification at nominal frequencies at 50, 60 or 400 hertz.
  - .5 The Circuit Monitor shall operate properly over a wide range of control power including 100-264 VAC or 100-300 VDC.
  - .6 Each Circuit Monitor shall be equipped with integral communications to permit information collected by the circuit monitor to be sent to central locations for display, analysis, and logging.
    - .1 Each Circuit Monitor shall have a spade lug connector for connection to an RS-485 serial communication link. The link shall use a common industry protocol that is factory proven.
    - .2 The Circuit Monitor shall be equipped with a front panel communications port as standard equipment. The port shall be completely accessible during normal operation and shall not require exposure of the operator to life-threatening voltage when in use. The operator shall be able to quickly connect a small Personal Computer (PC) to this port without use of tools or splices. This front panel port shall have all of the communication functionality of the standard hard wired rear port. When a connection is made to the front port, the Circuit Monitor shall disregard communication from the rear port until the front port is disconnected.
- .7 The Circuit Monitors shall accept inputs from industry standard instrument transformers (120 VAC secondary PTs and 5A secondary CTs). Connection to 480Y/277 circuits shall be possible without use of PTs. In the interest of safety, provision shall be made that if PTs are not used, it shall not be necessary to bring voltages greater than 120 VAC (line to neutral) to the Circuit Monitor itself.
  - .1 PT primaries through 1.2 MV shall be supported.
  - .2 T primaries through 32 kA shall be supported.
- .8 All set-up parameters required by the Circuit Monitors shall be stored in non-volatile memory and retained in the event of a control power interruption. Any battery or other device used to provide non-volatile memory shall be user serviceable from the front of the Circuit Monitor and servicing shall not require removing the Circuit Monitor from the gear in which it is mounted.

- .9 The Circuit Monitor shall maintain in non-volatile memory maximum and minimum values for each of the instantaneous values reported as well as the time and date that the minimum or maximum was set.
- .10 Any Circuit Monitor may be applied in three phase, three or four wire systems. A fourth CT input shall be available to measure neutral or ground current. If the fourth CT is not used, then a residual current shall be calculated by vectorial addition of the phase currents.
- .11 In 4-wire connections, the Circuit Monitor shall utilize the circuit neutral common reference and not earth ground to provide metering accuracy.
- .12 The Circuit Monitor shall flush mount to an enclosure and be provided with an attractive finish bezel ring.
  - .1 The Circuit Monitors shall be equipped with an integral, continuous duty, long-life display to provide local access to continuous duty, long-life display to provide local access to the following metered quantities as well as the minimum and maximum value since last reset of each quantity:
    - .1 current, per phase RMS and neutral (if applicable)
    - .2 voltage, phase-to-phase & phase-to-neutral
    - .3 real power, per phase and 3-phase total
    - .4 reactive power, per phase and 3-phase total
    - .5 apparent power, per phase and 3-phase total
    - .6 power factor, 3-phase total and per phase
    - .7 frequency
    - .8 demand current, per phase and 3-phase average
    - .9 demand real power, 3-phase
    - .10 demand apparent power, 3-phase
    - .11 accumulated energy, (MWH and MVARH)
    - .12 K-factor, current, per phase
  - .2 Reset of the following electrical parameters shall also be allowed from the front of the Circuit Monitor:
    - .1 peak demand current
    - .2 peak demand power (kW) and peak demand apparent power (kVA)
    - .3 energy (MWH) and reactive energy (MVARH)
  - .3 Set-up for system requirements shall be allowed from the front of the Circuit Monitor. Set-up provisions shall include:
    - .1 CT rating (xxxxx:5)
    - .2 PT rating (xxxxxxx:120)
    - .3 Demand interval (5 – 60 min.)
    - .4 Watt-hours per pulse
  - .4 All reset and set-up functions shall have a means for protection against unauthorized/accidental changes.

- .5 Displaying each of the Circuit Monitor quantities shall be accomplished through the use of vertical scroll buttons which select the next quantity in the list appearing on the face of the device.
- .6 For ease in operator viewing, the display shall remain on continuously, with no detrimental effect on the life of the Circuit Monitor.
- .13 It shall be possible to field upgrade the firmware in the Circuit Monitor to enhance functionality. These firmware upgrades shall be done through either the front or rear communication connection. No Circuit Monitor disassembly or changing of integrated circuit chips shall be required.
- .14 The following metered values as well as their minimum and maximum instantaneous readings since last reset shall be communicated by the Circuit Monitor:
  - .1 frequency
  - .2 temperature
  - .3 current, per phase RMS and neutral (if applicable)
  - .4 current, 3-phase average RMS
  - .5 current, apparent RMS
  - .6 voltage, phase-to-phase & phase-to-neutral
  - .7 power factor, per phase
  - .8 power factor, 3-phase total
  - .9 real power, per phase and 3-phase total
  - .10 reactive power, per phase and 3-phase total
  - .11 apparent power, per phase and 3-phase total
  - .12 demand current, per phase and 3-phase average
  - .13 demand real power, 3-phase average
  - .14 demand apparent power, 3-phase average
  - .15 accumulated energy, (MWH, MVAH< and MVARH)
  - .16 Total Harmonic Distortion (THD), voltage and current, per phase
  - .17 K-factor, per phase
- .15 All power demand calculations shall be done by any one of the following calculation methods, selectable by the user:
  - .1 Thermal demand using a sliding window updated every 15 seconds. The window length shall be set by the user from 5 to 60 minutes in 5 minute increments.
  - .2 Block interval, with optional sub-intervals. The window length shall be set by the user from 5 to 60 minutes in 5 minute intervals. The user shall be able to set the sub-interval length from 5 to 60 minutes in 5-minute intervals.
  - .3 External pulse synchronization, utilizing a synch pulse provided externally. An optional status input shall be used to sense the pulse.
  - .4 Sliding block interval with continuous sliding 15-second sub-intervals.
    - .1 The following demand readings shall be reported by the Circuit Monitor:

- .1 average demand current, per phase
  - .2 peak demand current, per phase
  - .3 average demand for real power, reactive power, and apparent power
  - .4 predicted demand for real power, reactive power, and apparent power
  - .5 peak demand for real power, reactive power and apparent power
- .2 The default demand calculation method shall be a 15-minute sliding window thermal demand.
- .16 Each Circuit Monitor shall be capable of receiving a broadcast message over the communications network that can be used to synchronize demand calculations by several Circuit Monitors. This message need not be addressed specifically to any one Circuit Monitor.
- .17 The following energy readings shall be reported by the Circuit Monitor:
  - .1 Accumulated energy
  - .2 Accumulated reactive energy
  - .3 Accumulated apparent energy
    - .1 For real and reactive energy reported values, separate totals for energy flow in each direction shall be kept, as well as an arithmetic sum.
    - .2 Each Circuit Monitor shall be capable of operating a solid state KYZ output relay to provide output pulses for a user definable increment of reported energy. Minimum relay life shall be in excess of one billion operations.

## 2.8 DISTRIBUTION SECTION

- .1 The distribution section to consist of a CDP type panelboard with molded case circuit breakers. Each breaker shall be manually operated, fixed type with trip ratings as shown on the drawings. Minimum interrupting rating to be 42,000 amps symmetrical.
- .2 The distribution section to be provided with a minimum of 8-200 amp, 3 pole frame spaces.

## 2.9 FINISHES

- .1 Apply finishes in accordance with Section 26 00 10:
  - .1 service entrance switchboard finish shall be exterior grey
  - .2 supply 2-spray cans of touch-up enamel
  - .3 treated to inhibit rusting.

## 2.10 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 00 10.
- .2 Nameplates:

- .1 black plate, white letters, size 7, to indicate voltage, amp rating and designation
- .2 Complete switchboard: labelled as above main disconnect: labelled “main breaker”.
- .3 Sub-breakers: labelled to indicate panel or equipment fed.

## **2.11 SHOP FABRICATION**

- .1 Assemble and wire complete service entrance board.
- .2 Energize switchboard.
- .3 Check meters and phase selector switches.
- .4 Prepare switchboard for shipment to site.

## **2.12 MANUFACTURERS**

- .1 Acceptable manufacturers: Cutler Hammer, Federal Pioneer, Square D, Siemens.

## **2.13 FUTURE ENERGY MANAGEMENT**

- .1 Provide terminal board and wiring from separate customer CT’s and PT’s to facilitate the future installation of thermal demand, watt-hour energy management equipment, recorders, etc.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate service entrance switchboard as indicated.
- .2 Connect main secondary service entrance cables to line terminals of switchboard.
- .3 Connect load terminals of distribution breakers to outgoing feeders, as indicated.
- .4 Check factory-made connections for mechanical security and electrical continuity.
- .5 Run one #3/0, bare copper, grounding conductor in 1” (25mm) conduit from ground bus to the main building ground.
- .6 Check relay settings against shop drawings to ensure proper working and protection of components.
- .7 Manufacturer to provide test equipment and field test overload, magnetic and ground fault tripping. Include test report in Maintenance Manuals.
- .8 Arrange for main distribution switchboard shall be mounted on 4” (100mm) housekeeping pad.

END OF SECTION



**Part 1            General**

**1.1                RELATED WORK**

- .1    Section 26 00 10 – Basic Electrical Materials and Methods
- .2    Section 26 05 34 – Conduit
- .3    Section 26 28 17 – Circuit Breakers

**1.2                SUBMITTALS**

- .1    Submit shop drawings in accordance with Section 26 00 10.
- .2    Drawings shall include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**1.3                PLANT ASSEMBLY**

- .1    Install circuit breakers in panelboards before shipment.
- .2    In addition to CSA requirements, manufacturer's nameplate shall show fault current that panel, including breakers, has been built to withstand.

**Part 2            Products**

**2.1                PANELBOARDS**

- .1    Panelboards: to CSA C22.2 No. 29-M1989, or latest edition.
- .2    CDP panels: to CSA C22.2 No. 29-M1989, or latest edition, and shall be manufactured to allow installation of two 200A frame breakers adjacent to each other – horizontally.
- .3    Panelboards shall be product of one manufacturer throughout project.
- .4    250V branch circuit panelboards: bus and breakers rated for 10 kA symmetrical interrupting capacity minimum or as indicated.
- .5    600V branch circuit panelboards: bus and breakers rated for 18kA symmetrical interrupting capacity, unless otherwise indicated.
- .6    250V CDP panelboards: bus and breakers rated for 25 kA symmetrical interrupting capacity, unless otherwise indicated. CDP panels shall be complete with doors.
- .7    600V CDP panelboards: bus and breakers rated for 22kA symmetrical interrupting capacity, unless otherwise indicated. CDP panels shall be complete with doors.
- .8    Sequence phase bussing such that circuit breakers shall be numbered vertically in consecutive order. Each breaker shall be identified by permanent number identification as to circuit number.
- .9    Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .10   Two keys for each panelboard and key panelboards alike.

