

**THIS DOCUMENT CONTAINS A SECURITY REQUIREMENT / DOCUMENT
CONTIENT DES EXIGENCES RELATIVES À LA SÉCURITÉ**

DEPARTMENT OF NATIONAL DEFENCE

**REAL PROPERTY OPERATIONS UNIT
DETACHMENT TRENTON**



SPECIFICATION

HANGAR 6 FIT-UP FOR SQUADRON OFFICES

8 Wing Trenton

PF# 500006755

Job No: L-T81-3019/2

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SPECIFICATIONS: NMS

<u>Division</u>	<u>Section</u>	<u>No. of Pages</u>

Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

Section 00 01 10 - Table of Contents.....	8

Division 01 - GENERAL REQUIREMENTS

Section 01 11 00 - Summary of Work.....	4
Section 01 14 00 - Work Restrictions.....	4
Section 01 21 00 - Allowances.....	1
Section 01 29 83 - Payment Procedures for Testing Laboratory Services	2
Section 01 31 19 - Project Meetings.....	3
Section 01 32 16.16 - Construction Progress Schedule - (CPM).....	13
Section 01 32 16.19 - Construction Progress Schedule - (GANTT).....	5
Section 01 33 00 - Submittal Procedures.....	4
Section 01 35 15 - Industrial Security.....	8
Section 01 35 27 - Special Procedures.....	2
Section 01 35 35 - DND Fire Safety Requirements.....	8
Section 01 35 43 - Environmental Procedures.....	6
Section 01 41 00.01 - Quality Management System (QMS).....	12
Section 01 45 00 - Quality Control.....	4
Section 01 51 00 - Temporary Utilities.....	3
Section 01 52 00 - Construction Facilities.....	4
Section 01 56 00 - Temporary Barriers and Enclosures.....	3
Section 01 61 00 - Common Product Requirements.....	6
Section 01 70 12 - Safety Requirements.....	4
Section 01 74 00 - Cleaning.....	3
Section 01 74 19 - Waste Management and Disposal.....	3
Section 01 77 00 - Closeout Procedures.....	2
Section 01 78 00 - Closeout Submittals.....	9
Section 01 79 00 - Demonstration and Training.....	2
Section 01 91 13 - General Commissioning (Cx) Requirements.....	11
Section 01 91 13.13 - Commissioning (Cx) Plan.....	12
Section 01 91 33 - Commissioning Forms.....	3
Section 01 91 41 - Commissioning Training.....	4

Division 02 - EXISTING CONDITIONS

Section 02 41 00.08 - Demolition - Minor Works	5
Section 02 41 19.16 - Selective Interior Demolition.....	12

Division 03 - CONCRETE

Section 03 10 00 - Concrete Forming and Accessories	4
Section 03 20 00 - Concrete Reinforcing	5
Section 03 30 00.01 - Cast-in-place Concrete	6
Section 03 35 00 - Concrete Finishing	5

Division 5 - METALS

Section 05 12 23 - Structural Steel for Buildings.....	6
Section 05 50 00 - Metal Fabrications.....	7

Division 6 - WOODS AND PLASTICS

Section 06 08 99 - Rough Carpentry for Minor Works.....	5
Section 06 40 00 - Architectural Woodwork.....	13

Division 07 - THERMAL AND MOISTURE PROTECTION

Section 07 21 16 - Blanket Insulation.....	4
Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.....	9
Section 07 62 00 - Sheet Metal Flashing and Trim.....	7
Section 07 81 00 - Applied Fireproofing.....	6
Section 07 84 00 - Fire Stopping.....	7
Section 07 92 00 - Joint Sealant.....	10

Division 08 - DOORS AND WINDOWS

Section 08 11 00 - Metal Doors and Frames	10
Section 08 11 16 - Aluminum Doors and Frames	7
Section 08 14 16 - Flush Wood Doors	5
Section 08 71 10 - Door Hardware.....	9
Section 08 80 00 - Glazing.....	8

Division 09 - FINISHES

Section 09 21 16 - Gypsum Board Assemblies	11
Section 09 22 16 - Non-Structural Metal Framing	8
Section 09 30 13 - Ceramic Tiling	10
Section 09 51 13 - Acoustical Panel Ceilings	10
Section 09 65 19 - Resilient Tile Flooring	8
Section 09 68 13 - Tile Carpeting	12
Section 09 77 20 - Fibre Reinforced Panels	6

Section 09 91 23 - Interior Painting	19

Division 10 - SPECIALTIES

Section 10 14 10 - Signage	6
Section 10 21 13.19 - Plastic Toilet Compartments	6
Section 10 28 00 - Toilet and Bath Accessories	7
Section 10 51 13 - Metal Lockers.....	5

Division 11 - EQUIPMENT

Section 11 23 00 - Commercial Laundry Equipment	5
Section 11 81 29 - Facilities Fall Protection	6

Division 12 - SPECIALTIES

Section 12 20 00 - Window Treatments	6

Division 21 - FIRE SUPPRESSION

Section 21 05 05 - Common Work Results for Fire Suppression.....	6
Section 21 13 13 - Wet Pipe Sprinkler Systems.....	12

Division 22 - PLUMBING

Section 22 05 00 - Common Work Results for Plumbing.....	5
Section 22 11 16 - Domestic Water Piping.....	7
Section 22 13 17 - Drainage Waste and Vent Piping - Cast Iron and Copper	3
Section 22 42 01 - Plumbing Specialties and Accessories.....	7
Section 22 42 03 - Commercial Washroom Fixtures.....	5
Section 22 42 16 - Commercial Lavatories and Sinks.....	3

Division 23 - HEATING, VENTILATING AND AIR CONDITIONING

Section 23 05 00 - Common Work Results for HVAC.....	6
Section 23 05 01 - Use of HVAC Systems During Construction.....	2
Section 23 05 05 - Installation of Pipework.....	6
Section 23 05 23.01 - Valves - Bronze.....	4
Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment	9
Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment	6
Section 23 05 49.01 - Seismic Restraint System (SRS) - Type P2 Buildings	7

Section 23 05 53.01 - Mechanical Identification.....	7
Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.....	6
Section 23 05 54 - Pressure Testing of Ducted Air Systems.....	4
Section 23 07 13 - Duct Insulation.....	7
Section 23 07 15 - Thermal Insulation for Piping.....	8
Section 23 08 01 - Performance Verification Mechanical Piping Systems	3
Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems	5
Section 23 11 23 - Facility Natural Gas Piping.....	6
Section 23 21 13.01 - Hydronic Systems Copper.....	7
Section 23 21 14 - Hydronic Specialties.....	5
Section 23 21 23 - Hydronic Pumps.....	6
Section 23 23 00 - Refrigerant Piping.....	6
Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.....	6
Section 23 33 00 - Air Duct Accessories.....	5
Section 23 33 14 - Dampers - Balancing.....	3
Section 23 33 16 - Dampers - Fire and Smoke.....	5
Section 23 33 46 - Flexible Ducts.....	3
Section 23 33 53 - Duct Liners.....	5
Section 23 36 00 - Air Terminal Units.....	4
Section 23 37 13 - Diffusers, registers and Grilles.....	3
Section 23 51 00 - Breechings, Chimneys and Stacks.....	5
Section 23 57 00 - Heat Exchangers for HVAC.....	7
Section 23 65 10 - Condensers, Coolers and Cooling Towers.....	7
Section 23 73 10 - Air Handling - Built-up.....	8
Section 23 82 36 - Finned Tube Radiation Heaters.....	4
Section 23 83 13 - Humidifiers.....	6

Division 25 - INTEGRATED AUTOMATION

Section 25 01 11 - EMCS: Start-Up Verification and Commissioning.....	7
Section 25 01 12 - EMCS: Training.....	3
Section 25 05 01 - EMCS: General Requirements.....	9
Section 25 05 02 - EMCS: Submittals and Review Process.....	4
Section 25 05 03 - EMCS: Project Record Documents.....	4
Section 25 05 54 - EMCS: Identification.....	3
Section 25 05 60 - EMCS: Field Installation.....	10
Section 25 08 20 - EMCS: Warranty and Maintenance.....	4
Section 25 10 01 - EMCS: Local Area Network (LAN).....	3
Section 25 30 01 - EMCS: Building Controllers.....	12
Section 25 30 02 - EMCS: Field Control Devices.....	18
Section 25 90 01 - EMCS: Sire Requirements, Applications and Systems Sequence of Operation.....	1

Division 26 - ELECTRICAL

Section 26 05 00 - Common Work Results for Electrical.....	8
Section 26 05 05 - Selective Demolition for Electrical.....	5
Section 26 05 20 - Wire and Box Connectors (0-1000 V).....	3
Section 26 05 21 - Wires and Cables (0-1000 V).....	4
Section 26 05 28 - Grounding - Secondary.....	4
Section 26 05 29 - Hangers and Supports Electrical Systems.....	3
Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.....	2
Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.....	3
Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.	4
Section 26 09 24 - Lighting Control Devices - Low Voltage.....	4
Section 26 09 43 - Network Lighting Controls.....	6
Section 26 22 19 - Control and Signal Transformers.....	3
Section 26 24 01 - Service Equipment.....	2
Section 26 24 16.01 - Panelboards Breaker type.....	4
Section 26 27 26 - Wiring Devices.....	4
Section 26 28 13.01 - Fuses - Low Voltage.....	2
Section 26 28 16.02 - Moulded Case Circuit Breakers.....	3
Section 26 28 23 - Disconnect Switches - Fused and Non-Fused.....	3
Section 26 29 01 - Contactors.....	3
Section 26 29 03 - Control Devices.....	3
Section 26 50 00 - Lighting.....	3
Section 26 52 13.16 - Exit Signs.....	2

Division 27 - COMMUNICATIONS

Section 27 01 10 - RDS.....	9
Section 27 05 00 - Common Works Results for Communications.....	3
Section 27 05 26 - Bonding and Grounding for Communications.....	6
Section 27 05 28 - Pathways for Communications.....	10
Section 27 51 16 - Public Address and Mass Notification Systems.....	6

Division 28 - ELECTRONIC SAFETY AND SECURITY

Section 28 10 00 - Access Control System.....	26
Section 28 16 00 - Intrusion Alarm System.....	30
Section 28 46 00 - Fire Detection and Alarm.....	10

APPENDICES

Annex A - Hangar 6 Fit-Up Project Parking Laydown CNSLT

Annex B - Hangar 6 CAT 6 Networks Design & Installation Tips

Annex C - Canadian Forces Fire Marshal Directive FMD 4005

DRAWING LIST

000 - COVER PAGE

001 - DRAWING LIST

201 - ROOF FRAMING PLANS & DETAILS FOR MECHANICAL FIT-UP

202 - 2ND FL. FRAMING PLANS & DETAILS FOR MECHANICAL FIT-UP

301 - SCHEDULES

302 - FIRE SEPARATION PLAN

303 - SECOND FLOOR DEMOLITION PLAN

304 - SECOND FLOOR RCP DEMOLITION - AREA 'A'

305 - SECOND FLOOR NEW CONSTRUCTION PLAN - AREA 'A'

306 - SECOND FLOOR NEW CONSTRUCTION PLAN - AREA 'B'

307 - SECOND FLOOR NEW CONSTRUCTION PLAN - AREA 'C'

308 - SECOND FLOOR NEW CONSTRUCTION RCP - AREA 'A'

309 - SECOND FLOOR NEW CONSTRUCTION RCP - AREA 'B'

310 - SECOND FLOOR NEW CONSTRUCTION RCP - AREA 'C'

311 - SECOND FLOOR FINISHES PLAN

312 - DETAILED PLAN; INTERIOR ELEVATIONS; MILLWORK DETAILS

313 - DETAILS

314 - DETAILS

315 - ENVELOPE DETAILS

401 - LEGENDS AND KEYPLAN

402 - FIRST LEVEL OVERHEAD PLUMBING PLAN

403 - SECOND LEVEL PLUMBING PLAN

404 - SECOND LEVEL HVAC DEMOLITION PLAN	
405 - SECOND LEVEL HVAC CONSTRUCTION PLAN	
406 - SECOND LEVEL HYDRONIC DEMOLITION PLAN	
407 - SECOND LEVEL HYDRONIC CONSTRUCTION PLAN	
408 - HVAC ROOF CONSTRUCTION PLAN	
409 - SECOND LEVEL SPRINKLER DEMOLITION PLAN	
410 - SECOND LEVEL SPRINKLER CONSTRUCTION PLAN	
411 - MECHANICAL SCHEDULES	
501 - ELECTRICAL LEGENDS AND KEYPLAN	
502 - LIGHTING DEMOLITION PLAN	
503 - LIGHTING CONSTRUCTION PLAN	
504 - POWER DEMOLITION PLAN	
505 - POWER CONSTRUCTION PLAN	
506 - POWER CONSTRUCTION PLAN	
507 - ELECTRICAL DETAILS 1 OF 2	
508 - SINGLE LINE DIAGRAMS AND ELECTRICAL DETAIL 2 OF 2	
509 - ELECTRICAL PANEL LEGENDS	
510 - MECHANICAL EQUIPMENT SCHEDULE & ELECTRICAL DETAIL	
701 - LEGENDS AND KEYPLAN	
702 - COMMUNICATIONS CABLE TRAY	
703 - UTP CATEGORY 6 LOCATIONS AND CONDUIT PATHWAYS	
704 - RDS DISTRIBUTION SYSTEM LOCATIONS AND CONDUIT PATHWAYS	
705 - TELECOM ROOM RACK LAYOUTS	
706 - RISER DIAGRAM - PUBLIC ADDRESS SYSTEM	
707 - PUBLIC ADDRESS SYSTEM	

801 - FIRE ALARM DEMOLITION PLAN
802 - FIRE ALARM CONSTRUCTION PLAN
803 - SECURITY SYSTEM DESIGN LEGEND AND GENERAL NOTES
804 - SECURITY COMPONENT LAYOUT INTRUSION
805 - SINGLE LINE DIAGRAM & SCHEDULE INTRUSION
806 - DOOR ELEVATIONS INTRUSION
807 - DOOR ELEVATIONS INTRUSION
808 - BACKBOARD ELEVATION INTRUSION
809 - SECURITY COMPONENT LAYOUT ACCESS CONTROL
810 - DOOR ELEVATIONS ACCESS CONTROL
811 - SINGLE LINE DIAGRAM AND SCHEDULE ACCESS CONTROL
812 - SECOND LEVEL SPRINKLER DEMOLITION PLAN
813 - SECOND LEVEL SPRINKLER CONSTRUCTION PLAN

END OF SECTION

Part 1 General**1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- .1 Work of this Contract comprises the fitting up of existing interior office and vacant suite located on the second floor of Hangar 6 at 8 Wing CFB Trenton, Trenton, Ontario.
- .2 The specific areas of work are identified as areas A (existing office space), B (partially finished suite) and C (partially finished suite).
- .3 Operations for a portion of Area C will need to be maintained throughout the duration of construction and will require phasing and relocation of specific rooms throughout construction.
 - .1 Final scheduling and logistics are to be coordinated with the DCC Representative after award of Contract.
 - .2 Intended phasing to meet operational requirements area as follows:
 - .1 Existing Pilot Planning Area Rm 2151 in Area C is to be maintained while Area A and B is refitted.
 - .2 Upon completion of Area A and partial occupancy, Pilot Planning is to be relocated from Area C to Area A, Rm 2026.
 - .3 Area C to be completed after Relocation of Pilot Planning.
 - .1 All partially occupied floor areas to be separated from construction areas with a 1hr fire rated and dust tight assembly per Canadian Forces Fire Marshal Directive FMD 4005 Partial Occupancy.
- .4 Construct Work under single lump sum contract.

1.2 WORK SEQUENCE

- .1 Construct Work in stages to accommodate DCC's continued use of premises during construction.
- .2 Co-ordinate Progress Schedule and co-ordinate with DCC Occupancy during construction.
- .3 Construct Work in stages to provide for continuous usage. Do not close off public usage of facilities until use of one stage of Work will provide alternate usage.
- .4 Maintain fire access/control.

1.3 CONTRACTOR USE OF PREMISES

- .1 DND will occupy portions of the building during construction. Delineate work areas under construction.
- .2 Co-ordinate use of premises under direction of DCC Representative.
- .3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .4 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .5 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by DCC Representative.
- .6 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.4 OWNER OCCUPANCY

- .1 Co-operate with DCC Representative in scheduling operations and interruptions to services to minimize conflict and to facilitate DCC usage.

1.5 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building operations and occupants, and normal use of premises. Arrange with DCC Representative to facilitate execution of work.

1.6 EXISTING SERVICES

- .1 Notify, DCC Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give 5 business day notice to DCC Representative for necessary interruptions of mechanical or electrical service throughout course of work. Identify planned interruptions on work plan schedule, update as required. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to DCC operations.
- .3 Establish location and extent of service lines in area of work before starting Work. Notify DCC Representative of findings.
- .4 Submit schedule to and obtain approval from DCC Representative for any shut-down or closure of active

service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

- .5 Provide temporary services when directed by Consultant to maintain critical building and tenant systems.
- .6 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .7 Where unknown services are encountered, immediately advise DCC Representative and confirm findings in writing.
- .8 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .9 Record locations of maintained, re-routed and abandoned service lines.
- .10 Construct barriers in accordance with Section 01 56 00-Temporary Barriers and Enclosures.

1.7 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy of each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.
 - .10 Health and Safety Plan and Other Safety Related Documents.
 - .11 Other documents as specified.

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 SECTIONS**

- .1 Section 01 32 16.19 - Construction Progress Schedules - Bar (GANTT) Chart.
- .2 Section 01 35 15 - Industrial Security.
- .3 Section 01 56 00 - Temporary Barriers and Enclosures.

1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with DCC Representative to facilitate work.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work, provide temporary means to maintain security.
- .4 Carry out work during regular work hours Monday to Friday from 0700 to 1530 hours. Contractor to make allowances for after-hours work as required.
- .5 Accept liability for damage, safety of equipment and overloading of existing equipment.
- .6 Closures: Protect work temporarily until permanent enclosures are completed.

1.3 CONTRACTOR USE OF PREMISES

- .1 Coordinate use of premises under direction of DCC Representative.
- .2 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

1.4 OWNER OCCUPANCY

- .1 Owner will occupy the First Floor of Hangar 6 and the Lunch Room 2062, Room 2051, and Locker Rooms 2052-2054 in the Middle section of the Second Floor during the entire construction period for execution of normal operations.
- .2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage. Contractor to make allowances for after-hours work as required.

1.5 EXISTING SERVICES

- .1 Notify DCC Site Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give DCC Site Representative 10 business days for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.
- .3 Conduct DND RP Ops work permit. Identify and locate all existing utility services present on construction site before starting work.
- .4 Submit schedule to and obtain approval from DCC Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .5 Provide temporary services when directed by DCC Representative to maintain critical building and tenant systems.

1.6 SPECIAL REQUIREMENTS

- .1 Deliver materials during hours 0700 to 1530 as approved by DCC Representative.
- .2 Smoking is NOT permitted on premises.
- .3 Area of work is on an active air base. Do not disrupt airport business except as permitted by DCC Representative.

1.7 CONTROL OF FOREIGN OBJECT DAMAGE (FOD)

- .1 Since the designated laydown area is adjacent to active airfield areas, the control of debris that causes FOD is critical.
- .2 The Contractor shall be responsible to keep this area clear of dirt and debris at all times. Inspect the area regularly and remove any debris found.
- .3 Failure to keep active areas free of debris to the satisfaction of the DCC & ATC Flight /OSS Representatives will result in shut-down of all construction activities until the situation is rectified.

1.8 FOD CONTROL PLAN

- .1 Foreign Object Damage (FOD) control procedures shall be enforced by the DCC Representative at all times in the construction and adjacent operational area(s). Keeping active runways, taxiways and aprons adjacent to the work clean during the Work shall be the responsibility of the Contractor.
- .2 The contractor shall submit a FOD Control Plan (FCP) to the DCC Representative for approval at least 14 calendar days prior to the start of work on-site. On-site work cannot start until the FCP is approved.
 - .1 The purpose of the Contractor's FCP is to assist the Contractor in demonstrating to the DCC Representative they have understood their responsibilities in managing FOD related issues throughout the project.
 - .2 The FCP shall address all aspects of how the Contractor will manage FOD control during the project, including which equipment they will be using and who will be the Contractor's designated person in charge of FOD control.
- .3 Site FOD sweeps shall be conducted as needed and when directed by the DCC Representative.

1.9 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.10 ALTERATIONS, ADDITONS OR REPAIRS TO EXISITNG BUILDING

- .1 Execute work with least possible interference or disturbance to occupants, building operations and normal use of premises. Arrange with DCC Representative to facilitate execution of work.

1.11 RESTRICTED OR SECURE AREA

- .1 Any area to which access is restricted by sign and/or monitored is a secure or restricted area.
- .2 Be responsible for construction personnel and vehicles employed on project and requiring access to restricted areas.

1.12 EVACUATION

- .1 The Contractor shall be required to abandon and evacuate the work site as directed, should an emergency situation be declared by DND.

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 CASH ALLOWANCES**

- .1 Include in Contract Price specified cash allowances.
- .2 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage, installation and other authorized expenses incurred in performing Work.
- .3 Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- .4 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
- .5 Include progress payments on accounts of work authorized under cash allowances in monthly certificate for payment.
- .6 List the amount of each allowance, for each work specified in each respective specification Section as follows:
 - .1 Section 28 16 00 Intrusion Alarm System include allowance of \$15,000 for purchase and installation of additional intrusion alarms.

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 REQUIREMENTS SPECIFIED ELSEWHERE

- .1 Particular requirements for inspection and testing to be carried out by testing laboratory designated by DCC Representative are specified under various sections.

1.2 APPOINTMENT AND PAYMENT

- .1 DCC Representative will appoint and pay for services of testing laboratory except as follows:
 - .1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
 - .2 Testing, adjusting and balancing of mechanical and electrical equipment and systems.
 - .3 Inspection and testing performed exclusively for Contractor's convenience.
 - .4 Mill tests and certificates of compliance.
 - .5 Compaction Testing
 - .6 Construction Dewatering Testing
 - .7 Tests specified to be carried out by Contractor under the supervision of DCC Representative.
- .2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by DCC Representative to verify acceptability of corrected work.

1.3 CONTRACTOR'S RESPONSIBILITIES

- .1 Provide labour, equipment and facilities to:
 - .1 Provide access to Work to be inspected and tested.
 - .2 Facilitate inspections and tests.
 - .3 Make good Work disturbed by inspection and test.
 - .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.
- .2 Notify DCC Representative sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.

- .4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by DCC 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 ADMINISTRATIVE**

- .1 DCC Representative will schedule and administer project meetings throughout the progress of the work.
- .2 DCC Representative will prepare agenda for meetings.
- .3 Provide physical space and make arrangements for meetings.
- .4 DCC Representative will preside at meetings.
- .5 DCC Representative will record the meeting minutes. Significant proceedings and decisions will be included. Actions by parties will be identified.
- .6 DCC Representative will reproduce and distribute copies of minutes within 5 days after meetings and transmit to meeting participants and, affected parties not in attendance.
- .7 Representative of Contractor, Subcontractor and suppliers attending meetings will be mandatory. Coordination of attendance will be verified by DCC representative 48 hours prior to the meeting date, or predetermined schedule.

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, DCC Representative will arrange a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Senior DCC Representatives, DCC Coordinator Construction Services, Consultant, Contractor, major Subcontractors and Contractor's field inspectors and supervisors will be in attendance.
- .3 DCC Representative will establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM) and Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart.

- .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Requirements for temporary facilities, offices, storage sheds, utilities, fences in accordance with Section 01 52 00 - Construction Facilities.
- .5 Delivery schedule of specified equipment.
- .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
- .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .10 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00 - Closeout Submittals.
- .11 Monthly progress claims, administrative procedures, photographs, hold backs.
- .12 Appointment of inspection and testing agencies or firms.
- .13 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 During course of Work and 2 weeks prior to project completion, progress meetings will be held every 14 days.
- .2 Contractor, major Subcontractors involved in Work and DCC Representative, are to be in attendance.
- .3 Parties will be notified a minimum of 5 days prior to meetings.
- .4 DCC Representative will record minutes of meetings and circulate to attending parties and affected parties not in attendance within 5 days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.

- .6 Corrective measures and procedures to regain projected schedule.
- .7 Revision to construction schedule.
- .8 Progress schedule, during succeeding work period.
- .9 Review submittal schedules: expedite as required.
- .10 Maintenance of quality standards and Contractor's Construction Quality Plan.
- .11 Review proposed changes for affect on construction schedule and on completion date.
- .12 Other business.

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 Project Management Institute (PMI Standards)
 - .1 A Guide to the Project Management Body of Knowledge (PMBOK Guide) - Fifth Edition.
 - .2 Practice Standard for Scheduling - 2019.

1.2 DEFINITIONS

- .1 Activity: Distinct, scheduled portion of work performed during course of a project.
- .2 Activity Duration: time in calendar units between start and finish of a scheduled activity. See also Duration.
- .3 Assumption: factor in planning process that is considered true, real, or certain without proof or demonstration.
- .4 Bar Chart (Gantt Chart): graphic display of schedule-related information.
 - .1 In typical bar chart, schedule activities or work breakdown structure components are listed down left side of chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.
- .5 Baseline: approved version of a work product that can be changed only through formal change control procedures and is used as a basis for comparison.
- .6 Budget: approved estimate for a project or work breakdown structure component or schedule activity.
- .7 Cash Flow: projection of progress payment requests based on cash loaded construction schedule.
- .8 Change Control: process whereby modifications to documents, deliverables, or baselines associated with a project are identified, documented, approved, or rejected.
- .9 Completion Milestones: they are firstly Substantial Completion and secondly Final Certificate.
- .10 Constraint: scheduled limiting factor that effects execution of a project, program, portfolio, or process.
- .11 Contract: mutually binding agreement that obligates a seller to provide a specified product or service or result and obligates a buyer to pay for it.

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- .12 Control: comparing actual performance with planned performance, analyzing variance, assessing trends, to effect process improvements, evaluating possible alternatives, and recommending appropriate corrective action as needed.
 - .13 Corrective Action: intentional activity that realigns performance of project work with project management plan.
 - .14 Critical Path: sequence of activities that represents longest path through a project, which determines shortest possible duration.
 - .15 Critical Path Activity: activity on critical path in a project schedule.
 - .16 Critical Path Method (CPM): method used to estimate minimum project duration and determine amount of scheduling flexibility on logical network of paths within schedule model.
 - .17 Data Date: point in time when the status of the project is recorded.
 - .18 Decomposition: technique used for dividing and subdividing project scope and project deliverables into smaller, more manageable parts.
 - .19 Deliverable: unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project.
 - .20 Duration: total number of work periods (not including holidays or other non-working periods) required to complete a schedule activity or work breakdown structure component.
 - .1 Usually expressed as workdays or work weeks.
 - .21 Early Finish Date (EF): in Critical Path Method, earliest possible point in time when uncompleted portions of schedule activity can finish based on schedule network logic, data date, and schedule constraints.
 - .1 Early finish dates can change as Project progresses and changes are made to Project plan.
 - .22 Early Start Date (ES): in Critical Path Method, earliest possible point in time when uncompleted portions of a schedule activity can start based on schedule network logic, data date, and schedule constraints.
 - .1 Early start dates can change as Project progresses and changes are made to Project Plan.

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- .23 Execute: directing, managing, performing, and accomplishing project work; providing deliverables, and providing work performance information.
 - .24 Finish Date: point in time associated with a schedule activity's completion.
 - .1 Usually qualified by one of following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.
 - .25 Float: (also known as slack) amount of time a schedule activity can be delayed without delaying early start date of a successor or violating a schedule constraint.
 - .1 This resource is available to both DCC and Contractor.
 - .26 Forecast: estimate or prediction of conditions and events in project future based on information and knowledge available at time of forecast.
 - .1 Information is based on projects past performance and expected future performance, and includes information that could impact project in future, a such as estimate at completion and estimate to complete.
 - .27 Gantt Chart: see Bar Chart.
 - .28 Impact Analysis: schedule analysis technique that adds a modeled delay to an accepted construction schedule to determined possible outcome of that delay on project completion.
 - .29 Imposed Date: a fixed date imposed on a schedule activity or schedule milestone, usually in form of a "start no earlier than" and "finish no later than" date.
 - .30 Lag: amount of time whereby a successor activity is required to be delayed with respect to a predecessor activity.
 - .31 Late Finish Date (LF): in critical path method, latest possible point in time when uncompleted portions of a schedule activity can finish based on schedule network logic, project completion date, and schedule constraints.
 - .32 Late Start Date (LS): in critical path method, latest possible point in time when uncompleted portions of a schedule activity can start based on schedule network logic, project completion date, and schedule constraints.
 - .33 Lead: amount of time whereby a successor activity can be advanced with respect to a predecessor activity.
 - .34 Logic Diagram: see Project network diagram.

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- .35 Logical Relationship: dependency between two activities or between an activity and a milestone.
 - .36 Master Schedule: summary-level schedule that identifies major deliverable; work breakdowns structure components, and key schedule milestones.
 - .37 Milestone: significant point or event in a project, program, or portfolio.
 - .38 Monitor: collect project performance data with respect to a plan, procedure performance measures, and report and - disseminate performance.
 - .39 Network: see Project Schedule Network Diagram.
 - .40 Non-Critical Activities: activities which when delayed, do not affect specified Contract duration.
 - .41 Project Control System: fully computerized system utilizing commercially available software packages.
 - .42 Project Management: application of knowledge, skills, tools, and techniques, to project activities to meet project requirements.
 - .43 Project Management Plan: approved document that describes how project will be executed, monitored, and controlled.
 - .1 Primary uses of Project management plan are to document planning assumptions and decisions, facilitate communication among stakeholders, and document approved scope, cost, and schedule baselines.
 - .2 Project management plan may be summary or detailed.
 - .44 Project Management Planning: development and maintenance of Project Management Plan.
 - .45 Project Management Planning, Monitoring and Control System: overall system operated to enable monitoring of Project Work in relation to established milestones.
 - .46 Project Schedule: planned dates for performing activities and planned dates for meeting milestones.
 - .47 Project Schedule Network Diagram: graphical representation of logical relationships among project schedule activities.
 - .1 Always drawn from left to right to reflect Project chronology.
 - .48 Project Scope: work performed to deliver a product, service, or result with specified features and functions.
 - .49 Quantified days duration: working days based on 5 day work week, discounting statutory holidays.

- .50 Risk: uncertain event or condition that, if it occurs, has positive or negative effect on one or more project objectives.
- .51 Schedule: see Project Schedule.
- .52 Schedule Data: collection of information for describing and controlling schedule.
- .53 Scope: see Project Scope.
- .54 Start Date: point in time associated with activity's start, usually qualified by one of following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.
- .55 Work Breakdown Structure (WBS): hierarchical decomposition of total scope of work to be carried out by project team to accomplish project objectives and create the required deliverables.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Ensure that planning process is iterative and results in generally top-down processing with more detail being developed as planning progresses, and decisions concerning options and alternatives are made.
 - .2 Ensure project schedule efficiencies through monitoring of project in detail to ensure integrity of Critical Path, by comparing actual completions of individual activities with their scheduled completions, and review progress of activities that has started but are not yet completed.
 - .3 Monitor sufficiently often so that causes of delays can immediately be identified and mitigated.
- .2 Project monitoring and reporting:
 - .1 Keep team aware of changes to schedule, and potential consequences as project progresses.
 - .2 Use narrative reports to provide advice on seriousness of challenges and measures to overcome them.
 - .3 Begin narrative reporting with statement on general status of project followed by summarization of delays, potential problems, corrective measures and project status criticality.
- .3 Critical Path Method (CPM) Requirements:
 - .1 Ensure Master Plan and Detail Schedule are practical and remain within specified contract duration.

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- .2 Revise Master Schedule and Detail Schedule deemed impractical by DCC Representative and resubmit for approval.
 - .3 Change to Contract Duration:
 - .1 Acceptance of Master Schedule and Detail Schedule showing scheduled Contract duration shorter than specified Contract duration does not constitute change to Contract.
 - .2 Duration of Contract may only be changed through bilateral Agreement.
 - .4 Consider Master Schedule and Detail Schedule deemed practical by DCC Representative, showing Work completed in less than specified Contract duration, to have float.
 - .5 First Milestone on Master Schedule and Detail Schedule will identify start Milestone with an Early Start, "ES", constraint date equal to Award of Contract date.
 - .6 Calculate dates for completion of milestones from Plan and Schedule using specified time periods for Contract.
 - .7 Substantial Completion with Late Finish, "LF", constraint equal to calculated date.
 - .8 Calculations on updates such that if early finish of Substantial Completion falls later than specified Contract duration then float calculation to reflect negative float.
 - .9 Delays to non-critical activities with float may not be basis for time extension.
 - .10 Do not use float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times or imposed dates other than required by Contract.
 - .11 Allow for adverse weather conditions normally anticipated and show in Master Plan and Detail Schedule.
 - .1 Specified Contract duration has been predicated assuming normal amount of adverse weather conditions.
 - .12 Provide necessary crews and manpower to meet schedule requirements for performing Work within specified Contract duration.
 - .1 Simultaneous use of multiple crews on multiple fronts on multiple critical paths may be required.

- .13 Arrange participation on and off site of subcontractors and suppliers, as required by DCC Representative, for purpose of network planning, scheduling, updating and progress monitoring.
 - .1 Approvals by DCC Representative of original networks and revisions do not relieve Contractor from duties and responsibilities required by Contract.
- .14 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Substantial Completion and Final Certificate as defined times of completion are of essence of this contract.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to DCC Representative, within 21 days after the award of contract, Project Control System for planning, scheduling, monitoring and reporting of project progress.
- .3 Submit Project Control System to DCC Representative for approval; failure to comply with each required submission, may result in progress payment being withheld.
- .4 Include costs for execution, preparation and reproduction of schedule submittals in bid documents.
- .5 Submit letter ensuring that schedule has been prepared in co-ordination with major sub- contractors.
- .6 Refer to article "Progress monitoring and reporting" of this specification Section for frequency of Project control system submittals.
- .7 Submit to DCC Representative Project planning, monitoring and control system data as part of initial schedule submission and monthly status reporting as in the following form.
 - .1 Electronic files in original scheduling software containing schedule and cash flow information, labelled with data date, specific update, and person responsible for update. Master Plan Bar Chart.
 - .2 Construction Detail schedule Bar Chart.
 - .3 Listing of project activities including milestones and logical connectors, networks (sub- networks) from Project start to end. Sort activities by activity identification number and accompany with descriptions.

List early and late start and finish dates together with durations, codes and float.

- .4 Criticality report listing activities and milestones with up to 5 days total float used as first sort for ready identification of critical or near critical paths through entire project. List early and late starts and finishes dates, together with durations, codes and float for critical activities.
- .5 Progress report in early start sequence, listing for each trade, activities due to start, underway, or finished within two months from monthly update date. List activity identification number, description and duration. Provide columns for entry of actual start and finish dates, duration remaining and remarks concerning action required.

1.5 QUALITY ASSURANCE

- .1 Use experienced personnel, fully qualified in planning and scheduling to provide services from start of construction to Final Certificate, including Commissioning.

1.6 WORK BREAKDOWN STRUCTURE (WBS)

- .1 Prepare and submit to DCC Representative construction Work Breakdown Structure (WBS) within 10 working days of Award of Contract date.
 - .1 Develop WBS through at least 5 levels: Project, stage, element, sub-element and work package.

1.7 PROJECT MILESTONES

- .1 Mandatory and recommended project milestones form targets for both Master Schedule and Detail Schedule of CPM construction network system.
 - .1 Award of Contract.
 - .2 Site Mobilization completed.
 - .3 Phasing of work activities between construction areas A, B and C.
 - .4 Partial Occupancy dates for phased work for areas A, B and C.
 - .5 Demolition completed for areas A, B and C.
 - .6 Finishing and fitting, Mechanical, and Electrical work completed for areas A, B and C.
 - .7 Finishing and fitting, Architectural work completed for areas A, B and C.
 - .8 Interim Certificate (Substantial Completion).

1.8 MASTER PLAN

- .1 Structure and base CPM construction networks system on WBS coding in order to ensure consistency throughout Project.
- .2 Prepare comprehensive construction Master Plan (CPM logic diagram) and dependent Cash Flow Projection within 15 working days of finalizing Agreement to confirm validity or alternates of identified milestones.
 - .1 Master Plan will be used as baseline.
 - .1 Revise baseline as conditions dictate and as required by DCC Representative.
 - .2 DCC Representative will review and return revised baseline within 10 workdays.
- .3 Reconcile revisions to Master Plan and Cash Flow Projections with previous baseline to provide continuous audit trail.
- .4 Initial and subsequent Master Plans will include:
 - .1 USB Drive containing schedule and cash flow information, clearly labelled with data date, specific update, and person responsible for update.
 - .2 Bar chart identifying coding, activity durations, early/late and start/finish dates, total float, completion as percentile, current status and budget amounts.
 - .3 Network diagram showing coding, activity sequencing (logic), total float, early/late dates, current status and durations.
 - .4 Actual/projected monthly cash flow: expressed monthly and shown in both graphical and numerical form.

1.9 DETAIL SCHEDULE

- .1 Provide detailed project schedule (CPM logic diagram) within 15 working days of Award of Contract date showing activity sequencing, interdependencies and duration estimates. Include listed activities as follows:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .6 Demolition.
 - .7 Structural Modifications.
 - .8 New Interior Framing.
 - .9 Plumbing for areas A, B and C.
 - .10 Electrical for areas A, B and C.
 - .11 Interior finishes and Fit-up for areas A, B and C.