- .1 Aluminum bus with full size neutral.
- .2 Flush or surface-mounted tubs as shown.
- .3 Finish trim and door baked grey enamel.
- .4 CDP-type panelboards (breakers or fusible) shall be provided with a minimum of 6 – 200A, 3-pole, frame spaces.
- .5 All panelboards and CDP's shall have “sprinklerproof” enclosures.

## **2.2 CUSTOM BUILT PANELBOARD ASSEMBLY**

- .1 Double section panels as indicated.
- .2 Feed through lugs as indicated.
- .3 Isolated ground bus as indicated.
- .4 Weatherproof enclosure as indicated.
- .5 Built-in contactors as indicated.

## **2.3 BREAKERS**

- .1 Breakers with thermal magnetic tripping in panelboards, except as indicated otherwise.
- .2 Main breaker: mounted on top or bottom of panel to suit cable entry.
- .3 Lock-on devices for 5% of 15A branch breakers installed as indicated. Turn over unused lock-on devices to The City.
- .4 Lock-on devices for fire alarm, emergency, door supervisory, intercom, stairway, exit light, and nightlight circuits.
- .5 Branch circuit breakers shall be 15A single-pole, unless otherwise indicated on drawings.
- .6 225A panelboards shall be able to accept and serve breakers up to 150A/2P or 150A/3P.
- .7 400A panelboards shall be able to accept and serve breakers up to 250A/2P or 250A/3P.

## **2.4 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 00 10.
- .2 Size 4 nameplate for each panelboard and CDP to indicate panel designation and voltage.
- .3 Size 3 nameplate for each breaker in CDP panelboards engraved to indicate load being supplied.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

## **2.5 LOAD CENTRES**

- .1 Load centres shall be used to provide branch circuit distribution requirements for suites in residential occupancies only.
- .2 Mains shall be rated at 120/240V, single-phase, 150A mains.
- .3 Number of circuits and number and size of branch circuit breakers shall be as indicated.
- .4 Flush or surface-mounted tubs as indicated, complete with door.

- .5 Sequence phase bussing such that circuit breakers shall be numbered vertically in consecutive order. Each breaker shall be identified with a circuit number.

## 2.6 MANUFACTURERS

- .1 Acceptable manufacturers: Cutler Hammer, Federal Pioneer, Square D, and Siemens.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface-mounted panelboards on U-channels. Where practical, group panelboards on common length of U-channel.
- .3 Mount panelboards to height indicated in Section 26 00 10, unless otherwise indicated.
- .4 Connect loads to circuits as indicated.
- .5 Provide a separate neutral for each branch circuit with the exception of:
  - .1 Split wired parking or kitchen countertop receptacles
  - .2 Balanced three-phase lighting circuits.
  - .3 Convenience receptacle circuits in corridors or stairwells.
- .6 Finish parking lot panel enclosures shall match site lighting poles.
- .7 Install spare conduits from recessed panelboards in accordance with Section 26 05 34.
- .8 Connect isolated ground bus in panelboards to main building grounds source or distribution secondary neutral with #2/0 AWG, green insulated ground wire, in conduit.
- .9 Mount panelboard such that the top is 6'-0" (1.83m) above finished floor.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1            Section 26 00 10 – Basic Electrical Materials and Methods
- .2            Section 26 05 34 – Conduits
- .3            Section 26 05 29 – Fastening and Supports

**Part 2            Products**

**2.1                LOCATION**

- .1            Locate splitters, junction and pullboxes as indicated or as needed for each system.

**2.2                SPLITTERS**

- .1            Sheet metal enclosure and hinged cover, suitable for locking in closed position.
- .2            Main and branch lugs, shall match required size and number of incoming and outgoing conductors, as indicated.

**2.3                JUNCTION AND PULLBOXES**

- .1            Sheet steel construction with screw-on flat covers for surface or recessed mounting.
- .2            Covers with 1” (25mm) minimum extension all around, for flush-mounted pull and junction boxes.
- .3            Cat-type with gasketed covers where exposed to weather.

**2.4                CABINETS**

- .1            Type E: sheet steel, hinged door and return flange overlapping sides, handles, lock and catch, for surface-mounting.
- .2            Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing ¾” (19mm) GIS fir plywood backboard. Cabinets shall be flush or surface-mounted as indicated.

**Part 3            Execution**

**3.1                SPLITTER INSTALLATION**

- .1            Install splitters as indicated and mount plumb, true and square to the building lines.
- .2            Extend splitters full length of equipment arrangement except where indicated otherwise.
- .3            Use splitters only where indicated on the drawings.

**3.2                JUNCTION, PULLBOXES AND CABINETS**

- .1            Install pullboxes in inconspicuous but accessible locations.
- .2            Mount cabinets with top not higher than 74” (1.9m) above finish floor.
- .3            Install terminal blocks, as indicated.

- .4 Provide pullboxes in conduit runs as described in Section 26 05 34.
- .5 Boxes and cabinets shall be installed plumb and square with building lines.
- .6 Install junction and pullboxes clear of all mechanical duct work and piping.
- .7 Junction and pullboxes shall be sized to C.E.C.

**3.3**

**IDENTIFICATION**

- .1 Identify splitters with Size 5 nameplates.
- .2 Identify junction and pullboxes with Size 1 nameplates.
- .3 Identify cabinet with Size 5 nameplates.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1        Section 26 00 10 – Basic Electrical Materials and Methods
- .2        Section 26 05 35 – Outlet Boxes and Fittings

**1.2                SUBMITTALS**

- .1        Submit shop drawings and product data in accordance with Section 26 00 10.

**Part 2            Products**

**2.1                SWITCHES**

- .1        Toggle-operated general purpose AC switches 15A and 20A, 120V AC and 347V AC, single pole, double pole, three-way and four-way switches as indicated, with the following features:
  - .1        Terminal holes approved for No. 10 AWG wire.
  - .2        Silver alloy contacts.
  - .3        Urea molding.
  - .4        Suitable for back and side wiring.
  - .5        Brown or white toggle as indicated.
  - .6        Fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .2        Switches of one manufacturer throughout project.
- .3        Switches shall be premium specification grade (Industrial spec grade or Commercial grade).
- .4        Acceptable Manufacturers:

Manufacturer	120 Volt	347 Volt
Hubbell	1200 Series	18200 Series
Leviton	1200 Series	54500 Series
Pass & Seymour	15AC1 Series	3715 Series
Copper Wiring Devices	1200 Series	18201 Series

**2.2                RECEPTACLES**

- .1        Duplex receptacles, NEMA No. 5-15R, 125V AC, 15A, U-ground with the following features:
  - .1        Nylon face. Confirm colour with Architect, Interior Designer of Contract Administrator.
  - .2        Suitable for No. 10 AWG for back and side wiring.
  - .3        Break-off links for use as split receptacles.

- .4 Triple wipe contacts and riveted grounding contacts.  
Cooper Wiring Devices: BR Series – Commercial Grade #5252 Industrial Grade – 5 wire contacts, terminal covers, one piece grounding system.
- .2 Single receptacles NEMA No. 5-15R, 125V AC, 15A, U-ground, with the following features:
  - .1 Nylon face. Confirm colour with Architect, Interior Designer or Contract Administrator.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Receptacles shall be identified isolated ground type where indicated either by orange colour face or orange triangle. Confirm option with Architect, Interior Designer or Contract Administrator. Provide a separate insulated ground wire for each isolated ground circuit.
  - .4 Receptacles shall be of one manufacturer throughout project.
  - .5 Acceptable Manufacturers: Hubbell, Copper Wiring Devices, Bryant, Woodhead, Pass & Seymour. Catalogue No. 5252 for all manufacturers.

### **2.3 SPECIAL WIRING DEVICES**

- .1 Special wiring devices: as indicated on drawings.
- .2 Pushbutton stations shall be flush or surface-mounted as required. Units shall be complete with up/down, or start/stop buttons, as required and green pilot light.

### **2.4 OCCUPANCY SENSORS**

- .1 General:
  - .1 Sensors shall control lighting in the sensed area only.
  - .2 The Contractor shall be responsible for a complete, operable system, and installation should be warranted for a period of one year after acceptance.
  - .3 The product shall be warranted for a period of (5) five years.
  - .4 The Contractor shall, when supplied with drawings to mark on, provide As-Builts to the facilities Engineer, noting the location of lighting zones, sensors, power packs and low voltage wire.
  - .5 Occupancy sensors shall be installed as per manufacturer's recommendations.
  - .6 Specific low voltage wire surface routing shall be approved by the facilities Engineer.
  - .7 Sensor and control unit manufacturer must have experience in the lighting controls industry equal to minimum of (5) years with a minimum of (5) five similar projects.
  - .8 Contractor shall be responsible for contacting the manufacturer for proper placement and adjusting of sensor.
  - .9 To ensure quality and reliability, sensors shall be manufacture red by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
  - .10 Occupancy sensors shall be CSA or cUL listed.
- .2 Area Design:

- .1 A lighting load zone is defined as an area of lighting with between one and many circuits (usually one or two) that is controlled by one or a group of occupancy sensors to turn lighting on and off.
  - .2 Lighting loads for occupancy sensors control shall be distributed into evenly sectioned zones with the square footage of the zone never exceeding more than 2500 square feet (typical is 800 square feet)
  - .3 Each zone shall be the capability of being controlled on and off separately of all other zones.
  - .4 Each zone shall have coverage by occupancy sensors so no blind spots exist.
  - .5 Occupancy sensors shall be of the type that each sensor can operate independently and does not false trigger because of other sensors in its proximity.
- .3 Passive Infrared Wall Switch Sensors:
- .1 Sensor shall be capable of detecting presence in the control area by detecting changes in the infrared energy.
  - .2 The Passive Infrared (PIR) technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
  - .3 Sensor shall utilize SmartSet™ technology to optimize automatic time delay to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch setting.
  - .4 Sensor shall utilize Zero Crossing circuitry to reduce stress on the relay and therefore increase sensor life.
  - .5 PW-200 sensor shall utilize two relays capable of simultaneously controlling independent lighting loads or circuits. The secondary relay is isolated, allowing for two-circuit control.
  - .6 PW-100 sensor shall have no minimum load requirement and shall be capable of switching from 0-800 watts incandescent, 0-800 watts fluorescent or 1/6 hp at 120 VAC, 5-/60Hz, and 0-1200 watts fluorescent at 230/277 VAC, 50/60Hz.
  - .7 PW-100-347 sensor shall have no minimum load requirement and shall be capable of switching from 0-1500 watts fluorescent at 347 VAC, 50/60Hz.
  - .8 To blend in aesthetically, sensor shall not protrude more than 3/8” from the wall and utilize colour-matched lens.
  - .9 To assure detection at desktop level uniformly across the space, sensor shall have a 28 segment, two-level, Fresnel injection moulded lens.
  - .10 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if motion is detected after the first 30 seconds, set by DIP switch settings.
  - .11 To avoid false on activations and to provide immunity to RFI and EMI, Detection Signature Processing shall be used to examine the frequency, duration and amplitude of a signal, to respond only to those signals caused by human motion.
  - .12 Robotic test method as referred to in the NEMA WD 7 guide shall be utilized for minor motion coverage verification.