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- .12 Controls.
 - .13 Testing and Commissioning.
 - .14 Supplied Equipment Long Delivery Items.
 - .15 Engineer Supplied Equipment Required Dates.
-
- .2 Detail CPM schedule to cover in detail minimum period of 3 months beginning from Award of Contract date with each activity duration approximately 15 days.
 - .1 Show remaining activities for CPM construction network system up to Final Certificate and develop complete detail as project progresses.
 - .2 Detail activities completely and comprehensively throughout duration of project.
 - .3 Relate Detail Schedule activities to basic activities and milestones developed and approved in Master Plan.
 - .4 Clearly show sequence and interdependence of construction activities and indicate:
 - .1 Start and completion of all items of Work, their major components, and interim milestone completion dates.
 - .2 Activities for procurement, delivery, installation and completion of each major piece of equipment, materials and other supplies, including:
 - .1 Time for submittals, resubmittals and review.
 - .2 Time for fabrication and delivery of manufactured products for Work.
 - .3 Interdependence of procurement and construction activities.
 - .3 Include sufficient detail to assure adequate planning and execution of Work. Activities should generally range in duration from 3 to 15 workdays each.
 - .5 Provide level of detail for project activities such that sequence and interdependency of Contract tasks are demonstrated and allow co-ordination and control of project activities. Show continuous flow from left to right.
 - .6 Ensure activities with no float are calculated and clearly indicated on logical CPM construction network system as being, whenever possible, continuous series of activities throughout length of Project to form "Critical Path". Increased number of critical activities is seen as indication of increased risk.
 - .7 Insert Change Orders in appropriate and logical location of Detail Schedule. After analysis, clearly state and report

to DCC Representative for review effects created by insertion of new Change Order.

1.10 REVIEW OF THE CONSTRUCTION DETAIL SCHEDULE

- .1 Allow 5 workdays for review by DCC Representative of proposed construction Detail Schedule.
- .2 Upon receipt of reviewed Detail Schedule make necessary revisions and resubmit to DCC Representative for review within 10 workdays.
- .3 Promptly provide additional information to validate practicability of Detail Schedule as required by DCC Representative.
- .4 Submittal of Detail Schedule indicates that it meets Contract requirements and will be executed generally in sequence.

1.11 COMPLIANCE WITH DETAIL SCHEDULE

- .1 Comply with reviewed Detail Schedule.
- .2 Proceed with significant changes and deviations from scheduled sequence of activities that cause delay, only after written receipt of approval by DCC Representative.
- .3 Identify activities that are behind schedule and causing delay. Provide measures to regain slippage.
 - .1 Corrective measures may include:
 - .1 Increase of personnel on site for effected activities or work package.
 - .2 Increase in materials and equipment.
 - .3 Additional work shifts.
- .4 Submit to DCC Representative, justification, project schedule data and supporting evidence for approval of extension to Contract completion date or interim milestone date when required. Include as part of supporting evidence:
 - .1 Written submission of proof of delay based on revised activity logic, duration and costs, showing time impact analysis illustrating influence of each change or delay relative to approved contract schedule.
 - .2 Prepared schedule indicating how change will be incorporated into the overall logic diagram. Demonstrate perceived impact based on date of occurrence of change and include status of construction at that time.
 - .3 Other supporting evidence requested by DCC Representative.

- .4 Do not assume approval of Contract extension prior to receipt of written approval from DCC Representative.
- .5 In event of Contract extension, display in Detail Schedule that scheduled float time available for work involved has been used in full without jeopardizing earned float.
 - .1 DCC Representative will determine and advise Contractor number of allowable days for extension of Contract based on project schedule updates for period in question, and other factual information.
 - .2 Construction delays affecting project schedule will not constitute justification for extension of contract completion date.

1.12 PROGRESS MONITORING AND REPORTING

- .1 On ongoing basis, Detail Schedule on job site must show "Progress to Date". Arrange participation on and off site of subcontractors and suppliers, as, and when necessary, for purpose of network planning, scheduling, updating and progress monitoring. Inspect Work with DCC Representative at least once monthly to establish progress on each current activity shown on applicable networks.
- .2 Update and reissue project Work Breakdown Structure and relevant coding structures as project develops and changes.
- .3 Perform Detail Schedule update monthly with status dated (Data Date) on last working day of month. Update to reflect activities completed to date, activities in progress, logic and duration changes.
- .4 Do not automatically update actual start and finish dates by using default mechanisms found in project management software.
- .5 Submit to DCC Representative a copy of updated Detail Schedule.
- .6 Requirements for monthly progress monitoring and reporting are basis for progress payment request.
- .7 Submit monthly written report based on Detail Schedule, showing Work to date performed, comparing Work progress to planned, and presenting current forecasts. Report must summarize progress, defining problem areas and anticipated delays with respect to Work schedule, and critical paths. Explain alternatives for possible schedule recovery to mitigate any potential delay. Include in report:
 - .1 Description of progress made.
 - .2 Pending items and status of: permits, shop drawings, Change Orders, possible time extensions.

- .3 Status of Contract completion date and milestones.
- .4 Current and anticipated problem areas, potential delays and corrective measures.
- .5 Review of progress and status of Critical Path activities.

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 DEFINITIONS**

- .1 Activity: An element of Work performed during course of Project. An activity normally has an expected duration, an expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart). A graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally, Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: Original approved plan (for Project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five-day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Duration: Number of work periods (not including holidays or other nonworking periods) required to complete an activity or other Project element. Usually expressed as workdays or workweeks.
- .6 Master Plan: A summary-level schedule that identifies major activities and key milestones.
- .7 Milestones: A significant event in Project, usually completion of major deliverable.
- .8 Project Schedule: The planned dates for performing activities and the planned dates for meeting milestones. A dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involve using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.
- .9 Project Planning, Monitoring and Control System: Overall system operated by DCC Site Representative to enable monitoring of project work in relation to established milestones

1.2 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to DCC Representative within 5 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to DCC Representative within 5 working days of receipt of acceptance of Master Plan.

1.4 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule on bi-weekly basis reflecting activity changes and completions, as well as activities in progress.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.
- .3 Include dates for commencement and completion of each major element of construction.
- .4 Show projected percentage of completion of each item as of the first day of month.
- .5 Indicate progress of each activity to date of submission schedule.

- .6 Show changes occurring since previous submissions of schedule:
 - .1 Major changes in scope
 - .2 Activities modified since previous submission
 - .3 Revised projections of progress and completion
 - .4 Other identifiable changes.
 - .5 Phasing of work activities between construction areas A, B and C.
- .7 Provide a narrative report to define:
 - .1 Problem areas, anticipated delays and impact on schedule.
 - .2 Corrective action recommended and its effect
 - .3 Effect of changes on schedules of other prime contractors.

1.5 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.
- .3 Coordination Meetings
 - .1 Prior to commencement of construction work convene a meeting with affected trades, Project Manager and DCC Site Representative to review Contractor's proposed methodology for staging the construction, the removal of existing services and installation of new services.
 - .2 Prior to commencement of construction work and the preparation of interference drawings, convene a coordination meeting with all major trades, Project Manager and DCC Site Representative to review the integration of the building systems, their interrelationships, potential conflict areas and strategies for their resolution.
 - .3 Convene a meeting with all trades to review the placement of all interior and exterior devices, sensors, switches and other similar items to plan a coordinated approach to arranging these items.

1.6 PROJECT MILESTONES

- .1 Project milestones form interim targets for Project Schedule.
 - .1 Award of Contract.

- .2 Site Mobilization completed.
- .3 Phasing of work activities between construction areas A, B and C.
- .4 Partial Occupancy dates for phased work for areas A, B and C.
- .5 Demolition completed for areas A, B and C.
- .6 Finishing and fitting, Mechanical, and Electrical work completed for areas A, B and C.
- .7 Finishing and fitting, Architectural work completed for areas A, B and C.
- .8 Interim Certificate (Substantial Completion).

1.7 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 DCC Representative will review and return revised schedules within 5 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.8 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as a minimum milestone and activity types as follows:
 - .1 Award.
 - .2 Shop Drawings, Samples.
 - .3 Permits.
 - .4 Mobilization.
 - .6 Demolition.
 - .7 Structural Modifications.
 - .8 New Interior Framing.
 - .9 Plumbing for areas A, B and C.
 - .10 Electrical for areas A, B and C.
 - .11 Interior finishes and Fit-up for areas A, B and C.
 - .12 Partial occupancy for areas A, B and C.
 - .13 Controls.
 - .14 Testing and Commissioning.
 - .15 Supplied Equipment Long Delivery Items.
 - .16 Engineer Supplied Equipment Required Dates.

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 SECTIONS**

- .1 Section 01 32 16.19 - Construction Progress Schedules - Bar (GANTT) Chart.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 77 00 - Closeout Submittals.

1.2 ADMINISTRATIVE

- .1 Submit DCC Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .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 DCC Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated 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 DCC Representative, 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 are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by DCC Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by DCC Representative review.
- .10 Keep one reviewed copy of each submission on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 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 coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 10 business days for DCC Representative's review of each submission.
- .4 Adjustments made on shop drawings by DCC Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to DCC Representative prior to proceeding with Work.
- .5 Make changes in shop drawings as DCC Representative may require, consistent with Contract Documents. When resubmitting, notify DCC Representative in writing of revisions other than those requested.
- .6 Accompany submissions with transmittal letter, in duplicate, 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 sample
 - .5 Other pertinent data.
- .7 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 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.
 - .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 Relationship to adjacent work
- .8 After DCC Representative's review, distribute copies.
- .9 Submit electronic copies of shop drawings for each requirement requested in specification Sections.
- .10 Delete information not applicable to project.
- .11 Supplement standard information to provide details applicable to project.
- .12 If upon review by DCC Representative, no errors or omissions are discovered or if only minor corrections are made, copies 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.
- .13 Where required in specific Sections submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .14 Indicate specific product selections where product data provides multiple choices.

1.4 SAMPLES

- .1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to DCC Representative's site office.
- .3 Notify DCC Representative 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 DCC Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to DND Representative prior to proceeding with Work.
- .6 Make changes in samples which DND Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

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 REFERENCES****.1 Definitions:**

- .1 Contract Security Program (CSP) - A division of Public Services and Procurement Canada (PSPC), which developed the Contract Security Manual and helps industry to participate in Government of Canada and foreign government contracts. CSP provides security screening services needed for contractors before their employees can work with Protected and Classified information and assets.
- .2 Company Security Officer (CSO) - The CSO is the organization's official point of contact with the CSP. The CSO is responsible for monitoring the organization's security profile, addressing security issues, and is accountable to the CSP and to the organization's designated Key Senior Official on all industrial security matters.
- .3 Contractor CSO - The employee of the Contractor's company who is the CSO.
- .4 Contract Security Manual (CSM) - The CSM is a ready and simple reference which tells Company Security Officers what they must know about Canadian government security standards and procedures and how to ensure that their organization meets these security requirements.
- .5 Positive Control - Measures which guarantee that persons without appropriate clearance will not be left unattended to access the Department of National Defence/Canadian Armed Forces (DND/CAF) information, assets, resources, or locations.
- .6 Request for Visit (RFV) - A form to be filled out by an individual who requires access to sensitive DND property, personnel, information, assets and resources because they must be security screened at the appropriate level before commencement of their duties.
- .7 Restricted - Refers to a situation where authorized persons only, are allowed access to an area or information.
- .8 Security Implementation Plan - A detailed document which outlines the company's strategy and process to meet contract security requirements.

- .9 Security Requirements Check List (SRCL) - The SRCL is a Treasury Board Secretariat (TBS) form used to define the security requirements for a contract. The SRCL represents an evaluation of security threats and risks that may arise through the contracting process.
- .10 Sensitive - Records that are sensitive contain information that can cause different degrees of injury to an individual, a company, or the country if the information were disclosed in an unauthorized manner.
- .2 Reference Sites:
 - .1 Defence Construction Canada (DCC)
 - .1 <https://www.dcc-cdc.gc.ca/industry/security-requirements>
 - .2 PSPC Contract Security Manual
 - .1 <https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html>

1.2 GENERAL

- .1 Security requirements must form part of the contract between DCC and industry when defined by a SRCL.
- .2 These security requirements apply but are not limited to:
 - .1 construction and material objects;
 - .2 contractual arrangements;
 - .3 professional service contracts;
 - .4 facility maintenance contracts; and
 - .5 environmental and UXO contracts.
- .3 A SRCL is a form that is used to define the security requirements associated with each contract. The SRCL ensures that the appropriate security clauses are identified so they may be incorporated into the contract, thereby legally binding the parties to meet the contract's security requirements. **The SRCL must accompany all contract documents including subcontracts that contain security requirements.**
- .4 If multiple levels of screening are required, a Security Classification Guide may have been provided along with the SRCL as a contractual document. This document will provide further information related to security requirements when dealing with multiple levels of clearances within the contract.

1.3 PRIVATE SECTOR ORGANIZATION SCREENING AND CLEARANCES

- .1 Companies who will need access to or who will retain controlled goods, protected or classified property, information, assets or resources must be cleared as follows:
 - .1 Companies must be cleared to safeguard the highest level of information and asset to be retained/accessed, meaning:
 - .1 Designated Organization Screening (DOS) is required for contracts involving access to information at the protected level and/or secure worksites (Reliability status);
 - .2 Facility Security Clearance (FSC) is required for contracts involving access to information at the protected and/or classified levels and/or secure worksites (Secret status);
 - .3 Document Safeguarding Capability (DSC) is required to work on protected and/or classified information at their own worksite; and
 - .4 Companies who will electronically process protected or classified information must have IT media clearance and processing capability commensurate with the security classification level of the information to be processed and must be cleared to the level commensurate with the information or asset to be accessed.

1.4 PERSONNEL SECURITY SCREENING

- .1 Individuals requiring access to information and/or site must have their personnel security screening completed prior to submitting an RFV. As a part of the screening process, it is now a requirement for individuals to undergo a law enforcement inquiry through the RCMP, for electronic finger printing. Please refer to PSPC website for more information.
- .2 Prior to Contract Award, personnel security screenings may not be initiated due to CSP requirements. Therefore, contractors must allow time in their schedules to seek personnel security screenings as required by the contract.
 - .1 Reliability status processing is anticipated to take seven (7) business days per employee after a request has been properly submitted to CSP; and

- .2 Secret clearance processing is anticipated to take seventy-five (75) business days per employee after a request has been properly submitted to CSP.

1.5 VISIT CLEARANCE REQUESTS (VCR) APPROVAL

- .1 All individuals (including subcontractors) who will have access to sensitive DND or CAF property, personnel, information, assets, and resources, must be security screened at the appropriate level before the commencement of their duties in relation to the contract.
- .2 Access to Operations Zones: security screening is not required for certain personnel if positive control of those individuals is maintained throughout their visit. Positive control measures must be outlined in the Security Implementation Plan. Positive control can be used for the following personnel:
 - .1 Logistics activities - material drop-off, waste removal, snow removal;
 - .2 Transit through an operations zone (no work); and
 - .3 Authorities having jurisdiction.
- .3 The VCR process verifies that those who are permitted access onto DND property have the required clearance level as outlined within the SRCL for the contract.

1.6 POST AWARD PROCESS OVERVIEW

- .1 The Contractor's CSO is provided a blank RFV form by the DCC Representative in order to obtain an approved VCR.
- .2 All employees of the successful bidder who will be accessing restricted sites or sensitive information during the execution of the contract require a VCR. The Contractor's CSO must forward the completed form to the DCC Representative for processing.
 - .1 The CSO of each company completing an RFV form must submit a picklist from the Online Industrial Security Services (OLISS) portal instead of filling in the details of each visitor on the form. Only the employees of the company who require access to the restricted site or sensitive information for that contract shall be listed on the picklist.
 - .2 If the Contractor intends to use Union Hall members, the CSO will request the Union Hall to provide the CSO with a separate picklist for all members to be used on the contract. Only the individuals of the Union Hall

- who require access to the site for that contract shall be listed on the picklist.
- .3 The CSO of the company will input "SEE ATTACHED PICKLIST" when completing Particulars of Visitors.
- .3 It is the responsibility of the Prime Contractor to submit and receive an approved SRCL for each subcontract containing security requirements. This responsibility extends to all subcontracts held by subcontractors.
- .1 Instructions on this process are in the CSM located at <https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html>
- .2 Prior to Contract Award, subcontract SRCL security screenings may not be initiated due to CSP requirements. Therefore, contractors must allow time in their schedules for subcontract SRCL approvals as required by the contract.
- .1 When a Private Sector Organization Screening (PSOS) is **not** required, contractors shall allow 45 business days (from the date on which a complete and correct subcontract SRCL is received by CSP) for approval of a subcontract SRCL by CSP.
- .2 When a PSOS **is** required:
- .1 For sub-contractors to be sponsored to the level of DOS, contractors shall allow for 50 business days (from the date on which a complete and correct PSOS is submitted to CSP) for approval of a subcontract SRCL by CSP; and
- .2 For sub-contractors to be sponsored to the level of FSC (Secret), contractors shall allow 124 business days (from the date on which a complete and correct PSOS is submitted to CSP) for approval of a subcontract SRCL by CSP.
- .3 All security related pre-construction activities shall proceed immediately after award.
- .4 For subcontracts, the RFV shall not be submitted until after the subcontract SRCL has been approved and permission to award the contract is granted by CSP.
- .1 Contractor to allow a minimum of 15 business days for VCR processing.
- .5 Personnel not meeting the required security clearances will not be allowed access to restricted sites or any sensitive

information pertaining to the contract, except as permitted in 1.6.2.

- .6 Approved VCRs are valid for the duration of the contract or one year less one day, whichever is less. Extension to VCRs will need to be requested as required, again allowing a minimum of 15 business days for processing.

1.7 SUBMITTALS

- .1 Submit to the DCC Representative copies of the following documents, including updates issued:
 - .1 Security Implementation Plan
 - .2 Approved subcontract SRCLs
 - .3 Completed Request for Visit forms for all personnel working under the contract
 - .4 Incident reports within (1) working day
 - .5 Submit other data, information and documentation upon request by the DCC Representative.

1.8 RESPONSIBILITY

- .1 It is the responsibility of the Contractor to have no security breaches while undertaking the work for this contract.

1.9 MEETINGS

- .1 Prior to commencement of work, the Contractor will attend a pre-commencement meeting conducted by the DCC Representative. Ensure, as minimum, attendance by Contractor's site superintendent.
 - .1 The DCC Representative will advise of time, date and location of the meeting and will be responsible for recording and distributing the minutes.
 - .2 If requested by the DCC Representative, the Contractor's CSO will be required to participate in the pre-commencement meeting.
- .2 Conduct site specific security meetings as required to ensure the management of security is in accordance with the contract.
 - .1 Record and post minutes of all meetings as allowed by the security requirements of the contract.

1.10 SECURITY IMPLEMENTATION PLAN

- .1 Contractors are required to have in place a contract specific Security Implementation Plan that addresses the security requirements outlined in the contract.
- .2 Provide one copy of the Security Implementation Plan to the DCC Representative prior to the commencement of work.
- .3 At a minimum, the plan shall contain details addressing:
 - .1 CSO name and contact information;
 - .2 Schedule for subcontract SRCLs and RFVs;
 - .3 Site Access and Control Monitoring including verification that all people entering secure areas on site have approved VCRs in accordance with contractual security requirements, or any planned positive control measures;
 - .4 Security Education (i.e. Restrictions on photographs); and
 - .5 Security Incident Reporting.
- .4 The DCC Representative will coordinate review of the Security Implementation Plan by the DND Project Security Authority to be completed within 10 business days of receipt following which the DCC Representative shall confirm DND's acceptance or rejection with comments.

1.11 INCIDENT REPORTING

- .1 Investigate and report any security incidents immediately to the DCC Representative.
 - .1 Immediately provide a copy of the incident/investigation reports to the DCC Representative.
 - .2 Refer to Chapter 5 of the CSM <https://www.tpsgc-pwgsc.gc.ca/esc-src/msc-csm/index-eng.html> for more information.
- .2 For the purpose of this contract, immediately notify the DCC Representative of incidents that involve a security breach from the identified clauses on the SRCL or an interruption to adjacent and/or integral infrastructure operations with potential loss implications.
- .3 In the investigation and reporting of incidents, the Contractor is required to respond in a timely fashion (within 5 working days) to correct the action that was deemed to have caused the incident and advise in writing on the action taken to prevent a re-occurrence of the incident.

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 SECTIONS**

- .1 Section 01 14 00 - Work Restrictions.
- .2 Section 01 56 00 - Temporary Barriers and Enclosures.

1.2 GENERAL PROTECTION

- .1 Do not disrupt airport business except as permitted by DCC Representative.
- .2 Provide temporary protection for safe handling personnel, vehicular and aircraft traffic to Section 01 56 00 - Temporary Barriers and Enclosures.

1.3 MOVEMENT OF EQUIPMENT AND PERSONNEL

- .1 Area of work is on an active air base. The following work Procedures shall be observed at all times:
 - .1 Obtain DCC Representative's approval on scheduling of Work.
 - .2 Control movements of equipment and personnel as directed by DCC Representative.
 - .3 Set up barriers to define traffic lanes in accordance with DCC Representative's directions. Keep all vehicle movements to include delivery trucks with-in established traffic lanes.
 - .4 No stockpiling of aggregates or excavated material is permitted at work site. Remove excavated materials directly into haul trucks. All excavated material to be inspected by DCC prior to removal from site.
 - .5 Cleaning of concrete delivery trucks at work site is not permitted. Remove trucks from work site and clean vehicles off DND property.
 - .6 The Contractor is to notify the DCC Representative 7 business days in advance of the use of any cranes and the details thereof.

1.4 RESTRICTED OR SECURE AREA

- .1 Any area to which access is restricted by sign and/or monitored is a secure or restricted area.
- .2 Be responsible for construction personnel and vehicles employed on project and requiring access to restricted areas.

1.5 EVACUATION

- .1 The Contractor shall be required to abandon and evacuate the work site as directed, should an emergency situation be declared by DND.

1.6 PHOTOGRAPHS

- .1 Photographs within restricted areas are prohibited.

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 CONSTRUCTION FIRE SAFETY**

- .1 The Contractor shall provide construction fire safety in accordance with the National Fire Code of Canada.

1.2 FIRE DEPARTMENT BRIEFING

- .1 DCC Representative will co-ordinate arrangements for Pre-Commencement Meeting following contract award. Contractors will be briefed on Fire Safety by the Fire Chief or his designated representative before work starts.

1.3 REPORTING FIRES

- .1 The Contractor shall inform the DCC representative and Fire Chief of all fire incidents at the construction site, regardless of size.
- .2 Know location of nearest fire alarm pull station and telephone, including emergency phone number.
- .3 Report immediately fire incidents to Fire Department as follows:
 - .1 Activate nearest fire alarm pull station.
 - .2 Telephone.
- .4 Person activating fire alarm pull station will remain at the front entrance to direct Fire Department to scene of fire.
- .5 When reporting fire by telephone, give location of fire, name or number of building and be prepared to verify location.

1.4 FIRE SAFETY PLAN

- .1 Submit a fire safety plan for the construction site prior to commencement of construction work. The fire safety plan shall conform to the National Fire Code of Canada.
- .2 The fire safety plan shall be submitted to the DCC representative for review by local fire department. Any comments by local fire department shall be implemented by the Contractor.
- .3 The fire safety plan shall be limited to the area of construction only. Contractor is not responsible for

amending fire safety plans in existing buildings.

- .4 Post the fire safety plan at the entrance to the construction site or near the construction site's health and safety board.
- .5 The fire safety plan shall conform to the National Fire Code of Canada, and shall contain, at minimum:
 - .1 Emergency procedures to be used in case of fire, including
 - .1 Sounding the fire alarm;
 - .2 Notifying the fire department;
 - .3 Instructing occupants on procedures to be followed when the fire alarm sounds;
 - .4 Evacuating occupants, including special provisions for persons requiring assistance; and
 - .5 Confining, controlling and extinguishing fires.
 - .2 The appointment and organization of designated supervisory staff to carry out fire safety duties.
 - .3 The training of supervisory staff and other occupants in their responsibilities for fire safety.
 - .4 Documents including diagrams, showing the type, location and operation of building fire emergency systems.
 - .5 The holding of fire drills (where applicable).
 - .6 The control of fire hazards in the building.
 - .7 The inspection and maintenance of building facilities provided for the safety of occupants.

1.5 FIRE WARNING SYSTEM

- .1 Provide a fire warning system for entire construction site, capable of notifying construction personnel of a fire emergency in construction area.
- .2 Provide system with sufficient coverage so that alarms are capable of being heard throughout building and anywhere on site.

1.6 FIRE PROTECTION SYSTEM IMPAIRMENT

- .1 Maintain existing systems in an operational state at all times during construction.
- .2 Use of fire hydrants, standpipes or hose systems for purposes other than fire-fighting unless authorized by Senior Fire Fighter, is prohibited.
- .3 Existing fire protection and alarm systems will not be obstructed, shut off, disabled or left inactive at end of each working day or shift without written authorization from

Senior Fire Fighter.

- .4 Submit written notification to DCC Representative and Senior Fire Fighter 48 hours in advance of planned interruption of services. Submit written notification for operation including shutting down active fire protection system, including water supply, fire suppression, fire detection and life safety systems.
- .5 Where a fire protection system that provides fire alarm monitoring is impaired in an existing building, provide a fire watch as directed by Senior Fire Fighter.
- .6 Conduct work on fire protection system where systems are affected or impaired in accordance with National Fire Code of Canada conforming to Base Fire Orders.

1.7 FIRE EXTINGUISHERS

- .1 Supply fire extinguishers, as scaled by the Fire Chief, necessary to protect work in progress and contractor's physical plant on site.
- .2 Provide supplemental fire extinguishers to these areas and otherwise as directed by Senior Fire Fighter:
 - .1 Adjacent to hot works.
 - .2 In areas where combustibles are stored.
 - .3 Adjacent to areas where flammable liquids or gases are stored or handled.
 - .4 Near or on any internal combustion engines.
 - .5 Adjacent to temporary oil fired or gas fired equipment.
 - .6 Adjacent to bitumen heating equipment.
- .3 Provide extinguishers rated as follows: 4A:40BC. Minimum 20 pounds unless otherwise directed by Senior Fire Fighter.
- .4 Provide dry chemical type extinguishers unless otherwise required by hazard being protected.
- .5 Provide sufficient numbers of extinguishers based on a maximum travel distance between extinguishers of 23.0 meters (75 feet).

1.8 ACCESS FOR FIRE FIGHTING

- .1 Provide and maintain access for firefighting in accordance with National Fire Code of Canada.
- .2 Provide written notification to Senior Fire Fighter a minimum of 5 working days in advance of operation that would

impede fire apparatus response including:

- .1 Violation of minimum horizontal and overhead clearances.
- .2 Other operations as directed by Senior Fire Fighter.
- .3 Erecting of barricades and digging of trenches.
- .3 Maintain a minimum clear horizontal width on access routes of 5.0 meters or otherwise as defined by Senior Fire Fighter.
- .4 Maintain a minimum vertical clearance of 6.0 meters or otherwise as defined by Senior Fire Fighter.

1.9 SMOKING PRECAUTIONS

- .1 Smoking is prohibited in buildings including buildings under construction.
- .2 Obey posted signs and confine smoking only to designated smoking areas. Observe posted smoking restrictions near existing buildings.

1.10 RUBBISH AND WASTE MATERIALS

- .1 Keep rubbish and waste materials at minimum quantities.
- .2 Burning of rubbish is prohibited.
- .3 Remove rubbish from work site at end of workday or shift or more frequently as directed by Senior Fire Fighter.
- .4 Storage:
 - .1 Store oily waste in approved receptacles to ensure maximum cleanliness and safety.
 - .2 Deposit greasy or oily rags and materials subject to spontaneous combustion in approved receptacles and remove specified.

1.11 FLAMMABLE AND COMBUSTIBLE LIQUIDS

- .1 Handling, storage and use of flammable and combustible liquids governed by current National Fire Code of Canada.
- .2 Keep flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use in quantities not exceeding 45 litres provided they are stored in approved safety cans bearing Underwriters' Laboratory of Canada or Factory Mutual seal of approval. Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires permission of Fire Chief.

- .3 Transfer of flammable and combustible liquids is prohibited within buildings or jetties.
- .4 Transfer of flammable and combustible liquids will not be carried out in vicinity of open flames or any type of heat producing devices.
- .5 Use of flammable liquids having flash point below 38 degrees C such as naphtha or gasoline as solvents or cleaning agents is prohibited.
- .6 Storing flammable and combustible waste liquids on site is prohibited. Remove daily or more frequently as directed by Senior Fire Fighter.

1.12 HOT WORK

- .1 Implement a hot works program in accordance with National Fire Code of Canada and NFPA 51B Standard for Fire Prevention. Apply hot works program to processes involving welding, cutting, roofing and other hot works as defined by Senior Fire Fighter.
- .2 Obtain a "Hot Works" permit from Senior Fire Fighter for hot works in construction area. Frequency of renewal for hot works permits is at discretion of the Senior Fire Fighter.
- .3 When work is carried out in dangerous or hazardous areas involving use of heat, provide fire watchers equipped with sufficient fire extinguishers. Determination of dangerous or hazardous areas along with level of protection necessary for Fire Watch is at discretion of the Senior Fire Fighter.
- .4 Provide fire watch service for work as directed by Senior Fire Fighter and as defined in Fire Department Briefing. Provide fire watchers trained in use of fire extinguishing equipment.
- .5 Carry out hot works processes in areas free of combustible and flammable content.
- .6 Where hot works must be carried out in areas where combustibles are present:
 - .1 Protect flammable and combustible materials within 15.0 meters of hot works in accordance with National Fire Code of Canada.
 - .2 Provide a fire watch during hot work and for a minimum of 60 minutes after work is complete unless otherwise directed by Senior Fire Fighter.

- .3 Conduct a final inspection of area not less than 4 hours after completion of hot works unless otherwise directed by Senior Fire Fighter.
- .7 Where there is a possibility of sparks leaking onto combustible materials in areas adjacent to areas where the hot work is carried out:
 - .1 Cover or close openings in walls, floors or ceilings to prevent passage of sparks to such adjacent areas.
 - .2 Provide a fire watch during hot works and for a minimum of 60 minutes after work is complete.
 - .3 Conduct a final inspection not less than 4 hours after completion of hot works unless otherwise directed by Senior Fire Fighter.
- .8 Protection of flammable or combustible materials:
 - .1 Remove flammable and combustible materials including combustible or flammable dust or residue from area where hot works is carried out.
 - .2 When removal is not possible, protect materials with a non-combustible covering.
- .9 Provide a fire extinguisher within 3.0 meters of hot works. Provide a minimum size of 20 lbs. Type ABC extinguisher unless otherwise directed by Senior Fire Fighter.

1.13 HAZARDOUS SUBSTANCES

- .1 Perform work involving the use of toxic or hazardous materials, chemicals or explosives, or otherwise creating hazard to life, safety or health, in accordance National Fire Code of Canada (NFC).
- .2 Provide ventilation where flammable liquids, such as lacquers or urethanes are used. Eliminate sources of ignition. Provide written notification to the Senior Fire Fighter a minimum of 5 days prior to starting work and immediately at completion of work.

1.14 PARTIAL OCCUPANCY

- .1 Implement partial occupancy procedures as defined in General Conditions of the Contract. Partial occupancy is defined as when construction occurs adjacent to work areas occupied by Departmental or Canadian Forces personnel. This includes:
 - .1 Phased new construction.
 - .2 Early or partial occupancy of new construction.

- .3 New construction being added onto an existing building.
- .4 Renovation or recapitalization of an existing building.
- .5 Phased renovation or recapitalization of an existing building.
- .2 Where partial occupancy occurs, implement requirements as indicated in drawings and specifications. This may include construction of a rated fire separation between occupied and construction areas as required by National Fire Code.
- .3 If work is carried out in an occupied building, provide regular inspections every hour, throughout entire period of demolition.
- .4 If work is carried out in an occupied building and where building does not have a Fire Alarm system or similar automatic monitoring or protection equipment, provide regular inspections every hour for entire period of construction.

1.15 QUESTIONS AND/OR CLARIFICATION

- .1 Direct questions or clarification on Fire Safety to DCC Representative.
- .2 DCC Representative will obtain clarifications from Senior Fire Fighter. Do not contact directly with Senior Fire Fighter for notification, authorization or any requests unless situation constitutes an immediate emergency.

1.16 FIRE INSPECTION

- .1 Co-ordinate site inspections by Senior Fire Fighter through DCC Representative.
- .2 Allow Senior Fire Fighter unrestricted access to work site.
- .3 Co-operate with Senior Fire Fighter during routine fire safety inspection of work site.
- .4 Immediately remedy unsafe fire situations observed by Senior Fire Fighter.

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 Impact Assessment Act, 2019
- .2 Canadian Environmental Protection Act, 1999
- .3 Fisheries Act, 1985
- .4 Transportation of Dangerous Goods Act, 1992
- .5 Ontario Environmental Protection Act, 1990
- .6 Ontario Regulation 347 - General - Waste Management
- .7 Wing Standing Order (WSO) 15.04 Emergency Response To Hazardous Materials Spills

1.2 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to commencing construction activities submit an Environmental Protection Plan to include the following:
 - .1 Spill Prevention and Response Plan.
- .3 Submit other data, information and documentation upon request by the DCC Representative and as stipulated elsewhere in this section.

1.3 GENERAL

- .1 Comply with all federal, provincial, and municipal regulatory requirements and guidelines for environmental protection and natural resource conservation, including in section 1.0 References, noted above.
- .2 The Work site is subject to inspection by the Base Environment Officer, or designate, as well as, the DCC Representative, without prior notice.
- .3 Failure to comply with environmental requirements may result in a stop work order or assessment of damages commensurate with repair of damage.
- .4 All references to payment referred to in OPSS references are to be disregarded and do not apply to this contract.

- .5 The Contractor will be unable to request extra funding to meet environmental requirements that are within the contract.
- .6 It is the Contractor's responsibility to be aware of environmental requirements and the best management practices and pollution control measures necessary to meet them.
- .7 Blasting is not permitted on DND property.
- .8 Fires and burning of rubbish are not permitted on DND property.

1.4 SPILLS AND REPORTING SPILLS

- .1 A spill or release is an accidental discharge of a pollutant (solid, liquid or gas) into the environment. After a spill or release, always ensure human health and safety is protected above all else.
- .2 All spills, regardless of size, that occur on DND property shall be reported to the Base Fire Hall and 8 Wing Environment. This includes all spills of any substance that is or is of suspect of being a hazardous or environmentally hazardous substance.
- .3 Substances such as engine oil, hydraulic fluid, fuel, paint, varsol, thinners and other petroleum-based products where storage containers do not always indicate a hazardous material, are considered hazardous to the environment. These materials must be stored in secondary containment and all Safety Data Sheets (SDS) must be readily available on site. Treat all spills in accordance with the regulations.
- .4 Submit to the DCC Representative a project-specific Spill Prevention and Response (SPR) Plan prior to work on-site.
 - .1 The SPR shall include environmental response measures necessary to prevent and to mitigate a pollutant release on National Defence property.
 - .2 The SPR is to include: roles and responsibilities, contact information, spill notification procedure, emergency spill response measures, project and site-specific clean up measures for spills, waste disposal, restoration activities, and reporting requirements.
 - .3 Identify storage locations of materials or wastes that may require emergency spill response. Identify spill control kit inventory and location(s).
 - .4 SPR shall identify equipment fueling location, methodology and control measures. Refueling operations shall be conducted within a secondary

containment area. Refuel equipment no closer than 30 metres from water bodies.

- .5 The SPR is to be modified and updated as necessary. On-going assessments shall be performed during the progress of work identifying and documenting new or potential spill hazards and measures not previously known and identified.
- .6 Prior to starting work, provide to the DCC Representative an inventory of hazardous material to be brought to the site, including volume or mass, and Safety Data Sheets (SDS).
- .7 Display an information placard on all such material and equipment containing liquid products that will be located overnight or longer on DND property.
 - .1 Information placards to include: Contractor's name and address, contact person, emergency telephone numbers, and liquid contents.
 - .2 Post the information placard either on the exterior of the container, or on the dashboard of the vehicle, where applicable.
- .8 The Contractor is to prepare an Emergency Spill Response Plan to deal with potential leaks and spills during their operations on site.
 - .1 Emergency Response:
 - .1 With respect to liquid spills, provide enough on-site equipment to control for one hour a liquid spill of 110% of any material brought on to-or handled at-the site.
 - .2 The on-site spill control kit required to include absorbent pads, absorbent granular, nitrile gloves, garbage bags and/or pails with lids, and shovels, and applicable to the chemical used. A spill control kit shall be located wherever significant quantities of materials or wastes that may require emergency spill response are used or stored.
 - .3 In the event of a spill, invoke Contractor's SPR Plan and make immediate notifications to Base Fire Hall, DCC Coordinator, and Wing Environment.
 - .4 In the event of a spill into the natural environment, do everything practicable to prevent, eliminate, and ameliorate adverse effects, and to restore the natural environment.
 - .5 Emergency response planning is to include measures to escalate the response in the event of

an emergency that exceeds on-site equipment capabilities.

- .9 The Contractor must ensure all emergency response equipment be available on site to deal with any spills and leaks, is of sufficient size to contain the largest amount of fluid on site, as well as ensure their personnel are trained to respond.
- .10 All spills must be reported by dialling the Base Fire Hall at 911. The Wing Environmental Officer, the Project Manager and DCC representative must also be informed immediately.
- .11 A spill report must be completed by the Contractor and sent to 8 Wing Environment within 24 hours of the spill occurring as per WSO 15.04 Emergency Response to Hazardous Materials Spills.

1.5 DISPOSAL OF WASTE

- .1 Do not bury rubbish and waste materials on site.
- .2 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm, floor or sanitary sewers.
- .3 Remove legally and dispose of off site all surplus materials, debris, and waste materials resulting from the proposed project activities.
- .4 All waste and excess materials shall be disposed in accordance with all Provincial regulations and requirements.
- .5 All rubbish and/or waste must be transported and disposed of at a licensed facility off National Defence property compliant to the Provincial Regulatory requirements.
- .6 Waste contaminated by chemicals, hydrocarbons or other sources due to on site releases and spills by the Contractor must be disposed of at a licensed facility off National Defence property. DND's waste generator number is not to be used for waste disposal purposes. The Contractor shall provide their own waste generator number.
- .7 Copies of all waste manifests and documentation resulting from the project activities shall be submitted to DCC and Wing Environment.

1.6 DRAINAGE

- .1 Do not pump water containing suspended materials into waterways, sewer or drainage systems.

- .2 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.
- .3 Ensure that sufficient erosion control measures are in place prior to project commencement and are monitored and maintained throughout the duration of the project.

1.7 POLLUTION CONTROL

- .1 Control emissions from equipment and plant to local authorities' emission requirements.
- .2 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

1.8 ENVIRONMENTAL MITIGATION MEASURES

- .1 No refuelling in the vicinity of any watercourse or drainage system. A refuelling area complete with spill response equipment is to be established at a minimum of 30 meters from any shoreline, water course or catch basin.
- .2 Prevent construction debris, chemicals, hydrocarbons and contaminated effluent from entering the storm water drainage system. Cover catch basins, floor drains and manhole inlets on site.
- .3 Waste or contaminated materials must not be released into the storm water system or all other waterways. Install erosion control measures to prevent sediment migration into streams or watercourses.
- .4 All spills regardless of size or chemical compound (hydrocarbons, NPRI, or other) must be reported in accordance with contract requirements.
- .5 All potentially contaminating chemical compounds will be stored away from water or sewage areas and will have secondary containment.
- .6 Tools and construction materials removed from site must be inspected and cleaned prior to leaving the site.
- .7 The Contractor shall monitor site activities on a daily basis with respect to waste control devices, secondary containment for chemical compounds and general site conditions. Any anomalies must be noted, dealt with and reported to DCC/DND OPI.
- .8 Site disturbances shall be restored prior to project completion.

Part 2 Products**2.1 NOT USED**

- .1 Not Used.

Part 3 Execution**3.1 CLEANING**

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

END OF SECTION

Part 1 General**1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 19 13 - General Commissioning (Cx) Requirements.
- .4 Section 01 91 13.13 - Commissioning Plan.

1.2 QUALITY MANAGEMENT SYSTEM

- .1 The Contractor shall adopt a documented Quality Management System to ensure that the specified quality standards for this project are achieved.
- .2 Purpose: Under the terms of the Contract, the Contractor is responsible for the delivery of a facility that meets the standards of quality demanded by the specification as it applies to materials, workmanship, and completed results. The purpose of the Contractor Quality Management System is to assist in the fulfillment of this obligation and to provide the DCC Representative with a means to confirm that the specified level of quality is being achieved.
- .3 Quality Management System: The Quality Management System (QMS) consists of the organizational structure and the inherent responsibilities, procedures, processes and resources needed to implement quality management of the building process. In addition, and for the purpose of this project, "Commissioning" will be considered an integral element of the quality management system. The QMS has three sub-systems as follows:
 - .1 Quality Assurance (QA): QA refers to the documented intent outlining the activities that are implemented in the QMS to provide confidence that the project will satisfy the relevant quality standards and specifications.
 - .2 Quality Control (QC): QC refers to the actual monitoring of specific project results to determine if they comply with relevant quality standards. There are a number of deliverables associated with the QC sub-system, most of these are generally already used on typical construction projects. The deliverables include, shop drawing reviews, on-site inspections and tests and related reports, site meeting minutes etc. In addition, the Commissioning Report is an important

and integral element of the QC sub-system deliverables.

- .3 Commissioning Plan (CP): Contractor commissioning Coordinator will participate in the preparation of the detailed commissioning plan in consultation with the mechanical, electrical and other subcontractors. The Commissioning Authority will require the contractor's contributions to be completed prior to the 60% completion of the construction work at the site.

1.3 ROLES AND RESPONSIBILITIES

- .1 There will be four key individuals (parts) in the project's Quality Management System. The DCC Representative, the Contractor's Project Manager, the Contractor's Quality Manager and the Contractor's Commissioning Coordinator. Their responsibilities and roles are defined as follows:
 - .1 The Project DCC Representative: The Project DCC Representative is the person appointed by Defence Construction Canada to act on their behalf in matters of contract issues and to ensure that the activities match the Contractors schedule and that the construction processes are in accordance with contract documents. The Project DCC Representative is responsible to ensure that a Quality Management System has been established by the Contractor and that it will satisfy the quality objectives of the project as outlined in the specification. The Project DCC Representative will review and accept the Quality Management Plan and will appoint a Commissioning Agent to review the Commissioning Plan.
 - .2 Contractor's Project Manager: The Contractor's Project Manager is responsible for developing and implementing an effective Quality Management System. This will cover the full spectrum of work with which the Contractor is involved during the contract period. The Contractor's Project Manager will demonstrate the existence of the Quality Management System by submitting a Quality Management Plan and appointing a Quality Manager.
 - .3 Contractor's Quality Manager (QM): The Contractor shall appoint a Quality Manager for the project. The duties of the Quality Manager are independent of and play no role in the work production to which QA/QC activities are applied. The Quality Manager cannot be the project manager or the project supervisor. The Quality Manager shall be empowered to carry out duties

and to require conformance to the quality standards and requirements of the Contract Documents.

- .1 Will be responsible for:
 - .1 Day to day execution of the Quality Plan;
 - .2 Working with trade contractors to explain the nature of the Quality Plan, their role in it and ensuring quality workmanship on site;
 - .3 Maintaining Quality records on site including:
 - .1 inspections and test reports;
 - .2 non-conformance reports; and
 - .3 corrective action reports and sign offs.
 - .4 Facilitating quality inspections by the DCC Representative's representatives;
 - .5 Reporting to the Contractor Project Manager on the Quality Process for the project.
- .4 Contractor's Commissioning Coordinator: The Contractor's Commissioning Coordinator will be appointed by the contractor. The Coordinator's responsibilities will include the following:
 - .1 Actively participate in the preparation of the detailed commissioning plan;
 - .2 Assemble the contractor's commissioning team
 - .3 Coordinating the Contractor's team's input into the commissioning process;
 - .4 Coordinating the mechanical, electrical, controls, and other subcontractor's input into the commissioning process; and
 - .5 Execute the Commissioning Plan in consultation with the Commissioning Authority, DCC Representative, the Contractor's PM, and the Contractor's Quality Manager.

1.4 DELIVERABLES

- .1 Quality Management Plan: The Quality Management Plan will address quality assurance and quality control issues and serves as the guide to the quality related activities the Contractor will undertake over the course of the project. The plan will be delivered within 4 weeks after award. As a minimum, the plan will direct the following activity:
 - .1 Implementing an active program to instill in management staff, design professionals, supervisory

personnel and sub-contractors an awareness of the requirement for quality work and obtaining the commitment to produce it.

- .2 Assembling an experienced staff capable of performing good quality work and engaging sub-contractors capable of producing good quality work, for example:
 - .1 Perform Work in accordance with standard accepted industry practices for type of Work unless specifications stipulate more precise requirements.
 - .2 Do Work in neat and careful manner to retain Work plumb, square, and straight.
 - .3 Ensure Work is properly related to form close joints and appropriately aligned junctions, edges and surfaces and is free of warp, twist, wind, wave or other irregularities.
 - .4 When required by specifications or by manufacturers recommendations, have manufacturer, supplier or accredited agent, inspect work which incorporates their products.
 - .5 Do not permit materials to come in contact with other materials whether in presence of moisture or otherwise if conditions will result in corrosion, stain or discoloration or deterioration of completed Work. Provide compatible, durable separators where contact is unavoidable.
 - .6 When any of the above conditions are not met, the DCC Representative may require the Contractor to redo the work at no additional cost and with no additional construction time to the contract.
- .3 Establishing as-built drawing review to ensure that the construction requirements meet the specification and are understood by all project stakeholders. The documentation of these reviews shall form the auditable trail of change between the requirements in the specification with the construction documents.
- .4 Maintaining an effective shop drawing verification and approval system.
- .5 Establishing a system of inspection reports that demonstrate an active site inspection routine by the Contractor's team and the Quality Manager complete with a system of inspection reports.
 - .1 The Contractor's Quality Management Plan shall describe in detail proposed quality control practices. The Quality Management Plan shall:

- .1 Identify items of work which will be subject to controls, and list particular checks and tests which are to be performed for each item of work,
 - .2 indicate frequency of checks, tests and milestones at which they are to be carried out, and
 - .3 provide for reports on results of these activities, with reports submitted to DCC Representative and Quality Auditor.
- .6 Consulting with supervisory personnel, workmen and sub-contractors to confirm that the requirements of the drawings and specification are thoroughly understood and executed.
- .7 Maintaining material ordering procedures and records that verify and confirm the materials purchased meet the specified standards.
- .8 Ensuring adequate materials and assembly testing procedures are in place throughout the project.
- .9 Verifying that the equipment which is to be used to perform the work is appropriate and in good working order.
- .10 Providing inspection services, in some cases by engaging specialist firms, of certain high risk installations, e.g. roofing, HVAC testing and balancing.
- .11 Providing an inspection framework to ensure conformance of work of one stage before the next stage is performed, for example:
 - .1 verifying that granular base material is compacted to the specified standards before placing reinforcing steel,
 - .2 verifying reinforcing steel installation for conformity to spec and accepted practice, before placing concrete,
 - .3 hydrostatic, pneumatic pressure testing prior to backfilling or closing in.
- .12 Providing mock-ups or sample sections of repetitive work to establish acceptable standard of workmanship e.g. concrete pavement sections, concrete block masonry and/or brickwork, roof curbing details etc.
- .13 Systems Commissioning as described in the Commissioning Plan.
- .14 The Contractor's Quality Manager will be responsible for all quality aspects on this contract. The contractor's responsibilities include the work

activities carried out by Subcontractors, suppliers, manufacturers and fabricators working on behalf of the Contractor.

- .15 Implement the Quality Management Plan to organize, demonstrate and document the work is performed in accordance with the requirements of the Contract Documents.
- .16 Incorporate required inspection and testing of work by Contractor's subcontractors, suppliers and fabricators into the Quality Management Plan.
- .17 Incorporate documented Quality Program and procedures including provisions for equipment procurement, manufacture and installation, construction, testing, start-up, operational training and maintainability.
- .18 The following items must be addressed in the Contractor's Quality Control Plan:
 - .1 Management responsibilities,
 - .2 Quality Management organizational structure,
 - .3 Quality Management personnel,
 - .4 Integration of subcontractors, suppliers and fabricators quality programs with the Contractor's Quality Program,
 - .5 Documentation of the Contractor's Quality Program,
 - .6 Document control,
 - .7 Purchasing control,
 - .8 Product identification and traceability,
 - .9 Process control,
 - .10 Inspection and testing,
 - .11 Inspection, Measuring and Testing Equipment,
 - .12 Inspection and testing status,
 - .13 Standards of acceptance for mock-ups and test panels where they are not identified by specifications,
 - .14 Non-conformance,
 - .15 Corrective/ preventative action,
 - .16 Quality records and;
 - .17 User training.
- .19 The Contractor's Quality Manager will carry out weekly inspections of all divisions of work on-site. The Quality Manager shall submit a written report within 2 working days of weekly inspections to the DCC Representative. The written reports shall identify work completed in a particular division, any specific

problems with the completed work, any non-conforming work, proposed corrective action and detailed notes pertaining to the quality of the installed works.

- .20 The Quality Management Plan shall be organized by NMS divisional format. Each division shall contain the following elements:

- .1 Scope of the work subject to control and quality measures,
- .2 Proposed quality control processes,
- .3 Description of proposed Inspection and Testing activities and equipment,
- .4 Standards of acceptance for results from inspection and testing activities,
- .5 Specific Inspection forms and Checklists.

- .2 Commissioning Plan: The Commissioning Plan will be a separately bound volume of the Quality Management Plan. It will describe the commissioning activity, and address quality assurance and quality control issues related to the commissioning of building systems. The Commissioning Plan will be prepared by the Contractor's Commissioning Coordinator, in concert with the DCC Representative's Commissioning Agent, the Contractor's PM, Sub-contractors, and the DCC Representative.

The Plan will address the following items:

- .1 The objectives of the commissioning process for this project.
- .2 The general approach which will be taken to implement the commissioning of building systems.
- .3 A description of the commissioning team (to include owner identified representatives and a brief terms of reference for the team members.
- .4 A listing and description of the systems which are to be commissioned.
- .5 A sequential listing of the commissioning activities and tests for each system and outline descriptions of each activity and test.
- .6 A tentative schedule of the commissioning activities which will be refined throughout the contract period.
- .7 A full commissioning plan, c/w with all test sheets and implementation schedule must be presented by the 60% completion of the construction work at the site.

All Contractor QA and QC activities on the Contract, as well as those QA and QC activities carried out by designers, consultants, sub consultants, trade contractors, suppliers,

manufacturers and fabricators working on behalf of the Contractor may be subject to auditing by the DCC Representative. On notice of a quality audit the contractor will facilitate the audit activity by providing back up documentation and access to work areas.

1.5 QUALITY CONTROL REPORTS AND RETURNS

- .1 Site Services. QM to provide the following:
 - .1 Installation of site services to be approved by QM and DCC Representative.
 - .2 Weekly inspection by QM. Report to comment on joints, bedding, thrust blocks, slope, general workmanship.
 - .3 Hydrostatic testing certified by QM.
 - .4 Flushing and disinfecting certified by QM.
 - .5 Final certification of all structural fills, subgrade, proof rolling and granular fills by soils consultant.
- .2 Structural. QM to provide the following:
 - .1 Inspection sign-off sheets for formwork, rebar and soils testing for each concrete pour by QM.
 - .2 Inspection of soils during foundation installation by soils consultant.
 - .3 Weekly inspection of foundation and other concrete work. Report to comment on rebar, and/or bolts, inserts, formwork concreting materials and methods and conformance to specification and drawings, as well as code requirements by QM. All concrete Quality Control testing to be provided and paid for by the Contractor.
 - .4 Inspection and approval of cold weather concreting practices by QM during weekly inspections. Include form removal practices.
 - .5 Structural steel mill test reports by QM.
 - .6 Weekly inspection of structural steel installation by QM to certify conformance to specifications and drawings.
 - .7 Inspection of bolt torque and weld by QM.
 - .8 Structural weld radiography by QM. Radiography to be performed at manufacturers shop before arrival of steel on site. Percentage of welds to be tested to be per CSA Standard and as noted on the drawings and specified herein. A corrective action will be put in place in the event of non conforming welds, and will at a minimum consist of if a weld fails, adjacent welds are to be tested. If adjacent weld fails, 100% welds will be tested all at Contractors expense.

- .9 Certification by QM that all erectors, fabricators and welders are certified in accordance with the appropriate CSA standard.
- .3 Architectural. QM to provide the following:
 - .1 Masonry and mortar test reports.
 - .2 Pre-cast concrete test reports.
 - .3 Air barrier installation inspection. Provide reports.
 - .4 Inspection of insulation and vapour barrier. Approval by DCC Representative before cover-up.
 - .5 Inspection and approval of fireproofing and fire barriers by QM.
 - .6 Weekly site inspections by QM. Include report on overall conformance to specifications and drawings, quality, accuracy, alignments, levelness and plumbness.
- .4 Mechanical. QM to provide the following:
 - .1 Pressure tests of all underground and concealed piping. QM to certify.
 - .2 Weekly inspection and report on piping installations by QM.
 - .3 Inspection and report by QM that all plumbing clean-outs are installed such that the entire drainage system can be rodded.
 - .4 Inspection and report by QM on pipe hangers, hanger spacing and rod diameter.
 - .5 Inspection and report by QM on position of service valves. Certify that valves are oriented correctly.
 - .6 Inspection and report by QM on adequate service clearance being provided for mechanical equipment.
 - .7 Inspection and report by QM on isolation valves and unions being properly located for specific equipment.
 - .8 Inspection and report by QM on adequate headroom being provided.
 - .9 Inspection and report by QM on installation of expansion joints and flex connectors in piping system.
 - .10 QM to inspect and report weekly on general installation conformance to specifications and drawings.
 - .11 Inspection and report on ventilation air balancing work done by an independent specialized firm, QM to monitor
 - .12 Inspection and report of Energy Monitoring of all controls systems by QM.

- .5 Electrical. QM to provide the following:
 - .1 QM to inspect and report weekly on general installation conformance to specifications and drawings.
 - .2 Conduct and pay for tests of the following:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting systems and controls.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system, communication systems.
 - .6 Testing and reporting of grounding systems.
 - .1 Power ground system.
 - .2 Telecommunication ground system.
 - .3 Carry out tests in presence of DCC Representative
 - .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
 - .5 Test all systems in accordance with details in appropriate sections.
 - .6 Testing methods and test results: in accordance with CSA, CEC and regulations of the supply authority and other authorities having jurisdiction.
 - .7 Remove and replace with new materials all conductors that are found to be shorted or grounded.
 - .8 Conduct dielectric tests, hi-pot tests, insulation resistance tests and ground continuity tests as required by the nature of the various systems and equipment.
- .6 Fire Alarm System Testing and Adjusting. QM to provide the following:
 - .1 Ensure that the manufacturer makes an inspection of the fire alarm and smoke detection system and equipment. The inspection tests to conform to CAN/ULC-S537 Inspection and Testing of Fire Alarm System.
 - .2 On completion of the inspection and when all of the above conditions have been complied with, the manufacturer shall issue to the DCC Representative the following:

- .1 A copy of the inspecting technician's report showing the location of each device and certifying the test results of each device.
- .2 A certificate of verification confirming that the inspection has been completed and showing the conditions upon which, such inspection and certification have been rendered.
- .3 Proof of liability insurance for the inspection.
- .3 The Canadian Forces Fire Marshal (CFFM) shall conduct commissioning testing following verification. A manufacturer's representative shall be present during the testing.
- .4 The QM must be present at and during the verification and certification in order for the verification to be valid. The Contractor must furnish to the DCC Representative, prior to verification, as-built drawings showing exact routing of all conduits, exact location of all devices including end-of-line devices and exact wire counts.
- .5 Provide weekly inspection reports by QM on general installation and conformance to specifications and drawings.
- .6 Specialized Equipment to be commissioned as per manufacturer's or supplier instruction and recommendation.

1.6 DCC REPRESENTATIVE QUALITY AUDIT

- .1 DCC Representative will arrange for Quality Audit during all phases of the Contract. DCC Representative may appoint Quality Audit Personnel to assist in conducting the audit. Contractor shall provide access to all areas of the Work and provide any assistance required by the DCC Representative or his appointed quality audit personnel to carry out quality audit.
- .2 DCC Representative's Quality Audit Process will be a series of activities, which will permit the DCC Representative to ascertain that Work is being performed in accordance with the drawings and specifications, contractor's Quality Control Program and all applicable codes and standards.
- .3 The Audit process will enable the DCC Representative to monitor quality control and quality assurance mechanisms which are in place, and to request any adjustment to quality control or quality assurance processes, should such adjustments become necessary. The Audit process will allow the DCC Representative to verify, on a continuing basis,

that an appropriate Quality Management System is in place and being implemented effectively.

- .4 The Quality Audit Personnel appointed by the DCC Representative will investigate and evaluate the work and contractor's degree of compliance with the project requirements. The Quality Audit Personnel may perform up to three different types of audit during the course of the project:

- .1 Targeted Audit to attain assurance that the critical requirements have been met:
- .2 Random Audits to provide assessment of the contractor's performance in satisfying the contractual, performance and quality requirements of the work;
- .3 Monitoring Audits to investigate the compliance of possible non-conformance observed by the DCC Representative's representatives in the course of their other duties.

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 SECTIONS**

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

1.2 INSPECTION

- .1 Allow DCC Representative and DND technical authority access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by DCC Representative instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 DCC Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, DCC Representative shall pay cost of examination and replacement.

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by DCC Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by DCC Representative.
- .2 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .3 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by DCC Representative at no

cost to DCC Representative. Pay costs for retesting and re-inspection.

1.4 ACCESS TO WORK

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

1.5 PROCEDURES

- .1 Notify appropriate agency and DCC Representative 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 orderly sequence to not cause delays 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.
- .4 Carry out work using qualified licensed workers or apprentices in accordance with Provincial Act. Permit employees registered in Provincial apprenticeship program to perform specific tasks only if under direct supervision of qualified licensed workers.

1.6 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by DCC Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.
- .3 If in opinion of DCC Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, DCC Representative will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by DCC Representative.

1.7 REPORTS

- .1 Submit electronic copies of inspection and test reports to DCC Representative.
- .2 Provide copies to subcontractor of work being inspected or tested manufacturer or fabricator of material being inspected or tested.

1.8 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by DCC Representative and may be authorized as recoverable.

1.9 MOCK-UPS

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Construct in locations acceptable to DCC Representative.
- .3 Prepare mock-ups for DCC Representative's review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 If requested, DCC Representative will assist in preparing schedule fixing dates for preparation.

1.10 MILL TESTS

- .1 Submit mill test certificates as requested or as required of specification sections.

1.11 EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

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 SECTIONS**

- .1 Section 01 52 00 - Construction Facilities.
- .2 Section 01 56 00 - Temporary Barriers and Enclosures.

1.2 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order and to execute work expeditiously.
- .2 Remove from site all such work after use.

1.3 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be flameless (vent free) type. Solid fuel salamanders are not permitted.
- .3 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 regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees Celsius in areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases 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 cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.
- .7 On completion of Work for which permanent heating system is used, replace filters, and clean HVAC units and duct work.
- .8 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.4 TEMPORARY POWER AND LIGHT

- .1 Connect to existing power supply in accordance with Canadian Electrical Code.
- .2 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of DCC Representative provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract
- .3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.

1.5 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide and pay for temporary telephone, fax and data lines necessary for own use.

1.6 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.

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 SECTIONS**

- .1 Section 01 51 00 - Temporary Facilities.
- .2 Section 01 56 00 - Temporary Barriers and Enclosures.

1.2 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.3 SCAFFOLDING

- .1 Provide and maintain scaffolding, ramps and ladders.
- .2 Scaffolding in accordance with CAN/CSA-S269.2.

1.4 HOISTING

- .1 Provide, Operate and maintain cranes required for moving workers, materials, and equipment.
- .2 Cranes shall be operated by a qualified operator.
- .3 Should cranes, high lift booms or any other equipment with raised apparatus be used, Requests should be sent to Wing Operations Office no later than 7 business days prior to intended erection, through DCC Representative. The request must contain the crane's exact location diagram/map with a mark showing crane's exact location, information regarding crane dimensions, hours of operation, duration of use and emergency contact.

1.5 ELEVATORS

- .1 Designated existing elevators to be used by construction personnel and transporting of materials. Co-ordinate use with DCC Representative.
- .2 Provide protective coverings for finish surfaces of cars and entrances.

1.6 SITE STORAGE/LOADING

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.7 CONSTRUCTION PARKING

- .1 Four parking spots will be permitted on site, additional parking provided south of Highway 2.
- .2 Provide and maintain adequate access to project site.
- .3 Use existing roads for access to project site. Make good damage resulting from Contractors' use of roads.

1.8 OFFICES

- .1 Provide office heated to 22degrees C, lighted 750lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.
- .4 Allocate space for when DCC Representative visits site.

1.9 EQUIPMENT TOOLS AND MATERIALS STORAGE

- .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

- .2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

1.10 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.11 CONSTRUCTION SIGNAGE

- .1 Construction signs to be placed in locations designated by DCC Representative.
- .2 Signs and notices for safety and instruction shall be in both official languages. Graphic symbols shall conform to CAN3-Z321.
- .3 Maintain approved signs and notices in good condition for duration of project and dispose of off-site on completion of project.

1.12 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by DCC Representative.
- .3 Provide measures for protection and diversion of traffic, including provision of watchpersons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs.
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.

- .7 Construct access and haul roads necessary.
- .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control: adequate to ensure safe operation at all times.
- .11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by DCC Representative.
- .12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .13 Provide snow removal during period of Work.
- .14 Remove, upon completion of work, haul roads designated by DCC Representative.

1.13 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

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 SECTIONS**

- .1 Section 01 51 00 - Temporary Utilities.
- .2 Section 01 52 00 - Construction Facilities.

1.2 INSTALLATION AND REMOVAL

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

1.3 HOARDING

- .1 Erect temporary site enclosures using 38 x 89 mm construction grade lumber framing at 600 mm centres and 1200 x 2400 x 13 mm exterior grade fir plywood to CSA 0121.
- .2 Apply plywood panels vertically flush and butt jointed.

1.4 GUARD RAILS AND BARRICADES

- .1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs.
- .2 Provide as required by governing authorities.

1.5 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

1.6 DUST TIGHT SCREENS

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

1.7 ACCESS TO SITE

- .1 Maintain access roads, sidewalk crossings, as may be required for access to Work.

1.8 FIRE ROUTES

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.
- .2 Provide yellow marker tape to restrict DND personnel from traversing work area.

1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.10 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Be responsible for damage incurred due to lack of or improper protection.

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 SECTIONS**

- .1 Section 01 45 00 - Quality Control.

1.2 REFERENCE STANDARDS

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

1.3 QUALITY

- .1 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.
- .2 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.
- .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with DCC Representative based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

- .5 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.

1.4 AVAILABILITY

- .1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify DCC Representative 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 DCC Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, DCC Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.5 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, 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 seal 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.
- .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 sheet materials and lumber 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 DCC Representative.

- .9 Touch-up damaged factory finished surfaces to DCC Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.6 TRANSPORTATION

- .1 Pay costs of transportation of products required in performance of Work.

1.7 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, 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 DCC Representative in writing, of conflicts between specifications and manufacturer's instructions, so that DCC Representative may establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes DCC Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.8 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 DCC Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. DCC Representative reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with DCC Representative, whose decision is final.

1.9 CO-ORDINATION

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Contractor shall coordinate installation of Work with all trades. Anticipate potential space restrictions prior to installation and ensure that placement of one trade's work

does not exclude or interfere with placement of work of other trades.

1.10 CONCEALMENT

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

1.11 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate 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.

1.12 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform DCC Representative of conflicting installation. Install as directed.

1.13 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 requested 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 a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.14 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.

1.15 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of DCC Representative.

1.16 EXISTING UTILITIES

- .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 occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.17 PRODUCTS

- .1 Contractors options for selection of materials for bidding:
 - .1 Materials specified by referenced standard, select any material that meets or exceeds the specified standard.
 - .2 Materials specified by "Prescriptive" or "Performance" specification, select any material meeting or exceeding specification.
 - .3 Materials specified by naming one or more materials, select any material named. For the purpose of these

specifications, the term "Acceptable Material" is deemed to be a complete and working commodity as described by a manufacturer's name, catalogue number, trade name or any combination thereof.

- .4 When materials are specified by a Standard, Prescriptive or Performance specification, upon request of the DCC Representative, obtain from manufacturer an independent testing laboratory reporting, showing that the material or equipment meets or exceeds the specified requirements.
- .5 The design and drawings are based upon the acceptable materials or products. The acceptable materials or products may not be identified in all aspects. A later claim by the Contractor for an addition to the contract price because of changes to work necessitated by use of acceptable materials or products shall not be considered.

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 SUBMITTALS

- .1 Submit to the DCC Representative copies of the following documents, including updates issued:
 - .1 Health and Safety Program as indicated in paragraph 1.9, prior to commencement of work on the work site.
 - .2 Reports or directions issued by authorities having jurisdiction, immediately upon issuance from that authority.
 - .3 Accident or Incident Reports, within 24 hrs of occurrence.
- .2 Submit other data, information and documentation upon request by the DCC Representative as stipulated elsewhere in this section.

1.2 COMPLIANCE REQUIREMENTS

- .1 Comply with the latest edition of the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act.
- .2 Observe and enforce construction safety measures required by:
 - .1 National Building Code of Canada (latest edition).
 - .2 Provincial Worker's Compensation Board.
 - .3 Municipal statutes and ordinances.
- .3 In event of conflict between any provisions of above authorities the most stringent provision shall apply.
- .4 Provide and maintain Worker's Compensation Board coverage for all employees for the duration of the contract. Prior to commencement of the work, at the time of Interim Completion and prior to final payment, provide to the DCC Representative a letter certificate of Clearance from the Workers' Compensation Board indicating that the Contractor's account is in good standing.
 - .1 Should the Contractor be a sole proprietor, provide documented proof in a form acceptable to the DCC Representative, of an alternative means of personal coverage that meets or exceeds the requirements set out above for Worker's Compensation Board coverage.

1.3 RESPONSIBILITY

- .1 The Contractor is responsible for safety of persons and property on the work site and for protection of federal employees and the general public circulating adjacent to work site operations to extent that they may be affected by conduct of work.
- .2 The Contractor is to enforce compliance by workers and other persons granted access to work site with safety requirements of Contract Documents, applicable

federal, provincial, and local statutes, regulations, and ordinances, and with the Contractor's Health and Safety Program.

- .3 Should an unforeseen or peculiar safety related hazard or condition become evident during performance of work, immediately take measures to rectify the situation and prevent damage or harm. Advise the DCC Representative verbally and in writing of the hazard or condition.

1.4 SITE CONTROL AND ACCESS

- .1 Control all work site access points and work site activities. Delineate and isolate the work site from adjacent and surrounding areas by use of appropriate means to maintain control of all work site access points.
- .2 Make provisions for granting permission to access onto work site to all persons who require access. Procedures for granting permission to access are to be in accordance with the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act and the Contractor's Health and Safety Program.
- .3 Ensure persons granted access to the work site are in possession of and wear the minimum personal protective equipment (PPE) designated by the Contractor's Health and Safety Program. Ensure persons granted access to the work site are provided with, trained in the use of, and wear, appropriate PPE that are required above and beyond the designated minimums previously noted and as specifically related to the work site activity that they are involved in. Be responsible for the efficacy of the PPE that is provided above and beyond the designated minimums.
- .4 Erect signage at access points and at other strategic locations around the work site clearly identifying the work site area(s) as being "off-limits" to non-authorized persons. Signage must be professionally made with well understood graphic symbols and is not to be used as advertising but for the specific use as related to site safety and key contact information.
 - .1 Information to be provided on the signage is as follows:
Project Name/Description:
Contractor Company Name:
Project Superintendent's Name/Phone No.:
DCC Point of Contact Name/Phone No.:
- .5 Secure the work site at all times to protect against un-authorized access.

1.5 FILING OF NOTICE

- .1 File Notice of Project and any other required Notices with the Provincial/Territorial Authorities prior to commencement of the work. Provide the DCC Representative with a copy of the filed Notice(s) prior to commencement of the work.

1.6 PERMITS

- .1 Obtain permits, licenses and compliance certificates at appropriate times and frequencies as required by the authorities having jurisdiction.

- .2 Post all permits, licenses and compliance certificates on work site and provide copies to the DCC Representative.

1.7 PROJECT/SITE CONDITIONS

- .1 The following are the known hazardous substances and/or hazardous conditions at the work site which shall be considered as health or environmental hazards and shall be properly managed should they be encountered as part of the work:
 - .1 Contractors are required to be aware of the known hazardous substances and/or hazardous conditions and are to include in their tender price all work associated in working with, in and around the hazards.
- .2 The above lists shall not be construed as being complete and inclusive of all safety and health hazards encountered as a result of the Contractor's operations during the course of work. Include above items into the hazard assessment program specified herein.

1.8 MEETINGS

- .1 Prior to commencement of work attend a pre-commencement meeting conducted by the DCC Representative. Ensure minimum attendance by contractor's site superintendent. The DCC Representative will advise of time, date and location of the meeting and will be responsible for recording and distributing the minutes.
- .2 Conduct site specific occupational health and safety meetings as required by the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act.
- .3 Record and post minutes of all meetings in plain view on the work site. Make copies available to the DCC Representative upon request.

1.9 HEALTH AND SAFETY PROGRAM

- .1 Contractors are required under the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act to have in place a Health and Safety Program. Compliance requirements for the content, detail and implementation of the program resides with the provincial/territorial authority.
- .2 The Health and Safety Program shall include a site-specific Health and Safety Plan that acknowledges, assesses and addresses the hazardous substances and/or hazardous conditions known and identified in paragraph 1.7 above, and on-going hazard assessments performed during the progress of work identifying and documenting new or potential health risks and safety hazards not previously known and identified.
- .3 Provide one copy of the Health and Safety Program to the DCC Representative prior to commencement of work on the work site. The copy provided to the DCC Representative is for the purpose of review against the contract requirements related to the known hazardous substances and/or hazardous conditions. The review is not to be construed to imply approval by the DCC Representative that the program is

complete, accurate and legislatively compliant with the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act, and shall not relieve the Contractor of their legal obligations under such legislation.

1.10 ACCIDENT REPORTING

- .1 Investigate and report incidents and accidents as required by Ontario Occupational Safety and Health Act, and the Regulations made pursuant to the Act.
- .2 For the purpose of this contract immediately investigate and provide a report to the DCC Representative on incidents and accidents that involve:
 - .1 A resulting injury that may or may not require medical aid but involves lost time at work by the injured person(s).
 - .2 Exposure to toxic chemicals or substances.
 - .3 Property damage.
 - .4 Interruption to adjacent and/or integral infrastructure operations with potential loss implications.
 - .5 Safety incidents that are of contractual nature, requested by the DCC Representative.
- .3 In the investigation and reporting of incidents and accidents, the Contractor is required to respond in a timely fashion to correct the action that was deemed to have caused the incident and/or accident and advise in writing on the action taken to prevent a re-occurrence of the incident and/or accident.

1.11 RECORDS ON SITE

- .1 Maintain on site a copy of the safety documentation as specified in this section and any other safety related reports and documents issued to or received from the authorities having jurisdiction.
- .2 Upon request, make copies available to the DCC Representative.

END OF SECTION

PART 1 General**1.1 RELATED SECTIONS**

- .1 Section 01 77 00 - Closeout Procedures.

1.2 PROJECT CLEANLINESS

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

1.3 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 and leave Work clean and suitable for occupancy.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 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.
- .5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- .6 Clean lighting reflectors, lenses, and other lighting surfaces.
- .7 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .8 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .11 Remove dirt and other disfiguration from exterior surfaces.
- .12 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .13 Sweep and wash clean paved areas.
- .14 Clean equipment and fixtures to sanitary condition; replace filters of mechanical equipment.
- .15 Clean roofs, downspouts, and drainage systems.
- .16 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

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 DEFINITIONS**

- .1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
- .2 Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, re modeling, and demolition operations.
- .3 Hazardous: Exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.
- .4 Non-hazardous: Exhibiting none of the characteristics of hazardous substances, including properties such as ignitability, corrosiveness, toxicity, or reactivity.
- .5 Non-toxic: Not poisonous to humans either immediately or after a long period of exposure.
- .6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- .7 Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- .8 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form; recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Return: To give back reusable items or unused products to vendors for credit.
- .10 Reuse: To reuse a construction waste material in some manner on the project site.
- .11 Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- .12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run off water.
- .13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

- .14 Toxic: Poisonous to humans either immediately or after a long period of exposure.
- .15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- .16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:
 - .1 Solvents in paints and other coatings;
 - .2 Wood preservatives; strippers and household cleaners;
 - .3 Adhesives in particleboard, fiberboard, and some plywood; and foam insulation.
 - .4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.
- .17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.2 MATERIALS SOURCE SEPARATION PROGRAM

- .1 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.
- .2 Provide containers to deposit reusable and recyclable materials.
- .3 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- .4 Locate separated material(s) in area(s) which minimize material damage.
- .5 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

1.3 STORAGE, HANDLING AND PROTECTION

- .1 Store/stockpile materials to be reused, recycled and salvaged in locations as directed by DCC Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.

- .4 Protect surface drainage, mechanical and electrical from damage and blockage.

1.4 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.
- .2 Do not dispose of waste into waterways, storm, or sanitary sewers.
- .3 Dispose of all waste materials off-site at licensed facility in accordance with appropriate provincial and municipal regulations.
- .4 Keep records of construction waste including:
 - .1 Number and size of bins.
 - .2 Waste type of each bin.
 - .3 Total tonnage generated.
 - .4 Tonnage reused or recycled.
 - .5 Reused or recycled waste destination.

PART 2 Products

2.1 NOT USED

- .1 Not Used.

PART 3 Execution

3.1 APPLICATION

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

3.2 CLEANING

- .1 Remove tools and waste materials on completion of Work and leave work area in clean and orderly condition.
- .2 Clean up work area as work progresses.