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- .13 Sensor shall cover up to 1,000 square feet for walking motion with a field of view of 180 degrees.
  - .14 Sensor shall have automatic-on or manual-on operation selected with DIP switch setting.
  - .15 Sensor shall have a time delay that is adjusted automatically (with SmartSet setting) and shall have a fixed time delay of 5 to 30 minutes set by DIP switches.
  - .16 In automatic mode, sensor shall be capable to automatically return to Automatic-on after lights are turned off manually.
  - .17 Sensor shall have the option for an audible warning that shall beep to warn the end-user before the lights turn off automatically.
  - .18 Sensor shall have the option for a visual warning that shall flash the lights to warn the end-user before the lights turn off automatically.
  - .19 Sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled.
  - .20 Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure, set by a DIP switch hidden behind the cover plate.
  - .21 Sensor shall be able to control incandescent, magnetic low voltage, electronic low voltage and fluorescent loads.
  - .22 Sensor shall have a built-in light level featuring simple, one-step daylighting setup that works from 8 to 180 footcandles.
  - .23 Switching mechanism shall be a relay(s). Triac and other harmonic generating devices shall not be allowed. Sensor shall have a ground wire and grounded strap for safety.
  - .24 The PIR wall switch sensor shall be a completely self-contained control device that replaces a standard toggle switch.
  - .25 Standard of acceptance is Wattstopper.
  - .26 Types: XXX: PW-100           Single relay  
          XXX: PW-100-347       Single relay  
          XXX: PW-1033-Way  
          XXX: PW-200           Dual relay  
          XXX: PW-200-347      Dual relay
- .4 Ultrasonic Wall Switch Sensors:
- .1 Sensor shall be capable of detecting presence in the control area by detecting Doppler shifts transmitted ultrasound
  - .2 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40KHz. It shall utilise Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout the controlled space.
  - .3 Sensor shall utilize SmartSet™ technology to optimize automatic time delay to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch setting.
  - .4 Sensor shall utilize Zero Crossing circuitry to reduce stress on the relay and therefore increase sensor life.

- .5 UW-200 sensor shall utilize two relays capable of simultaneously controlling independent lighting loads or circuits. The secondary relay is isolated, allowing for two-circuit control.
- .6 UW-100 sensor shall have no minimum load requirement and shall be capable of switching from 0-800 watts incandescent, 0-800 watts fluorescent or 1/6 hp at 120 VAC, 5-/60Hz, and 0-1200 watts fluorescent at 230/277 VAC, 50/60Hz.
- .7 UW-100-347 sensor shall have no minimum load requirement and shall be capable of switching from 0-1500 watts fluorescent at 347 VAC, 50/60Hz.
- .8 To blend in aesthetically, sensor shall not protrude more than 3/8" from the wall and utilize colour-matched lens.
- .9 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if motion is detected after the first 30 seconds, set by DIP switch settings.
- .10 Robotic test method as referred to in the NEMA WD 7 guide shall be utilized for minor motion coverage verification.
- .11 Sensor shall cover up to 400 square feet for walking motion with a field of view of 180 degrees.
- .12 Sensor shall have automatic-on or manual-on operation selected with DIP switch setting.
- .13 Sensor shall have a time delay that is adjusted automatically (with SmartSet setting) and shall have a fixed time delay of 5 to 30 minutes set by DIP switches.
- .14 In automatic mode, sensor shall be capable to automatically return to Automatic-on after lights are turned off manually.
- .15 Sensor shall have the option for an audible warning that shall beep to warn the end-user before the lights turn off automatically.
- .16 Sensor shall have the option for a visual warning that shall flash the lights to warn the end-user before the lights turn off automatically.
- .17 Sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled.
- .18 Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure, set by a DIP switch hidden behind the cover plate.
- .19 Sensor shall be able to control incandescent, magnetic low voltage, electronic low voltage and fluorescent loads.
- .20 Sensor shall have a built-in light level featuring simple, one-step daylighting setup that works from 8 to 180 footcandles.
- .21 Switching mechanism shall be a relay(s). Triac and other harmonic generating devices shall not be allowed. Sensor shall have a neutral wire, ground wire and grounded strap for safety.
- .22 The PIR wall switch sensor shall be a completely self-contained control device that replaces a standard toggle switch.
- .23 Standard of acceptance is Wattstopper.
- .24 Types: XXX: UW-100 Single relay  
XXX: UW-100-347 Single relay  
XXX: UW-200 Dual relay

- .5 Dual Technology Wall Switch Sensors:
  - .1 Sensor shall be capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
  - .2 Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies to reduce likelihood of false operations.
  - .3 For best results, sensor shall feature a trigger mode where the end-user can choose which technology will activate the sensor from the off mode (initial), the type of detection that will reset the time delay (maintain), and the type of detection that will cause the sensor to be turned back on immediately after the lights are turned off due to a lack of motion (re-trigger). Selection of technologies for initial, maintain and re-trigger shall be done with DIP switches.
  - .4 Sensor shall have its trigger mode factory preset to allow for quick installation in most applications. In this default setting, both technologies must occur in order to initially activate the lighting system. Detection by either technology shall maintain lighting on, and detection by either technology shall turn lights back on after lights were turned off for 5 seconds or less in automatic mode and 30 seconds or less in manual mode.
  - .5 Sensor shall have four occupancy logic options for customized control to meet application needs.
  - .6 Robotic test method as referred to in the NEMA WD 7 guide shall be utilized for minor motion coverage verification.
  - .7 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40KHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout the controlled space.
  - .8 The Passive Infrared (PIR) technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
  - .9 Sensor shall utilize SmartSet™ technology to optimize automatic time delay to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch setting.
  - .10 Sensor shall utilize Zero Crossing circuitry to reduce stress on the relay and therefore increase sensor life.
  - .11 DW-200 sensor shall utilize two relays capable of simultaneously controlling independent lighting loads or circuits. The secondary relay is isolated, allowing for two-circuit control.
  - .12 DW-100 sensor shall have no minimum load requirement and shall be capable of switching from 0-800 watts incandescent, 0-800 watts fluorescent or 1/6 hp at 120 VAC, 5-/60Hz, and 0-1200 watts fluorescent at 230/277 VAC, 50/60Hz.
  - .13 DW-100-347 sensor shall have no minimum load requirement and shall be capable of switching from 0-1500 watts fluorescent at 347 VAC, 50/60Hz.
  - .14 To blend in aesthetically, sensor shall not protrude more than 3/8" from the wall and utilize colour-matched lens.

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- .15 To assure detection at desktop level uniformly across the space, sensor shall have a 28 segment, two-level, Fresnel injection moulded lens.
  - .16 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if motion is detected after the first 30 seconds, set by DIP switch settings.
  - .17 To avoid false on activations and to provide immunity to RFI and EMI, Detection Signature Processing shall be used to examine the frequency, duration and amplitude of a signal, to respond only to those signals caused by human motion.
  - .18 Sensor shall cover up to 1,000 square feet for walking motion with a field of view of 180 degrees.
  - .19 Sensor shall have automatic-on or manual-on operation selected with DIP switch setting.
  - .20 Sensor shall have a time delay that is adjusted automatically (with SmartSet setting) and shall have a fixed time delay of 5 to 30 minutes set by DIP switches.
  - .21 In automatic mode, sensor shall be capable to automatically return to Automatic-on after lights are turned off manually.
  - .22 Sensor shall have the option for an audible warning that shall beep to warn the end-user before the lights turn off automatically.
  - .23 Each sensing technology shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled.
  - .24 Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure, set by a trim pot.
  - .25 Sensor shall be able to control incandescent, magnetic low voltage, electronic low voltage and fluorescent loads.
  - .26 Sensor shall have a built-in light level featuring simple, one-step daylighting setup that works from 8 to 180 footcandles.
  - .27 Switching mechanism shall be a relay(s). Triac and other harmonic generating devices shall not be allowed. Sensor shall have a neutral wire, ground wire and grounded strap for safety.
  - .28 The PIR wall switch sensor shall be a completely self-contained control device that replaces a standard toggle switch.
  - .29 Standard of acceptance is Wattstopper.
  - .30 Types: XXX: DW-100           Single relay  
          XXX: DW-103           3-Way  
          XXX: DW-100-347       Single relay  
          XXX: DW-200           Dual relay  
          XXX: DW-200-347       Dual relay
- .6 Passive Infrared Wall or Ceiling Sensors:
- .1 The passive infrared sensors shall be capable of detecting presence, in the floor area to be controlled, by detecting changes in the infrared energy. Small movements shall be detected such as when a person is writing while seated at a desk within 15 feet of the sensor.