END OF SECTION

Part 1 General**1.1 RELATED SECTIONS**

- .1 Section 01 78 00 - Closeout Submittals.
- .2 Section 01 91 13 - General Commissioning (Cx) Requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: Contractor: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify DCC Representative in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request DCC Representative's inspection.
 - .2 DCC Representative's Inspection:
 - .1 DCC Representative and Contractor to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted, balanced and fully operational.
 - .4 Certificates required by Fire Commissioner and Utility companies: submitted.
 - .5 Operation of systems: demonstrated to Owner's personnel.
 - .6 Commissioning of mechanical systems: completed in accordance with 01 91 13 - General Commissioning Requirements and 01 91 13.13 - Commissioning Plan and copies of final Commissioning Report submitted to DCC Representative.
- .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by DCC Representative, and Contractor.

.2 When Work incomplete according to DND and DCC Representative, complete outstanding items and request reinspection.

.2 Declaration of Substantial Performance: when DND and DCC Representative consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance.

.3 Commencement Warranty Periods: date of DND's acceptance of submitted declaration of Substantial Performance shall be date for commencement for warranty period.

.4 Final Payment: When DND and DCC Representative consider final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. If Work is deemed incomplete by DND and DCC Representative, complete outstanding items and request re-inspection.

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 SECTIONS**

- .1 Section 01 45 00 - Quality Control.
- .2 Section 01 77 00 - Closeout Procedures.
- .3 Section 01 91 13 - General Commissioning (Cx) Requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting one week prior to contract completion with contractor's representative and DCC Representative, in accordance with Section 01 31 19 - Project Meetings to:
 - .1 Verify Project requirements.
 - .2 Review warranty requirements.
 - .2 DCC Representative 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 INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the DCC Representative, four final copies and an electronic copy of operating and maintenance manuals in English.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.4 FORMAT

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets, filled no more than 2/3rds full.
- .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 type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems or process flow, 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 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide one copy of the operating and maintenance manuals in digital

1.5 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents: provide title of project;
 - .1 Date of submission; names,
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
 - .3 Schedule of products and systems indexed to content of volume.
- .2 For each product or system:
 - .1 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 in Section 01 45 00 - Quality Control.

1.6 AS-BUILT DOCUMENTS AND SAMPLES

- .1 In addition to requirements in General Conditions, maintain at the site for DCC Representative one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to 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 inspection by DCC Representative.

1.7 RECORDING ACTUAL SITE CONDITIONS

- .1 Contractor shall maintain during construction two sets of white prints for record drawing purposes. Record changes and at completion of project submit one marked copy to the DCC Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: 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 change orders and addenda.
 - .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 At completion of project, transfer recorded changes to Construction Drawings and submit as-built drawings to DCC Representative. DCC Representative will furnish copy of original construction drawings in electronic format. As built drawing submissions shall include one (1) marked copy of the Construction Drawings, one (1) hard copy of the As-built drawings and one (1) copy of As-built drawings in electronic format: AutoCAD 2004 or later. All drawings shall be submitted and marked As-Built.
- .8 Provide digital photographs, if requested by DCC representative.

1.8 EQUIPMENT AND SYSTEMS

- .1 Each item of equipment and each system: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions.
 - .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 Panelboard 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 coordination 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 Additional requirements: As specified in individual specification sections.

1.9 MATERIALS AND FINISHES

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations.

- .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.

1.10 STORAGE, HANDLING AND PROTECTION

- .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 DCC Representative.

1.11 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned prewarranty conference, to DCC Representative for approval.
- .3 Warranty management plan to include required actions and documents to assure that DCC Representative receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to DCC Representative for approval prior to each monthly pay estimate.
- .6 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 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.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 11-month warranty inspection, measured from time of acceptance, by DCC Representative.
- .9 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 HVAC balancing, pumps, motors, and commissioned systems such as fire protection, alarm systems, and sprinkler 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 11-month postconstruction 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.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .11 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the DCC Representative to proceed with action against Contractor.

1.12 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water-resistant tag approved by DCC Representative.
- .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**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 ADMINISTRATIVE REQUIREMENTS**

- .1 Demonstrate Operation and maintenance of equipment and systems to Owner's personnel two weeks prior to date of substantial performance completion.
- .2 Owner: provide list of personnel to receive instructions and coordinate their attendance at agreed-upon times.
- .3 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure equipment has been inspected and put into operation.
 - .4 Ensure testing, adjusting, and balancing has been performed in accordance with Section 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.
- .5 Time Allocated for Instructions: ensure amount of time required for instruction of each item of equipment or system as follows:
 - .1 Section 23 73 10 - Air Handling Unit: 8 hours of instructions.
 - .2 Section 23 65 10 - Condensers, Coolers and Cooling Towers: 8 hours of instructions.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for DCC Representative's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
 - .1 Instruct Owner's personnel.
 - .2 Provide written report that demonstration and instructions have been completed.

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 relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Acronyms:
 - .1 AFD - Alternate Forms of Delivery, service provider.
 - .2 BMM - Building Management Manual.
 - .3 Cx - Commissioning.
 - .4 EMCS - Energy Monitoring and Control Systems.
 - .5 O&M - Operation and Maintenance.
 - .6 PI - Product Information.
 - .7 PV - Performance Verification.
 - .8 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the BMM.
 - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .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 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.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.
- .4 AFD managed projects the term DCC Representative in Cx specifications to be interpreted as AFD Service Provider.

1.3 COMMISSIONING OVERVIEW

- .1 Section 01 91 31- Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31- Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.
- .6 DCC Representative will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by DCC Representative .
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by DCC Representative , to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review Contract Documents, confirm by writing to DCC Representative.
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.
 - .4 Have Cx documentation shelf-ready.
 - .5 Understand completely design criteria and intent and special features.
 - .6 Submit complete start-up documentation to DCC Representative .
 - .7 Have Cx schedules up-to-date.
 - .8 Ensure systems have been cleaned thoroughly.
 - .9 Complete TAB procedures on systems, submit TAB reports to DCC Representative for review and approval.
 - .10 Ensure "As-Built" system schematics are available.
- .4 Inform DCC Representative in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to DCC Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.
 - .1 Submit no later than 4weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.

- .2 Request in writing to DCC Representative for changes to submittals and obtain written approval at least 8weeks prior to start of Cx.
- .3 Submit proposed Cx procedures to DCC Representative where not specified and obtain written approval at least 8weeks prior to start of Cx.
- .4 Provide additional documentation relating to Cx process required by DCC Representative .

1.8 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 33- Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 DCC Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to DCC Representative .

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.06- Construction Progress Schedule - Critical Path Method (CPM) 01 32 16.07- Construction Progress Schedules - Bar (GANTT) Chart.
- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.10 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings: Section 01 32 16.06- Construction Progress Schedule - Critical Path Method (CPM) 01 32 16.07- Construction Progress Schedules - Bar (GANTT) Chart and as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Section 01 32 16.07- Construction Progress Schedules - Bar (GANTT) Chart 01 32 16.06- Construction Progress Schedule - Critical Path Method (CPM). DCC Representative to call a separate Cx

scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:

- .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
- .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by DCC Representative Cx Agent Contractor, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 14days notice prior to commencement.
- .2 DCC Representative to witness of start-up and testing.
- .3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:
 - .1 Coordinate time and location of testing.
 - .2 Provide testing documentation for approval by DCC Representative .
 - .3 Arrange for DCC Representative to witness tests.
 - .4 Obtain written approval of test results and documentation from DCC Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with DCC Representative

- .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
- .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from DCC Representative after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by DCC Representative . If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

- .1 Minor equipment/systems: implement corrective measures approved by DCC Representative.
- .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by DCC Representative .
- .3 If evaluation report concludes that major damage has occurred, DCC Representative shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to DCC Representative for approval before commencement of commissioning.
- .2 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 DCC Representative to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit DCC Representative for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

- .1 Notify DCC Representative at least 21days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

- .1 Submit to DCC Representative for review and approval:
 - .1 Complete list of instruments proposed to be used.
 - .2 Listed data including, serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide the following equipment as required:
 - .1 2-way radios.
 - .2 Ladders.
 - .3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under actual accepted simulatedoperating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.
- .4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

- .1 DCC Representative to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority 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 DCC Representative within 5days of test and with Cx report.

1.23 COMMISSIONING CONSTRAINTS

- .1 Since access into secure or sensitive areas will be very difficult after occupancy it is necessary to complete Cx of occupancy, weather, and seasonal sensitive equipment and systems in these areas before issuance of the Interim Certificate, using, if necessary, simulated thermal loads.

1.24 EXTRAPOLATION OF RESULTS

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by DCC Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.25 EXTENT OF VERIFICATION

- .1 Laboratory areas:
 - .1 Provide manpower and instrumentation to verify up to 100% of reported results.
- .2 Elsewhere:
 - .1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.
- .3 Number and location to be at discretion of DCC Representative .
- .4 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .5 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .6 Perform additional commissioning until results are acceptable to DCC Representative .

1.26 REPEAT VERIFICATIONS

- .1 Assume costs incurred by DCC Representative for third and subsequent verifications where:
 - .1 Verification of reported results fail to receive DCC Representative's approval.
 - .2 Repetition of second verification again fails to receive approval.
 - .3 DCC Representative deems Contractor's request for second verification was premature.

1.27 SUNDRY CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.28 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of DCC Representative .
- .2 Report problems, faults or defects affecting Cx to DCC Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from DCC Representative .

1.29 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by DCC Representative .

1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.31 TRAINING

- .1 In accordance with Section 01 91 41- Commissioning (Cx) - Training.

1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.33 OCCUPANCY

- .1 Cooperate fully with DCC Representative during stages of acceptance and occupancy of facility.

1.34 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under Contract for TAB and PV if:
 - .1 Accuracy complies with these specifications.

- .2 Calibration certificates have been deposited with DCC Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.35 PERFORMANCE VERIFICATION TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 10% of specified values.
- .2 Instrument accuracy tolerances:
 - .1 To be of higher order of magnitude than equipment or system being tested.
- .3 Measurement tolerances during verification:
 - .1 Unless otherwise specified actual values to be within +/- 2% of recorded values.

1.36 OWNER'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by DCC Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

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 GENERAL

- .1 Provide a fully functional system:
 - .1 Systems, equipment, and components meet user's functional requirements before date of acceptance and operate consistently at peak efficiencies, and within specified energy budgets under normal loads.
 - .2 Facility user and O&M personnel have been fully trained in aspects of installed systems.
 - .3 Optimized life cycle costs.
 - .4 Complete documentation relating to installed equipment and systems.
- .2 Term "Cx" in this Section means "Commissioning".
- .3 Use this Cx Plan as Master Planning Document for Cx:
 - .1 Outlines organization, scheduling, allocation of resources, documentation, pertaining to implementation of Cx.
 - .2 Communicates responsibilities of team members involved in Cx Scheduling, documentation requirements, and verification procedures.
 - .3 Sets out deliverables relating to O&M, process, and administration of Cx.
 - .4 Describes process of verification of how built works meet design requirements.
 - .5 Produces a complete functional system prior to issuance of Certificate of Occupancy.
 - .6 Management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 - .1 Overview of Cx.
 - .2 General description of elements that make up Cx Plan.
 - .3 Process and methodology for successful Cx.
- .4 Acronyms:
 - .1 BMM - Building Management Manual.
 - .2 Cx - Commissioning.
 - .3 EMCS - Energy Monitoring and Control Systems.
 - .4 PI - Product Information.
 - .5 PV - Performance Verification.
 - .6 TAB - Testing, Adjusting and Balancing.
 - .7 WHMIS Safety Data Sheets (SDS).

.8 WHMIS - Workplace Hazardous Materials Information System.

- .5 Commissioning terms used in this Section:
- .1 Bumping: Short-term start-up to prove ability to start and prove correct rotation.
 - .2 Deferred Cx - Cx activities delayed for reasons beyond Contractor's control due to lack of occupancy, weather conditions, need for heating/cooling loads.

1.2 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 100% completed within eight (12) weeks of award of Contract to consider:
 - .1 Approved Shop Drawings and product data.
 - .2 Approved changes to Contract.
 - .3 Contractor's project schedule.
 - .4 Cx schedule.
 - .5 Contractor's, sub-contractor's, and suppliers' requirements.
 - .6 Project construction team's and Cx team's requirements.
- .2 Submit completed Cx Plan to DCC Representative and obtain written approval.

1.3 REFINEMENT OF CX PLAN

- .1 During construction phase, revise, refine and update Cx Plan to include:
 - .1 Changes resulting from Client program modifications.
 - .2 Approved design and construction changes.
- .2 Revise, refine and update every 2 months during construction phase. At each revision, indicate revision number and date.
- .3 Submit each revised Cx Plan to DCC Representative for review and obtain written approval.
- .4 Include testing parameters at full range of operating conditions and check responses of equipment and systems.

1.4 COMPOSITION, ROLES, AND RESPONSIBILITIES OF CX TEAM

- .1 DCC Representative to maintain overall responsibility for project and is sole point of contact between members of Cx team.
- .2 Project Manager will select Cx Team consisting of following members:
 - .1 DCC Representative is responsible for:

-
- .1 Organizing Cx.
 - .2 Monitoring operations Cx activities.
 - .3 Witnessing, certifying accuracy of reported results.
 - .4 Witnessing and certifying TAB and other tests.
 - .5 Developing BMM.
 - .6 Ensuring implementation of final Cx Plan.
 - .7 Implementation of Training Plan.
 - .2 Construction Team: Contractor, subcontractors, suppliers, and support disciplines, are responsible for construction/installation in accordance with Contract Documents, including:
 - .1 Testing.
 - .2 TAB.
 - .3 Performance of Cx activities.
 - .4 Delivery of training and Cx documentation.
 - .5 Assigning one (1) person as point of contact with DCC Representative for administrative and coordination purposes.
 - .3 Contractor's Cx agent implements specified Cx activities including:
 - .1 Monitoring operations Cx activities.
 - .2 Performing verification of performance of installed systems and equipment.
 - .3 Demonstrations.
 - .4 Training.
 - .5 Testing.
 - .6 Preparation, submission of test reports.
 - .4 Property Manager: Represents lead role in Operation Phase and onwards and is responsible for:
 - .1 Receiving facility.
 - .2 Day-To-Day operation and maintenance of facility.

1.5 CX PARTICIPANTS

- .1 Employ the following Cx participants to verify performance of equipment and systems:
 - .1 Installation Contractor/Subcontractor:
 - .1 Equipment and systems except as noted.
 - .2 Equipment Manufacturer: Equipment specified to be installed and started by manufacturer.
 - .1 To include performance verification.

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- .3 Specialist Subcontractor: Equipment and systems supplied and installed by specialist subcontractor.
 - .4 Specialist Cx Agency:
 - .1 Possessing specialist qualifications and installations providing environments essential to Client's program but are outside scope or expertise of Cx specialists on this project.
 - .5 Client: Responsible for intrusion and access security systems.
 - .6 Ensure that Cx participant:
 - .1 Could complete Work within scheduled time frame.
 - .2 Available for emergency and troubleshooting service during first year of occupancy by user for adjustments and modifications outside responsibility of O&M personnel, including:
 - .1 Modify ventilation rates to meet changes in off-gassing.
 - .2 Changes to heating or cooling loads beyond scope of EMCS.
 - .3 Changes to EMCS control strategies beyond level of training provided to O&M personnel.
 - .4 Redistribution of electrical services.
 - .5 Modifications of fire alarm systems.
 - .6 Modifications to voice communications systems.
 - .7 Provide names of participants to DCC Representative and details of instruments and procedures to be followed for Cx three (3) months prior to starting date of Cx for review and approval.

1.6 EXTENT OF CX

- .1 Commission mechanical systems and associated equipment:
 - .1 Plumbing systems:
 - .1 Domestic CWS and HWS.
 - .2 Regular sanitary waste systems.
 - .2 HVAC and exhaust systems:
 - .1 HVAC systems AHU-11, CU-11
 - .2 Computer Room Air Conditioning: AC-01
 - .3 Terminal Devices: All new VAV boxes.
 - .3 Fire and life safety systems:
 - .1 Special fire suppression systems identified herein:
 - .1 Wet pipe sprinkler systems.

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- .4 EMCS:
 - .1 Control systems for new mechanical equipment.
 - .2 Commission electrical systems and equipment:
 - .1 Low voltage below 750 V:
 - .1 Low voltage equipment.
 - .2 Low voltage distribution systems.
 - .3
 - .4 Electronic data and communications information systems.
 - .2 Lighting systems:
 - .1 Lighting equipment.
 - .2 Distribution systems.
 - .3 Emergency lighting systems, including battery packs.
 - .4 Fire exit emergency signage.
 - .3 Fire alarm systems, equipment:
 - .1 Control panels.
 - .4 Other systems and equipment:
 - .1 Intrusion and access security and safety systems.

1.7 DELIVERABLES RELATING TO O&M PERSPECTIVES

- .1 General Requirements:
 - .1 Compile English documentation.
 - .2 Documentation to be computer-compatible format ready for inputting for data management.
- .2 Provide deliverables:
 - .1 Warranties.
 - .2 Project record documentation.
 - .3 Inventory of spare parts, special tools, and maintenance materials.
 - .4 Maintenance Management System (MMS) identification system used.
 - .5 WHMIS information.
 - .6 WHMIS Safety Data Sheets (SDS).
 - .7 Electrical panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.8 DELIVERABLES RELATING TO THE CX PROCESS

- .1 General:

-
- .1 Start-up, testing, and Cx requirements, conditions for acceptance and specifications form part of relevant technical Sections of these Specifications.
 - .2 Definitions:
 - .1 Cx as used in this Section includes:
 - .1 Cx of components, equipment, systems, subsystems, and integrated systems.
 - .2 Factory inspections and performance verification tests.
 - .3 Deliverables: Provide:
 - .1 Cx Specifications.
 - .1 Startup, pre-Cx activities, and documentation for systems and equipment.
 - .2 Completed installation checklists (ICL).
 - .3 Completed Product Information (PI) report forms.
 - .4 Completed Performance Verification (PV) report forms.
 - .5 Results of Performance Verification Tests and Inspections.
 - .6 Description of Cx activities and documentation.
 - .7 Description of Cx of integrated systems and documentation.
 - .8 Tests performed by DCC Representative.
 - .9 Training Plans.
 - .10 Cx Reports.
 - .11 Prescribed activities during warranty period.
 - .4 DCC Representative to witness and certify tests and reports of results provided to DCC Representative.
 - .5 DCC Representative to participate.

1.9 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: By DCC Representative prior to permission to start-up and rectification of deficiencies to DCC Representative's satisfaction;
 - .2 DCC Representative to use approved checklists;
 - .3 DCC Representative will monitor all pre-start-up inspections;
 - .4 Include completed documentation with Cx report;
 - .5 Conduct pre-start-up tests: Conduct pressure, static, flushing, cleaning, and "bumping" during construction, as specified in Technical Sections. To be witnessed and

-
- certified by DCC Representative and does not form part of Cx specifications;
- .6 DCC Representative will monitor some of these inspections and tests;
 - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - ARCHITECTURAL AND STRUCTURAL:
- .1 Exterior roof systems at penetrations: conduct thermographic surveys to ensure appropriate level of tightness after exterior envelope has been completed. Permanent HVAC systems are able to provide appropriate negative or positive pressure, a temperature of at 20 degrees C can be maintained between inside and outside and wind speed is less than 10 kph.
 - .2 Pre-Cx activities - MECHANICAL:
 - .1 Plumbing systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 Complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .2 HVAC equipment and systems:
 - .1 "Bump" each item of equipment in its "stand-alone" mode.
 - .2 At this time, complete pre-start-up checks and complete relevant documentation.
 - .3 After equipment has been started, test related systems in conjunction with control systems on a system-by-system basis.
 - .4 Perform TAB on systems. TAB reports to be approved by DCC Representative.
 - .3 EMCS:
 - .1 EMCS trending to be available as supporting documentation for performance verification.
 - .2 Perform point-by-point testing in parallel with start-up.
 - .3 Carry out point-by-point verification.
 - .4 Demonstrate performance of systems, to be witnessed by DCC Representative prior to start of 30 day Final Acceptance Test period.
 - .5 Perform final Cx and operational tests during demonstration period and 30 day test period.

-
- .6 Only additional testing after foregoing have been successfully completed to be "Off-Season Tests".
 - .4 Pre-Cx activities - LIFE SAFETY SYSTEMS
 - .1 Include equipment and systems identified above.
 - 1. Reports of test results to be witnessed and certified by [DCC Representative] before verification.
 - .5 Pre-Cx activities - ELECTRICAL:
 - .1 Low voltage distribution systems under 750 V:
 - 1. Requires independent testing agency to perform preenergization and post-energization tests.
 - .2 Lighting systems:
 - 1. Emergency lighting systems:
 - .1 Tests to include verification of lighting levels and coverage, initially by disrupting normal power.
 - .3 Fire alarm systems: test after other safety and security systems are completed. Testing to include a complete verification in accordance with ULC requirements. DCC Representative has witnessed and certified report, demonstrate devices and zones to DCC Representative.
 - .4 Low voltage systems: these include:
 - 1. Low voltage lighting control systems and data communications systems.
 - .5 Security, surveillance and intrusion alarm systems: to include verification by MP, and DCC Representative.

1.10 START-UP

- .1 Start up components, equipment, and systems.
- .2 Equipment manufacturer, supplier, installing specialist sub-contractor, as appropriate, to start-up, under Contractor's direction, following equipment and systems:
 - .1 AHU-11, CU-11, AC-01.
- .3 DCC Representative to monitor all start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of DCC Representative.
- .4 Performance Verification (PV):
 - .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to DCC Representative.

-
- .2 Use procedures modified generic procedures to suit project requirements.
 - .3 DCC Representative to witness and certify reported results using approved PI and PV forms.
 - .4 DCC Representative to approve completed PV reports and provide to DCC Representative.
 - .5 DCC Representative reserves right to verify up to 100% of reported results at random.
 - .6 Failure of randomly selected item shall result in rejection of PV report or report of system start-up and testing.

1.11 CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Perform Cx by specified Cx agency using procedures developed by DCC Representative and approved by DCC Representative.
- .2 DCC Representative to monitor Cx activities.
- .3 Upon satisfactory completion, Cx agency performing tests to prepare Cx Report using approved PV forms.
- .4 DCC Representative to witness, certify reported results of Cx activities, and forward to DCC Representative.
- .5 DCC Representative reserves right to verify a percentage of reported results at no cost to Contract.

1.12 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Cx to be performed by specified Cx specialist, using procedures developed and approved by DCC Representative.
- .2 Tests to be witnessed by DCC Representative and documented on approved report forms.
- .3 Upon satisfactory completion, Cx specialist to prepare Cx Report, to be certified by DCC Representative, and submitted to DCC Representative for review.
- .4 DCC Representative reserves right to verify percentage of reported results.
- .5 Integrated systems to include:
 - .1 HVAC and associated systems forming part of integrated HVAC systems:AHU-11, CU-11, VAV boxes, AC-01.
 - .2 Fire alarm systems.
 - .3 Emergency lighting systems.
- .6 Identification:
 - .1 In later stages of Cx, before hand-over and acceptance DCC Representative, Contractor, and Cx Manager to co-

operate to complete inventory data sheets and provide assistance to DCC Representative in full implementation of MMS identification system of components, equipment, sub-systems, systems.

1.13 DELIVERABLES RELATING TO ADMINISTRATION OF CX

.1 General:

- .1 Because of risk assessment, complete Cx of occupancy, weather and seasonal-sensitive equipment and systems in these areas before building is occupied.

1.14 CX SCHEDULES

- .1 Prepare detailed Cx Schedule and submit to DCC Representative for review and approval same time as project Construction Schedule. Include:
 - .1 Milestones, testing, documentation, training and Cx activities of components, equipment, subsystems, systems and integrated systems, including:
 - .1 Design criteria, design intents.
 - .2 Pre-TAB review: 28 days after contract award, and before construction starts.
 - .3 Cx agents' credentials: 60 days before start of Cx.
 - .4 Cx procedures: 3 months after award of contract.
 - .5 Cx Report format: 3 months after contract award.
 - .6 Discussion of heating/cooling loads for Cx: 3 months before start-up.
 - .7 Submission of list of instrumentation with relevant certificates: 21 days before start of Cx.
 - .8 Notification of intention to start TAB: [21] days before start of TAB.
 - .9 TAB: after successful start-up, correction of deficiencies and verification of normal and safe operation.
 - .10 Notification of intention to start Cx: 14 days before start of Cx.
 - .11 Notification of intention to start Cx of integrated systems: after Cx of related systems is completed 14 days before start of integrated system Cx.
 - .12 Identification of deferred Cx.
 - .13 Implementation of training plans.
 - .14 Cx reports: immediately upon successful completion of Cx.

.15 Emergency evacuation exercises: after [80]% occupancy [and at same time as Cx of stair shaft pressurization systems].

.2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Property Manager.

.2 After approval, incorporate Cx Schedule into Construction Schedule.

.3 Consultant, Contractor, Contractor's Cx agent, and DCC Representative will monitor progress of Cx against this schedule.

1.15 CX REPORTS

.1 Submit reports of tests, witnessed and certified by DCC Representative to DCC Representative who will verify reported results.

.2 Include completed and certified PV reports in properly formatted Cx Reports.

.3 Before reports are accepted, reported results to be subject to verification by DCC Representative.

1.16 ACTIVITIES DURING WARRANTY PERIOD

.1 Cx activities must be completed before issuance of Substantial Completion, it is anticipated that certain Cx activities may be necessary during Warranty Period, including:

.1 Fine tuning of HVAC systems.

.2 Adjustment of ventilation rates to promote good indoor air quality and reduce deleterious effects of VOCs generated by off-gassing from construction materials and furnishings.

.3 Full-scale emergency evacuation exercises.

1.17 FINAL SETTINGS

.1 Upon completion of Cx to satisfaction of DCC Representative lock control devices in their final positions, indelibly mark settings marked and include in Cx Reports.

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 Commissioning forms to be completed for equipment, system and integrated system.

1.2 INSTALLATION/START-UP CHECK LISTS

- .1 Include the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by DCC Representative supplemental additional data lists will be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to DCC Representative . Check lists will be required during Commissioning and will be included in Building Maintenance Manual (BMM) at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the BMM at completion of work.

- .2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain DCC Representative's approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain DCC Representative's approval.

1.5 SAMPLES OF COMMISSIONING FORMS

- .1 DCC Representative will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
- .2 Revise items on Commissioning forms to suit project requirements.
- .3 Samples of Commissioning forms and a complete index of produced to date will be attached to this section.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

- .1 When additional forms are required, but are not available from DCC Representative develop appropriate verification forms and submit to DCC Representative for approval prior to use.
 - .1 Additional commissioning forms to be in same format as provided by DCC Representative

1.7 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 DCC Representative provides Contractor project-specific Commissioning forms with Specification data included.
 - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .3 Confirm operation as per design criteria and intent.

- .4 Identify variances between design and operation and reasons for variances.
- .5 Verify operation in specified normal and emergency modes and under specified load conditions.
- .6 Record analytical and substantiating data.
- .7 Verify reported results.
- .8 Form to bear signatures of recording technician and reviewed and signed off by DCC Representative .
- .9 Submit immediately after tests are performed.
- .10 Reported results in true measured SI unit values.
- .11 Provide DCC Representative with originals of completed forms.
- .12 Maintain copy on site during start-up, testing and commissioning period.
- .13 Forms to be both hard copy and electronic format with typed written results in Building Management Manual in accordance with Section 01 91 51- Building Management Manual (BMM) .

1.8 LANGUAGE

- .1 To suit the language profile of the awarded contract.

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 This Section specifies roles and responsibilities of Commissioning Training.

1.2 TRAINEES

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Property Facility Manager, building operators, maintenance staff, security staff, and technical specialists as required.
- .2 Trainees will be available for training during later stages of construction for purposes of familiarization with systems.

1.3 INSTRUCTORS

- .1 DCC Representative will provide:
 - .1 Descriptions of systems.
 - .2 Instruction on design philosophy, design criteria, and design intent.
- .2 Contractor and certified factory-trained manufacturers' personnel: to provide instruction on the following:
 - .1 Start-Up, operation, shut-down of equipment, components and systems.
 - .2 Control features, reasons for, results of, implications on associated systems of, adjustment of set points of control and safety devices.
 - .3 Instructions on servicing, maintenance and adjustment of systems, equipment and components.
- .3 Contractor and equipment manufacturer to provide instruction on:
 - .1 Start-up, operation, maintenance and shut-down of equipment they have certified installation, started up and carried out PV tests.

1.4 TRAINING OBJECTIVES

- .1 Training to be detailed and duration to ensure:
 - .1 Safe, reliable, cost-effective, energy-efficient operation of systems in normal and emergency modes under all conditions.

- .2 Effective on-going inspection, measurements of system performance.
- .3 Proper preventive maintenance, diagnosis and trouble-shooting.
- .4 Ability to update documentation.
- .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.5 TRAINING MATERIALS

- .1 Instructors to be responsible for content and quality.
- .2 Training materials to include:
 - .1 "As-Built" Contract Documents.
 - .2 Operating Manual.
 - .3 Maintenance Manual.
 - .4 Management Manual.
 - .5 TAB and PV Reports.
- .3 Project Manager, Commissioning Manager and Property Facility Manager will review training manuals.
- .4 Training materials to be in a format that permits future training procedures to same degree of detail.
- .5 Supplement training materials:
 - .1 Transparencies for overhead projectors.
 - .2 Multimedia presentations.
 - .3 Manufacturer's training videos.
 - .4 Equipment models.

1.6 SCHEDULING

- .1 Include in Commissioning Schedule time for training.
- .2 Deliver training during regular working hours, training sessions to be 3hours in length.
- .3 Training to be completed prior to acceptance of facility.

1.7 RESPONSIBILITIES

- .1 Be responsible for:
 - .1 Implementation of training activities,
 - .2 Coordination among instructors,
 - .3 Quality of training, training materials,
- .2 DCC Representative will evaluate training and materials.
- .3 Upon completion of training, provide written report, signed by Instructors, witnessed by DCC Representative .

1.8 TRAINING CONTENT

- .1 Training to include demonstrations by Instructors using the installed equipment and systems.
- .2 Content includes:
 - .1 Review of facility and occupancy profile.
 - .2 Functional requirements.
 - .3 System philosophy, limitations of systems and emergency procedures.
 - .4 Review of system layout, equipment, components and controls.
 - .5 Equipment and system start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
 - .6 System operating sequences, including step-by-step directions for starting up, shut-down, operation of valves, dampers, switches, adjustment of control settings and emergency procedures.
 - .7 Maintenance and servicing.
 - .8 Trouble-shooting diagnosis.
 - .9 Inter-Action among systems during integrated operation.
 - .10 Review of O&M documentation.
- .3 Provide specialized training as specified in relevant Technical Sections of the construction specifications.

1.9 VIDEO-BASED TRAINING

- .1 Manufacturer's videotapes to be used as training tool with DCC Representative's review and written approval 3months prior to commencement of scheduled training.
- .2 On-Site training videos:
 - .1 Videotape training sessions for use during future training.
 - .2 To be performed after systems are fully commissioned.
 - .3 Organize into several short modules to permit incorporation of changes.
- .3 Production methods to be professional high quality.

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 REQUIREMENTS**

- .1 Section 02 41 19.16 - Selective Interior Demolition.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 2012
 - .2 Canadian Environmental Protection Act (CEPA), 2012
 - .1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations.
 - .2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34
 - .4 Motor Vehicle Safety Act (MVSA), 1995
 - .5 Hazardous Materials Information Review Act, 1985
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 241 - 96, Standard for Safeguarding Construction, Alteration, and Demolition Operations
- .4 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
 - .2 National Fire Code of Canada 2015 (NFC).
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S660-08, Standard for Non-metallic Underground Piping for Flammable and Combustible Liquids
 - .2 ULC/ORD-C58.15-1992, Overfill Protection Devices for Flammable Liquid Storage Tanks
 - .3 ULC/ORD-C58.19-1992, Spill Containment Devices for Underground Flammable Liquid Storage Tanks

1.3 DEFINITIONS

- .1 Demolition: rapid destruction of building following removal of hazardous materials.
- .2 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, may include

but not limited to: asbestos PCB's, CFC's, HCFC's poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health or wellbeing or environment if handled improperly.

- .3 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements .
- .4 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19- Waste Management and Disposal.
- .5 Construction Waste Management Report (CWM Report): Written report identifying actual materials that formed CWM Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with DCC Representative for the material ownership including but not limited to:
 - .1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain DCC Representative's property, demolished materials shall become Contractor's property and shall be removed from Project site.
- .2 Scheduling:
 - .1 Employ necessary means to meet project timelines without compromising specified minimum rates of material diversion.
 - .2 In event of unforeseen delay notify DCC Representative.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Shop Drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Ontario as follows:
 - .2 Submit in accordance with Section 01 33 00 - Submittal Procedures and 01 74 19 - Waste Management and Disposal.

- .2 Informational Submittals: Provide the following submittals when requested by the Consultant:

- .1 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of Consultants and DCC Representative, for work of similar complexity and extent.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements. Ensure Work is performed in compliance with:
 - .1 CEPA , Canadian Environmental Protection Act, 1999
 - .2 CEAA , Canadian Environmental Assessment Act, 2012
 - .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .4 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.
 - .5 All applicable Provincial/Territorial and Municipal regulations .
- .2 Comply with hauling and disposal regulations of Authority Having Jurisdiction.
- .3 Standards: Comply with ANSI A10.6 and NFPA 241.

1.7 SITE CONDITIONS

- .1 If material resembling spray or trowel-applied asbestos or other designated substance be encountered, stop work, take preventative measures, and notify DCC Representative immediately.
 - .1 Proceed only after receipt of written instructions have been received from DCC Representative.
- .2 Notify DCC Representative before disrupting building access or services.
- .3 Environmental protection:
 - .1 Ensure Work is done in accordance with Section 01 35 43 - Environmental Procedures.

Part 2 Products**2.1 NOT USED**

- .1 Not Used.

Part 3 Execution**3.1 EXAMINATION**

- .1 Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.
- .2 When unanticipated mechanical, electrical, or structural elements are encountered, investigate and measure the nature and extent of the element.
- .3 Promptly submit a written report to DCC Representative.
- .4 Verify that hazardous materials have been remediated before proceeding with demolition operations.

3.2 PREPARATION

- .1 Protection of In-Place Conditions:
 - .1 Prevent movement, settlement, or damage to adjacent and landscaping features and parts of building utilities, structures, to remain in place. Provide bracing and shoring required.
 - .2 Keep noise, dust, and inconvenience to occupants to minimum.
 - .3 Protect building systems, services and equipment.
 - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
 - .5 Do Work in accordance with Section 01 70 12 - Health and Safety Requirements.
- .2 Demolition/Removal:
 - .1 Demolish structures as indicated.
 - .2 Remove parts of existing building to permit new construction.
 - .3 Trim edges of partially demolished building elements to tolerances as defined by DCC Representative to suit future use.
 - .4 At end of each day's work, leave Work in safe and stable condition.
 - .5 Protect interiors of parts not to be demolished from exterior elements at all times.

.6 Demolish to minimize dusting. Keep materials wetted as directed by DCC Representative.

.7 Only dispose of material specified by selected alternative disposal option as directed by DCC Representative.

3.3 REPAIRS

.1 General: Promptly repair damage to adjacent construction caused by demolition operations.

.2 Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

.3 Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Refer to demolition drawings and specifications for items to be salvaged for reuse.

.4 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 RELATED REQUIREMENTS

- .1 Section 02 41 00.08 - Demolition - Minor Works

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI A10.8 2011, Safety Requirements for Scaffolding
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM C475/C475M-15, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
- .3 CSA Group (CSA)
 - .1 CSA S350M 1980 (R2003), Code of Practice for Safety in Demolition of Structures
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 2012
 - .2 Canadian Environmental Protection Act (CEPA), 2012
 - .1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations
 - .2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34
 - .4 Motor Vehicle Safety Act (MVSA), 1995
 - .5 Hazardous Materials Information Review Act, 1985
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 241 13, Standard for Safeguarding Construction, Alteration, and Demolition Operations

1.3 DEFINITIONS

- .1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.
- .2 Remove and Salvage: Detach items from existing construction and deliver them to ready for reuse to DCC Representative.
- .3 Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

- .4 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.
- .5 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements .
- .6 Draft Construction Waste Management Plan (Draft CWM Plan): Detailed inventory of materials in building indicating estimated quantities of reuse, recycling and landfill, prepared in accordance with Section 01 74 19 - Waste Management and Disposal and as follows:
 - .1 Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project.
- .7 Construction Waste Management Plan (CWM Plan): Written plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19- Waste Management and Disposal.
- .8 Construction Waste Management Report (CWM Report): Written report identifying actual materials that formed CWM Plan for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 - Waste Management and Disposal.
- .9 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.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with DCC Representative for the material ownership as follows:
 - .1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain DCC Representative's property, demolished materials shall become Contractor's property and shall be removed from Project site.
 - .2 Coordinate selective demolition work so that work of this Section adheres to aesthetic criteria established by the Drawings and specified dimensions with all elements in planes as drawn, maintaining their relationships with all other building elements.

- .3 Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to DCC Representative that may be encountered during selective demolition remain Representative's property:
 - .1 Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to DCC Representative.
- .2 Pre Demolition Meeting: Convene pre-installation meeting 1 week prior to beginning on-site installation, with DCC Representative in accordance to:
 - .1 Confirm extent of salvaged and demolished materials
 - .2 Review Contractor's demolition plan
 - .1 Verify existing site conditions adjacent to demolition work
 - .2 Coordination with other construction sub trades
- .3 Hold project meetings biweekly throughout construction.
- .4 Ensure project manager, site supervisor key personnel attend.
- .5 DCC Representative will provide written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

1.5 ACTION AND INFORMATION SUBMITTALS

- .1 Action Submittals: Provide the following submittals before starting any work of this Section:
 - .1 Schedule of Selective Demolition Activities: Coordinate with Section 01 32 16.19 - Construction Progress Schedule , and indicate the following:
 - .1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
 - .2 Coordinate with DCC Representative's and user group ongoing site operations and limit the number of interruptions during regular business hours.
 - .3 Interruption of utility services.
 - .4 Coordination for shutoff, capping, and continuation of utility services.
 - .5 Use of elevator and stairs.
 - .6 Locations of temporary partitions and means of egress, including for others affected by selective demolition operations.
 - .7 Coordination with DCC Representative's continuing occupancy of portions of existing building.

- .2 Contractor is required to develop demolition details and submit a demolition plan prepared by a professional engineer employed by the Contractor
 - .1 Demolition Plan: Submit a plan of demolition area indicating extent of temporary facilities and supports, methods of removal and demolition prepared by a professional engineer in accordance with requirements of Authority Having Jurisdiction, and as follows:
 - .2 Proposed Dust Control and Noise Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. DCC Representative reserves the right to make modifications where proposed methods interfere with the Owner's ongoing operation
 - .3 Inventory: Submit a list of items that have been removed and salvaged after selective demolition is complete.
 - .4 Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes
 - .5 Pre demolition Photographs: Submit photographs indicating existing conditions of adjoining construction and site improvements prior to starting Work. Include finish surfaces that may be misconstrued as damage caused by selective demolition operations.
- .2 Informational Submittals: Provide the following submittals when requested by the DCC Representative:
 - .1 Qualification Data: Submit information for companies and personnel indicating their capabilities and experience to perform work of this Section including; but not limited to, lists of completed projects with project names and addresses, names and addresses of architects and owners, for work of similar complexity and extent.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work as follows; use most restrictive requirements where differences occur between the municipal, provincial and federal jurisdictions:
 - .1 Provincial and Federal Requirements: Perform work in accordance with governing environmental notification

requirements and regulations of the Authority Having Jurisdiction.

- .2 Municipal Requirements: Perform hauling and disposal operations in accordance with regulations of Authority Having Jurisdiction.
- .2 Qualifications: Provide proof of qualifications when requested by DCC Representative :
 - .1 Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project:
 - .1 Conform to the provincial Occupational Health and Safety Act and Regulation.
 - .2 Conform to Workers' Compensation Board Regulations.
 - .3 Conform to local bylaws and regulations governing this type of work.

1.7 SITE CONDITIONS

- .1 Owner will occupy portions of building immediately adjacent to selective demolition area:
 - .1 Conduct selective demolition so that Owner's operations will not be disrupted.
 - .2 Provide not less than 72 hours notice to DCC Representative of activities that will affect Owner's operations.
- .2 Maintain access to existing means of egress, walkways, corridors, exits, and other adjacent occupied or used facilities in accordance with Section 01 35 15:
 - .1 Do not close or obstruct means of egress, walkways, corridors, exits, or other occupied or used facilities without written acceptance from authorities having jurisdiction.
- .3 DCC Representative assumes no responsibility for condition of areas to be selectively demolished:
 - .1 Conditions existing at time of Pre Bid Site Review will be maintained by DCC Representative as far as practical.

Part 2 Products

2.1 TEMPORARY SUPPORT STRUCTURES

- .1 Design temporary support structures required for demolition work and underpinning and other foundation supports necessary

for the project using a qualified professional engineer registered or licensed in province of Ontario.

2.2 DESCRIPTION

- .1 This section of the Work includes, but is not necessarily limited to, the following:
 - .1 Demolition, removal completely from site, and disposal of all identified components, materials, equipment and debris
 - .2 Selective demolition to allow new walls, bulkheads, ceilings and other materials to meet existing construction as indicated
 - .3 All material from demolition shall be removed from site immediately with no salvage, selling, sorting or burning permitted on site
 - .4 Retain items indicated on drawings for re use in new construction

2.3 DEBRIS

- .1 Make all arrangements for transport and disposal of all demolished materials from the site.

2.4 EQUIPMENT

- .1 Provide all equipment required for safe and proper demolition of the building interiors indicated.

2.5 REPAIR MATERIALS

- .1 Use repair materials identical to existing materials:
 - .1 If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - .2 Use a material whose installed performance equals or surpasses that of existing material.
 - .3 Comply with material and installation requirements specified in individual Specification Sections.
- .2 Floor Patching and Levelling Compounds: Cement based, trowelable, self levelling compounds compatible with specified floor finishes; gypsum based products are not acceptable for work of this Section.
- .3 Concrete Unit Masonry: Lightweight concrete masonry units, and mortar, cut and trimmed to fit existing opening to be filled. Provide standard hollow core units, square end units and bond beam units as indicated on drawings.

- .4 Prefinished Sheet Steel: Prefinished sheet steel, colour to match existing radiation cabinets, bent and profiled to match existing radiation cabinets.
- .5 Gypsum Board Patching Compounds: Joint compound to ASTM C475/C475M, bedding and finishing types thinned to provide skim coat consistency to patch and prepare existing gypsum board walls ready for new finishes in accordance with Section 09 21 16 - Gypsum Board Systems.

2.6 EXISTING MATERIALS

- .1 Items to be retained for re use in new construction include, but are not limited to the following:
 - .1 Confirm with DCC Representative any materials that appear to be in re usable condition prior to disposal.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that utilities have been disconnected and capped.
- .2 Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- .3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- .4 Notify the Representative Consultant where existing mechanical, electrical, or structural elements conflict with intended function or design:
 - .1 Investigate and measure the nature and extent of conflict and submit a written report to Representative Consultant.
 - .2 Representative Consultant will issue additional instructions or revise drawings as required to correct conflict.
- .5 Perform surveys as the work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

- .1 Coordinate existing services indicated to remain and protect them against damage during selective demolition operations.
- .2 Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.
 - .1 Arrange to shut off affected utilities with utility companies.

- .2 If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.
- .3 Cut off pipe or conduit in walls or partitions to be removed. **Remove pipe and conduit back to panel or source.** Where not feasible, cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- .4 Cut off pipe or conduit to a minimum of 25 mm below slab and remove concrete mound. Patch concrete using cementitious grout.
- .3 Coordinate with Mechanical and Electrical Divisions for shutting off, disconnecting, removing, and sealing or capping utilities.
- .4 Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

- .1 Identify and mark all equipment and materials identified to be retained by DCC Representative or to be re used in subsequent construction. Separate and store items to be retained in an area away from area of demolition and protect from accidental disposal.
- .2 Post warning signs on electrical lines and equipment that must remain energized to serve other areas during period of demolition.
- .3 Confirm that all electrical and telephone service lines entering buildings are not disconnected.
- .4 Do not disrupt active or energized utilities crossing the demolition site.
- .5 Provide and maintain barricades, warning signs, protection for workmen and the public during the full extent of the Work. Read drawings carefully to ascertain extent of protection required.
- .6 Mark all materials required to be re used, store in a safe place until ready for re installation.
- .7 Adjust all junction boxes, receptacles and switch boxes flush with new wall construction where additional layers to existing construction are indicated.
- .8 Remove permanent marker lines used or found on exposed surfaces and at surfaces indicated for subsequent finish materials. Mechanically remove permanent marker lines and associated substrates where permanent marker lines occur and

patch surface. Sealing or priming over permanent marker lines is not acceptable.

3.4 CONCRETE SLAB REINFORCING

- .1 Locate location of reinforcing steel in concrete slabs prior to cutting or coring using non-destructive, non-ionizing radio frequency locators.
- .2 Core concrete slabs to avoid reinforcing steel, electrical conduit or water pipes; adjust core location and coordinate with Structural Engineer or DCC Representative where slab features interfere with core drilling.
- .3 Notify the DCC Representative immediately for further instructions where coring or cutting will damage existing slab features.

3.5 SELECTIVE DEMOLITION

- .1 Demolish and dismantle work in a neat and orderly manner and in strict accordance with all regulations.
- .2 At end of each day's work, leave Work in safe condition so that no part is in danger of toppling or falling.
- .3 Demolish in a manner to minimize dusting and to prevent migration of dust.
- .4 Selling or burning of materials on the site is not permitted.
- .5 Remove concrete bases by cutting and chipping, take precautions against slab cracking and degradation. Grind edges smooth, fill and make level with self levelling grout.
- .6 Fill all openings in concrete block walls with concrete masonry units, coursing to match existing, prepare ready to receive new finishes to match existing.
 - .1 Provide bond beams in new openings cut into existing concrete masonry unit walls.
 - .2 Provide finished end masonry units to patch and repair for new jamb sections in existing concrete masonry unit walls.
- .7 Fill all openings in gypsum board walls with gypsum board and steel framing to match existing, skim coat to make wall smooth and even.
- .8 Demolish existing carpet, resilient flooring and adhesive remnants as follows:
 - .1 Vacuum existing carpet thoroughly, prior to removal, using vacuum equipped with power head/sweeper.

- .2 Apply fine mist water spray to carpet as required to minimize dust generation during removal. Avoid spraying near electrical outlets.
- .3 Demolish existing carpet and resilient floor finishes, remove and dispose of off site.
- .4 Remove adhesive to the greatest extent possible using scrapping tools and as follows:
 - .1 Do not use solvent based cleaners to remove adhesive remnants.
 - .2 Lightly shot blast or grind floor using machine designed for purpose to remove adhesive remnants.
 - .3 Vacuum floor ready for application of skim coating.
 - .4 Repair all slab depressions and damage with cementitious patching compound.
 - .5 Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials.
- .5 Floor substrate shall be smooth, free from ridges and depressions, and adhesive remnants that could telegraph through resilient flooring materials and carpets.
- .6 Recycle materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .9 Demolish existing ceramic tile finishes. Remove setting bed or adhesive to the greatest extent possible using mechanical scrapping tools and as follows:
 - .1 Saw cut edge of tile for clean and even transition joint between existing tile to remain and new flooring materials
 - .2 Lightly shot blast or grind floor to remove remnants of setting materials
 - .3 Vacuum floor ready for application of skim coating
 - .4 Repair all slab depressions and damage with cementitious patching compound. Skim coat floor with minimum 1 mm thick cementitious floor underlayment compatible with new flooring materials
- .10 Demolish completely all ceiling panels and grid as indicated.
- .11 Remove all wall coverings scheduled for demolition. Patch and repair wall surfaces with skim coat of gypsum board joint compound leaving wall surfaces smooth and even ready for new wall finishes.
- .12 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.

- .13 Patch and repair all radiation cabinets, mechanical equipment and electrical fixtures damaged or exposed during demolition to match adjacent finished surfaces.

3.6 PATCHING AND REPAIRING

- .1 Floors and Walls:
 - .1 Where walls or partitions that are demolished extend from one finished area into another, patch and repair floor and wall surfaces in the new space.
 - .2 Provide a level and smooth surface having uniform finish colour, texture, and appearance.
 - .3 Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.
 - .4 Patch with durable seams that are as invisible as possible.
 - .5 Provide materials and comply with installation requirements specified in other Sections of these Specifications.
 - .6 Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - .7 Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
- .2 Ceilings: patch, repair, or re hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.7 PROTECTION

- .1 Prevent debris from blocking drainage inlets and systems and ground draining and protect material and electrical systems and services that must remain in operation.
- .2 Arrange demolition and shoring work so that interference with the use of adjoining areas by the Owner and users is minimized.
- .3 Maintain safe access to and egress from occupied areas adjoining.
- .4 Provide and maintain fire prevention equipment and alarms accessible during demolition.

3.8 CLEANING

- .1 Waste Management: Separate waste materials for recycling and reuse in accordance with Section 01 74 19 - Waste Management and Disposal, and as follows:
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .2 Divert excess materials from landfill to site approved Representative Consultant.
- .3 Promptly as the Work progresses, and on completion, clean up and remove from the site all rubbish and surplus material. Remove rubbish resulting from demolition work daily.
- .4 Maintain access to exits clean and free of obstruction during removal of debris.
- .5 Keep surrounding and adjoining roads, lanes, sidewalks, municipal rights of way clean and free of dirt, soil or debris that may be a hazard to vehicles or persons.
- .6 Transport material designated for alternate disposal using approved facilities and in accordance with applicable regulations.
- .7 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA O86-14, Engineering Design in Wood.
 - .3 CSA O121-08(R2013), Douglas Fir Plywood.
 - .4 CSA O151-09(2014), Canadian Softwood Plywood.
 - .5 CSA O153-13, Poplar Plywood.
 - .6 CAN/CSA O325.0-16, Construction Sheathing.
 - .7 CSA O437 Series-93(R2011), Standards for OSB and Waferboard.
 - .8 CSA S269.1-16, Falsework and Formwork.
 - .9 CAN/CSA S269.3-M92(R2003), Concrete Formwork.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with Section 01 31 19 - Project Meetings, convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure key personnel, site supervisor, DCC Representative, speciality contractor - finishing, forming attend.
 - .1 Verify project requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 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 proprietary materials used in formwork liners and coatings and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 70 12 - Health and Safety Requirements.

1.4 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.

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 and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect formwork from damages.
 - .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 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA 0121, CAN/CSA 086, CSA 0437 Series, CSA 0153.
 - .2 For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2.
 - .3 Rigid insulation board: to CAN/ULC-S701.
- .2 Form ties:
 - .1 For concrete not designated 'Architectural': removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes minimum 25 mm diameter in concrete surface.
 - .2 For Architectural concrete; snap ties complete with plastic cones and light grey concrete plugs.
- .3 Form liner:
 - .1 Plywood: Douglas Fir to CSA 0121, Canadian Softwood Plywood to CSA 0151, Poplar to CSA 0153.

- .4 Form release agent: Proprietary, non-volatile material not to stain concrete or impair subsequent application of finishes or coatings to surface of concrete, derived from agricultural sources, non petroleum containing, non-toxic, low VOC.
- .5 Falsework materials: to CSA S269.1.
- .6 Sealant: to Section 07 92 00 - Joint Sealants.

Part 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels, and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Consultant's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7 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.
- .8 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .9 Use 25 mm chamfer strips on external corners and 25 mm fillets at interior corners, joints, unless specified otherwise.
- .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .11 Construct forms for architectural concrete, and place ties as indicated and as directed.
 - .1 Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- .12 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.

- .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

- .13 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 2 days for housekeeping pads.
- .2 Remove formwork when concrete has reached 70% of its 28-day design strength or minimum period noted above, whichever comes later.
- .3 Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .4 Re-use formwork and falsework subject to requirements of CSA A23.1/A23.2.

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 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 REFERENCE STANDARDS

- .1 American Concrete Institute (ACI)
 - .1 SP-66-04, ACI Detailing Manual 2004.
- .2 ASTM International (ASTM)
 - .1 ASTM A123/A123M - 15 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A143/A143M-07(2014), Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - .3 ASTM A641/A641M-09a(2014), Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .4 ASTM A775/A775M-17, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - .5 ASTM A884/A884M-14 Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 - .6 ASTM A1064/A1064M-17, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .3 CSA Group (CSA)
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA A23.3-14, Design of Concrete Structures.
 - .3 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA G40.20/G40.21-13(R2014), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 CSA W186-M1990(R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with Section 01 31 19 - Project Meetings, convene pre-installation meeting one week prior to beginning concrete works.

- .1 Ensure key personnel, site supervisor, DCC Representative, speciality contractor - finishing, forming attend.
 - .1 Verify project 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 proprietary materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 When Chromate solution used as replacement for galvanizing non-prestressed reinforcement, provide product description for review by Consultant prior to its use.
 - .3 Submit 2 copies of WHMIS Safety Data Sheet (SDS) in accordance with Section 01 70 12 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings to Consultant for review and approval.
 - .1 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and SP-66.
 - .2 Indicate placing of reinforcement and:
 - .3 Detail lap lengths and bar development lengths to CAN/CSA A23.3, unless otherwise indicated.
 - .4 Indicate position and size of openings in slabs and walls. Coordinate with trades requiring openings.
- .4 Quality Assurance Submittals:
 - .1 Submit in accordance with Section 01 45 00 - Quality Control and as described in PART 2 - SOURCE QUALITY CONTROL.
 - .2 Mill Test Report: upon request, submit to Representative certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.
 - .3 Upon request submit in writing to DCC Representative proposed source of reinforcement material.
 - .4 Upon request submit to DCC Representative epoxy coating applicator certificates identified in Quality Assurance.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.
- .4 Handle, transport, store and install epoxy coated reinforcing steel bars to prevent damage to coating. Prevent bar-to-bar abrasion and excessive sagging. Do not drop or drag bars. Store on suitable non-metallic supports. For lifting use nylon lifting slings, padded slings, separators or other means recommended by epoxy coated reinforcing steel supplier.
- .5 Develop Construction Waste Management Plan related to Work of this Section.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Consultant.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CSA G30.18.
- .4 Cold-drawn annealed steel wire ties: to ASTM A1064/A1064M.
- .5 Deformed steel wire for concrete reinforcement: to ASTM A1064/A1064M.
- .6 Welded steel wire fabric:
 - .1 Plain in accordance ASTM A1064/A1064M, fabricated from as drawn steel wire into flat sheets; sizes as indicated on Drawings.
- .7 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .8 Tie wire: 1.5 mm diameter annealed wire.

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 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
- .3 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide DCC Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.
- .2 Upon request inform DCC Representative of proposed source of supplied material.

Part 3 Execution

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.
- .2 When field bending authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars, which develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Cutting or puncturing vapour retarder is not permitted; repair damage and reseal vapour retarder before placing concrete.
- .2 Place reinforcing steel as indicated on placing drawings and in accordance with CSA A23.1/A23.2.
- .3 Prior to placing concrete, obtain Consultant's approval of reinforcing material and placement.
- .4 Maintain cover to reinforcement during concrete pour.

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 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 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .2 ASTM D260-86(2001), Standard Specification for Boiled Linseed Oil.
 - .3 ASTM D1751-04, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.
- .3 CSA International
 - .1 CSA-A23.1/A23.2-2004, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .3 CAN/CSA-G30.18-M92(R2002), Billet-Steel Bars for Concrete Reinforcement.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with Section 01 32 16.06- Construction Progress Schedule - Critical Path Method (CPM) or Section 01 32 16.07- Construction Progress Schedules - Bar (GANTT) Chart, convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure Departmental Representative, speciality contractor - finishing, forming, key personnel, DCC Representative, site supervisor, attend.
 - .2 Verify project requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit placing drawings prepared in accordance with plans to clearly show size, shape, location and necessary details of reinforcing.

- .3 At least 4 weeks prior to beginning Work, inform DCC Representative of source of fly ash.
 - .1 Do not change source of fly ash without written approval of DCC Representative.
- .4 At least 4 weeks prior to beginning Work, submit to DCC Representative samples of following materials proposed for use: curing compound, joint filler, waterstops.
- .5 Provide testing results for review by Consultant and do not proceed without written approval when deviations from mix design or parameters are found.
- .6 Concrete hauling time: provide for review by DCC Representative deviations exceeding maximum allowable time of 120 for concrete to be delivered to site of Work and discharged after batching.

1.4 QUALITY ASSURANCE

- .1 Provide to DCC Representative, 4 weeks minimum prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
 - .1 Quality Control Plan: provide written report to DCC Representative verifying compliance that concrete in place meets performance requirements.
 - .2 Sustainability Standards Certification:
 - .1 Construction Waste Management: provide copy of plan.
 - .2 Recycled Content:
 - .1 Provide listing of recycled content products used.
 - .2 When Supplementary Cementing Materials (SCMs) are used, provide evidence to certify reduction in cement from Base Mix to Actual SCMs Mix, as percentage.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Do not modify maximum time limit without receipt of prior written agreement from Consultant and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by the DCC Representative

- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials, pallets, padding, crates, in accordance with Section 01 74 21- Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Alternative 2 - Prescriptive to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by DCC Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Cement: to CSA A3001.
- .2 Blended hydraulic cement: to CSA A3001.
- .3 Supplementary cementing materials: with maximum 30% Type CH fly ash replacement, by mass of total cementitious materials to CSA A3001.
- .4 Water: to CSA A23.1/A23.2.
- .5 Reinforcing bars: to CAN/CSA-G30.18, Grade 400.
- .6 Welded steel wire fabric: to ASTM A185.
- .7 Premoulded joint filler:
 - .1 Bituminous impregnated fibreboard: to ASTM D1751.
- .8 Joint sealer/filler: grey to CAN/CGSB-19.24, Type 1, Class B.
- .9 Sealer: proprietary poly-siloxane resin blend or boiled linseed oil to ASTM D260, mixed with mineral spirits 1:1.
- .10 Other concrete materials: to CSA A23.1/A23.2.

2.4 MIXES

- .1 Alternative 2 - Prescriptive Method for specifying concrete in accordance with CSA A23.1.
 - .1 Ensure materials used in concrete mix have been submitted for testing and meet requirements of CSA A23.1.

- .2 DCC Representative to proportion concrete mix for normal including:
 - .1 Class of exposure: See schedule.
 - .2 Intended application: footings, piers, slab-on-grade, curbs
 - .3 Aggregate: normal-density, maximum size 20mm
 - .4 Admixture: chemical to ASTM C 494/C 494M.
 - .5 Supplementary cementing materials: with maximum 30% Type CH fly ash replacement, by kg/m³ of total cementitious material.
 - .6 Water: maximum 0.4 water-to-cement ratio
 - .7 Air content category: See schedule.
 - .8 Slump: See schedule.

Part 3 Execution

3.1 PREPARATION

- .1 Provide DCC Representative 24 hours notice before each concrete pour.
- .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 rehandling, and without damage to existing structure or Work.
- .4 Protect previous Work from staining.
- .5 Clean and remove stains prior to application of concrete finishes.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.
- .2 Sleeves and inserts:
 - .1 Cast in sleeves, ties, slots, anchors, reinforcement, frames, conduit, bolts, waterstops, joint fillers and other inserts required to be built-in.
 - .2 Sleeves and openings greater than 100 mm x 100 mm not indicated, must be submitted to DCC Representative for review.

3.3 FINISHES

- .1 Equipment pads: provide smooth trowelled surface and 12x12mm beveled edge around perimeter.

3.4 CURING

- .1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.

3.5 SEALING APPLICATION

- .1 After curing is complete, apply poly-siloxane resin blend sealer at 4 m²/L.

3.6 SITE TOLERANCES

- .1 Concrete floor slab finishing tolerance to CSA A23.1/A23.2.

3.7 FIELD QUALITY CONTROL

- .1 Concrete testing: to CSA A23.1/A23.2 by testing laboratory designated and paid for by DCC Representative.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 11- Cleaning.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate cleaning area for tools to limit water use and runoff.
- .4 Cleaning of concrete equipment to be done in accordance with Section 01 35 43 Environmental Procedures.
- .5 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 21- Construction/Demolition Waste Management and Disposal
 - .1 Materials and Resources Credit MRc2.1 Construction Waste Management: Divert 50% From Landfill and MRc2.2 Construction Waste Management: Divert 75% From Landfill: prepare Construction Waste Management plan in accordance with Section 01 74 21- Construction/Demolition Waste Management and Disposal.
 - .2 Use excess concrete for: additional paving, post footing anchorage, mud slab, flowable fill, footing bottom, underground utility pipe kickers.
 - .3 Divert unused concrete materials from landfill to local facility or quarry after receipt of written approval from DCC Representative.
 - .4 Provide appropriate area on job site where concrete trucks and be safely washed.

- .5 Divert admixtures and additive materials from landfill to approved official hazardous material collections site after receipt of written approval from DCC Representative.
- .6 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.

3.9 CONCRETE SCHEDULE

LOCATION	EXPOSURE CLASS	COMPRESSIVE STRENGTH	PERMITTED SLUMP RANGE	AIR ENTRAINMENT
Interior slab-on-grade & Equipment pads	N	25 MPa	100±25mm	-
Lean concrete	N	10 MPa	-	-

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM C309-03, Liquid Membrane-Forming Compounds for Curing Concrete.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .3 CSA Group (CSA)
 - .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction//Methods of Test for Concrete.
- .4 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1113-A2016, Architectural Coatings.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit WHMIS Safety Data Sheet (SDS) in accordance with Section 01 70 12 - Health and Safety Requirements.
 - .1 Submit 2 copies of WHMIS SDS.
 - .3 Include application instructions for concrete floor treatments.

1.3 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Minimum 4 weeks prior to starting concrete finishing work, provide proposed quality control procedures for review by DCC Representative on following items:
 - .1 Hardening.
 - .2 Sealing.
 - .3 Curing.

- .4 Finishes.
- .3 Mock-Ups:
 - .1 Provide site mock-up for concrete finishes indicating methods and materials, and procedures proposed to achieve concrete finishes in accordance with Section 01 45 00 - Quality Control, and to comply with following requirements, using materials indicated for completed work:
 - .1 Build mock-ups in location and of size as directed by DCC Representative.
 - .2 Obtain DCC Representative's acceptance of mock-ups before starting construction; mock-up to be used throughout construction period and used as standard of acceptance for subsequent architectural concrete work.
 - .3 Mock-up may form part of permanent structure when accepted by DCC Representative; repair or replace unacceptable mock-ups at no additional cost to Owner.
 - .4 In presence of DCC Representative, damage part of exposed face for each finish, colour, and texture, and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

2.1 SITE CONDITIONS

- .1 Temporary lighting: Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
- .2 Electrical power: Provide sufficient electrical power to operate equipment normally used during construction

- .3 Work area: Make work area water-tight protected against rain and detrimental weather conditions.
- .4 Temperature: Maintain minimum 10 degrees C ambient temperature for 7 days before installation and minimum 48 hours after completion of work and maintain relative humidity maximum 40% during same period.
- .5 Moisture: Ensure concrete substrate within moisture limits prescribed by flooring manufacturer.
- .6 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
 - .1 DCC Representative will arrange for ventilation system to be operated during installation of concrete floor treatment materials. Ventilate area of work as directed by DCC Representative by use of approved portable supply and exhaust fans.
 - .2 Provide continuous ventilation during and after coating application.

Part 3 Products

3.1 PERFORMANCE REQUIREMENTS

- .1 Product quality and quality of work in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Submit written declaration components used compatible and not adversely affect finished flooring products and their installation adhesives.

3.2 CHEMICAL HARDENERS

- .1 Type 1 - Sodium silicate.
- .2 Water: potable.

3.3 SEALING COMPOUNDS

- .1 Surface sealer: acrylic carnuba wax.
- .2 Surface sealers not contain aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium and their compounds.
- .3 VOC limit: maximum 100g/L to SCAQMD Rule 1113. Sealants: maximum VOC limit 250g/L to SCAQMD Rule 1168.

3.4 CURING COMPOUNDS

- .1 Waterborne membrane forming curing membrane to ASTM C309, Type 1 Clear Class B.
 - .1 Verify compatibility with subsequent finishes.

3.5 CONCRETE STAINS

- .1 Select low VOC, water-based concrete stains.

3.6 MIXES

- .1 Mixing ratios in accordance with manufacturer's written instructions.

Part 4 Execution

4.1 EXAMINATION

- .1 Verify slab surfaces ready to receive work and elevations as indicated on shop drawings or as recommended by manufacturer's written instructions.

4.2 PREPARATION OF EXISTING SLAB

- .1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radiused edges unless otherwise indicated.
- .2 Saw cut control joints to CSA A23.1, 24 hours maximum after placing of concrete.
- .3 Use strong solvent to remove chlorinated rubber or existing surface coatings.
- .4 Use protective clothing, eye protection, respiratory equipment during stripping of chlorinated rubber or existing surface coatings.

4.3 Concrete Staining

- .1 Coordinate with Section 03 30 00 for wet curing. Liquid curing compounds not permitted under staining.
- .2 Cure concrete for minimum 60 days.
- .3 Clean and prepare concrete in accordance with manufacturers written instructions.
- .4 Apply 2 coats of chemical stain materials in accordance with manufacturers written instructions; obtain DCC Representative's acceptance after application of both first and second coats.
- .5 Apply recommended cure/seal materials in accordance with manufacturer's written instructions, in number of coats to achieve flat floor lustre.

4.4 APPLICATION

- .1 Apply concrete finishing floor hardener in accordance with manufacturer's written instructions.
- .2 After floor treatment dry, seal control joints and joints at junction with vertical surfaces with sealant.
- .3 Apply floor treatment in accordance with Sealer manufacturer's written instructions.
- .4 Clean over spray. Clean sealant from adjacent surfaces.

4.5 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 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.

4.6 PROTECTION

- .1 Protect finished installation in accordance with manufacturer's instructions.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .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 A307-7b, 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 Manufacturers Association (CPMA).
 - .1 Handbook of the Canadian Institute of Steel Construction.
 - .2 CISC/CPMA Standard 2-75, Quick-Drying Primer for use on Structural Steel.
- .4 CSA Group (CSA)
 - .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 Master Painters Institute
 - .1 MPI-INT 5.1-08, Structural Steel and Metal Fabrications.
 - .2 MPI-EXT 5.1-08, Structural Steel and Metal Fabrications.
- .6 The Society for Protective Coatings (SSPC) and National Association of Corrosion Engineers (NACE) International
 - .1 NACE No. 3/SSPC SP-6-06, Commercial Blast Cleaning.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, 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 Ontario, Canada.
- .5 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 practise in Province of Ontario, Canada.

.6 Fabricator Reports:

- .1 Provide structural steel fabricator's affidavit stating that materials and products used in fabrication conform to applicable material and products standards specified and indicated.

1.3 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.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer, of pallets, crates, padding, and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Design details and connections in accordance with requirements of CAN/CSA-S16 and CAN/CSA-S136 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 Submit sketches and design calculations stamped and signed by qualified professional engineer licensed in Province of Ontario, Canada for non standard connections.

2.2 MATERIALS

- .1 Structural steel: to CSA-G40.20/G40.21 Grade 300W.
- .2 Anchor bolts: to CSA-G40.20/G40.21, Grade 300W.
- .3 High strength anchor bolts: to ASTM A193/A193M, Grade 55.
- .4 Bolts, nuts and washers: to ASTM 307.
- .5 Welding materials: to CSA W48 Series and certified by Canadian Welding Bureau.
- .6 Shop paint primer: to CISC/CPMA2-75 solvent reducible alkyd, grey.
- .7 Hot dip galvanizing: galvanize steel, where indicated, to CAN/CSA-G164, minimum zinc coating of 600 g/m².

2.3 FABRICATION

- .1 Fabricate structural steel in accordance with CAN/CSA-S16 and in accordance with reviewed shop drawings.
- .2 Continuously seal members by continuous welds where indicated. Grind smooth.

2.4 SHOP PAINTING

- .1 Clean, prepare surfaces and shop prime structural steel in accordance with CAN/CSA-S16.
- .2 Clean members, remove loose mill scale, rust, oil, dirt and foreign matter. Prepare surface according to NACE No.3/SSPC-SP-6.
- .3 Apply one coat of primer in shop to steel surfaces to achieve minimum dry film thickness of 1 to 2 mils, 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.
- .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 DCC Representative 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, and in accordance with reviewed erection drawings.
- .2 Field cutting or altering structural members: to approval of Consultant.
- .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 DCC Representative.

- .2 Provide safe access and working areas for testing on site, as required by testing agency and as authorized by DCC Representative.
- .3 Submit test reports to DCC Representative within 1 week of completion of inspection.
- .4 DCC Representative will pay costs of tests as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
- .5 Test shear studs in accordance with CSA W59.

3.7 FIELD PAINTING

- .1 Paint in accordance with Section 09 91 23 - Interior Painting.
 - .1 Touch up damaged surfaces and surfaces without shop coat with primer to NACE No.3/SSPC-SP-6 except as specified otherwise. Apply in accordance: MPI Architectural Painting Specification Manual.

3.8 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and 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 A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A269M-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.
- .2 CSA Group (CSA)
 - .1 CSA G40.20-13/G40.21-13, 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 CSA S16-14, Design of Steel Structures.
 - .4 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .5 CSA W59-13, Welded Steel Construction (Metal Arc Welding) Metric
- .3 Environmental Choice Program (ECP)
 - .1 CCD-048-95(2006), Surface Coatings - Recycled Water-borne
- .4 Green Seal Environmental Standards (GS)
 - .1 GS-11-2011, Paints and Coatings
- .5 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition
- .6 Underwriters Laboratories (UL)
 - .1 UL 2768-11, Architectural Surface Coatings

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedure.
- .2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS SDS in accordance with Section 01 70 12 - Health and Safety Requirements. .1
For finishes, coatings, primers, and paints
applied on site: indicate VOC concentration in g/L.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.3 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.

- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300w.
- .2 Welding materials: to CSA W59.
- .3 Welding electrodes: to CSA W48 Series.
- .4 Bolts and anchor bolts: to ASTM A307.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof flat headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Exposed welds continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.
- .2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper, 0.010 mm thickness of nickel, and 0.0025 mm thickness of chromium.
- .3 Shop coat primer: MPI-INT 5.1A.
- .4 Zinc primer: zinc rich, ready mix to MPI-INT 5.2C.

2.4 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of bituminous paint:

- .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
- .2 Concrete, mortar and masonry.
- .3 Wood.

2.5 SHOP PAINTING

- .1 Primer: VOC limit 250 g/L maximum to UL 2768, GS-11, or UL 2760.
- .2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Paint when temperature minimum 7 degrees C.
- .4 Clean surfaces to be field welded; do not paint.

2.6 CHANNEL FRAMES

- .1 Fabricate frames from steel, sizes of channel and opening as indicated.
- .2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.
- .3 Finish: prime coat painted.

2.7 MECHANICAL CURBS

- .1 Prefabricated insulated roof curb to be manufactured of prime 14-gauge galvanized steel construction.
- .2 To ASTM A653/653M, with welded corners and with seams joined by continuous water and air tight welds.
- .3 Roof curb shall be internally reinforced with angles 1200mm on center complete with a factory installed wood nailer.
- .4 Internally insulated 50mm rigid insulation minimum RSI 1.76 (R10).

- .5 Dimensions as required for support of mechanical unit.
Height minimum 200mm above finished deck membrane or as indicated.
- .6 Top of all roof curbs shall be level, with pitch built into curb when deck slopes.

Part 3 Execution

3.1 EXAMINATION

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

3.2 ERECTION - GENERAL

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to DCC Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.

- .6 Make field connections with bolts to CSA S16, or weld field connection.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:
 - .1 Primer: maximum VOC limit 250 g/L to GS-11.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
 - .1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 CHANNEL FRAMES

- .1 Install steel channel frames to openings as indicated.

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.

3.5 PROTECTION

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

National Defence
8 Wing Trenton
Job No. L-T81-3019/2

METAL FABRICATIONS

Section 05 50 00
Page 7 of 7
2025-03-28

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.
- .2 Section 06 40 00 - Architectural Woodwork.
- .3 Section 09 91 23 - Interior Painting.
- .4 Section 10 21 13.19 - Plastic Toilet Compartments.
- .5 Section 10 28 00 - Toilet and Bath Accessories.
- .6 Section 10 51 13 - Metal Lockers.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM E84-20, Standard Test Method for Surface Burning Characteristics of Building Materials
 - .2 ASTM D5516-18, Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures
 - .3 ASTM D6305-08(2015)e1, Standard Practice for Calculating Bending Strength Design Adjustment Factors for Fire-Retardant-Treated Plywood Roof Sheathing
- .2 CSA Group (CSA)
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA O80-20, Series 15 (R2020) Wood Preservation.
 - .3 CSA O121-08, Douglas Fir Plywood.
 - .4 CSA O141-05(R2009), Softwood Lumber.
 - .5 CSA O151-09, Canadian Softwood Plywood.
 - .6 CAN/CSA-O325.0-07, Construction Sheathing.
 - .7 CAN/CSA-Z809-08, Sustainable Forest Management.
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .4 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .5 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2010.
- .6 Underwriters Laboratories of Canada (ULC)

- .1 CAN/ULC S102M, "Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

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 rough carpentry work and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood identification: by grade mark in accordance with applicable CSA standards.
- .3 Plywood, OSB and wood based composite panel construction sheathing identification: by grademark in accordance with applicable CSA standards.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions and 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 off ground, indoors and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wood from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of crates, padding, pallets, packaging materials, banding, as specified in in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 MATERIALS**

- .1 Lumber: unless specified otherwise, softwood, S4S, moisture content 19% or less in accordance with following standards:
 - .1 CAN/CSA-O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
 - .3 CAN/CSA-Z809 or FSC or SFI certified.
- .2 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
 - .1 Board sizes: "Standard" or better grade.
 - .2 S2S is acceptable for use in unexposed constructions.
 - .3 Dimension sizes: "Standard" light framing or better grade.
 - .4 Post and timbers sizes: "Standard" or better grade.
- .3 Panel Materials:
 - .1 Douglas fir plywood (DFP): to CSA O121, standard construction.
 - .1 Urea-formaldehyde free.
 - .2 Canadian softwood plywood (CSP): to CSA O151, standard construction.
 - .1 Urea-formaldehyde free.
 - .3 Plywood, OSB and wood based composite panels: to CAN/CSA-O325.
 - .1 Urea-formaldehyde free.
 - .4 Fire Rated Plywood
 - .1 ULC certified to CAN/ULC S102M.
- .4 Wood Preservative:
 - .1 Surface-applied wood preservative: coloured copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.
 - .2 Pentachlorophenol use is restricted to building components that are in ground contact and subject to decay or insect attack only. Where used, pentachlorophenol-treated wood must be covered with two coats of an appropriate sealer.
 - .3 Structures built with wood treated with pentachlorophenol and inorganic arsenicals must not be used for storing food nor should the wood come in contact with drinking water.