- .2 To avoid false ON activations and to provide high sensitivity to minor motion, Pulse Count Processing and Detection Signature Analysis shall be used to examine the frequency, duration and amplitude of the signal received by the sensor to respond only to those signals caused by human motion.
  - .3 Sensor shall utilize mixed signal ASIC (Application Specific Integrated Circuit) technology which combines analog and digital processing into one chip package, to provide immunity to RFI and EMI.
  - .4 Sensor shall utilize a temperature compensated dual element sensor and a multi-element Fresnel lens.
  - .5 Standard and Long Range Fresnel lens shall be a Poly IR4 based material to offer superior performance in the infrared wave-lengths. Aisleway lenses shall be a Poly IR2 based material that offers greater sensitivity to motion. Lens shall have grooves facing in to avoid dust and residue build-up which effects IR reception.
  - .6 To ensure sensitivity to small motion at desk top, the sensor shall have a standard 30 element lens with 15 layers horizontally and 4 layers vertically, a 14 element Long Range lens with 9 layers horizontally and 4 layers vertically, a 9 element 1-sided Aisle Way lens with 9 layers vertically or an 18 element 2-sided Aisle Way lens with 9 layers vertically.
  - .7 Sensor shall cover up to 2,000 square feet with the Standard Lens, up to 90 linear feet with the Long Range lens, up to 120 linear feet with the 2-Sided Aisle lens, and up to 50 linear feet with the 1-sided Aisle Way Lens for walking motion when mounted at a ceiling height of 10 feet.
  - .8 Sensor shall operate at 24 VDC and utilize a power pack.
  - .9 Sensor shall have an additional single pole, double throw isolated relay with normally open, normally closed and common outputs rated for 1 amp at 24 VDC. The isolated relay is for use with HVAC control, data logging and other control options.
  - .10 Sensor shall have two outputs: one output based on occupancy only and one output based on occupancy with a hold OFF and an internal photocell setting when a minimum light level is present (adjustable from 3 to 200 footcandles).
  - .11 For accuracy and consistency, sensor shall have a DIP switch controlled, digital time delay adjustable from 15 seconds to 30 minutes.
  - .12 Sensor shall have user-adjustable sensitivity settings.
  - .13 Sensor shall be furnished with a DIP switch override-ON function for use in the unlikely event of failure.
  - .14 Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering.
  - .15 Sensor can be wired in parallel to allow coverage of large areas.
  - .16 Standard of acceptance is Wattstopper.
  - .17 Type: XXX: CX-100 Standard  
XXX: CX-100-1 Long Range  
XXX: CX-100-3 Two-Sided Aisleway  
XXX: CX-100-4 One-Sided Aisleway
- .7 Passive Infrared Ceiling Sensors:

- .1 The passive infrared sensors shall be capable of detecting presence, in the floor area to be controlled, by detecting changes in the infrared energy. Small movements shall be detected such as when a person is writing while seated at a desk within an 8 feet radius of the sensor.
- .2 To avoid false ON activations and to provide high sensitivity to minor motion, Pulse Count Processing and Detection Signature Analysis shall be used to examine the frequency, duration and amplitude of the signal received by the sensor to respond only to those signals caused by human motion.
- .3 Sensor shall utilize SmartSet™ technology to optimize automatic time delay to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch setting.
- .4 Sensors shall be mounted to the ceiling with a flat, unobtrusive appearance and provide 360° of coverage.
- .5 Sensor shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
- .6 The sensors shall feature terminal style wiring, which makes installation easier.
- .7 To ensure sensitivity to small motion at desk top, the sensor shall have a 34 element extended range lens (standard) or a 55 element High Density lens.
- .8 Sensor shall cover 360°, up to 1,200 square feet of walking motion with the Standard Lens and up to 500 square feet of walking motion with the High Density lens when mounted at a ceiling height of 8 feet.
- .9 Sensors shall operate at 24 VDC/VAC and half-wave rectified and utilize a power pack.
- .10 CI-355 shall incorporate a switching power supply for reduce power consumption, shall operate at 120/277/347 VAC, 50/60Hz and shall not require a power pack.
- .11 CI-300 sensor shall have an additional single pole, double throw isolated relay with normally open, normally closed and common outputs rated for 1 amp at 24 VDC. The isolated relay is for use with HVAC control, data logging and other control options.
- .12 CI-300 and CI-355 sensors shall have a built-in light level sensor that works from 10 to 300 footcandles.
- .13 Sensors shall have a time delay that is adjusted automatically ( with the SmartSet setting) or shall have a fixed time delay of 5 to 30 minutes, set by DIP switch settings.
- .14 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
- .15 The CI-300 sensor shall have a manual on function that is facilitated by installing a momentary switch.
- .16 The sensor shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less visibility.
- .17 Standard of acceptance is Wattstopper.

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- .18    Type:   XXX:  CI-300           Standard  
              XXX:  CI-300-1       High Density  
              XXX:  CI-355       Line Voltage
- .8    Ultrasonic Ceiling Sensors:
- .1    Sensors shall be capable of detecting presence, in the floor area to be controlled by detecting Doppler shifts in transmitted ultrasound.
- .2    The ultrasonic frequency shall be 25 kHz at +/- .005%. The sensor shall be precision crystal controlled and shall not interfere with each other when two or more are placed in the same area.
- .3    Sensor shall utilize Advanced Signal processing to automatically adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow through the controlled space. Ultrasonic circuit shall be solid state crystal controlled.
- .4    Sensors of varying frequencies shall not be allowed to prevent sensors from interfering with each other and to assure compatibility in the event more sensors are added or units are replaced.
- .5    Sensor shall have a multi-directional transmitter with temperature and humidity resistant, 25kHz tuned ultrasonic receivers. Ultrasonic receivers shall be temperature and humidity resistant with less than a 6dB shift in the humidity range of 10% to 90% and less than a 10dB shift in the temperature range of -20° to 60°C.
- .6    Detection shall be maintained when a person of average size and weight moves only within or a maximum distance of 12 inches either in a horizontal or vertical manner at the approximate speed of 12 inches per second. The sum of this distance, volume and speed represent the average condition ultrasonic sensors must meet in order for the lights to not go off when a person is reading or writing while seated at a desk.
- .7    Each sensor shall be furnished with a convenient shunt provision which will enable a Custodian or Building Engineer to by-pass the sensor in the event of failure. This by-pass provision pin shall remain in the sensor and be visible from the floor as a constant reminder that the automatic function has been by-passed.
- .8    The sensors are to be ceiling mounted and not protrude more than 1.25 inches and should blend in aesthetically with the ceiling.
- .9    Sensors can be wired to parallel with up to 3 sensors per Power Pack to allow coverage of large areas.
- .10   Time delay range shall be adjustable from 15 seconds to 15 minutes.
- .11   Sensitivity adjustment shall range from off at “0” to maximum at “10”.
- .12   Sensors shall operate at 24 VDC and utilize a power pack.
- .13   Standard of acceptance is Wattstopper.
- .14   Type:   XXX:  W-500A  
              XXX:  W-1000A  
              XXX:  W-2000A  
              XXX:  W-2000H       Hallway

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- .9 Dual Technology Wall or Ceiling Sensors:
- .1 Sensor shall be capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
  - .2 Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies.
  - .3 Sensor shall have a retrigger feature in which detection of either technology shall retrigger the lighting system on within 5 seconds of being switched off.
  - .4 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40kHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout the space.
  - .5 Sensor shall be capable of corner mounting to a wall or ceiling in order to eliminate detection through open doorways and outside of the controlled area. To provide superior small motion detection and immediate activation upon entry, coverage of both technologies must be complete and overlapping throughout the controlled area.
  - .6 To avoid false ON activations and to provide high sensitivity to minor motion, Pulse Count Processing and Detection Signature Analysis shall be used to examine the frequency, duration and amplitude of the signal received by the sensor to respond only to those signals caused by human motion.
  - .7 Sensor shall operate at 24 VDC/VAC and half wave rectified and use and power pack.
  - .8 The Passive Infrared (PIR) technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
  - .9 The sensor lens shall cover up to 2,000 square feet for walking motion when mounted at 10 feet and 1,000 square feet of desktop motion.
  - .10 DT-200 sensors shall have an additional single pole, double throw isolated relay with normally open, normally closed and common outputs. The isolated relay is for use with HVAC control, data logging and other control options.
  - .11 Sensor shall utilize SmartSet™ technology to optimize automatic time delay to fit occupant usage patterns. The use of SmartSet shall be selectable with a DIP switch setting.
  - .12 Sensor shall have a time delay that is adjusted automatically (with SmartSet setting) and shall have a fixed time delay of 5 to 30 minutes set by DIP switches.
  - .13 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if motion is detected after the first 30 seconds, set by DIP switch settings.
  - .14 Sensor shall have an override ON function for use in the unlikely event of failure.
  - .15 Sensor shall have a built-in light level sensor that works from 10 to 300 footcandles.



- .16 Sensor shall have 8 occupancy logic options for customized contro to meet applications needs.
  - .17 Sensor shall have a manual ON function that is facilitated by installing a momentary switch.
  - .18 Each sensing technology shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled.
  - .19 Standard of acceptance is Wattstopper.
  - .20 Types: XXX: DT-200
- .10 Power Packs:
- .1 Power pack shall be a self-contained power supply and relay module measuring 1.6” x 2.75” x 1.6” (40.6mm x 69.9mm x 40.6mm) HxWxD
  - .2 For ease of installation, power pack shall have a ½” snap-in nipple for ½” knockouts and mounting on outside of enclosures.
  - .3 Power pack shall have dry contacts capable of switching 20-amp ballast and incandescent load at 120 VAC, 60Hz: 20 amp ballast at 277 VAC, 60Hz: 1 hp at 120-250 VAC, 60Hz.
  - .4 Power pack shall have a primary voltage of 120/230/277 VAC, 50/60Hz.
  - .5 Power pack shall provide 14 VDC. 225mA output with the relay connected.
  - .6 Power pack shall provide #14 AWG wires for reliable 20A operation.
  - .7 Power pack shall be capable of parallel wiring without regard to AC phasing on primary.
  - .8 Power pack can be used as a stand-alone, low-voltage switch, or can be wired to sensor for auto control.
  - .9 Power pack shall have an LED to indicate the status of the relay.
  - .10 Power pack shall have over-current protection if the low voltage current draw exceeds 225 mA. In the event of an over-current, the low voltage +24 VDC output shuts down to prevent permanent damage and the LED will blink continuously to indicate a fault condition.
  - .11 Power pack shall be UL 2043 plenum rated and shall have low voltage Teflon coated leads rate at 300 volts.
  - .12 Power pack shall utilize zero-crossing circuitry to protect from the effects of in-rush current and increase product life.
  - .13 To be environmentally friendly, power pack shall use lead free material and be RoHS compliant.
  - .14 Standard of acceptance is Wattstopper
  - .15 Types: XXX: BZ-50

## 2.5 COVERPLATES

- .1 Coverplates from one manufacturer throughout project.
- .2 Stainless steel coverplates for wiring devices mounted in flush-mounted outlet boxes.
- .3 Sheet steel utility box cover for wiring devices installed in surface mounted utility boxes.

- .4 Cast gasketed coverplates for wiring devices mounted in surface mounted FS or FD-type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminium coverplates, complete with gaskets for duplex receptacles as indicated.
- .6 Weatherproof coverplates, complete with gaskets for single receptacles or switches as indicated.
- .7 Confirm colour of Phenolic plates (if used), with Architect, Interior Designer of Contract Administrator.

**Part 3 Execution**

**3.1 INSTALLATION – SWITCHES**

- .1 Install single throw switches with handle in “UP” position when switch closed.
- .2 Install switches in gang-type outlet box when more than one switch is required in one location.
- .3 Mount toggle switches at height specified in Section 26 00 10 or as indicated.