- .5 Coatings, Primers, Paints: in accordance with manufacturer's recommendations for surface conditions: refer to Section 09 91 23 - Interior Painting.

2.2 ACCESSORIES

- .1 Fasteners: to CAN/CSA-G164, for interior highly humid areas, exterior work, pressure-treated preservative, fire-retardant treated lumber.
- .2 Nails, spikes and staples: to CSA B111.
- .3 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .4 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by 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 rough carpentry installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 PREPARATION

- .1 Treat surfaces of material with wood preservative, before installation.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and 1 minute soak on plywood.
- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
- .4 Treat material as indicated and including:
 - .1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.
 - .2 Wood furring for parapet construction

3.3 INSTALLATION

- .1 Comply with requirements of National Building Code of Canada (NBC), supplemented by the following paragraphs.
- .2 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding and other work as required.
- .3 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .4 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .5 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.
- .6 Install wood backing, dressed, tapered and recessed slightly below top surface of roof insulation for roof hopper.
- .7 Install sleepers as indicated.
- .8 Use caution when working with particle board. Use dust collectors and high quality respirator masks.
- .9 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .10 Countersink bolts where necessary to provide clearance for other work.
- .11 Provide electrical equipment backboards for mounting electrical equipment as indicated. Use 19 mm thick plywood on 19 x 38 mm furring around spacing, perimeter and at maximum 300 mm intermediate

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling 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 RELATED REQUIREMENTS**

- .1 Section 05 50 00 - Metal Fabrications.
- .2 Section 07 92 00 - Joint Sealants.
- .3 Section 08 80 00 - Glazing.
- .4 Section 09 91 23 - Interior Painting.
- .5 Section 22 42 16 - Commercial Lavatories and Sinks.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASME 18.6.1 1981 (R2012) Wood Screws (Inch Series).
 - .2 ANSI/BHMA A156.9-2010, Cabinet Hardware.
 - .3 ANSI/BHMA A156.11-2014, Cabinet Locks.
 - .4 ANSI/BHMA A156.16-2013, Auxiliary Hardware.
 - .5 ANSI/BHMA A156.18-2012, Materials and Finishes.
 - .6 ANSI/BHMA A156.20-2006, Strap and Tee Hinges and Hasps.
 - .7 ANSI A208.1-09, Particleboard.
- .2 Architectural Woodwork Manufacturers Association of Canada (AWMAC)
 - .1 Architectural Woodwork Standards (AWMAC AWS), 2014.
- .3 ASTM International
 - .1 ASTM A 153/A 153M-16, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .2 ASTM E 1333-14, Standard Test Method for Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber.
 - .3 ASTM F1667-13 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
 - .4 ASTM D638-10, Standard Test Method for Tensile Properties of Plastics
 - .5 ASTM D2832-92(R2011), Standard Guide for Determining Volatile and Non-volatile Content of Paint and Related Coatings.
 - .6 ASTM D5116-10, Standard Guide For Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
 - .7 ASTM G21-13, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
 - .8 ASTM G22-76 (96), Standard Practice for Determining Resistance of Plastics to Bacteria

- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-11.3-M87, Hardboard.
 - .2 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
 - .3 CAN/CGSB-71.19-M88, Adhesive, Contact, Sprayable.
- .5 CSA Group (CSA)
 - .1 CSA 0112-M Series 1977 (R2006) Standards for Wood Adhesives.
 - .2 CSA 0121-08 (R2013), Douglas Fir Plywood.
 - .3 CSA 0141-05 (R2014), Softwood Lumber.
 - .4 CSA 0151-14, Canadian Softwood Plywood.
 - .5 CSA 0153-M1980 (R2014), Poplar Plywood.
 - .6 CAN/CSA-Z809-08 (R2013), Sustainable Forest Management.
- .6 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .8 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA LD-3-05, High-Pressure Decorative Laminates (HPDL).

1.3 DEFINITIONS

- .1 Exposed Surfaces of Casework:
 - .1 Surfaces visible when doors and drawers are closed. Including visible surfaces in open cabinets or behind glass doors.
- .2 Semi-exposed Surfaces of Casework:
 - .1 Surfaces visible when opaque doors and drawer fronts are open, including interior faces of doors and interiors and sides of drawers.
- .3 Concealed Surfaces of Casework:
 - .1 Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers and ends of cabinets installed directly against and completely concealed by walls or other cabinets.
 - .2 Tops of wall cabinets are defined as concealed.

1.4 PRE-INSTALLATION MEETING

- .1 Prior to enclosing framing, convene a meeting of contractor, casework fabricator, casework installer, framing subcontractor and DCC Representative.
 - .1 Review locations of backing required for casework installation as shown on shop drawings and as necessary for installation.
 - .2 Review method of attachment for backing to wall system.
 - .3 Review coordination with other affected sections.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Prepare and submit material list in accordance with AWMAC AWS, cross-referenced to specifications.
 - .2 Include manufacturer's instructions, printed product literature, data sheets and catalogue pages for all materials and products to be incorporated into architectural wood casework and include product characteristics, performance criteria, dimensions and profiles, finish and limitations on use.
 - .3 Submit electronic copy of WHMIS SDS in accordance with Section 01 70 12 - Health and Safety Requirements.
- .3 Hardware List:
 - .1 Submit hardware list cross-referenced to specifications.
 - .2 Include manufacturer's specification sheets indicating name, model, material, function, finish, BHMA designations and other pertinent information.
- .4 Shop Drawings:
 - .1 Prepare and submit shop drawings in accordance with AWMAC AWS and as follows.
 - .2 Submit electronic copy of shop drawings for initial review in accordance with requirements of Division 01. Revise as directed, submit electronic copy for final acceptance and distribution.
 - .3 Indicate details of construction, profiles, jointing, fastening and other related details.
 - .1 Scales: profiles full size, details half full size.
 - .4 Indicate materials, thicknesses, finishes and hardware.

- .5 Indicate locations of service outlets in casework, typical and special installation conditions, and connections, attachments, anchorage and location of exposed fastenings.
- .6 Show location on casework elevations of backing required in supporting structure for attachment of casework.
- .7 Indicate AWMAC AWS quality grade where different from predominant grade specified.
- .8 Include color schedule of all casework items, including all countertop, exposed, and semi-exposed cabinet finishes, finish material manufacturer, pattern, and color.

.5 Samples:

- .1 Prepare and submit samples in accordance with AWMAC AWS and as follows.
- .2 Apply sample finishes to specified substrate or core material minimum 300 x 300 mm to match. For veneers with transparent finish submit three samples to illustrate range and colour of grain expected.
- .3 Shop applied coatings:
 - .1 For transparent finish, submit one samples of each species and cut of wood to be used, finished as specified.
 - .2 For opaque finish, submit one samples for each colour selection, finished as specified.
- .4 Submit duplicate samples of laminated plastic for each specified colour selection.
- .5 Submit duplicate samples of laminated plastic joints, edging, cutouts and post-formed profiles.
- .6 Certifications: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .7 Submit statement of experience and qualifications of architectural wood casework fabricator.

1.6 QUALITY ASSURANCE

- .1 Perform Work of this Section by single architectural wood casework fabricator with current architectural casework production experience and having completed minimum one project with value within 20% of the cost of the work of this Section.
- .2 Independent inspection/testing agency may be engaged by DCC Representative for purpose of inspecting and/or testing Work of this Section.
- .3 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Shop prepare one wall cabinet, convector cabinet, countertop, base cabinet unit, shelving unit, complete with hardware, shop applied finishes, and install where directed by DCC Representative.
 - .3 Allow 72 hours for inspection of mock-up by DCC Representative before proceeding with Work.
 - .4 When accepted, mock-up will demonstrate minimum standard for Work.

.5 Do not proceed with work prior to receipt of written acceptance of mock-up by DCC Representative.

.6 Accepted mock-up may remain as part of finished work.

1.7 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 Deliver wood casework only when area of work is enclosed, plaster and concrete work is dry, and area is broom clean and site environmental conditions are acceptable for installation.

.3 Protect millwork against dampness and damage during and after delivery.

.4 Store millwork in ventilated areas, protected from extreme changes of temperature and humidity, and within range recommended by AWMAC AWS for location of project.

.5 Store materials indoors and in dry location in clean, dry, well-ventilated area.

.6 Protect architectural woodwork and hardware from nicks, scratches, and blemishes.

.7 Replace defective or damaged materials with new.

.8 Waste Management: for packaging and materials, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 SUSTAINABILITY CHARACTERISTICS

.1 Lumber, plywood and composite wood products to be CAN/CSA-Z809 or FSC or SFI certified.

2.2 QUALITY GRADE

.1 Provide all materials and perform all fabrication in accordance with AWMAC AWS Premium Grade

.2 In case of conflict between Contract Documents and AWMAC AWS grade requirements, Contract Documents govern.

2.3 LUMBER

.1 Softwood and Hardwood Lumber: Sound lumber to specified AWMAC AWS quality grade requirements, kiln-dried to moisture content recommended by AWMAC AWS for location of the Work.

.2 Machine stress-rated lumber is acceptable for all purposes.

2.4 PANEL MATERIALS

- .1 Interior mat-formed wood particleboard: to ANSI/NPA A208.1, industrial grade M-3, medium density (640-800 kg/m³), thickness 19 mm unless indicated otherwise.
- .2 Douglas fir plywood (DFP): to CSA O121, standard construction.
- .3 Hardwood plywood: to ANSI/HPVA HP-1 and CHPA grading rules.
- .4 Canadian softwood plywood (CSP): to CSA O151, standard construction.
- .5 Poplar plywood (PP): to CSA O153, standard construction.
- .6 Hardboard: To CAN/CGSB-11.3.

2.5 LAMINATED PLASTIC MATERIALS

- .1 Laminated plastic for flatwork: to NEMA LD3.
 - .1 High pressure decorative laminated (HPDL) plastic.
 - .1 Type: GP (general purpose).
 - .2 Horizontal Surfaces: HGL to suit application, 1.2 mm thick.
 - .3 Vertical Surfaces: VGL to suit application, 0.71mm thick.
 - .4 Colour: integral colour throughout.
 - .5 Pattern: woodgrain, printed pattern or solid.
 - .6 Finish: satin,
 - .2 Laminated plastic for backing sheet:
 - .1 Type: backer.
 - .2 Thickness: same thickness as face laminate.
 - .3 Colour: same colour as face laminate .
 - .3 Edge finishing for doors, drawer fronts, shelves and false fronts:
 - .1 HPDL to match face .
 - .4 Laminated plastic adhesive:
 - .1 Adhesive: contact adhesive to CAN/CGSB-71.20.

2.6 CASEWORK FABRICATION - GENERAL

- .1 Fabricate casework of specified core and surface finish materials to specified AWMAC AWS quality grade.
- .2 Casework.
 - .1 Fabricate caseworks to AWMAC premium grade.
 - .2 Frameless construction. Flush overlay for doors and drawers.

- .3 Furring, blocking, nailing strips, grounds and rough bucks and sleepers.
 - .1 S2S
 - .2 Board sizes: "Standard" or better grade.
 - .3 Dimension sizes: "Standard" light framing or better grade.
- .4 Case bodies (ends, divisions and bottoms).
 - .1 Particleboard grade M3, 19 mm thick, laminated with HPDL.
- .5 Backs.
 - .1 Particleboard grade M3, 13 mm thick, laminated with HPDL.
- .6 Shelving.
 - .1 Semi-exposed.
 - .1 Particleboard grade M3, 19 mm thick, laminated with HPDL.
 - .2 Edge banding: laminated with HPDL to match shelving surfaces.
 - .1 For shelf widths exceeding 760mm provide 16mm x 32mm solid maple edge stiffening strip along front edge of shelf.
 - .1 laminated with HPDL to match shelving surfaces.
- .3 Drawers
 - .1 Fabricate drawers to AWMAC premium grade supplemented as follows:
 - .2 Sides and Backs.
 - .1 Particleboard grade M3, 16 mm thick, laminated with HPDL.
 - .3 Bottoms.
 - .1 Particleboard grade M3, 16 mm thick, laminated with HPDL.
- .4 Casework Doors/Drawer Fronts
 - .1 Fabricate doors to AWMAC premium grade supplemented as follows:
 - .2 Particleboard grade M3, 19 mm thick, laminated with HPDL.
- .5 Shop install cabinet hardware for doors, shelves and drawers. Recess shelf standards unless noted otherwise.

- .6 Shelving to cabinetwork to be adjustable unless otherwise noted.
- .7 Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes and other fixtures.
- .8 Shop assemble work for delivery to site in size easily handled and to ensure passage through building openings.
- .9 Obtain governing dimensions before fabricating items which are to accommodate or abut appliances, equipment and other materials.

2.7 LAMINATED PLASTIC CASEWORK FABRICATION

- .1 Do laminated plastic fabrication in compliance with NEMA LD3, Annex A and specified AWMAC AWS quality grade.
- .2 Ensure adjacent parts of continuous laminate work match in colour and pattern.
- .3 Veneer laminated plastic to core material in accordance with adhesive manufacturer's instructions. Ensure core and laminate profiles coincide to provide continuous support and bond over entire surface. Use continuous lengths up to 2400mm. Keep joints 600 mm from sink cutouts.
- .4 Form shaped profiles and bends as indicated, using post-forming grade laminate to laminate manufacturer's instructions.
- .5 Use straight self-edging laminate strip for flatwork to cover exposed edge of core material. Chamfer exposed edges uniformly at approximately 20 degrees. Do not mitre laminate edges.
- .6 Apply laminate backing sheet to reverse side of core of plastic laminate work.
- .7 Apply laminated plastic liner sheet to interior of cabinetry.

2.8 CABINET HARDWARE

- .1 Cabinet hardware: to AWMAC AWS quality grade specified and to ANSI/BHMA A156.9, designated by letter B and numeral identifiers as listed below.
- .2 Slides:
 - .1 Side mounted, medium duty, full extension, with self-closing mechanism and hold in detent.
- .3 Hinges:
 - .1 Concealed European cup style, full overlay with 110° opening minimum with self-closing mechanism. 6-way adjustment.

- .4 Handles: "D" type, 96mm c.c. with satin stainless steel and antimicrobial finish.
- .5 Adjustable shelf standards:
 - .1 Recessed, 16mm wide, zinc plated metal standards.
 - .2 Adjustments in 13mm increments.
 - .3 Full height of cabinet unless otherwise specified.
 - .4 Provide four (4) shelf clips per shelf.
 - .5 Provide additional twenty four (24) clips for Client replacement stockpiles.

2.9 ACCESSORIES

- .1 Wood screws: plain, type and size to suit application.
- .2 Nails and staples: to CSA B111 and ASTM F1667.
- .3 Splines: wood .
- .4 Sealant: in accordance with Section 07 92 00 - Joint Sealants.

2.10 WINDOW SILLS, JAMBS (where indicated).

- .1 Fabricate window sills and jambs (where indicated) to AWMAC premium grade supplemented as follows:
 - .1 Veneer core plywood G1S, 19 mm thick, laminated with HPDL.

2.11 COUNTERTOPS

- .1 Solid surface material.
 - .1 19mm thick.
 - .2 Colour selected by DCC Representative from manufactures standard range. Maximum of four (4) colours for project.
 - .1 Refer to finish schedule for application types.
 - .3 Edge profile: double round over edge unless otherwise as indicated.
 - .4 Class A material rating.
 - .1 Flame spread <25
 - .2 Smoke Development <25
 - .5 Physical Properties:
 - .1 Tensile Strength: 6000 psi min to ASTM D638.
 - .2 Tensile Modulus: 1.5 x 10⁶ psi min to ASTM D638
 - .3 Tensile Elongation: 0.4% min. to ASTM D638
 - .4 Flexural Strength: 10000 psi min to ASTM D790

- .5 Flexural Modulus: 1.2×10^6 psi min to ASTM D790
- .6 Hardness: >85-Rockwell "M" scale min.to ASTM D785
- .7 Thermal Expansion: 2.2×10^{-5} in./in./°F to ASTM E228
- .8 Fungi and Bacteria: Does not support microbial growth to ASTM G21 & G22
- .9 Microbial Resistance: Highly resistant to mold growth to UL 2824
- .10 Ball Impact: No fracture - 1/2 lb. Ball: to NEMA LD 3, Method 3.8 12 mm slab - 3658mm (144") drop.
- .11 Weatherability: $\Delta E^*94 < 5$ in 1,000 hrs to ASTM G155
- .12 Flammability: ASTM E84, NFPA 255 & UL 723
- .6 Acceptable products:
 - .1 *Corian* by DuPont; www.corian.com
 - .2 *Staron Solid Surface* by Samsung; www.staron.com
 - .3 *Wilsonart Solid Surface* by Wilsonart; www.wilsonart.com
 - .4 *Formica Solid Surfacing* by Formica; www.formica.com
- .2 Stainless Steel Countertops (Rm 2056b, VIP Supply Lock-up)
 - .1 304 Stainless Steel 1.6mm (16 Ga).
 - .2 Satin Finish.
 - .3 Edges: 38mm boxed.
 - .1 All around perimeter for freestanding islands.
 - .2 75mm integral upturn backsplash adjacent to walls.
 - .4 All seams welded and ground smooth.
 - .5 Substrate: two layers 19mm DFP plywood.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for architectural woodwork installation in accordance with manufacturer's instructions.

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Install architectural wood casework in accordance with AWMAC AWS grade for respective items.
- .2 In case of conflict between Contract Documents and AWMAC AWS grade requirements, Contract Documents govern.
- .3 Coordinate with other trades for installation of required blocking, electrical and plumbing components.
- .4 Install prefinished millwork at locations shown on drawings.
 - .1 Position accurately, level, plumb straight.
- .5 Fasten cabinets securely to adjacent units and to backing.
 - .1 Fasten wall cabinets through back, near top and bottom, at ends and not less than 610mm o.c.
 - .2 Provide heavy duty fixture attachments for wall mounted cabinets.
- .6 Countersink mechanical fasteners at exposed and semi-exposed surfaces, excluding installation attachment screws and screws securing cabinets end to end.
- .7 Use draw bolts in countertop joints.
- .8 Scribe and cut as required to fit abutting walls and to fit properly into recesses and to accommodate piping, columns, fixtures, outlets or other projecting, intersecting or penetrating objects.
- .9 At junction of plastic laminate counter back splash and adjacent wall finish, apply small bead of sealant in accordance with Section 07 92 00 - Joint Sealants.
- .10 Apply moisture barrier between wood framing members and masonry or cementitious construction.
- .11 Fit hardware accurately and securely in accordance with manufacturer's written instructions.
- .12 Make cutouts for inset equipment and fixtures using templates provided.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Clean cabinet work, outside surfaces, millwork, inside cupboards and drawers.
 - .2 Remove excess glue, pencil and ink marks from surfaces.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

3.4 PROTECTION

- .1 Protect cabinet work and millwork from damage until final inspection.
- .2 Protect installed products and components from damage during construction.
- .3 Repair damage to adjacent materials caused by architectural woodwork installation.
- .4 Prior to substantial completion, examine work for damages. Repair or replace such damaged work to original condition.
- .5 Check and correct operating mechanisms for proper operation. Adjust and lubricate hinges, catches and other operating hardware.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C553-13, Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 ASTM C665-12, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .3 ASTM C1320-10, Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
- .2 CSA Group
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA B149 PACKAGE-10, Consists of B149.1, Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S604-2012, Standard for Factory-Built Type A Chimneys.
 - .2 CAN/ULC-S702-2012, Standard for Mineral Fibre Insulation for Buildings.

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 blanket insulation and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates:
 - .1 Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.4 Test Reports:

- .1 Submit certified test reports showing compliance with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and 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, indoors and off ground 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 Packaging Waste Management: remove for reuse and return of padding, crates, pallets, packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 INSULATION

- .1 Batt and blanket mineral fibre: to CAN/ULC-S702.
- .1 Type: 1.
- .2 Thickness: as indicated .
- .3 Fire performance: Non-Combustibility: to CAN/ULC S114.
- .4 Density: > 32 kg/m3
- .5 Acoustical Performance:
- .1 Airborne sound transmission loss: To ASTM E90.
- .2 Rating sound insulation: To ASTM E413.
- .3 Sound absorption co-efficients: To ASTM C423 as per chart:

Sound Absorption Co-efficiencies at Frequencies							
Thickness (mm)	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
25	0.14	0.25	0.65	0.90	1.01	1.01	0.70
38	0.18	0.44	0.94	1.04	1.02	1.03	0.85
50	0.28	0.60	1.09	1.09	1.05	1.07	0.95
75	0.52	0.96	1.18	1.07	1.05	1.05	1.05
100	0.86	1.11	1.20	1.07	1.08	1.07	1.10

- .4 Impedance and absorption of acoustic materials:
To ASTM E1050.

2.2 ACCESSORIES

- .1 Nails: galvanized steel, length to suit insulation plus 25 mm, to CSA B111.
- .2 Staples: 12 mm minimum leg.
- .3 Tape: as recommended by 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 blanket insulation application in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSULATION INSTALLATION

- .1 Install insulation to maintain continuity of acoustical separation to building elements and spaces and to ASTM C1320.
- .2 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .3 Do not compress insulation to fit into spaces.

- .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN/ULC-S604 Type A chimneys CSA B149.1 and CSA B149.2 Type B L vents.
- .5 Do not enclose insulation until it has been inspected and approved by DCC Representative.

3.3 CLEANING

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

- .1 ASTM International Inc.
 - .1 ASTM D1876-08(2015)e1 - Peel Resistance of Adhesives (T-Peel Test).
 - .2 ASTM D4434/D4434M-15 - Poly(Vinyl Chloride) Sheet Roofing.
 - .3 ASTM D6878/D6878M-13 - Thermoplastic Polyolefin Based Sheet Roofing.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M89, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Canadian Roofing Contractors' Association (CRCA)
 - .1 CRCA Roofing Specification Manual 1997.
- .4 CSA Group (CSA)
 - .1 CSA A123.21-14 , Standard Test Method for the Dynamic Wind Uplift Resistance of Mechanically Attached Membrane-Roofing Systems
 - .2 CSA A231.1/A231.2-14 , Precast Concrete Paving Slabs/Precast Concrete Pavers.
 - .3 CSA O121-17, Douglas Fir Plywood.
 - .4 CSA O151-17, Canadian Softwood Plywood.
- .5 Factory Mutual (FM Global)
 - .1 FM Approval Standard # 4470 Class 1 Roof Covers.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-17 , Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .2 CAN/ULC-S702.2-10 , Standard for Mineral Fibre Thermal Insulation for Buildings.
 - .3 CAN/ULC-S704-17 , Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
 - .4 CAN/ULC-S706-09 , Standard for Wood Fibre Thermal Insulation for Buildings.

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 insulation membranes and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies of WHMIS SDS in accordance with Section 01 70 12 - Health and Safety Requirements.
- .3 Provide shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
 - .2 Indicate field fabricated seams, flashing, tapered insulation and penetrations details.
 - .1 Match existing adjacent slopes for tapered insulation.
- .4 Test and Evaluation Reports: submit laboratory test reports certifying compliance of roofing membrane with specification requirements.
 - .1 Compatibility of materials: submit written declaration to DCC Representative as described in Part 2, Performance Criteria.
- .5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

1.3 QUALITY ASSURANCE

- .1 Installer qualifications: company or person specializing in application of TPO roofing systems approved by manufacturer.
- .2 Source Limitations: Obtain each type of thermoplastic polyolefin (TPO) roofing membrane through one (1) source from a single manufacturer.
- .3 Mock-ups:
 - .1 Construct mock-up in accordance with Section 01 45 00-Quality Control.
 - .2 Construct mock-up 1 m² minimum size showing typical lap joint, one outside corner and one roof to parapet transition.
 - .3 Construct mock-up where directed.
 - .4 Mock-up will be used:

- .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .5 Allow 72 hours for inspection of mock-up by DCC Representative before proceeding with roofing work.
- .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work.
- .7 Approved mock-up may remain as part of finished Work once accepted by DCC Representative.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00-Common Product Requirements.
- .2 Storage and Handling Requirements:
 - .1 Provide and maintain dry, off-ground weatherproof storage.
 - .2 Store materials on supports to prevent deformation.
 - .3 Remove only in quantities required for same day use.
 - .4 Store uncured flashing and jointing materials to prevent premature curing and freezing.
 - .5 Store insulation protected from sunlight, weather and deleterious materials.
 - .6 Store roofing materials in accordance with manufacturer's written instructions, to prevent damage or loss of performance.
 - .7 Products stored on the roof deck must not cause permanent deck deflection.
- .3 Packaging Waste Management: remove for reuse and return of padding, crates, pallets, packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
 - .2 Fold up metal banding, flatten and place in designated area for recycling.

1.5 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Apply TPO membrane only when surfaces and ambient temperatures are within manufacturers' prescribed limits.
 - .2 Do not install TPO membrane when air and substrate temperature remain below 5 degrees C or when wind

chill gives equivalent cooling effect for minimum 48 hours before installation.

- .3 Install TPO membrane on dry substrate, free of snow and ice. Use only dry materials and apply only during weather that will not introduce moisture into system.
- .2 Ventilation:
 - .1 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities .
 - .2 Provide continuous ventilation during and after roofing application.
 - .1 Run ventilation system during installation.

1.6 WARRANTY

- .1 For the Work of this Section 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing provide 12 months warranty period.
- .2 Manufacturer's warranty to warrant roofing system against material and manufacturing defects and agree to repair any leak caused by a defect in the roofing system or workmanship of the installer.

Part 2 Products

2.1 DESCRIPTION - ROOFING SYSTEM

- .1 Thermoplastic Polyolefin (TPO) membrane roofing consisting of reinforced membrane for use in fully adhered system.

2.2 PERFORMANCE CRITERIA

- .1 Compatibility between components of system and adjacent materials is essential.
 - .1 Provide a written declaration to DCC Representative stating that all materials and components, as assembled in system, meet this requirement.
- .2 Roofing system: to CSA A123.21 for wind uplift resistance.

2.3 DECK COVERING

- .1 Glass Mat Gypsum Board: to Type X 12.7 mm thick, ASTM C1177/C1177M.

2.4 VAPOUR RETARDER

- .1 Self adhesive membrane to CAN/CGSB-51.33 , Type 1, 1mm thick.

2.5 TPO ROOFING MEMBRANE

- .1 TPO Sheet: ASTM D6878/D6878M, internally fabric or scrim reinforced, 1.5mm (60 mils) thick, with no backing.

2.6 POLYSTYRENE INSULATION

- .1 Extruded polystyrene (XPS) insulation : to CAN/ULC-S701 , Type 3 or 4 thickness and profile to match existing adjacent insulation. 150mm minimum.
 - .1 Form cant strips and tapered insulation from same material.

2.7 OVERLAY BOARD

- .1 Glass Mat Gypsum Board: to Type X 12.7 mm thick, ASTM C1177/C1177M.

2.8 OVERLAY BOARD ADHESIVE

- .1 Adhesive for securing overlay board and insulation:
 - .1 Single component, moisture cured, polyurethane adhesive.

2.9 SEALERS

- .1 Sealants: asbestos-free sealant, compatible with systems materials, recommended by system manufacturer.

2.10 FASTENERS

- .1 Sheathing to steel deck: No.10 flat head, self tapping, Type S, cadmium plated screws to ASTM C1002 .
- .2 Insulation to substrate: fasteners and plates must meet FM Approval Standard #4470 for wind uplift and corrosion resistance.
- .3 Membrane to substrate: fasteners and spacing as recommended by manufacturer.

2.11 PROTECTION MAT

- .1 Non-woven polypropylene needle punched felt.

2.12 FASTENING

- .1 Bar, with prepunched holes and screws as recommended by manufacturer.
- .2 Screws and washers as recommended by manufacturer.

2.13 ADHESIVES, TAPES AND PRIMERS

- .1 Adhesive, tapes and primers, in accordance with manufacturer's recommendations and compatible with surrounding roofing membranes.

2.14 SOURCE QUALITY CONTROL

- .1 Provide laboratory test reports certifying compliance of roofing materials with specification requirements as described in PART 1, SUBMITTALS/QUALITY CONTROL.

2.15 ROOFTOP MECHANICAL SUPPORTS

- .1 Mechanical Supports:
 - .1 Designed to support piping, HVAC/Ducts, roof walkways, conduit and cable tray over SBS roof membranes.
 - .2 Composed of solid UV resistant rubber and galvanized metal securement channels and fastenings.

2.16 ROOFTOP MECHANICAL CURBS

- .1 Mechanical Curbs:
 - .1 Premanufactured insulated metal curbs.
 - .2 Refer to Section 05 50 00 - Metal Fabrications.

Part 3 Execution**3.1 QUALITY OF WORK**

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Do examination, preparation and roofing Work in accordance with CRCA Roofing Specification Manual.
- .3 Assembly, component and material connections will be made in consideration of appropriate design loads, with reversible mechanical attachments.

3.2 SUBSTRATE EXAMINATION

- .1 Verification of Conditions: examine substrates and immediately inform DCC Representative in writing of defects.
 - .1 Verify that substrates are visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263-83(2012).

- .2 Verify that minimum drying period recommended by roofing manufacturer has passed.
- .3 Proceed with installation only after unsatisfactory conditions have been corrected.
- .2 Evaluation and Assessment: prior to beginning work ensure:
 - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and swept clean of dust and debris.
 - .2 Curbs have been built.
 - .3 Existing drains are not affected or blocked by new work.
- .3 Correct unsatisfactory conditions before beginning roofing work.
- .4 Do not install roofing materials during rain or snowfall.

3.3 PROTECTION OF IN-PLACE CONDITIONS

- .1 Cover walls, walks, sloped roofs and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers:
 - .1 Maintain in good order until completion of Work.
- .3 Dispose of rain water away from face of building in work area until drains or hoppers are operational.
- .4 Protect from traffic and damage:
 - .1 Comply with precautions deemed necessary by DCC Representative.
- .5 Place plywood runways over work to enable movement of material and other traffic.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed Work and materials out of storage.
- .7 Seal exposed edges.
- .8 If metal connectors are used, treat connectors and decking with rust proofing or galvanization.

3.4 DECK SHEATHING

- .1 Mechanically fasten Glass Mat Gypsum Board to steel deck with reversible mechanical attachments spaced 400 mm on centre each way.
- .2 Place with long axis of each sheet transverse to steel deck ribs, with end joints staggered and fully supported on ribs.

3.5 VAPOUR RETARDER (STEEL DECK)

- .1 Install self adhering vapour retarder using solvent based adhesive as per manufacturer's instructions.

3.6 INSULATION: FULLY ADHERED, ADHESIVE APPLICATION

- .1 Adhere insulation to laminated vapour barrier using solvent-based adhesive.
- .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
- .3 Apply adhesive in continuous ribbons at 300 mm on centre.
- .4 Cut end pieces to suit.

3.7 TAPERED INSULATION: APPLICATION

- .1 Install tapered insulation and cants as second insulation layer, in accordance with shop drawings.
 - .1 Stagger joints between layers 150 mm minimum.
- .2 Edge securement:
 - .1 Attach fastening strips to mechanically secure membrane. Ensure screws penetrate into deck or curb.
 - .2 Adhesive recommended by manufacturer.
- .3 Flashings:
 - .1 Install cured or uncured TPO membrane flashings in accordance with manufacturer's written instructions.
- .4 Penetrations:
 - .1 Install, vent stack covers and other penetration flashings and seal to membrane in accordance with manufacturer's recommendations and details.

3.8 FIELD QUALITY CONTROL

- .1 Inspection:
 - .1 Inspection and testing of TPO membrane application will be carried out by testing laboratory designated by DCC Representative.
 - .2 Conduct a non-destructive moisture detection test and membrane integrity testing after cap sheet has been installed for all areas of work.
 - .3 Utilize one of the approved methods:
 - .1 Infrared Thermography to ASTM C1153.
 - .2 Nuclear Backscatter to ASTM

- .4 Submit results of moisture testing to DCC Representative according to Section 01 33 00 - Submittal Procedures.
- .5 Costs of tests will be paid by Contractor.

3.9 CLEANING

- .1 Clean Work in accordance with Section 01 74 11 - Cleaning.
- .2 Clean to DCC Representative's approval, soiled surfaces, spatters, and damage caused by Work of this Section.
- .3 Check drains to ensure cleanliness and proper function, and remove debris, equipment and excess material from site.
- .4 Waste Management: separate waste materials for recycling, reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Collect, package and store TPO membrane cut-offs and waste material for recycling and return to recycler in accordance with Waste Management Plan.
 - .2 Place used hazardous sealant tubes, adhesive containers and materials defined as hazardous or toxic in designated containers.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 07 42 46 - Fibre Reinforced Cementitious Wall Panels
- .2 Section 07 92 00 - Joint Sealing.
- .3 Section 08 11 00 - Metal Doors and Frames
- .4 Section 08 50 00 - Windows

1.2 REFERENCE STANDARDS

- .1 The Aluminum Association Inc. (AAI)
 - .1 AA Aluminum Design Manual 2015 Part VIII Guidelines for Aluminum Sheet Metal Work in Building Construction.
 - .2 AAI DAF45-2003 (R2009), Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA 621-02 Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Substrates.
 - .2 AAMA 2603-15, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 - .3 AAMA 2604-13 Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - .4 AAMA 2605-13 Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- .3 American National Standards Institute (ANSI)
 - .1 ANSI/SPRI/FM 4435/ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems 2011.
- .4 ASTM International
 - .1 ASTM A 653/A 653M-15e1, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A755/A755M-16e1 Standard Specification for Steel Sheet, Metallic coated by the Hot-Dip Process and

- Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
- .3 ASTM A 792/A 792M-10 (2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .4 ASTM B32-08 (2014), Standard Specification for Solder Metal.
 - .5 ASTM B209-14 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .6 ASTM B 370-12, Standard Specification for Copper Sheet and Strip for Building Construction.
 - .7 ASTM D 523-14, Standard Test Method for Specular Gloss.
 - .8 ASTM D1970/D1970M-15a Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - .9 ASTM D4587-11 Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings.
 - .10 ASTM F1667-15 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
 - .5 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual 2012.
 - .6 Canadian Sheet Steel Building Institute (CSSBI)
 - .1 CSSBI S8-2008 Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.
 - .2 CSSBI B17-2002 Barrier Series Prefinished Steel Sheet: Product Performance & Applications.
 - .3 CSSBI Sheet Steel Facts #12 2003 Fastener Guide for Sheet Steel Building Products.
 - .7 CSA Group
 - .1 CSA A123.3-05 (2015), Asphalt Saturated Organic Roofing Felt.
 - .2 CSA A123.22-08 (2013) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - .8 FM Global
 - .1 Property Loss Prevention Data Sheets 1-49 Perimeter Flashing.
 - .9 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).
- .10 Sheet Metal and Air Conditioning Contractors Association of North America (SMACNA)
 - .1 Architectural Sheet Metal Manual (2012)
 - .2 Residential Sheet Metal Guidelines (2001)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature including product specifications and technical data sheets for sheet metal flashing fasteners and accessory materials. Include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 70 12 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit shop drawings for all sheet metal fabrications.
 - .2 Indicate sheet thickness, flashing dimensions and fastenings. Include anchorage, expansion joints and other provisions for thermal movement.
 - .3 Submit manufacturer's catalogue cut sheets for manufactured items.
- .4 Samples:
 - .1 Submit 50 x 50 duplicate mm samples of each type of sheet metal material, finishes and colour.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section on-site installation, with DCC Representative to:
 - .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.

1.5 MOCK-UPS

- .1 Include flashings in mock-ups as specified for work of other affected sections.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Handle and store flashing materials to prevent creasing, buckling, scratching, or other damage.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.

Part 2 Products**2.1 BASE SHEET METAL MATERIALS**

- .1 Provide sheet metal in base metal thickness specified. Where no thickness specified, provide base sheet metal in thickness recommended in SMACNA Architectural Sheet Metal Manual for type of item being fabricated, but not less than the thickness required by the authority having jurisdiction.
- .2 Zinc coated steel sheet: .6 mm thickness unless otherwise indicated, commercial quality to ASTM A653/A653M, with Z275 designation zinc coating.
- .3 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality, grade 37 with AZ150 coating, regular spangle surface.

2.2 PREFINISHED STEEL SHEET

- .1 Prefinished steel sheet with coating system consisting of base metal pre-treatment, primer, silicone modified polyester or polyester topcoat meeting requirements of CSSBI S8.
 - .1 Finished one side with wash coat and primer on back.
 - .2 Colour selected by DCC Representative from manufacturer's standard range.
 - .3 Specular gloss: 20 units +/- 5 gloss units in accordance with ASTM D 523.
 - .4 Exposed coating thickness: dry film coating system thickness not less than 22 micrometres.

- .2 Prefinished steel with factory applied two-coat polyvinylidene fluoride resin on specified steel sheet substrate conforming to ASTM A755 and AAMA 621-02 :
 - .1 Finished colour finished on both sides.
 - .2 Colour selected by DCC Representative from manufacturers standard range.
 - .3 Specular gloss: 25 units +/- in accordance with ASTM D523.
 - .4 Exposed coating thickness: dry film coating system thickness not less than 22 micrometres.
- .3 Prefinished steel with factory applied primer and polyvinyl chloride heat-cured topcoat.
 - .1 Class F1S.
 - .2 Colour selected by DCC Representative from manufacturers standard range.
 - .3 Specular gloss: 30 units +/- 5 in accordance with ASTM D523.
 - .4 Coating thickness: not less than 200 micrometres.
 - .5 Resistance to accelerated weathering for chalk rating of 8, colour fade 5 units or less and erosion rate less than 20 % to ASTM D45878 as follows:
 - .1 Cycle #4 General Metal Coatings.
 - .2 Exposure period: 2000 hours.