**3.2 INSTALLATION – RECEPTACLES**

- .1 Install receptacles in gang-type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles vertically at height specified in Section 26 00 10, or as indicated.
- .3 Install cord sets on ranges and dryers.

**3.3 INSTALLATION – COVERPLATES**

- .1 Install suitable common coverplates where wiring devices are ganged.
- .2 Do not use coverplates intended for flush outlet boxes on surface mounted boxes.
- .3 Provide a coverplate on each outlet.

**3.4 IDENTIFICATION**

- .1 Identify receptacles with size Ø nameplate indicating panel and circuit number. Nameplates to be pre-glued with peel-off paper backing.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1    Section 26 00 10 – Basic Electrical Materials & Methods
- .2    Section 26 06 21 – Mechanical Equipment Connections
- .3    Section 26 24 19 – Motor Control Centres

**1.2                SUBMITTALS**

- .1    Submit shop drawings and product data in accordance with Section 26 00 10.
- .2    Indicate:
  - .1    Mounting method and dimensions.
  - .2    Starter size and type.
  - .3    Layout of identified internal and front panel components.
  - .4    Enclosure types.
  - .5    Wiring diagram for each type of starter.
  - .6    Interconnection diagrams.

**1.3                OPERATION AND MAINTENANCE DATA**

- .1    Provide data for incorporation into Maintenance Manual specified in Section 26 00 10.
- .2    Include operation and maintenance data for each type and style of starter.

**1.4                MAINTENANCE MATERIALS**

- .1    Provide maintenance materials in accordance with Section 26 00 10.
  - .1    4 contacts, stationary.
  - .2    4 contacts, movable.
  - .3    2 contacts, auxiliary.
  - .4    2 control transformers.
  - .5    2 operating coils.
  - .6    2 fuses.
  - .7    10 indicating lamps.
  - .8    OA kit.

**Part 2            Products**

**2.1                MATERIALS**

- .1    Starters: to CSA C22.2 No. 14, EEMAC E14-1.
  - .1    Starters smaller than EEMAC “1” are not acceptable.
  - .2    EEMAC/NEMA rated type only – IEC type not allowed.

## 2.2 MANUAL MOTOR STARTERS

- .1 Single-phase and three-phase manual motor starters of size, type, rating, and EEMAC “1” enclosure with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 Overload heaters, manual reset, trip indicating handle.
- .2 Accessories:
  - .1 Toggle switch.
  - .2 Indicating light.
  - .3 Locking tab to permit padlocking in “ON” or OFF” position.
  - .4 Flush-mounted type for public areas or as indicated.

## 2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic of size, type, rating and EEMAC “1” enclosure with components as follows:
  - .1 Contactor solenoid operated rapid-action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Power and control terminals.
  - .4 Wiring and schematic diagram inside starter enclosure in visible location.
  - .5 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
  - .6 Control transformer.
- .2 Accessories:
  - .1 Pushbuttons and selector switches labelled as indicated.
  - .2 Two indicating lights:
  - .3 RED – “OFF” and GREEN – “ON
  - .4 Two N/O and two N/C spare auxiliary contacts, unless otherwise indicated.
  - .5 HOA selector switch.

## 2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage, as indicated and 120V secondary, complete with secondary fuse, installed within starter enclosure.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

## 2.5 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 00 10.

## 2.6 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 00 10.
- .2 Identify manual starters with Size 2 nameplates, indicating motor number, description and horsepower.

- .3 Identify magnetic starters with Size 4 nameplates, indicating motor number, description, horsepower and voltage.

## 2.7 MANUFACTURERS

- .1 Acceptable manufacturers are: Westinghouse Canada Inc., Square D Company Limited, Allen Bradley Canada Company, Siemens Canada Ltd., and Cutler Hammer Canada Limited.

## Part 3 Execution

### 3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Install correct fuses and overload devices.

### 3.2 TESTS

- .1 Perform tests in accordance with Section 26 00 10 and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of motors and controls.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .5 Ensure that motor rotation corresponds with the direction required by the driven equipment.

END OF SECTION

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Drawings and general provisions of the contract, including general and supplementary conditions and division 01 specification sections, apply to this section.

**1.2 REFERENCES**

- .1 Comply with common work results for electrical, section 26 05 00 and all other documents referred to therein.

**1.3 SUBMITTALS**

- .1 Submittals:
  - .1 Submit shop drawings for all products as follows:
    - .1 Provide complete, fully dimensioned detail drawings including all major components and details fabrication of each fixture type.
    - .2 Provide requisite schematics and plans indicating assembly and installation of components. Submit complete photometric data prepared by an independent testing laboratory for luminaires where specified for approval by Contract Administrator.
    - .3 Submit shop drawings and product data in accordance with Section 26 00 10. Shop drawings shall include luminaire lamp type, ballast and/or driver data including manufacturer name and model number, for each luminaire type. Include total luminaire power consumption including ballast and/or driver losses, voltage, base type, and order codes. Lamp data shall include color temperature, and CRI.
    - .4 Maintenance manuals shall include a list of replacement lamps, ballasts and/or drivers for each luminaire. Include manufacturer data including name and model number, lamp type. Voltage, wattage, base type and order code. Lamp data shall include color temperature and CRI.

**1.4 QUALITY ASSURANCE**

- .1 ALL components TO BE APPROVED/LISTED AND LABELLED BY AN APPROVED AGENCY.

**1.5 DELIVERY, STORAGE AND HANDLING**

- .1 All lighting equipment shall be individually packaged with sufficient, protective padding for the selected method of transport. All handling and shipping shall be performed in accordance with the equipment manufacturer's recommendations. Unopened containers shall be stored in a protected location.

**1.6 WARRANTY**

- .1 Provide contractor warranties as well as factory warranties. All equipment and labor in this contract shall be free from defects in products or workmanship for 24 months after substantial completion.

- .2 Drivers shall be warranties for a minimum of 5 years with a minimal hour of operation of 50,000 hours.

## 1.7 WORK INCLUDED

- .1 Provide all light fixtures, poles, and auxiliary equipment as required for a complete installation.
- .2 Contractor is responsible for releasing orders and coordinating deliveries of the light fixtures from the suppliers in order to adhere to the construction schedule. This contractor is responsible for receiving, handling and storing all light fixtures until ready for installation.
- .3 Inspect deliveries to ensure they are complete.
- .4 Install all electrical light fixtures including common area light fixtures, as per contract documents.

## 1.8 SOURCE QUALITY CONTROL

- .1 The Manufacturer of all products specified herein must have been engaged in the fabrication of the equipment for at least the past 5 years.
- .2 The light fixtures listed in the light fixture schedule are pre-approved and are the standard of acceptance to be met through quality, performance, and architectural design.

## Part 2 Products

### 2.1 ACCEPTABLE MANUFACTURERS

- .1 Acceptable fixture manufacturers are as listed in the luminaire schedules.

### 2.2 GENERAL

- .1 Luminaires shall carry the CSA label.
- .2 Where soffits or ceilings have thermal insulation, provide fixtures which are CSA approved for such use.
- .3 Provide new lighting fixtures complete with mounting accessories, junction boxes, trims, lamps and drivers as specified and per attached fixture cut sheets.
- .4 All 347 volt luminaires shall be complete with integral disconnect switch to meet CEC part 1 rule 30-308(4).
- .5 Drivers or ballasts used in exterior luminaires shall be rated at -40°C starting.
- .6 Fixture type catalogue numbers do not necessarily denote required mounting equipment or accessories. Provide complete mounting accessories appropriate for each mounting condition.
- .7 All fixtures shall be installed with a frame or canopy that is compatible with the ceiling type specified by the Contract Administrator.
- .8 Provide appropriate accessories for proper mounting of all fixtures. Include plaster frames for plaster ceiling and firestop protection for fixtures in rated ceiling. For fixtures

suspended from ceiling, provide pendants or aircraft cables complete with accessories to complete the installation as indicated on the drawings.

- .9 If the words “equivalent” or “approved equal” are not indicated after light fixture manufacturer and catalog number in the fixture schedule, no other manufacturer will be acceptable for that particular type.
- .10 Re-lamp all fixtures to be re-used.
- .11 Any unused fixtures above the ceiling must be removed and circuits terminated. Turn fixtures over to the City.

### **2.3 LIGHTING FIXTURE SCHEDULE**

- .1 Catalogue numbers in the luminaire schedule are shown to indicate approved manufacturer and fixture quality requirements.

### **2.4 WIRE GUARDS**

- .1 Provide wire guards to all fixtures that are mounted so that any part of the fixture is less than 8'-0" above adjacent floor, unless noted otherwise in the luminaire schedule.

## **Part 3 Execution**

### **3.1 INSTALLATION – GENERAL**

- .1 Lighting fixtures shall be installed as indicated on architectural reflected ceiling plans, Electrical Drawings and per approved shop drawings.
- .2 Lighting fixtures shall be installed in accordance with fixture manufacturers written instructions, applicable requirements of the Contract Administrator, applicable authorities, and with recognized industry practices.
- .3 Verify locations and spacing of lighting fixtures with reflected ceiling plans and notify Contract Administrator of any variance or conflict between the plans and field conditions. Do not proceed until conflict has been resolved.
- .4 Work shall be coordinated with other trades. Lighting fixture locations shall have priority over location of ducts, diffusers, sprinklers, smoke detectors and other non-structural obstructions.
- .5 All fixtures shall be supported directly from the building structural members or from bridging attached to the structural members by rod hangers and inserts. Provide all necessary hardware and blocking to ensure that fixtures hang true, square, plumb, and in proper alignment.
- .6 Where continuous rows of lighting are recessed or surface mounted individual fixtures shall be tightly butted together such that no gaps are visible.
- .7 Where fixtures are mounted between architectural features shop drawings shall be provided indicating installation length and mounting method.
- .8 Fixtures installed in suspended T-bar ceiling shall be equipped with suspension chains, securely fastened to fixture and slab above. The light fixture shall be centered in the ceiling



- grid opening. Provide a minimum of two chains, one each on diagonal opposite corners, and provide more chains if required by local authority having jurisdiction.
- .9 Where lighting fixtures are stem hung from ‘ball and socket’ swivels at the ceiling, use stranded wire, #16 AWG (19 x 29) minimum size from outlet box to the fixture.
  - .10 Where lighting fixtures are chain-suspended, use solid conductor in armored cable or flexible conduit and secure to chain with white or clear nylon cable ties.
  - .11 All fixtures shall be installed with the bottom of the fixture housing aligned with the finished ceiling line unless otherwise noted in manufacturers installation instructions.
  - .12 Support recessed linear fixtures by four hangers per fixture minimum independent of ceiling structure or tee bars unless ceiling system is designed to carry the fixtures.
  - .13 Provide wiring channel for mounting of fixtures and wiring in between fixtures, suspended below mechanical piping, ductwork, etc., as directed on 0.6"(152mm) rigid conduit or 0.4" (100mm) galvanized rod hangers, on 8 ft.(2500mm) centers.

### **3.2 INSTALLATION OF LINEAR FIXTURES**

- .1 Linear fixtures, surface mounted or suspended, shall not have more than ¼"(305mm) variation in alignment for any 15’-0” (4.6M) run.

### **3.3 FIELD QUALITY CONTROL**

- .1 Operate each fixture after installation and connection. Each fixture shall be inspected for proper connection and operation.
- .2 Perform testing of operation of temporary or emergency power systems.
- .3 Verify that all lenses, louvres, baffles, fixture trim cones, diffusers and other parts are thoroughly cleaned in a manner recommended by the manufacturer.

### **3.4 LUMINAIRE WIRING**

- .1 Connect recessed luminaires to outlet boxes with 4” (100mm) flexible conduit and 90 Degrees C wire.
- .2 Provide dedicated neutral for all luminaires dimmed or connected to a lighting control system.

### **3.5 FIXTURES IN SERVICE ROOMS**

- .1 Before mounting any fixture in mechanical, electrical or other service room. Layout must suit equipment limitations in the room.

### **3.6 ADJUSTMENTS**

- .1 All adjustable fixtures shall be aimed as instructed by the Contract Administrator. Personnel, lifts, and ladders shall be provided as required.

### **3.7 CLEANING**

- .1 All unnecessary equipment, materials, wiring, and fixtures shall be removed from those areas affected by the construction. Materials that are not part of the lighting or electrical distribution system shall be removed from the Site.
- .2 All lighting fixtures shall be cleaned in a manner approved by the manufacturer and shall be free of dirt and debris upon completion of installation.

**3.8 PROTECTION**

- .1 Lighting fixtures, once installed, shall be protected from damage during the remainder of construction period.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK SPECIFICATIONS**

- .1        Section 26 00 10 – Basic Electrical Material and Methods
- .2        Section 26 05 29 – Fastenings and Supports
- .3        Section 26 05 35 – Outlet Boxes

**1.2                SYSTEM DESCRIPTION**

- .1        Exit lighting shall identify exits and means of egress.

**Part 2            Products**

**2.1                EXIT LIGHTS**

- .1        Exit lights: to CSA C22.2 No.141-10 and CSA C860.
- .2        Housing: cold rolled steel minimum.
- .3        Lamps: LED-2.5W 120v or 347 V.
- .4        Operation: designed for over 100,000 hours of continuous operation.
- .5        Pictogram: Units supplied with two pictogram film per face for directional selection.
- .6        Two-wire universal AC input: 120 to 347V ac,
- .7        Two wire standard DC input: 6 to 24V dc.
- .8        Universal mounting – end, wall or ceiling.
- .9        Manufacturers:
  - .1        Lumacell or equal.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1        Install exit lights as indicated, in accordance with MBC-1011, NRCAN C860.
- .2        Connect exit lights to exit light circuits as indicated.
- .3        Connect emergency connection to emergency circuits as indicated.
- .4        Ensure that exit light circuit breaker is locked in on position.
- .5        Wiring for exit light circuits shall be installed in a separate conduit system.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1            Section 26 00 10 – Basic Electrical Materials and Methods
- .2            Section 27 05 30 – Communication Raceways

**1.2                SYSTEM DESCRIPTION**

- .1            Complete empty data cable raceway system consists of outlet boxes, coverplates, pullboxes, pull cords, sleeves and grounding conductors.

**Part 2            Products**

**2.1                MATERIAL**

- .1            Conduits: EMT as per Section 26 05 34.
- .2            Junction boxes and T-cabinets: as per Section 26 27 16.
- .3            Outlet boxes and fittings: to Section 26 05 35.
- .4            Pull cord: polypropylene type.

**2.2                DATA OUTLETS**

- .1            Flush wall mounted data outlet to consist of a 2-gang backbox with a single gang extension ring and blank coverplate. Provide a 1” (25mm) conduit from each outlet stubbed into the ceiling space.
- .2            Floor mounted pedestal-type data outlet to consist of a 5” (125mm) square low profile, 2-piece fitting with steel frame and black plastic housing. Bottom steel plate to have a slot for conduit entry.
- .3            Floor mounted flush-type telephone outlet to consist of a Hubbell #B-2529 round formed steel shallow concrete pour box and #S-2555 round cover, brass.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Install empty raceway system, pull cords, terminal cabinets, outlet boxes, floor boxes, pullboxes, coverplates, conduit, sleeves and caps, and miscellaneous material to constitute a complete system.
- .2            Conduit bends to be 10 times the interior diameter of conduit.
- .3            Install pullboxes such that no conduit run is longer than 50’ (15m) or contains more than two 90° bends along its length. Conduit fittings are not acceptable as pullboxes.
- .4            Install pull cord in all empty conduits.

- .5 Install a conduit clip support system for data cables as shown on drawing. Refer to detail sheets and plans for location and method of installation.
- .6 Identify raceway system components as per Section 26 00 10.

END OF SECTION

**Part 1            General**

**1.1                RELATED WORK**

- .1            Section 26 00 10 – Basic Electrical Materials and Methods

**1.2                CODES AND STANDARDS**

- .1            CAN/CSA-T529 (Electrical Installations).
- .2            CAN/CSA-T528 (Wiring Systems Administration)
- .3            CAN/CSA-T530 (Telecommunication Pathways and Spaces)
- .4            IEEE Std. 1100 (Powering and Grounding Sensitive Electronic Equipment.
- .5            EIA/TIA, IEEE, FCC Standards (Data System Performance Standards).
- .6            Manitoba Building Codes (Fire Ratings, Wall Penetration, etc.).
- .7            CAN/CSA C22.1 Section 60.
- .8            Obtain work permits as required by authority having jurisdiction for all data installations.

**1.3                CONTRACTOR QUALIFICATION**

- .1            Only experienced Data Installation Contractors will be considered for the work. Contractors must be able to provide evidence of having performed work of a similar type as specified.
- .2            Contractor shall be trained and authorized by the manufacturers they represent. All bidders shall include evidence of their certification and references with their bids.
- .3            Contractor shall own and maintain tools and test equipment necessary for the successful installation and testing of the Cat. 6 communications cabling system.
- .4            All personnel employed in the installation of these systems shall be adequately trained in the use of such equipment and testers.
- .5            Contractor shall list the type and manufacturer of all test equipment to be used under section 27 13 10.3.2.

**1.4                TENDERED EQUIPMENT LIST**

- .1            Prepare a printed form listing the various materials as well as the manufacturer's name, catalogue numbers, if any, and the suppliers name. Category 6 compliance demands a common manufacturer of cable and components.
- .2            The above list shall be submitted with the tender documents. Manufacturers and suppliers listed shall be those used in the preparation of the tender and whose products shall be used to execute the respective contract work.
- .3            Any and all sub-contractors used to assist in the completion of this work shall be identified on the Tended Equipment List.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Provide Cat 6 twisted pair cable UTP, FT6 plenum rated for new data outlets shown. Connect back to existing communication rack. Exact location shall be confirmed on site.
- .2 Provide Communication Room termination on Client's existing patch panel and provide additional patch panel(s) as required to match existing.
- .3 Provide outlets at each location to match existing.
- .4 Provide cross connect patch cords (3m) for each drop.
- .5 Test all cables to Cat 6 250 MHz standards in accordance to ANSI/EIA/TIA 568-B Standards.
- .6 Identify all cables with numbered markers at both ends. Transfer identity number to as-built drawing for record purposes.
- .7 Clearly identify all communication outlets with direct thermal transfer adhesive print tape. Labels shall be white with black letters.
- .8 Connector Performance: All equipment used to terminate horizontal data wiring in data station fields shall be required to comply with the same transmission performance criteria set forth for RJ45 jack in communication outlet assemblies. The specific criteria are as follows:
  - .1 RJ45 Pair to Pair crosstalk: Minimum loss of 40 db at a frequency of 250 MHz.
  - .2 RJ45 Insertion Loss (Attenuation): Maximum loss of 0.4 db at a frequency of 250 MHz.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Supply and install all data lines and associated terminal equipment as previously specified.
- .2 Ensure that all plenum cabling is kept clear of all power equipment and lighting fixtures.
  - .1 INSTALLATION GUIDELINES

.1	TRANSFORMERS UP TO 5kVA	= > 1M
.2	POWER LINES (120V Systems)	= > 300mm
.3	LIGHTING	= > 300mm
.4	POWER LINES (600V Systems)	= > 1M
.5	ELECTRICAL MOTORS	= > 1M
- .3 Identify all cables with numbered markers at both ends. Transfer identity number on to mark-up drawing for record purposes.
- .4 Ensure that all equipment is constructed to the Standards specified above. All like materials shall be by a single manufacturer.
- .5 No splicing, tapping or bridging devices will be used between specified connecting hardware and outlet assemblies.

- .6 Cabling should be installed over corridor areas and/or along lines parallel to building structures. Penetrations through full-height wall partitions should be made through pre-established horizontal openings or sleeves.
- .7 Cabling installed in ceiling plenum spaces will be installed in a clip wireway as on detailed sheet attached. Support by cable ties to existing structures will only be approved by written consent of the Engineer.
- .8 All cable installations shall be protected from mechanical damage.
- .9 Cable should be free from tension over the entire length of each run.
- .10 Cable installation and termination methods shall be completed in a manner that will not degrade the cable specification. All I.D.C. terminations shall be inserted by the use of the proper tool. Use of the "dust cap" to effect insertion will not be considered adequate. Bundling, supporting, stripping of outer jacket, and retention of wiring twist will be subject to the final approval of the Engineer. Work not meeting the above criteria will be re-done.
- .11 All cables shall be labelled generally as indicated on drawings and shall adhere to CSA-T528 standard.
- .12 All conduit ends, including vertical stubs in wall cavities, shall be fitted with insulated grommets.
- .13 Where the use of concealed or surface conduit must be used a minimum box size for data/voice termination shall be 4 x 4 x 2 1/4 inches, complete with either a single gang or double gang mud-ring as required by number of drops specified.
- .14 Use approved cable clips or hangers at 4'-0" centres to effectively support all multi-cable harnessing.
- .15 Small numbers of cables splitting off the harness to individual room drops shall be supported by either Velcro straps or combined Panduit wirewraps/nylon ties (see detail).
- .16 Where installation is arranged in a hollow wall construction, MP1 or MP2 plates shall be used to allow maximum cable space in wall cavity.
- .17 Cables dropped in wall cavity shall have insulated bushings fitted to the top wall plate.
- .18 Vertical faceplate installation is preferred for voice/data use.
- .19 Where numbers warrant, centre hung cable tray shall be installed to support major harnessing, preferably over corridor areas.
- .20 Cable tray drop-off chutes shall be fitted where cable exits this tray downward.
- .21 During installation data cable coils shall not be suspended from the structure by nylon ties or equivalent. Proper support of coils to prevent damage is essential.
- .22 One small loop of cable shall be arranged in the cable before entering the wall cavity. Excessive slack cable should be avoided as this increases run length.
- .23 Bundle data cable in transition areas between conduit and tray runs. Utilize data grade velcro ties for bundling only and not to support weight.