2.3 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Loose laid underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.
- .3 Self-adhesive membrane underlay and tie-in membrane for metal flashings: To CSA A123.22 or ASTM D1970, minimum 1.0mm (40mils) thickness.
- .4 Sealants: in accordance with Section 07 92 00, in colour to match flashing finish colour.
- .5 Cleats and hook strips: of same material, and temper as sheet metal, minimum one-third width of secured flashing 50 mm wide. Thickness same as sheet metal being secured.
- .6 Nails: of same material as sheet metal, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.

- .7 Screws: of same material as sheet metal, Suitable for substrate and material being fastened, coloured head, neoprene washer.
- .8 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

- .1 Fabricate sheet steel flashings and other sheet steel work as indicated and in accordance with applicable SMACNA architectural details and CRCA 'FL' series details.
- .2 Form pieces in 2400 mm maximum lengths.
 - .1 Make allowance for expansion at joints.
- .3 Hem exposed edges on underside 12 mm.
 - .1 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 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated and SMACNA architectural details and CRCA 'FL' series details thickness as indicated, minimum 0.6mm (24 gauge) thick prefinished steel.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install sheet metal work as detailed and in accordance with SMACNA architectural details and CRCA 'FL' series details.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal.
 - .1 Secure in place and lap joints 100 mm.

- .2 Provide self-adhesive membrane to tie into adjacent assemblies.
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
 - .1 Flash joints using S-lock forming tight fit over hook strips.
- .5 Lock end joints and caulk with sealant.
- .6 Insert metal flashing to form weather tight junctions.
- .7 Caulk flashing with sealant.
- .8 Where flashing installed with mechanical fasteners, install fasteners in slots or oversize holes to allow expansion and contraction of flashings.
- .9 Provide isolation coating or impervious self-adhesive membrane to separate aluminum items from concrete and masonry.
- .10 Where flashing details lap each other provide sufficient overlap material to hide substrates and accommodate movement.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning and Waste Management.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

END OF SECTION

Part 1 General**1.1 REFERENCE STANDARDS**

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN-ULC-S101-04, Standard Methods of fire Endurance Tests of Building Construction and Materials.
 - .2 CAN-ULC-S102-03, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 SYSTEM DESCRIPTION

- .1 Spray-applied fire protection material to be applied to structural steel.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit two copies of WHMIS SDS - Safety Data Sheets.
- .3 Samples: submit duplicate 300 x 300 mm size sample of exposed fireproofing for approval of texture and colour.
- .4 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test Reports:
 - .1 Submit product data including certified copies of test reports verifying fireproofing applied to substrate as constructed on project will meet or exceed requirements of Specification.
 - .2 Submit test results in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
 - .3 For assemblies not tested and rated, submit proposals based on related designs using accepted fireproofing design criteria.

- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
- .4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer: company specializing in the manufacture of fire protection products.
 - .2 Installer: company specializing in sprayed-on fireproofing, with experience and licenced/approved by manufacturer.
 - .1 Fireproofing is to be installed by a contractor who is primarily engaged in the business of installing fireproofing systems and is to be certified by the manufacturer of the fireproofing product.
- .2 Site Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section, with contractor's representative and DCC Representative.
 - .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 Prior to start of Work arrange for site visit with Departmental Representative to examine existing site conditions adjacent to demolition work.
 - .3 Ensure subcontractor representatives, site supervisor, key personnel, project manager attend.
 - .4 Departmental Representative will provide written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

- .3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work 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.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver packaged materials in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
 - .1 Store materials indoors in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
 - .3 Damaged or opened containers will be rejected.
 - .4 Packaging to indicate shelf-life and materials to be applied prior to expiration of shelf-life.
 - .5 Provide temporary enclosures to prevent spray from contaminating air beyond application area.
 - .6 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of fireproofing materials.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for recycling and reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 AMBIENT CONDITIONS

- .1 At temperatures less than 5 degrees C, ensure that 5 degrees C air and substrate temperature is maintained during and for 24 hours after application. Ensure that natural ventilation to properly dry the fireproofing during and subsequent to its application is provided. In enclosed areas lacking openings

for natural ventilation, ensure that interior air is circulated and exhausted to the outside.

- .2 Maintain relative humidity within limits recommended fireproofing manufacturer.
- .3 Ensure that natural ventilation to properly dry fireproofing during and subsequent to its application is provided.
- .4 In enclosed areas lacking openings for natural ventilation, provide minimum of 4 air exchanges per hour by forced air circulation.

Part 2 Products

2.1 MATERIALS

- .1 Sprayed fireproofing: ULC certified asbestos-free mineral fibre fireproofing qualified for use in ULC Designs specified and fungus resistant for 28 days.
- .2 Curing compound: type recommended by fireproofing manufacturer, qualified for use in ULC Designs specified.
- .3 Sealer: type recommended by fireproofing manufacturer, qualified for use in ULC Design appropriate for fire rating indicated.
 - .1 Colour: from manufacturer standard range as approved by Departmental Representative.
- .4 Fireproofing: minimum dry density and cohesion/adhesion properties as follows:
 - .1 Fireproofing for structural components concealed above ceiling, or within wall, chase, or furred space: minimum applied dry density of 240 kg per cubic metre and cohesion/adhesion strength of 9.57 kPa.
 - .2 Fireproofing for exposed structural components, except where otherwise specified or indicated: minimum applied dry density of 350 kg per cubic metre and cohesion/adhesion strength of 20.83 kPa.
 - .3 Fireproofing for structural components located in mechanical rooms and storage areas: minimum applied dry density of 640 kg per cubic metre and cohesion/adhesion strength of 350 kPa.
 - .4 Ensure spray-applied fireproofing: does not crack, spall, or delaminate under downward deflection conditions over 3 m clear span.
 - .5 Minimum compressive strength: 48 kPa.

- .6 Spray-Applied fireproofing material: not contribute to corrosion of test panels.
- .7 Dust removal: not exceed 0.25 gram per square meter.

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 datasheets.

3.2 PREPARATION

- .1 Substrate: free of material, which would impair bond.
- .2 Verify that painted substrates are compatible and have suitable bonding characteristics to receive fireproofing.
- .3 Remove incompatible materials.
- .4 Ensure that items required to penetrate fireproofing are placed before installation of fireproofing.
- .5 Ensure that ducts, piping, equipment, or other items which would interfere with application of fireproofing are not positioned until fireproofing work is completed.

3.3 APPLICATION

- .1 Apply bonding adhesive or primer to substrate if recommended by manufacturer.
- .2 Apply fireproofing to correspond with tested assemblies, or acceptable calculation procedures to provide following fire resistance ratings.
- .3 Apply fireproofing over substrate, building up to required thickness to cover substrate with monolithic blanket of uniform density and texture.
- .4 Apply fireproofing directly to open web joists without use of expanded lath.
- .5 Tamp smooth, surfaces visible in finished work.
- .6 Apply curing compound to surface of cementitious fireproofing as required by manufacturer.
- .7 Apply sealer to surface of mineral fibre fireproofing as required by manufacturer where fireproofing is to be painted and as indicated.

3.4 FIELD QUALITY CONTROL**.1 Manufacturer's Field Services:**

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting, and cleaning of product and submit Manufacturer's Field Reports 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.

3.5 PATCHING

- .1 Patch damage to fireproofing caused by testing or by other trades before fireproofing is concealed, or if exposed, before final inspection.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Clean surfaces not indicated to receive fireproofing of sprayed material within 24 hours period after application.
- .3 On 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 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .3 Underwriter's Laboratories of Canada (ULC)
 - .1 ULC-S115-1995, Fire Tests of Fire stop Systems.

1.2 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1(1) and 9.10.9.6(1)): penetrating items that are cast in place in buildings of non-combustible construction or have "0" annular space in buildings of combustible construction.
 - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00-Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two copies of WHMIS SDS - Material Safety Data Sheets.
- .3 Shop Drawings:
 - .1 Submit shop drawings to show location, proposed material, reinforcement, anchorage, fastenings and method of installation.
 - .2 Construction details should accurately reflect actual job conditions.
- .4 Samples:
 - .1 Submit duplicate 300 x 300 mm samples showing actual fire stop material proposed for project.
- .5 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports: in accordance with CAN-ULC-S101 for fire endurance and CAN-ULC-S102 for surface burning characteristics.
 - .1 Submit certified test reports from approved independent testing laboratories, indicating compliance of applied fire stopping with specifications for specified performance characteristics and physical properties.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
 - .4 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company specializing in fire stopping installations approved by manufacturer with documented experience.
 - .2 As per FMD 4003 single installation company specializing in the installation of firestop and single firestop manufacturer to be used.
 - .3 To be in good standing with CFIA for minimum 2 years.
- .2 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning work of this Section, with DCC Representative in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart to:
 - .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.
- .3 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete, but before installation begins.
 - .2 Twice during progress of Work at 25%\ and 60% complete and;
 - .3 Upon completion of Work, after cleaning is carried out.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer and ULC markings.
- .2 Storage and Protection:
 - .1 Store materials in dry location, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Replace defective or damaged materials with new.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for recycling and reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
 - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended.
 - .2 Fire stop system rating: 1hr, unless otherwise indicated.
- .2 Service penetration assemblies: systems tested to CAN-ULC-S115.
- .3 Service penetration fire stop components: certified by test laboratory to CAN-ULC-S115.
- .4 Fire-resistance rating of installed fire stopping assembly in accordance with NBC.
- .5 Fire stopping and smoke seals at openings intended for ease of re-entry such as cables: elastomeric seal.
- .6 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal.
- .7 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .8 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .9 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .10 Sealants for vertical joints: non-sagging.

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 datasheets.

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
 - .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

3.4 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by DCC Representative.
- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.

- .4 Mechanical pipe insulation: certified fire stop system component.

- .1 Ensure pipe insulation installation precedes fire stopping.

3.5 FIELD QUALITY CONTROL

- .1 Inspections: notify DCC Representative when ready for inspection and prior to concealing or enclosing fire stopping materials and service penetration assemblies.

- .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.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Remove temporary dams after initial set of fire stopping and smoke seal materials.

3.7 SCHEDULE

- .1 Fire stop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Edge of floor slabs at curtain wall and precast concrete panels.
 - .3 Top of fire-resistance rated masonry and gypsum board partitions.
 - .4 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .5 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

- .6 Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
- .7 Openings and sleeves installed for future use through fire separations.
- .8 Around mechanical and electrical assemblies penetrating fire separations.
- .9 Rigid ducts: greater than 129 cm²: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 06 40 00 - Architectural Woodwork.
- .2 Section 08 11 00 - Metal Doors and Frames.
- .3 Section 08 80 00 - Glazing.
- .4 Section 09 21 16 - Gypsum Board Assemblies.
- .5 Section 09 30 13 - Ceramic Tiling.
- .6 Section 09 65 19 - Resilient Tile Flooring.
- .7 Section 09 91 23 - Interior Painting.
- .8 Section 10 21 13.19 - Plastic Toilet Compartments.
- .9 Section 10 28 00 - Toilet and Bath Accessories.
- .10 Section 22 42 01 - Plumbing Specialties and Assemblies.
- .11 Section 22 42 03 - Commercial Washroom Fixtures.
- .12 Section 22 42 16 - Commercial Lavatories and Sinks.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C919-08, Standard Practice for Use of Sealants in Acoustical Applications.
- .2 Canadian General Standards Board (CGSB)
 - .1 CGSB 19-GP-5M-1984, Sealing Compound, One Component, Acrylic Base, Solvent Curing (Issue of 1976 reaffirmed, incorporating Amendment No. 1).
 - .2 CAN/CGSB-19.13-M87, Sealing Compound, One-component, Elastomeric, Chemical Curing.
 - .3 CGSB 19-GP-14M-1984, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing (Reaffirmation of April 1976).
 - .4 CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
 - .5 CAN/CGSB-19.24-M90, Multi-component, Chemical Curing Sealing Compound.
- .3 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).

- .4 General Services Administration (GSA) - Federal Specifications (FS)
 - .1 FS-SS-S-200-E (2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .6 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).

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 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 2 copies of WHMIS SDS in accordance with Section 01 70 12 - Health and Safety Requirements.
- .3 Samples:
 - .1 Submit 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.

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 incorporation into manual.

1.5 QUALITY ASSURANCE/MOCK-UP

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct mock-up to show location, size, shape and depth of joint s complete with back-up material, primer, caulking and sealant.
- .3 Mock-up will be used:
 - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .4 Locate where directed.
- .5 Allow 24 hours for inspection of mock-up by DCC Representative before proceeding with sealant work.
- .6 When accepted, mock-up will demonstrate minimum standard of quality required for this Work. Approved mock-up may remain as part of finished Work.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, off ground and 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 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.
- .5 Place materials defined as hazardous or toxic in designated containers.
- .6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .7 Unused sealant material 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.

- .8 Divert unused joint sealing material from landfill to official hazardous material collections site approved by DCC Representative.
- .9 Empty plastic joint sealer containers are not recyclable. Do not dispose of empty containers with plastic materials destined for recycling.

1.7 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Proceed with installation of joint sealants only when:
 - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 4.4 degrees C.
 - .2 Joint substrates are dry.
 - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
 - .1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
 - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 PROJECT CONDITIONS

- .1 Environmental Limitations:
 - .1 Do not proceed with installation of joint sealants under following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 degrees C.
 - .2 When joint substrates are wet.
- .2 Joint-Width Conditions:
 - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:

- .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of Material Safety Data Sheets (SDS) acceptable to Health Canada.
- .2 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .3 Ventilate area of work as directed by DCC Representative by use of approved portable supply and exhaust fans. DCC Representative will arrange for ventilation system to be operated on maximum outdoor air and exhaust during installation of caulking and sealants.

Part 2 Products

2.1 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 exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.
- .3 Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 For joints in storefront, and other vertical and sloping surfaces, structural glazing: Conform to CAN/CGSB 19.13-M87, silicone based, single component, non-sag, one of the following:
 - .1 GE Silicones SCS 2000 Series
 - .2 Dow Corning 795.
 - .3 Tremco Spectrem 2.
- .2 For joints in concrete, concrete masonry, and plaster walls and other vertical and sloping surfaces: Conform to

CAN/CGSB-19.13 M87, silicone based, single component, non-sag, one of the following:

- .1 GE Silicones Silpruf.
 - .2 Dow Corning 790
 - .3 Tremco Spectrem 1 or Spectrem 3
- .3 For joints in wood and laminated plastic, and between these materials and gypsum wallboard. One component, paintable acrylic latex sealant. Conform to CAN/CGSB 19-GP-17M:
- .1 Tremco 834 Latex.
 - .2 DAP Alex Plus Latex with Silicone.
 - .3 Sherwin-Williams 950A Siliconized Acrylic Latex Caulk
- .4 For joints in horizontal surfaces, including floor slabs and paving, subjected to foot traffic. Multi or single component, polyurethane based, self-leveling or slope grade type. Conform to CAN/CGSB 19.24-M90:
- .1 Sonneborn SL 2.
 - .2 Vulkem 245
 - .3 Tremco THC 900/901.
- .5 Mildew resistant silicone sealant at ceramic wall tile, plumbing fixtures, etc. conform to CAN/CGSB-19.22-M89,
- .1 Dow Corning 786.
 - .2 GE Silicones 1700 Sanitary Sealant
 - .3 Tremco Tremsil 200.
- .6 For joints in Galvanized steel: Multicomponent nonsag urethane sealant, Type M, Grade NS, Class 25, with not less than 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement: Conform to CAN/CGSB-19.24-M90, Type II Class B:
- .1 Sonolastic NP2, BASF
 - .2 Sikaflex - 2c NS, Sika Corporation
 - .3 Dymeric 511, Tremco
- .7 For joints in all materials in food preparation, handling and serving areas. Conform to CAN/CGSD-19.13-M87:
- .1 Dow Corning 999A
 - .2 Tremco Vulkem 921
 - .3 GE SSG4000AC UltraGlaze
- .8 For bedding joints and metal flashing. Butyl rubber and polyisobutylene: Conform to CAN/CGSB 19-GP-14M
- .1 Butyl Sealant, Tremco

- .2 Sikasil GP, Sika
- .3 DOWSil 335, Dow Corning.
- .9 For control joints in masonry units. Conform to CAN/CGSD 19.13-M87
 - .1 Dymonic, Tremco
 - .2 790 Silicone Building Sealant, Dow Corning
 - .3 POURTHANE NS, WR Meadows
- .10 General purpose construction sealant. Conform to CAN/CGSD 19.13-M87
 - .1 Vulkem 116, Tremco
 - .2 999A, Dow Corning
 - .3 Sikaflex, Sika
- .11 Acoustical Sealant. Conform to CAN/CGSB 19.21 M87.
 - .1 Acoustical Sealant, Tremco.
 - .2 Quiet Zone, Owens Corning.
 - .3 Green Glue, Certainteed.
 - .4 Silent FX, Certainteed.
- .12 For sealing roof penetrations: One component, low expansion, CFC-free, polyurethane spray foam air barrier. Conforming to ASTM D1622-20, ASTM E84-21a and CAN/ULC-S102-10.
- .13 Preformed Compressible and Non-Compressible back-up materials.
 - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded closed cell foam backer rod.
 - .2 Size: oversize 30 to 50%.
 - .2 Neoprene or Butyl Rubber.
 - .1 Round solid rod, Shore A hardness 70.
 - .3 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/m³ density, or neoprene foam backer, size as recommended by manufacturer.
 - .4 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape which will not bond to sealant.

2.3 JOINT CLEANER

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant recommended by sealant manufacturer.
- .2 Primer: in accordance with sealant manufacturer's written recommendations.

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 joint sealants installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 PROTECTION

- .1 Protect installed Work of other trades from staining or contamination.

3.3 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 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.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

3.4 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.

3.5 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.6 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.7 APPLICATION

- .1 Sealant:
 - .1 Apply sealant in accordance with manufacturer's written 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.
 - .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.
- .2 Curing:
 - .1 Cure sealants in accordance with sealant manufacturer's instructions.
 - .2 Do not cover up sealants until proper curing has taken place.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

- .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 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and reuse 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.

3.9 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

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 07 92 00 - Joint Sealant.
- .2 Section 08 14 16 - Flush Wood Doors.
- .3 Section 08 71 00 - Door Hardware.
- .4 Section 08 80 00 - Glazing.
- .5 Section 09 91 23 - Interior Painting.
- .6 Section 10 14 00 - Signage.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M-06a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames, 2006.
 - .2 CSDMA, Selection and Usage Guide for Commercial Steel Doors, 2009.
- .5 National Association of Architectural Metal Manufactures (NAAMM)
 - .1 HMMA 8100-09, Hollow Metal Doors.
- .6 National Fire Protection Association (NFPA)
 - .1 NFPA 80-99, Standard for Fire Doors and Fire Windows.
 - .2 NFPA 252-03, Standard Methods of Fire Tests of Door Assemblies.

- .7 Royal Canadian Mounted Police (RCMP)
 - .1 Standard G13-01, Secure Storage Rooms (SSR)
- .8 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-01, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .2 CAN/ULC-S702-97, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
 - .3 CAN/ULC-S704-03, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
 - .4 CAN4-S104-M80, Standard Method for Fire Tests of Door Assemblies.
 - .5 CAN4-S105-M85, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 All doors and materials to CSDMA, Recommended Specifications for Commercial Steel Doors and Frame, and as supplemented below:
 - .2 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35 degrees C to 35 degrees C.
 - .3 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
 - .4 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104, NFPA 252 for ratings specified or indicated.
 - .5 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104, NFPA 252, ASTM E152 and listed by nationally recognized agency having factory inspection services.
 - .6 Secure Doors and Frames to RCMP Standard G13-01, Secure Storage Rooms (SSR).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.

- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, arrangement of hardware fire rating and finishes.
 - .3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings reinforcing and fire rating finishes.
 - .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
 - .5 Submit test and engineering data, and installation instructions.
- .4 Provide samples in accordance with Section 01 33 00-Submittal Procedures.
- .5 Submit one 300 x 300 mm corner sample of each type of frame.
 - .1 Show glazing stops.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 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

2.1 MATERIALS

- .1 Cold rolled sheet steel, commercial quality to ASTM A1008 / A1008M - 08a Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- .2 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.

.3 Reinforcement:

- .1 Structural steel channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.
- .2 Steel Plate to ASTM A627.

2.2 DOOR CORE MATERIALS

- .1 Interior doors: face sheets welded to perimeter framing and laminated to honeycomb construction: structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.
- .2 Exterior doors: face sheets welded to perimeter framing and laminated to insulated core. Polyurethane insulation: to CAN/ULC-S704. Rigid closed cell board with foil facing both sides. Density 32 kg/m³.
- .3 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door to 250 degrees C at 60 minutes. Core to be tested as part of a complete door assembly, in accordance with CAN4-S104 and NFPA 252, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.
- .4 Secure Doors: (D2036)
 - .1 Face metal thickness: 1.6 mm (16 gauge) steel.
 - .2 Construction: Laminated core with vertical steel stiffeners at 150mm OC (stiffeners welded or laminated to each face sheet with voids between stiffeners filled with fiberglass or mineral batt type material).
 - .3 Caps: 'Flush Closing Channel' or 'Flush Channel' top and bottom.
 - .4 Edges: all edges and top and bottom caps to be continuously welded and ground smooth.
 - .1 Refer to NAAMM 810-09 Part 2. A. Figures E and F for edge details.

2.3 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.

2.4 PRIMER

- .1 Touch-up prime CAN/CGSB-1.181.

2.5 PAINT

- .1 Field paint steel doors and frames in accordance with Section 09 91 23 - Interior Painting. Provide final finish free of scratches or other blemishes.

2.6 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Touch-up primer: by manufacturer. To match G90 galvanized coating.
- .3 Exterior and interior top bottom caps: steel.
- .4 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .5 Door bottom seal: recessed automatic. Refer to Section 08 71 00 - Door Hardware.
- .6 Metallic paste filler: to manufacturer's standard.
- .7 Sealant: As per Section 07 92 00 - Joint Sealant.
- .8 Glazing: As per Section 08 80 00 - Glazing.
- .9 Make provisions for glazing as indicated and provide necessary glazing stops.
 - .1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.
 - .2 Design exterior glazing stops to be tamperproof.

2.7 FRAMES FABRICATION GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Exterior frames: 1.6 mm welded, thermally broken type construction.
- .4 Interior frames: 1.6 mm welded type construction.
- .5 Blank, reinforce, drill and tap frames for mortised, templated hardware, electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

- .1 DCC Representative to provide requirements for electronic hardware as required.
- .6 Protect mortised cutouts with steel guard boxes.
- .7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .8 Manufacturer's nameplates on frames and screens are not permitted.
- .9 Conceal fastenings except where exposed fastenings are indicated.
- .10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .11 Insulate exterior frame components with polyurethane insulation.

2.8 FIRE RATED DOORS and FRAMES

- .1 Provide fire labelled doors and frames for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN4-S104 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.

2.9 FRAME ANCHORAGE

- .1 Provide appropriate anchorage to 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 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.
- .4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.10 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.
- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.
- .7 Fabricate frame products for openings.
- .8 Securely attach lead to inside of frame profile from return to jamb soffit (inclusive) on door side of frame only.

2.11 FRAMES: SECURE ROOMS

- .1 Metal thickness: 1.6 mm (16 gauge) steel.
- .2 Frame construction: Welded or fully field welded 3-piece "knock-down" (for retrofit applications only).
- .3 Welding in accordance with CSA W59.
- .4 Anchors: "Z" shape steel wall anchors welded to frame.
- .5 Reinforcing:
 - .1 Reinforcing at latch: as per lock manufacturer recommendations. Lock specifications must be provided to the supplier/manufacturer to provide necessary reinforcing requirements.
 - .2 Provide 6.4 mm x 25 mm x 610 mm steel plate inside the frame Secure using tack welds on every edge and align centre with the lock bolt.

2.12 DOOR FABRICATION GENERAL

- .1 Fabricate interior doors from 1.6 mm thick galvanized sheet steel. Faces laminated under pressure to honeycomb core and spot welded to perimeter door framing.
- .2 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .3 Blank, reinforce, drill doors and tap for mortised, templated hardware. Prepare for electronic hardware.
- .4 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .5 Reinforce doors where required, for surface mounted hardware.
- .6 Provide inverted, recessed, flush, spot welded steel channel caps to top and bottom of interior doors.

- .7 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in strict conformance with CAN4-S104, ASTM E152 and 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.
- .8 Manufacturer's nameplates on doors are not permitted.
- .9 Protect finish on doors and frames throughout manufacturing, shipping, factory preparation, delivery and construction. Installations with visible defects will be rejected.

2.13 DOORS: HONEYCOMB CORE CONSTRUCTION

- .1 Form face sheets for exterior doors from 1.2 mm sheet steel with honeycomb polyurethane core laminated under pressure to face sheets.
- .2 Form face sheets for interior doors from 1.2 mm sheet steel with honeycomb core laminated under pressure to face sheets.

2.14 DOORS: HOLLOW STEEL CONSTRUCTION

- .1 Form face sheets for exterior doors from 1.6 mm sheet steel.
- .2 Form face sheets for interior doors from 1.6 sheet steel.
- .3 Reinforce doors with vertical stiffeners, securely welded to face sheets at 150 mm on centre maximum.
- .4 Fill voids between stiffeners of exterior doors with polyurethane core.
- .5 Fill voids between stiffeners of interior doors with honeycomb temperature rise rated core.
- .6 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN4-S104 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.

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 datasheets.

3.2 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.
- .1 Secure Doors and Frames: Provide and install all secure door and framers as per RCMP Standard G13-01, Secure Storage Rooms (SSR) for secure room doors.

3.3 FRAME INSTALLATION

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .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 Caulk perimeter of frames between frame and adjacent material.
- .6 Maintain continuity of air barrier.

3.4 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .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: 10 mm.
- .3 Adjust operable parts for correct function.

3.5 FINISH REPAIRS

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 GLAZING

- .1 Install glazing for doors in accordance with Section
 08 80 00 - Glazing.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 07 92 00 - Joint Sealing.
- .2 Section 08 80 00 - Glazing.
- .3 Section 09 22 16 - Non-Structural Metal Framing.

1.2 REFERENCE STANDARDS

- .1 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA 609/610-15, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.20-M89, Structural Design of Glass for Buildings.
- .3 CSA Group (CSA)
 - .1 CSA G40.20/G40.21-04(R2009), 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.
- .4 Underwriters Laboratories (UL)
 - .1 UL 2761-2011 Sealants and Caulking Compounds.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section, with DCC Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other construction subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.
- .2 Sequencing: sequence with other work in accordance with Section 09 22 16 - Non-Structural Metal Framing
- .3 Scheduling: schedule with other work in accordance with Section 08 80 00 - Glazing

1.4 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 doors and frames and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 70 12 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Indicate materials and profiles and provide full-size, scaled details of components for each type of glazed screen and frame. Indicate:
 - .1 Interior trim and exterior junctions with adjacent construction.
 - .2 Junctions between combination units.
 - .3 Elevations of units.
 - .4 Core thicknesses of components.
 - .5 Type and location of exposed finishes, method of anchorage, number of anchors, supports, reinforcement, and accessories.
 - .6 Location of caulking.
 - .7 Each type of glazed screen system including location.
 - .8 Arrangement of reinforcing for hardware and joints.
 - .9 Arrangement of hardware and required clearances.
- .4 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples returned for inclusion into work.
 - .3 Submit one 300 x 300 mm corner sample of each type door and frame.
 - .4 Submit sample showing glazing detail, reinforcement, finish and location of manufacturer's nameplates.
 - .5 Frame sample to show glazing stop, door stop, jointing detail, finish.
- .5 Test Reports:

- .1 Submit substantiating engineering data, test results of previous tests which purport to meet performance criteria, and supportive data.

- .6 Field Reports:

- .1 Submit manufacturer's field reports within 3 working days of manufacturer representative's site visit and inspection.

- .7 Installer Qualifications:

- .1 Submit letter verifying installer's experience with work similar to work of this Section.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual.

1.6 QUALITY ASSURANCE

- .1 Manufacturers Reports:

- .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 working days of review, verifying compliance of Work, as described in Part 3 - Field Quality Control.

- .2 Certifications: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

- .3 Mock-Up:

- .1 Provide site mock-up for work of this Section indicating methods and materials, and procedures proposed to achieve final results in accordance with Section 01 45 00 - Quality Control, and to comply with following requirements, using materials indicated for completed work:

- .1 Build mock-ups in location and of size as directed by DCC Representative.
 - .2 Obtain DCC Representative's acceptance of mock-ups before starting construction; mock-up used throughout construction period as standard of acceptance for subsequent work.
 - .3 Mock-up may form part of permanent structure when accepted by DCC Representative; repair or replace

unacceptable mock-ups at no additional cost to Owner.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions and 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.
 - .1 Apply temporary protective coating to finished surfaces. Remove coating after erection. Use easy to remove, residue free coatings.
 - .2 Leave protective covering in place until final cleaning of building.
- .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 aluminum doors and frames from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.8 AMBIENT CONDITIONS

- .1 Install sealants when ambient and surface temperature is above 5 degrees C minimum.
- .2 Maintain this minimum temperature during and for 48 hours minimum after installation of sealants.

1.9 WARRANTY

- .1 Manufacturer's warranty: Submit, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Glazed aluminum framed interior screen system.
- .2 Size glass thickness and glass unit dimensions to limits in accordance with CAN/CGSB-12.20.

- .3 Rectilinear design for framing and caps.

2.2 MATERIALS

- .1 Frame System and Components:

- .1 All sections shall be comprised of aluminum extrusions of 6063 alloy with a T5 heat treatment.
- .2 Finish coatings: Class 2, AA-M12C22A31 clear anodized coating, 0.4-.07 mill thickness minimum.
- .3 Framing wall thicknesses 3.2mm on exposed surfaces and 4.75mm on internal webs.

- .2 Steel reinforcement: to CSA G40.20/G40.21, grade 300 W.

- .1 Steel members to be galvanized.

- .3 Trim: aluminum 45mm width x depth to match partition depth.

- .4 Fasteners: stainless steel.

- .5 Glazing materials: Per Section 08 80 00 - Glazing.

- .6 Sealants: colour selected by DCC Representative in accordance with Section 07 92 00 - Joint Sealants.

2.3 FABRICATION

- .1 Framing and glazed screen system by same manufacturer.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Provide structural steel reinforcement as required.
- .4 Fit joints tightly and secure mechanically.
- .5 Conceal fastenings.
- .6 Isolate aluminum from direct contact with dissimilar metals, concrete and masonry.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for aluminum doors and frames installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.

- .2 Inform DCC 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 DCC 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 Set frames plumb, square, level at correct elevation in alignment with adjacent work.
- .3 Anchor securely.
- .4 Make allowances for deflection of structure to ensure structural loads not transmitted to frames.
- .5 Glaze aluminum frames in accordance with Section 08 80 00-Glazing.
- .6 Seal joints to provide air, vapour seal at inside.
- .7 Apply sealant in accordance with Section 07 92 00 - Joint Sealants. Conceal sealant within aluminum work except where exposed use permitted by DCC Representative.

3.3 FIELD QUALITY CONTROL

- .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 Manufacturer's Field Services: 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:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends completed, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning carried out.
- .4 Obtain reports within 3 working days of review and submit.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Perform cleaning of aluminum components in accordance with AAMA 609.1 - Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum.
 - .3 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
 - .4 Clean aluminum with damp rag and approved non-abrasive cleaner.
 - .5 Remove traces of primer, caulking, epoxy and filler materials; clean doors and frames.
 - .6 Clean glass and glazing materials with approved non-abrasive cleaner.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and reuse 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 aluminum door and frame installation.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 08 11 00 - Metal Doors and Frames.
- .2 Section 08 71 00 - Door Hardware.
- .3 Section 08 80 00 - Glazing.
- .4 Section 09 91 23 - Interior Painting.
- .5 Section 10 14 00 - Signage.

1.2 REFERENCE STANDARDS

- .1 Architectural Woodwork Manufacturers Association of Canada (AWMAC).
 - .1 North American Architectural Woodwork Standards (NAAWS) 2019.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-71.19-M88, Adhesive, Contact, Sprayable.
 - .2 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .3 Canadian Standards Association (CSA Group).
 - .1 CSA O115-M1982(R2001), Hardwood and Decorative Plywood.
 - .2 CAN/CSA O132.2 Series-90(R2003), Wood Flush Doors.
- .4 National Fire Protection Association (NFPA).
 - .1 NFPA 80-2019, Standard for Fire Doors and Fire Windows.
 - .2 NFPA 252-2017, Standard Method of Fire Tests of Door Assemblies.
- .5 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN-4S104-10, Standard Method for Fire Tests of Door Assemblies.
 - .2 CAN4-S105M-85 (R1992), Fire Door Frames Meeting the Performance Required by CAN4-S104.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit two copies of WHMIS SDS - Material Safety Data Sheets in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC's:

- .1 For caulking materials during application and curing.
 - .2 For door materials and adhesives.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate door types and cutouts for louvres, lights, sizes, core construction, transom panel construction and cutouts.

1.4 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00-Submittal Procedures.
- .2 Submit one 300 x 300 mm corner sample of each type wood door.
- .3 Show door construction, core, glazing detail and faces.
- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Wood fire rated doors: labelled and listed by an organization accredited by Standards Council of Canada.
- .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Storage and Protection:
 - .1 Protect doors from dampness. Arrange for delivery after work causing abnormal humidity has been completed.
 - .2 Store doors in well ventilated room, off floor, in accordance with manufacturer's recommendations.

- .3 Protect doors from scratches, handling marks and other damage. Wrap doors.
- .4 Store doors away from direct sunlight.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Dispose of plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bin for recycling in accordance with site waste management program.
- .3 Unused or damaged glazing materials are not recyclable and must not be diverted to municipal recycling programs.
- .4 Divert unused adhesive material from landfill to official hazardous material collections site approved by DCC Representative.
- .5 Do not dispose of unused paint materials into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 FIRE RATED WOOD DOORS

- .1 Wood doors: tested in accordance with CAN4-S104 to achieve rating as scheduled.
 - .1 Face panels: Natural Birch Veneer Premium Face Grade AA, Booked Match.

2.2 WOOD FLUSH DOORS

- .1 Solid core: to CAN/CSA-O132.2.1.
 - .1 Construction:
 - .1 Solid particleboard core: stile and rail frame bonded to particleboard core with wood lock blocks and security hardware wood blocking, 7-ply construction.
 - .1 natural birch wood edge band AWMAC # 1 Edge 7-ply door, abrasive planned before veneering, with the edge of the veneer but not the edge of the cross band exposed.
 - .2 Face Panels:
 - .1 Hardwood; veneer grades: Natural Birch Veneer Premium Face Grade AA, Booked Match.
 - .3 Adhesive: Type I (water resistant) for interior doors.

2.3 GLAZING

- .1 Install glazing for doors frames in accordance with Section 08 80 00 - Glazing.

2.4 FABRICATION

- .1 Vertical edge strips to match face veneer.
- .2 Bevel vertical edges of single acting doors 3 mm in 50 mm on lock side and 1.5 mm in 50 mm on hinge side.

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 Unwrap and protect doors in accordance with CAN/CSA-0132.2 Series, Appendix A.
- .2 Install labelled fire rated doors to NFPA 80.
- .3 Install doors and hardware in accordance with manufacturer's printed instructions and CAN/CSA-0132.2 Series, Appendix A.
- .4 Adjust hardware for correct function.
- .5 Install glazing in accordance with Section 08 80 00-Glazing.
- .6 Install stops.

3.3 ADJUSTMENT

- .1 Re-adjust doors and hardware just prior to completion of building to function freely and properly.

3.4 CLEANING

- .1 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking; clean doors and frames.
- .3 Clean glass and glazing materials with approved non-abrasive cleaner.
- .4 On completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 08 11 00 - Metal Doors and Frames.
- .2 Section 08 11 16 - Aluminum Doors and Frames.
- .3 Section 08 14 16 - Flush Wood Doors.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1-2000, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2-2003, Bored and Preamsembled Locks and Latches.
 - .3 ANSI/BHMA A156.3-2001, Exit Devices.
 - .4 ANSI/BHMA A156.4-2000, Door Controls - Closers.
 - .5 ANSI/BHMA A156.5-2001, Auxiliary Locks and Associated Products.
 - .6 ANSI/BHMA A156.6-2005, Architectural Door Trim.
 - .7 ANSI/BHMA A156.8-2005, Door Controls - Overhead Stops and Holders.
 - .8 ANSI/BHMA A156.10-1999, Power Operated Pedestrian Doors.
 - .9 ANSI/BHMA A156.12-2005, Interconnected Locks and Latches.
 - .10 ANSI/BHMA A156.13-2002, Mortise Locks and Latches Series 1000.
 - .11 ANSI/BHMA A156.15-2006, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .12 ANSI/BHMA A156.16-2002, Auxiliary Hardware.
 - .13 ANSI/BHMA A156.17-2004, Self-closing Hinges and Pivots.
 - .14 ANSI/BHMA A156.18-2006, Materials and Finishes.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames - 2009.