### 3.2

### TESTING



- .1 Test for continuity, pair placement, pair reversal and incorrectly terminated cables. All tests in accordance with EIA/TIA 568 Level III.
- .2 Test and record in tabular form the following for each outlet:
  - .1 Attenuation.
  - .2 Resistive impedance.
  - .3 Link test all individual cables in compliance with EIA/TIA 568.
  - .4 Wire Map
  - .5 Length
  - .6 Near End Crosstalk (NEXT)
  - .7 Return Loss
  - .8 PSNEXT, FEXT (including ELFEXT and PSELFEXT measurements)
  - .9 Propagation Delay
  - .10 Delay Show
- .3 Test and record the length of all horizontal data field wiring from the wire management panel to the workstation outlet assembly.
- .4 Supply Engineer with a test summary sheet and full test results on computer disk upon completion of project. Disk format should allow client to download individual test sheets to view and print. (Microsoft Word) A copy of the summary sheet and the test data disk should be included in the Maintenance Manuals prepared by the Contractor.
- .5 An experienced data installer in compliance with Clause 1.3.1 shall perform the above testing.

### **3.3 WARRANTY**

- .1 The installation contractor will support the above system for a period of one year from the date of acceptance by the Engineer. The response time to repair reported failures shall be four (4) hours within the City of Winnipeg.

### **3.4 MAINTENANCE AGREEMENTS**

- .1 The installation contractor shall indicate a willingness to enter into a Maintenance Agreement at the termination of the above Warranty period.

END OF SECTION

## **1 General**

### **1.01 RELATED WORK**

- .1 Section 26 00 10 – Basic Electrical Materials and Methods
- .2 Section 26 05 34 – Conduit
- .3 Section 26 05 19 – Wire and Cable
- .4 Section 26 05 35 – Outlet Boxes and Fittings
- .5 Section 27 05 30 – Communications Raceways

### **1.02 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 26 00 10 including:
  - .1 Layout of equipment.
  - .2 Complete wiring diagram, including connections to devices.

### **1.03 OPERATION AND MAINTENANCE DATA**

- .1 Provide data for incorporation into Maintenance Manual specified in Section 26 00 10.
- .2 Operation and Maintenance Manual shall include:
  - .1 Operation and maintenance instructions for complete sound system to permit effective operation and maintenance.
  - .2 Technical data – illustrated parts lists with parts catalogue numbers.
  - .3 Copy of reviewed shop drawings.

### **1.04 MAINTENANCE**

- .1 Provide one year's free maintenance with two inspections by manufacturer during the first year of service. Submit Inspection Report to City. Replace or repair the equipment not functioning as intended.

### **1.05 SERVICE**

- .1 The supplier of the system shall employ factory-trained technicians and maintain a service organization within driving distance of the job site.

### **1.06 WARRANTY**

- .1 The system shall carry a one-year from date of acceptance by the City.

### **1.07 ON-SITE INSTRUCTION**

- .1 The sound system supplier shall provide on-site instruction to familiarize personnel with operational techniques and procedures for the system.

### **1.08 SYSTEM DESCRIPTION**

- .1 The Electrical Subcontractor shall supply and install a complete and operating new sound system as herein specified and as shown on the drawings.
- .2 The new sound system shall be capable of the following functions:
  - .1 Transmission of paging messages to all loudspeakers from the telephone system.

- .2 Transmission of background music to all loudspeakers from an internal tape system, tuner or external source.
- .3 Suppression of background music during a paging message.
- .4 Zone paging to selected areas.
  - .1 Pool Area and Lobby
  - .2 Change Rooms
  - .3 Basement

## **2 Products**

### **2.01 POWER AMP/PRE-AMP**

- .1 The Mixer/Power Amplifier shall be Dukane or approved equal. The Mixer/Power Amplifier shall deliver 125 watts of continuous power with less than 1% distortion from 20 to 20,000 Hz (direct).
- .2 The signal-to-noise ratio shall be greater than 70 dB for auxiliary and telephone/page inputs. Signal-to-noise ratio for others inputs shall be greater than 60 dB for low impedance microphone and ceramic phono module inputs and greater than 70 dB for auxiliary and 55 dB for high impedance microphone modules.
- .3 The frequency response shall be 20 to 20,000 Hz plus or minus 1dB at 9dB below rated output (direct) per EIA SE101A.
- .4 The Mixer/Power Amplifier shall have six (6) inputs. Inputs 1 through 4 shall use associated input modules listed under Optional Equipment. An auxiliary input (Input 5) and telephone/page input (Input 6) shall be fixed inputs.
- .5 The Mixer/Power Amplifier shall have both an electronic foldback and thermal overload protection circuit, both self-restoring. The Mixer/Power Amplifier shall have at least 30 dB of muting.
- .6 Individual controls for Input 1-5, tone controls, master control and illuminated power switch shall be front panel accessible. The telephone/page control shall be rear mounted. Auxiliary #2 (Input 5), Mixer Out, Tape Out, Amp In and Preamp Out shall have RCA phono type connectors and all other terminations shall be screw terminals.
- .7 The Mixer/Power Amplifier shall operate on 120V AC, 60Hz and consume 3.0 amperes at rated output.
- .8 The Mixer/Power Amplifier shall be desk/shelf mounted or rack mounted using specific rack mount kits. The Mixer/Power Amplifier (1A1725) shall have dimensions of 17" (43.18 cm) wide x 13-3/4" (32.39 cm) deep x 5-1/4" 13.34 cm high. Rack mount dimensions shall be 19" (48.26 cm) wide x 12-3/4" (32.39 cm) deep x 5-1/4" (13.34 cm) high.
- .9 The Mixer/Power Amplifier shall be finished in charcoal gray, baked enamel with a polycarbonate overlay on the front panel. The cover shall have a textured finish of the same color. The Mixer/Power Amplifier shall weigh 27 pounds.

### **2.02 BAFFLES**

- .1 The flush ceiling baffle shall be a Burtek. The baffle shall be constructed of heavy gauge steel, finished in satin white baked enamel and shall measure 12 3/4" in diameter and 3/16" deep. Four holes shall be provided to mount the baffle to Burtek backbox.

### **2.03 BACKBOXES**

- .1 The ceiling backbox shall be a Burtek. The backbox shall be constructed of heavy gauge galvanized steel and shall measure 10” in diameter and 4” deep. The flange diameter shall be 11 5/8”. The round Burtek flush ceiling baffle shall mount to the backbox with screws to the provided speed nuts. Four combination 1/2” – 3/4” knockouts shall also be provided, spaced at 90° increments, about the circumference.

### **2.04 LOUDSPEAKERS**

- .1 The loudspeaker shall be Burtek. The loudspeaker shall be an 8” permanent magnet core-type using a 6 ounce ceramic magnet. Voice coil diameter shall be 1” and shall have in impedance of 8 ohms. Continuous power rating shall be 10 watts and uniform frequency range shall be from 50 to 18,000 Hz. The minimum of axial sensitivity shall be 93 dB at 4’ with 1 watt input.
- .2 Loudspeaker shall be mounted on wall in Pool areas.

### **2.05 MATCHING TRANSFORMER**

- .1 Transformer shall be Burtek. The transformer shall have a power handling capacity of 5 watts. Frequency response at full rated power shall be 100 – 10,000 Hz plus or minus 1.5 dB. Primary winding shall be tapped to draw 5, 2.5, 1.25, .62 and .31 watt from a 70.7 volt line with an 8 ohm load.

### **2.06 VOLUME CONTROLS**

- .1 Volume controls shall be Burtek. It provides control of area speaker volume on 25 volt or 70 volt speaker distribution lines, controlling up to 20 watts of audio power. Attenuation shall be accomplished 10 steps of 4 dB each, except for 6 dB before OFF position. The finish of the faceplate shall be satin, stainless steel. The unit shall mount in a single gang series 1104 electrical box.

### **2.07 ZONE PAGING**

- .1 Provide Soundalier relay pack for zone paging. Zone paging to be provided at general office area only.

### **2.08 WIRING**

- .1 Speaker wiring shall be 2-c #18 with overall jacket.
- .2 Paging microphone wiring shall be 2/c #18 twisted shielded.

## **3 Execution**

### **3.01 GENERAL**

- .1 Locate, install, wire and connect all components and devices in accordance with the requirements of the manufacturer.

### **3.02 MOUNTING OF EQUIPMENT**

- .1 Mount equipment at heights as described in Section 26 00 10.
- .2 Mount equipment square and plumb with building lines. Install devices flush and square with finished surfaces.

- .3 Install antenna on a roof-mounted mast and make the signal cable and ground connections. Connect the lightning arrestor with a separate down lead to a dedicated ground electrode.

**3.03 TERMINATION OF CONDUCTORS**

- .1 Terminate conductors directly to the terminals of each device.

**3.04 IDENTIFICATION**

- .1 Identify equipment as per Section 26 00 10.
- .2 Clearly identify zones on control panels, devices, etc.
- .3 Identify wires and cables with wire markers to indicate zone numbers. Identify wiring in each box, panel, cabinet, etc.

**3.05 WIRING AND CONDUIT**

- .1 Install wiring in an independent conduit system.
- .2 Install speaker backboxes to form part of the conduit system. Conduit to be sized to accommodate the wiring being installed.

**3.06 TESTING**

- .1 The complete system shall be tested in the presence of the Contract Administrator and City's representative on completion of the work. Tests shall demonstrate that the P.A. system will function in an acceptable manner.
- .2 Conduct intelligibility test. Adjust tap settings on individual speakers to suit volume requirements.
- .3 Set master controls.

**END OF SECTION**

**Part 1            General**

**1.1                SHOP DRAWINGS**

- .1        Submit shop drawings in accordance with section electrical general provisions
- .2        Include the following detail:
  - .1            A complete description of the system operation
  - .2            A complete description of each system component

**1.2                SCOPE OF WORK**

- .1        Division 26 shall supply and install all equipment and accessories in order to provide a complete electrically supervised non-coded, zoned, Fire Alarm System based on the Mircom as described herein and as shown on the drawings.
- .2        On completion of the installation, the manufacturers representative shall check the system proper operation and issue an inspection certificate
- .3        The contractor shall retain an independent qualified contractor to verify the system on completion of the installation.
- .4        The complete installation shall conform to the applicable sections of ULC S524-2006 and Local Code Requirements .

**1.3                ACCEPTABLE MANUFACTURERS**

- .1        The system specified herein is based on equipment and design of Mircom Technologies Ltd. As supplied by Fire-Tech Systems Inc.

**1.4                STANDARDS**

- .1        System:
  - .1            Must comply with applicable national and/or provincial/state building codes recognized at the time of installation.
  - .2            Must comply with the ULC/CAN - S524 Fire Alarm installation standards recognized at the time of installation.
  - .3            The system verification (see section 1.6 of this specification) must comply with the CAN/ULC - S537 verification standard recognized at the time of test.
  - .4            Installation must comply with requirements of local authority having jurisdiction.
- .2        Devices and Control Equipment
  - .1            Equipment described in the following Section must be listed under the current issue of the standard indicated
  - .2            Manual Fire Alarm Stations: CAN/ULC S528
  - .3            Heat Detectors: CAN/ULC S528, UL-521
  - .4            Smoke Detectors: CAN/ULC S530, UL 268 268A
  - .5            Audible Signal Devices: CAN/ULC S525, UL-464
  - .6            Control and Related Equipment: CAN/ULC S527, UL-864

- .7 Visual Signals: UL1638
- .3 Operation and Maintenance
  - .1 Provide Data to be incorporated into the maintenance manual specified herein and including the following:
    - .1 Operation and maintenance instructions for the complete Fire Alarm system to permit its effective operation and maintenance
    - .2 Technical data and illustrated parts lists with part numbers
    - .3 A copy of the final reviewed shop drawings
  - .4 Verification
    - .1 At the completion of the installation provide two letters of certification one from the electrical sub-contractor and one from the system manufacturer's representative. Each on company letterhead and signed by an authorized officer of the company. Each letter shall indicate the following:
      - .1 The name of the system
      - .2 The name of the facility
      - .3 The correct address of the facility
      - .4 A statement that the system has been installed and that it operates in accordance with the drawings and specifications and that the system was found to be in proper operating conditions

**Part 2 Products**

**2.1 FIRE ALARM CONTROL PANEL**

- .1 System Control Unit
  - .1 Provide new fire alarm control panel to replace the existing Mircom fire alarm panel. New panel shall and addressable contain the microprocessor system operating software and non-volatile programmed memory. The unit shall be used to process all system information.

**2.2 DETECTION DEVICES**

- .1 The Electrical Subcontractor shall install new devices or relocate existing as indicated on the drawings. All audible, alarm or supervisory zones that have been altered or added to shall be reverified by an agent acceptable to the Contract Administrator. The cost of this reverification shall be included in the contract price.
- .2 The Reverification Report shall accompany the record drawings.
- .3 Provide written confirmation of monitoring or Schedule A with City of Winnipeg, where required.
- .4 All new fire alarm devices shall match existing.
- .5 Where fire alarm devices are deleted, provide red coverplate and ensure continued accessibility. Paint coverplates of all fire alarm junction boxes, this area red.
- .6 All new and/or relocated fire alarm devices shall be listed and locations shown on a separate drawing to be issued to The City.

- .7 Provide separate zone where new fire wall shown and connect to new zone on existing system.

### **Part 3 Execution**

#### **3.1 INSTALLATION SCHEDULE**

- .1 System must be complete, approved and operational for completion date or contractor could be held accountable for costs associated with late opening.
- .2 Do not commence any item of work affecting any part of the existing system until all necessary materials are on site for that item of work. Having started such an item, carry out work continuously until that portion of the system is restored to full operation.
- .3 Ensure that in no case will the voltage drop to any signal exceed 10%. Use Class B connections for all initiation circuits, Class A for signal circuits.

#### **3.2 WIRING**

- .1 Provide all necessary supply interconnecting, and remote signal wiring, in accordance with the manufacturer's wiring diagrams and the requirements of the Electrical Code and the Inspection Authority.
- .2 Provide terminal cabinets, complete with terminal blocks for wiring convenience at various junction points in the system where recommended by the manufacturer.
- .3 All conductors shall be cut at each station, detector and bell and connections shall be made in the approved manner to ensure proper supervision of the wiring. This will involve using four screws at each device.

#### **3.3 TESTING AND INSPECTION**

- .1 The manufacturer's representative shall make an inspection of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual stations, thermal and smoke-actuated detectors and controls, whether or not manufactured by the manufacturer. The inspection shall comprise an examination and test of such equipment for the following:
  - .2 That the type of equipment installed is that designated by the specifications.
  - .3 That the wiring connections to all equipment components show that the installer undertook to have observed ULC and UL requirements.
  - .4 That all products-of-combustion (smoke) detectors have been properly calibrated and adjustments set correctly.
  - .5 That equipment of the manufacturer's manufacture has been installed in accordance with the manufacturer's recommendations and that all alarm-initiating, annunciation and signaling devices of whatever manufacture have been operated or tested to verify their operation.
  - .6 That supervisory wiring of those items of equipment connected to a supervised circuit is operating and that the wiring, having been met to the satisfaction of inspecting officials.



- .7 Testing to be done in the presence of the local building inspector and local Authority Having Jurisdiction
- .8 Fire alarm system shall be verified as per CAN4-S537-2004.

END OF SECTION

## **Part 1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 03 30 00 – Cast-in-Place Concrete.

### **1.2 MEASUREMENT PROCEDURES**

- .1 Provide Lump sum price for the foundation work in accordance with the structural drawings. Indicate quantity of piles to be sleeved that are included in lump sum price. Indicate additional cost per sleeved pile exceeding sleeve allowance.
- .2 Friction Piles:
  - .1 Provide Lump sum price for the foundation work in accordance with the structural drawings.

### **1.3 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A36/A36M-05, Standard Specification for Carbon Structural Steel.
  - .2 ASTM A53/A53M-05, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .2 American Welding Society (AWS)
  - .1 AWS D1.4/D1.4M-05, Structural Welding Code - Reinforcing Steel.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-04(July 2005), Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CAN/CSA-G30.18-M92(2002), Billet Steel Bars for Concrete Reinforcement.
  - .3 CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .4 CAN/CSA-S16-01(R2007), Limit States Design of Steel Structures.
  - .5 CSA W48-01(R2006), Filler Metals and Allied Materials for Metal Arc Welding.

### **1.4 EXISTING CONDITIONS**

- .1 Sub-surface investigation report has been included as part of this specification. Contractor is to review the report and become familiar with the subsurface conditions.
- .2 Notify Engineer in writing if subsurface conditions at site differ from those indicated and await further instructions from Geotechnical Engineer.

### **1.5 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:

- .1 Indicate: size of pile, reinforcing steel and ties.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Reinforcing steel: to CAN/CSA-G30.18 and in accordance with Section 03 20 00 - Concrete Reinforcing.
- .3 Steel casing: As required and designed by installer.
- .4 Grout: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

### **2.2 SOURCE QUALITY CONTROL**

- .1 Mill report to CAN/CSA-S16.
- .2 Concrete tests: to CSA-A23.1/A23.2.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Friction Piles:
  - .1 Bore holes to diameters and lengths as indicated. The tips of the piles should not penetrate the glacial till.
  - .2 Install within 50mm of exact centres set out, 2% of vertical plumb and 25mm of required elevation. Correction of deviations beyond those defined to be at the discretion of the Engineer, costs for correction are to be borne by the Contractor.
  - .3 Remove loose material, foreign matter and water as directed by geotechnical engineer.
  - .4 Vibrate top 4500mm of each pile.
- .2 Protective steel casing:
  - .1 Install casing as required. Cost of casing shall be included in lump sum for foundation work.
  - .3 Remove stones up to 300mm in dimension, boulders over 300mm and rock in whole or in part before boring tool is deflected. If required, lower boring tool and clean hole to ensure that machine auger has reached the required depth.
  - .4 Dispose of excavated materials off site.
  - .5 Install steel reinforcement in accordance with Section 03 20 00 - Concrete Reinforcing and as indicated.

- .6 Fill pile excavations with concrete to elevations as indicated.
  - .1 Place concrete in one continuous pour in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .7 Steel protective casing may be removed at option of Contractor.
- .8 Where steel protective casing is to be removed, provide concrete with minimum slump of 125 mm and with retarder to prevent arching or setting of concrete.
  - .1 Withdraw casing in conjunction with concrete placing, keeping bottom of casing below level of concrete.
- .9 Where steel protective casing is left in place, fill void space between casing and shaft excavation with concrete.
- .10 Use tremie pipe or concrete pumping as required. Costs of tremied concrete shall be included in the lump sum for the foundation work.

### **3.2 PROTECTION**

- .1 If superimposed work is to be placed later, protect top of each unit with at least 150mm of damp sand.

### **3.3 DEFECTIVE PILES**

- .1 Cased concrete shaft piles rejected where:
  - .1 Soil has entered casing.
  - .2 Water has entered casing.
  - .3 Casing is damaged, out of tolerance or alignment.
- .2 Defective Friction Piles:
  - .1 Leave rejected pile in place, place adjacent pile and modify pile cap as directed in writing by Engineer.
  - .2 No extra compensation will be made for additional piles and other costs due to installation of damaged or defective piles.

### **3.4 SAFETY**

- .1 Conform to the latest regulations of the Provincial Building Protection Act and Provincial Building Code and provide all necessary safety equipment required.

### **3.5 FIELD QUALITY CONTROL**

- .1 Independent review of friction piling operations shall be done by an independent inspection and testing agency under a cash allowance and retained by the City.
- .2 Maintain accurate records for each pile installation, including:
  - .1 Pile size and length, location of pile.
  - .2 Location.
  - .3 Top of Pile Elevation.

- .4 Bearing Condition.
  - .5 Bearing Capacity.
  - .6 Presence of Water.
  - .7 Other pertinent information.
- .3 Provide Engineer with three copies of records.

### **3.6 CLEANING**

- .1 Proceed in accordance with Section 01 74 00 – Project Clean-Up.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**