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 door hardware 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 Identify each sample by a label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
.4 After approval samples will be returned for incorporation in Work.

.4 Hardware List:

- .1 Submit contract hardware list.
.2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.

.5 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

.6 Manufacturer's Instructions: submit manufacturer's installation instructions.

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 door hardware for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
.1 Supply maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
.2 Tools:
.1 Supply 2 sets of wrenches for and fire exit hardware, locksets, door closers.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements:

- .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.7 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 Package items of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Storage and Handling Requirements:
 - .1 Store materials indoors and in dry location and off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect door hardware from nicks, scratches, and blemishes.
 - .3 Protect prefinished surfaces with wrapping and strippable coating.
 - .4 Replace defective or damaged materials with new.
- .5 Packaging Waste Management: remove for reuse by manufacturer and return of padding, packaging materials, crates, pallets, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 HARDWARE ITEMS

- .1 Use one manufacturer's products only for similar items.
- .2 Acceptable lock manufacturers:
 - .1 Schlage.
 - .2 Sargent.
 - .3 Corbin.

2.2 DOOR HARDWARE

- .1 Locks and latches:

- .1 Bored and preassembled locks and latches: to CAN/CGSB-69.17, series 4000 bored lock, Grade 1, designed for function and keyed as directed by DCC Representative.
- .2 Interconnected locks and latches: to CAN/CGSB-69.28, series 5000, interconnected lock, designed for function and keyed as directed by DCC Representative.
- .3 Mortise locks and latches: to CAN/CGSB-69.29, series 1000 mortise lock, heavy duty L series and standard duty commercial AL series, designed for function and keyed as directed by DCC Representative.
- .4 Lever handles: Heavy duty L series 07, Standard duty commercial Jupiter type. Finish 626 satin chrome.
- .5 Cylinders: key into keying system as directed.
- .6 Finished to 626 satin chrome.
- .7 Occupancy indicator, as required for unisex washroom.
- .8 Security Doors:
 - .1 High Security Cylinders: UL 437, ANSI 156.30 Level "A" or ANSI 156.5 Grade 1A.4.
- .2 Butts and hinges:
 - .1 Butts and hinges: to ANSI/BHMA A156.1, designated by letter A and numeral identifiers, followed by size and finish, listed in Hardware Schedule.
 - .2 Self-closing hinges and pivots: to ANSI/BHMA A156.17, designated by letter K and numeral identifiers listed in Hardware Schedule, with suffix letter F indicating listed for used on fire doors, finished to 626 satin chrome.
 - .3 Full mortise type bearing hinges: Three knuckle standard or heavy duty series. All doors to be heavy duty.
 - .4 Provide non-removable pins at all exterior and secure doors.
 - .5 Exterior door hinges brass or bronze base polished and plated.
 - .6 Interior door hinges steel base polished and plated.
 - .7 Size 114 x 101mm typical.
 - .8 Finished to 626 satin chrome.
 - .9 Secure doors: to ANSI/BHMA A156.1 Grade 2 and ANSI A8112 (Steel Material Standard) Full mortise, five knuckles, ball bearings, standard weight. Three (3) hinges per door (minimum). Minimum Dimensions: 114mm (4 ½") x 114mm (4 ½") x 3.4mm (0.124") thick.
 - .1 Provide non-removable pins (NRP) and maximum security pins (MSP) or safety studs/reverse safety studs at all secure doors.

- .3 Exit devices: to ANSI/BHMA A156.3, type , design .
 - .1 Aluminium doors: Concealed vertical rod with touch bar. Model 35A, Finish 628 Anodized Aluminum.
 - .2 Metal doors: Mortise lock type, Finish 626 dull chrome.
 - .3 Auxiliary items: door co-ordinator, type 21, for pairs of doors with overlapping astragals. Dust proof strikes for flush bolts.
- .4 Door Closers and Accessories:
 - .1 Door controls (closers): to ANSI/BHMA A156.4, designated by letter C and numeral identifiers listed in Hardware Schedule, size in accordance with ANSI/BHMA A156.4, table A1, finished to 626 satin chrome.
 - .2 Door controls - overhead holders: to ANSI/BHMA A156.8, designated by letter C and numeral identifiers listed in Hardware Schedule, finished to 626 satin chrome.
 - .3 Closer/holder release devices: to ANSI/BHMA A156.15, designated by letter C and numeral identifiers listed in hardware schedule, finished to 626 satin chrome.
 - .4 Door co-ordinator: concealed for pairs of doors with overlapping astragal.
- .5 Auxiliary locks and associated products: to CAN/CGSB-69.21.
 - .1 Dead bolt: key into keying system.
 - .2 Cylinders: for installation in deadlocks provided with special doors as listed in Hardware Schedule. Key into keying system.
 - .3 Automatic flush bolts: bolts are nonhanded but are not identical. The top bolt has no spring tension, resulting in lower actuation force with a smoother operation. Finish 626 satin chrome
- .6 Architectural door trim: to ANSI/BHMA A156.6, designated by letter J and numeral identifiers as listed below , finished to 626 satin chrome.
 - .1 Door protection plates: kick plate type, 1.27 mm thick stainless steel, x 450mm high x width to suit door size. Finish to brushed stainless steel or 26, satin chrome.
 - .2 Push plates: 1.27 mm thick stainless steel. Size 100 mm x 400 mm. Finish to brushed stainless steel or 26, satin chrome.
 - .3 Push/Pull units: aluminum or stainless steel to suit door material, 300 mm high, finished to 26, satin chrome.

- .7 Door bottom seal: heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene weather seal, recessed in door face with drip cap, closed ends, automatic retract mechanism when door is open, clear anodized finish.
- .8 Auxiliary hardware: to CAN/CGSB-69.32.
 - .1 Wall Stop: cast brass or stainless steel, finish 26 satin chrome, GSH 250B.
 - .2 Floor Stop: dome type, cast brass or stainless steel, bronze, finish 26 satin chrome, GSH 218B.
- .9 Thresholds: Wall width, mill finish, extruded aluminum surface, serrated, with thermal break of rigid PVC.
 - .1 Interlocking thresholds.
 - .2 Secure Doors: Aluminum interlocking style with hook strip installed on door.
- .10 NFPA/TDG, Materials Classification Placards:
 - .1 Conforms to National Fire Protection Association and Transport Canada Goods Requirements. For transportation of dangerous goods.
 - .2 Aluminium (0.64 gauge minimum) frame, complete with retention clips, designed to accept tag board identification labels.
 - .3 Tag board dimensions 273mm x 273mm as per Dangerous Goods Safety Marks, in the Canadian Transportation of Dangerous Goods Regulations.
 - .4 Refer to Section 10 14 00 - Signage for further requirements.
- .11 Lamocoid room number and name. Refer to Section 10 14 00 - Signage for further requirements. Room number and identification schedule to be provided by DCC Representative.

2.3 FASTENINGS

- .1 Use only fasteners provided by the manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match the finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

- .5 Use fasteners compatible with material through which they pass.

2.4 KEYING

- .1 Doors, padlocks and cabinet locks to be keyed as directed by DCC Representative. Prepare detailed keying schedule in conjunction with DCC Representative.
- .2 Supply keys in duplicate for every lock in this Contract.
- .3 Supply 3 master keys for each master key or grand master key group.
- .4 Stamp keying code numbers on keys and cylinders.
- .5 Supply construction cores.
- .6 Hand over permanent cores and keys to DCC Representative.

Part 3 Execution

3.1 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 Supply metal door and frame manufacturers 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 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
- .5 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .6 Install key control cabinet.
- .7 Use only manufacturer's supplied fasteners.
 - .1 Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .8 Remove construction cores and locks when directed by DCC Representative.
 - .1 Install permanent cores and ensure locks operate correctly.

3.2 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 ensure tight fit at contact points with frames.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
 - .3 Remove protective material from hardware items where present.
 - .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .2 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.

3.4 DEMONSTRATION

- .1 Keying System Setup and Cabinet:
 - .1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.
 - .2 Place file keys and duplicate keys in key cabinet on their respective hooks.
 - .3 Lock key cabinet and turn over key to DCC Representative.
- .2 Maintenance Staff Briefing:
 - .1 Brief maintenance staff regarding:
 - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
 - .2 Description, use, handling, and storage of keys.

.3 Use, application and storage of wrenches for and fire exit hardware locksets, door closers .

.3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by door hardware installation.

3.6 SCHEDULE

.1 Refer to drawings for hardware groups and door requirements.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 08 11 00 - Metal Doors and Frames.
- .2 Section 08 14 16 - Flush Wood Doors.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C542-05, Standard Specification for Lock-Strip Gaskets.
 - .2 ASTM D790-07e1, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - .3 ASTM D1003-07e1, Standard Test Method for Haze and Luminous Transmittance of Plastics.
 - .4 ASTM D1929-96(R2001)e1, Standard Test Method for Determining Ignition Temperature of Plastics.
 - .5 ASTM D2240-05, Standard Test Method for Rubber Property - Durometer Hardness.
 - .6 ASTM E84-10, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .7 ASTM E330-02, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - .8 ASTM F1233-08, Standard Test Method for Security Glazing Materials and Systems.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-M90, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.2-M91, Flat, Clear Sheet Glass.
 - .3 CAN/CGSB-12.3-M91, Flat, Clear Float Glass.
 - .4 CAN/CGSB-12.4-M91, Heat Absorbing Glass.
 - .5 CAN/CGSB-12.6-M91, Transparent (One-Way) Mirrors.
 - .6 CAN/CGSB-12.8-97, Insulating Glass Units.
 - .7 CAN/CGSB-12.8-97 (Amendment), Insulating Glass Units.
 - .8 CAN/CGSB-12.9-M91, Spandrel Glass.
 - .9 CAN/CGSB-12.10-M76, Glass, Light and Heat Reflecting.
 - .10 CAN/CGSB-12.12-M90, Plastic Safety Glazing Sheets.
 - .11 CAN/CGSB-12.13-M91, Patterned Glass.
- .3 Glass Association of North American (GANA)

- .1 GANA Glazing Manual - 2008.
- .2 GANA Laminated Glazing Reference Manual - 2009.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this Section on-site installation, with DCC Representative 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.
 - .2 Arrange for site visit with DCC Representative prior to start of Work to examine existing site conditions adjacent to demolition Work.
 - .3 Ensure project manager, subcontractor representatives, key personnel and site supervisor attend.
 - .4 DCC Representative will submit written notification of change to meeting schedule established upon contract award 72 hours prior to scheduled meeting.

1.4 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 glass, sealants, and glazing 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 Province of Ontario, Canada.
- .4 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit duplicate mm size samples of and sealant material.
- .5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified

performance characteristics and criteria and physical requirements.

- .6 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

- .1 Submit testing and analysis of glass under provisions of Section 01 45 00 - Quality Control.

- .2 Submit shop inspection and testing for glass.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for glazing for incorporation into manual.

1.6 QUALITY ASSURANCE

- .1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .2 Construct mock-up to include glass glazing, and perimeter air barrier and vapour retarder seal.
 - .3 Mock-up will be used:
 - .1 To judge quality of work, substrate preparation, operation of equipment and material application.
 - .2 For testing to determine compliance with performance requirements. Perform tests as follows:
 - .4 Locate where directed.
 - .5 Allow 72 hours for inspection of mock-up before proceeding with work.
 - .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and 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 indoors, off ground and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect glazing and frames from nicks, scratches, and blemishes.
 - .3 Protect prefinished aluminum surfaces with strippable coating and wrapping.
 - .4 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, padding, crates, packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

1.8 AMBIENT CONDITIONS

- .1 Ambient Requirements:
 - .1 Install glazing when ambient temperature is 10 degrees 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.

Part 2 Products

2.1 MATERIALS

- .1 Design Criteria:
 - .1 Size glass to withstand dead loads and positive and negative live loads to ASTM E330
 - .2 Limit glass deflection to flexural limit of glass with full recovery of glazing materials.
- .2 Flat Glass:
 - .1 Float glass: to CAN/CGSB-12.3
 - .2 Sheet glass: to CAN/CGSB-12.2,
- .1 Safety glass: to CAN/CGSB-12.1, transparent (Interior glazed screens, Interior Door Lites).
 - .1 10mm thick.
 - .2 Type 2 tempered.
 - .3 Class B-float.
 - .4 Category 2
 - .5 Edge treatment.
- .2 Silvered mirror glass:
 - .1 Type 1B-float glass for high humidity use.

- .3 Sealant: in accordance with Section 07 92 00 - Joint Sealants.

2.2 ACCESSORIES

- .1 Setting blocks: EPDM 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .2 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.
- .3 Glazing splines: resilient silicone, extruded shape to suit glazing channel retaining slot,
- .4 Glazing clips: manufacturer's standard type.
- .5 Lock-strip gaskets: to ASTM C542.
- .6 Mirror attachment accessories:
 - .1 Stainless steel clips.
 - .2 Mirror adhesive, chemically compatible with mirror coating and wall substrate.
- .7 Translucent Privacy Film (All interior glazed screens)
 - .1 Film material: Polyester
 - .2 Patterned (Dots, Stripes or squares), frosted.
 - .1 Pattern selected by DCC Representative from manufacturers full range.
 - .3 Thickness 0.05mm
 - .4 Privacy Rating of film: 4 minimum.
 - .5 % Visible Light transmittance: 71
 - .6 % Diffuse Visible Light Reflectance: 7

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glazing installation in accordance with manufacturer's written instructions.
 - .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 Visually inspect substrate in presence of DCC Representative.

- .4 Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.

3.2 PREPARATION

- .1 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: INTERIOR - DRY METHOD (TAPE AND TAPE)

- .1 Perform work in accordance with GANA Laminated Glazing Reference Manual for glazing installation methods .
- .2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.
- .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 tape for full contact at perimeter of light or unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described.
- .6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .7 Knife trim protruding tape.

3.4 INSTALLATION: INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

- .1 Perform work in accordance with GANA Glazing Manual, GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length and install against permanent stops, projecting 1.6 mm above sight line.
- .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 tape to ensure full contact at perimeter of light or unit.
- .5 Install removable stops, with spacer shims inserted between glazing and applied stops at 600 mm intervals, 6mm below sight line.
- .6 Fill gaps between light and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.

- .7 Trim protruding tape edge.

3.5 INSTALLATION: MIRRORS

- .1 Set mirrors with adhesive, applied in accordance with adhesive manufacturer's instructions.
- .2 Set mirrors with clips. Anchor rigidly to wall construction.
- .3 Set in frame.
- .4 Place plumb and level.

3.6 INSTALLATION: PLASTIC FILM

- .1 Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
- .2 Place without air bubbles, creases or visible distortion.
- .3 Fit tight to glass perimeter with razor cut edge.

3.7 INSTALLATION: PRIVACY FILM

- .1 Install privacy film with adhesive, applied in accordance with film manufacturer's instructions.
 - .1 Apply to all interior glazed screens in contract area to cover entire visible area of glazing.
- .2 Clean substrates thoroughly prior to installation
- .3 Apply to entire interior surface of glazing.
- .4 Install with no gaps or overlaps
- .5 If seamed, make seams non-overlapping
- .6 Fit tight to glass perimeter with razor cut edge neat, square corners and edges to within 3mm of the window frame.
- .7 Place without air bubbles, creases or visible distortion.
- .8 After installation, view film from a distance of 3 m against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, wrinkles, banding, thin spots or pinholes.
- .9 If installed film does not meet these criteria, remove and replace with new film.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .1 Remove traces of primer, caulking.

- .2 Remove glazing materials from finish surfaces.
- .3 Remove labels.
- .4 Clean glass and mirrors using approved non-abrasive cleaner in accordance with manufacturer's instructions.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for recycling and reuse 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.

3.9 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 After installation, mark each light with an "X" by using removable plastic tape or paste.
 - .1 Do not mark heat absorbing or reflective glass units.
- .3 Repair damage to adjacent materials caused by glazing installation.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 07 92 00 - Joint Sealants.
- .2 Section 09 22 16 - Non-Structural Metal Framing.
- .3 Section 09 91 23 - Interior Painting.

1.2 REFERENCE STANDARDS

- .1 Aluminum Association (AA)
 - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM C475-02(2015), Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - .2 ASTM C514-04(2014), Standard Specification for Nails for the Application of Gypsum Board.
 - .3 ASTM C840-16, Standard Specification for Application and Finishing of Gypsum Board.
 - .4 ASTM C954-15, 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.
 - .5 ASTM C1002-14, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
 - .6 ASTM C1047-14a, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - .7 ASTM C1177/C1177M-13, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
 - .8 ASTM C1178/C1178M-13, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
 - .9 ASTM C1280-13a, Standard Specification for Application of Gypsum Sheathing.
 - .10 ASTM C1396/C1396M-14a, Standard Specification for Gypsum board.
- .3 Association of the Wall and Ceilings Industries International (AWCI)
 - .1 AWCI Levels of Gypsum Board Finish-GA-214-2015.
- .4 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .2 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.
- .5 Expanded Metal Manufacturers Association (EMMA)
 - .1 EMMA 557-99: Standard for Expanded Metal, Introduction, Product Selection Considerations, Terminology, Manufacturing Process, Manufacturing Tolerances and Applications.
- .6 Royal Canadian Mounted Police (RCMP)
 - .1 Standard G13-01, Secure Storage Rooms (SSR)
 - .2 Standard G13-02, Secure Demising Wall (SDW)
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

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 gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit gypsum board assembly drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate components such as fastener type, dimensions, spacing and locations at gypsum board edges, ends and in field of board as well as installation methods. Components and work to confirm to ASTM C 840 standard specification for application and finishing of gypsum board.
 - .3 Indicate type of joint compound, and number of joint compound layers.
 - .4 Indicate number and location of electrical boxes for wall and ceiling.
- .4 Samples:

- .1 Submit for review and acceptance of each component specified or necessary for complete installation. Include technical descriptive data.

- .5 Certifications:

- .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

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 and applicable standard designation.
- .3 Exercise care in unloading gypsum board materials shipment to prevent damage.
- .4 Storage and Handling Requirements in accordance with ASTM C 840-16:
 - .1 Store gypsum board assemblies materials level flat indoors in dry location, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.
 - .3 Protect gypsum board from direct exposure to rain, snow, sunlight, or other excessive weather conditions.
 - .4 Protect ready mix joint compounds from freezing, exposure to extreme heat and direct sunlight.
 - .5 Protect from weather, elements and damage from construction operations.
 - .6 Handle gypsum boards to prevent damage to edges, ends or surfaces.
 - .7 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
 - .8 Replace defective or damaged materials with new.
- .5 Packaging Waste Management: remove for reuse and return of packaging materials, crates, padding, pallets.

1.5 AMBIENT CONDITIONS

- .1 Maintain temperature 10 °C minimum, 21 °C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.
- .2 Apply board and joint treatment to dry, clean, frost free surfaces.
- .3 Ventilation: 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 Standard board: to ASTM C1396/C1396M regular, thickness as indicated in assemblies schedule 1200 mm wide x maximum practical length, ends square cut, edges, bevelled and rounded
- .2 Gypsum sheathing board: to ASTM C1396/C1396M, regular, Type X and Type C thickness as indicated in assemblies schedule, 1200 mm wide x maximum practical length.
- .3 Backing board and coreboard: to ASTM C1396/C1396M thickness as indicated in assemblies schedule, rounded bevelled edges.
- .4 Water-resistant board: to ASTM C1396/C1396M thickness as indicated in assemblies schedule, 1200 mm wide x maximum practical length.
- .5 Glass mat water-resistant gypsum backing board: to ASTM C1178/C1178M, thickness as indicated in assemblies schedule, 1200 mm wide x maximum practical length.
- .6 Glass mat gypsum **(standard)** substrate sheathing: to ASTM C1177/C1177M, thickness as indicated in assemblies schedule, 1200 mm wide x maximum practical length.
- .7 Glass mat gypsum **(Fire Rated)** substrate sheathing: to ASTM C1177/C1177M, Type 'x' core, thickness as indicated in assemblies schedule, 1200 mm wide x maximum practical length.
- .8 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.
- .9 Resilient clips: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

- .10 Nails: to ASTM C514-14.
- .11 Steel drill screws: to ASTM C1002-14.
- .12 Stud adhesive: to ASTM C557, CAN/CGSB-71.25 .
- .13 Laminating compound: as recommended by manufacturer, asbestos-free.
- .14 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, zinc-coated by electrolytic process, 0.5 mm base thickness, perforated flanges, one piece length per location.
- .15 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Acoustic sealant: in accordance with Section 07 92 00-Joint Sealants.
- .16 Polyethylene: to CAN/CGSB-51.34, Type 2.
- .17 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.
- .18 Joint compound: to ASTM C475, asbestos-free.
- .19 Wall Reinforcement:
 - .1 Refer to 09 22 16 - Non-structural metal framing.
2.1.2.2.3
- .20 Corner Guards:
 - .1 915mm
 - .2 18Ga Stainless steel
 - .3 Type 304.
 - .4 Brushed finish
- .21 Stainless steel closure:
 - .1 Floor to ceiling - as identified
 - .2 18Ga Stainless steel
 - .3 Type 304.
 - .4 Brushed finish

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 DCC Representative.
- .2 Inform DCC 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 DCC Representative.

3.2 ERECTION

- .1 Do application and finishing of gypsum board to ASTM C840-16 except where specified otherwise.
- .2 Do application of gypsum sheathing to ASTM C1280-13a.
- .3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840-16 except where specified otherwise.
- .4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .5 Install work level to tolerance of 1:1200.
- .6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.
- .7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.
- .8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .10 Install wall furring for gypsum board wall finishes to ASTM C840-16, except where specified otherwise.
- .11 Furr openings and around built-in equipment, cabinets, access panels.
- .12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.
- .13 Erect drywall resilient furring transversely across studs joists , spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 25 mm drywall screw.
- .14 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

3.3 APPLICATION

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been approved.
- .2 Apply double and single layer gypsum board to metal furring or framing using for first layer screw fasteners , screw fasteners for second layer. Maximum spacing of screws 30] mm on centre.
 - .1 Single-Layer Application:
 - .1 Apply gypsum board on ceilings prior to application of walls to ASTM C840-16.
 - .2 Apply gypsum board on walls vertically or horizontally, providing sheet lengths that will minimize number of board edges or end joints.
 - .2 Double-Layer Application:
 - .1 Install gypsum board for base layer and exposed gypsum board for face layer.
 - .2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.
 - .3 Apply base layers at right angles to supports unless otherwise indicated.
 - .4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.
- .3 Apply single layer gypsum board to concrete block surfaces, where indicated, using laminating adhesive.
 - .1 Comply with gypsum board manufacturer's recommendations.
 - .2 Brace or fasten gypsum board until fastening adhesive has set.
 - .3 Mechanically fasten gypsum board at top and bottom of each sheet.
- .4 Ceilings: install gypsum board perpendicular to supports; stagger end joints over supports. Install with 6 mm gap where boards abut other work.
- .5 Apply water-resistant gypsum board adjacent to slop sinks, janitor's closets, where coating, wall tile to be applied. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

- .6 Apply 12 mm diameter 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, ducts.
- .7 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.
- .8 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.
- .9 Install gypsum board with face side out.
- .10 Do not install damaged or damp boards.
- .11 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.4 INSTALLATION

- .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 around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .5 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.
- .6 Provide continuous polyethylene dust barrier behind and across control joints.
- .7 Locate control joints at changes in substrate construction, at approximate 15 m spacing on ceilings, at approximate 10 m spacing on long corridor runs.
- .8 Install control joints straight and true.

- .9 Ensure that screws or nails are properly applied in process of attaching gypsum board to framing without damaging of gypsum board edges and ends.
- .10 Construct expansion joints, at building expansion and construction joints. Provide continuous dust barrier.
- .11 Install expansion joint straight and true.
- .12 Install cornice cap where gypsum board partitions do not extend to ceiling.
- .13 Fit cornice cap over partition, secure to partition track with two rows of sheet metal screws staggered at 300 mm on centre.
- .14 Splice corners and intersections together and secure to each member with 3 screws.
- .15 Install access doors to electrical and mechanical fixtures specified in respective sections.
 - .1 Rigidly secure frames to furring or framing systems.
- .16 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .17 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with AWCI Levels of Gypsum Board Finish:
 - .1 Finish for concealed walls and ceilings, located above acoustic tile ceilings:
 - .1 Level 2: embed tape for joints and interior angles in joint compound and apply one separate coat of joint compound over joints, angles, fastener heads and accessories; surfaces free of excess joint compound; tool marks and ridges are acceptable.
 - .2 Finish for all exposed and semi-exposed surfaces.
 - .1 Level 4: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads and accessories; surfaces smooth and free of tool marks and ridges.
 - .3 Finish for all exposed surfaces to be utilized as dry erase specialty finish.
 - .1 Level 5: embed tape for joints and interior angles in joint compound and apply three separate coats of joint compound over joints, angles,

fastener heads and accessories; apply a thin skim coat of joint compound to entire surface; surfaces smooth and free of tool marks and ridges.

- .18 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.
- .19 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, invisible after surface finish is completed.
- .20 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .21 Completed installation smooth, level or plumb, free from waves and other defects and ready for surface finish.
- .22 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.
- .23 Mix joint compound slightly thinner than for joint taping.
- .24 Apply thin coat to entire surface using trowel or drywall broad knife to fill surface texture differences, variations or tool marks.
- .25 Allow skim coat to dry completely.
- .26 Remove ridges by light sanding or wiping with damp cloth.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for recycling and reuse.
 - .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 gypsum board assemblies installation.

3.7 SCHEDULES

- .1 Construct fire rated assemblies where indicated.
- .2 Construct secure partitions where indicated.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 05 50 00 - Metal Fabrications.
- .2 Section 07 21 16 - Blanket Insulation.
- .3 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C645-14e1, Standard Specification for Non-structural Steel Framing Members.
 - .2 ASTM A653/A653M-07, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
 - .3 ASTM C754-15 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- .2 Royal Canadian Mounted Police (RCMP)
 - .1 Standard G13-01, Secure Storage Rooms (SSR)
 - .2 Standard G13-02, Secure Demising Wall (SDW)
- .3 Underwriter's Laboratories (UL) Environmental Standards
 - .1 UL-2768-2011, Architectural Surface Coatings.
 - .2 , Surface Coatings - Recycled Water-Borne. UL-2760-2011
- .4 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #26, Primer, Galvanized Metal, Cementitious.

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 metal framing and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 70 12 - Health and Safety Requirements.
- .3 Samples:
 - .1 Submit duplicate 300 mm long samples of non-structural metal framing.
- .4 Gypsum board assemblies are to be stamped and signed by a P.Eng. from the province of Ontario for compliance with seismic installation and reinforcement. This is to be carried by the installation contractor and letter of compliance and certification signoff to be provided upon completion of installation.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 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 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location and off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal framing from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of crates, packaging materials, padding, pallets, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products**2.1 MATERIALS**

- .1 Standard Framed Partitions:
 - .1 Non-load bearing channel stud framing: to ASTM C645, stud sizes as indicated in assemblies schedule, roll formed from 0.91 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board lath.
 - .1 Knock-out service holes at 460 mm centres.
 - .2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height.
 - .1 Floor track: snap-in type formed to hold studs securely in place at 50 mm intervals; fabricated from 0.5 mm thick steel sheet; size to suit studs.
 - .2 Ceiling track: channel shaped track for use with stud shoes and 1.2 mm diameter double wire ties; size to suit studs.
 - .3 After fabrication apply one shop coat of MPI #26 primer to steel surfaces.
 - .1 Descale and clean surfaces before painting.
- .2 Secure Framed Partitions: Construct Secure partitions to RCMP Standard G13-01, Secure Storage Rooms (SSR) and Standard G13-02, Secure Demising Wall (SDW)
 - .1 Non-load bearing channel stud framing: to ASTM C645, stud sizes as indicated in assemblies schedule, roll formed from 1.146 mm (18 gauge) thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board lath.
 - .1 Knock-out service holes at 460 mm centres.
 - .2 51mm x150mm
 - .2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height.
 - .1 Floor track: snap-in type formed to hold studs securely in place at 50 mm intervals; fabricated from 1.146 mm (18 gauge) thick steel sheet; size to suit studs.
 - .2 Ceiling track: channel shaped track for use with stud shoes and 1.2 mm diameter double wire ties; size to suit studs.
 - .3 Wall Reinforcement:
 - .1 Flattened Metal Mesh:

- .1 To EMMA 557-99, nominal strand thickness of 3.0mm. Diamond opening 14 x 43mm.
 - .2 Sheet Steel: 1.5mm (16 ga).
 - .3 Steel Rivets
 - .1 3/16" steel rivets and fender washer (1.5" O.D., 3/16" I.D.) at 200mm O.C.
 - .2 3/16" steel rivets at 200mm O.C.
 - .3 After fabrication apply one shop coat of MPI #26 primer to steel surfaces.
 - .1 Descale and clean surfaces before painting.
- .3 Metal channel stiffener: size as indicated by Structural, 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .4 Acoustical sealant: in accordance with Section 07 92 00 - Joint Sealants.
- .5 Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self sticking adhesive on one face, lengths as required.
- .6 Furring Channels: Commercial steel sheet in accordance with ASTM A653, Z180, hot dipped zinc-coated (galvanized), as follows:
 - .1 Hat Shaped, Rigid Furring Channels: ASTM C645, 0.75 mm thickness x 22 mm deep.
 - .2 Resilient Furring Channels: 0.46 mm thickness x 13 mm deep members designed to reduce sound transmission having asymmetrical face attached to single flange by a slotted leg (web).
- .7 Metal channel stiffener: 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .8 Acoustical sealant: in accordance with Section 07 92 00- Joint Sealants.

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 DCC Representative.
- .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation after unacceptable conditions have been remedied and after receipt of written approval to proceed from DCC Representative.

3.2 ERECTION

- .1 Standard Framed Partitions:
 - .2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
 - .3 Install damp proof course under stud shoe tracks of partitions on slabs on grade.
 - .4 Place studs vertically at spacing as indicated on assemblies schedule on centre and not more than 50 mm from abutting walls, and at each side of openings and corners.
 - .1 Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
 - .5 Erect metal studding to tolerance of 1:1000.
 - .6 Attach studs to bottom ceiling track using screws.
 - .7 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
 - .8 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
 - .9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified.
 - .1 Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
 - .10 Install heavy gauge single jamb studs at openings.
 - .11 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs.

- .1 Secure track to studs at each end, in accordance with manufacturer's instructions.
 - .2 Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .12 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .13 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .14 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .15 Extend partitions **full height** (underside of roof deck) except where noted otherwise on drawings.
- .16 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.
 - .1 Use double track (deflection track) slip joint except where noted otherwise on drawings.
- .17 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .18 Install three continuous beads of acoustical sealant under studs and tracks around perimeter of sound control partitions.
- .2 Secure Framed Partitions:
- .3 Construct Secure partitions to RCMP Standard G13-01, Secure Storage Rooms (SSR) and Standard G13-02, Secure Demising Wall (SDW)
 - .1 Align partition tracks at floor and ceiling and secure at 300 mm on centre maximum.
 - .4 Place studs vertically at 300mm on centre and not more than 50 mm from abutting walls, and at each side of openings and corners.
 - .1 Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
 - .2 Secure studs to top and bottom tracks with welds or rivets. Screws will not be acceptable.

- .5 Erect metal studding to tolerance of 1:1000.
- .6 Secure top and bottom steel stud track to both slabs at 300mm O.C. using any expanding (preferably double expanding) mechanical fastener. Non-expanding (e.g. "Tapcon") Screws are not acceptable.
- .7 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.
- .8 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .9 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified.
 - .1 Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .10 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs.
 - .1 Secure track to studs at each end, in accordance with manufacturer's instructions.
 - .2 Install intermediate studs above and below openings in same manner and spacing as wall studs.
 - .3 Install door frame per HMMA 840-07, part 3 A,B,C,D and E (exception that screws are not acceptable. Steel rivets to be provided).
- .11 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .12 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .13 Install steel studs or furring channel between studs for attaching electrical and other boxes. (All boxes are to be surface mounted and not concealed within wall) refer to electrical.
- .14 Extend partitions **full height** (underside of roof deck) except where noted otherwise on drawings.

.15 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs.

.1 Use double track (deflection track) slip joint except where noted otherwise on drawings.

.16 Install continuous insulating strips to isolate studs from uninsulated surfaces.

.17 Install continuous beads of fire-rated acoustical sealant under both sides of studs and tracks around perimeter of sound control partitions.

3.3 FIELD QUALITY CONTROL

.1 Notify DCC representative for inspection by National Defence (21 Military Police Flight) prior to concealment.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling 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 non-structural metal framing application.

END OF SECTION

Part 1 General**1.1 RELATED SECTIONS**

- .1 Section 06 40 00 - Architectural Woodwork.
- .2 Section 09 65 19 - Resilient Tile Flooring.
- .3 Section 10 21 13.19 - Plastic Toilet Compartments.
- .4 Section 10 28 00 - Toilet and Bath Accessories.
- .5 Section 22 42 16 - Commercial Lavatories and Sinks.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Ceramic Tile Institute (CTI)
 - .1 ANSI A108.1-99 , Specification for the Installation of Ceramic Tile (Includes ANSI A108.1A-C, 108.4-.13, A118.1-.10, ANSI A136.1).
 - .2 CTI A118.3-92, Specification for Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive (included in ANSI A108.1).
 - .3 CTI A118.4-92, Specification for Latex Cement Mortar (included in ANSI A108.1).
 - .4 CTI A118.5-92, Specification for Chemical Resistant Furan Resin Mortars and Grouts for Tile Installation (included in ANSI A108.1).
 - .5 CTI A118.6-92, Specification for Ceramic Tile Grouts (included in ANSI A108.1).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C144-04, Specification for Aggregate for Masonry Mortar.
 - .2 ASTM C207-06, Specification for Hydrated Lime for Masonry Purposes.
 - .3 ASTM C847-06, Specification for Metal Lath.
 - .4 ASTM C979-05, Specification for Pigments for Integrally Coloured Concrete.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

- .2 CGSB 71-GP-22M-78 (AMEND.), Adhesive, Organic, for Installation of Ceramic Wall Tile.
- .3 CAN/CGSB-75.1-M88, Tile, Ceramic.
- .4 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .4 CSA Group (CSA)
 - .1 CSA A123.3-05, Asphalt Saturated Organic Roofing Felt.
 - .2 CAN/CSA-A3000-03 (R2006), Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Include manufacturer's information on:
 - .1 Ceramic tile, marked to show each type, size, and shape required.
 - .2 Chemical resistant mortar and grout (Epoxy and Furan).
 - .3 Cementitious backer unit.
 - .4 Dry-set cement mortar and grout.
 - .5 Divider strip.
 - .6 Elastomeric membrane and bond coat.
 - .7 Reinforcing tape.
 - .8 Levelling compound.
 - .9 Latex cement mortar and grout.
 - .10 Commercial cement grout.
 - .11 Organic adhesive.
 - .12 Slip resistant tile.
 - .13 Waterproofing isolation membrane.
 - .14 Fasteners.
- .3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Base tile: submit duplicate, 100 x 600 mm sample panels of each colour, texture, size, and pattern of tile.
 - .2 Floor tile: submit duplicate, sample panels of each colour, texture, size, and pattern of tile.
 - .1 Main floor areas 300 x 600 mm

- .3 Wall tile: submit duplicate, sample panels of each colour, texture, size, and pattern of tile.
 - .1 Main wall areas: 300 x 600 mm,
 - .2 Janitor Closet areas: 50 x 50 mm mosaic,
 - .3 Kitchenette backsplash: 100 x 50mm
- .4 Trim shapes, bullnose cap and cove including bullnose cap and base pieces at internal and external corners of vertical surfaces, each type, colour, and size.
- .5 Provide Grout colour samples for final colour selection.
- .6 Adhere tile samples to 11mm thick plywood and grout joints to represent project installation.

1.4 QUALITY ASSURANCE

- .1 Quality Assurance Submittals:
 - .1 Manufacturer's Instructions: manufacturer's installation instructions.
 - .2 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling and reuse in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 AMBIENT CONDITIONS

- .1 Maintain air temperature and structural base temperature at ceramic tile installation area above 12 degrees C for 48 hours before, during, and 48 hours after, installation.
- .2 Do not install tiles at temperatures less than 12 degrees C or above 38 degrees C.
- .3 Do not apply epoxy mortar and grouts at temperatures below 15 degrees C or above 25 degrees C.

1.7 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

- .2 Provide minimum 2% of each type and colour of tile required for project for maintenance use. Store where directed.
- .3 Maintenance material same production run as installed material.

Part 2 Products

2.1 FLOOR TILE

- .1 Main Floor Areas: Porcelain tile: to CAN/CGSB-75.1, ANSI A118.4, Class MR (02 -3.0%), 300 x 600 x 10mm size, straight edges, smooth matte slip resistant surface, double loaded porcelain tile variegated to give appearance of limestone. Provide 3 colours for approval by DCC Representative from manufacturer's standard range. Colour as selected by DCC Representative.
- .2 Janitor Areas: Porcelain Mosaic tile: to CAN/CGSB-75.1, ANSI A118.4, Class MR (02 -3.0%), 50 x 50 x 10mm (sheet size 300x300mm) size, straight edges, smooth matte slip resistant surface. Provide 3 colours for approval by DCC Representative from manufacturer's standard range. Colour as selected by DCC Representative. Colour as selected by DCC Representative.

2.2 WALL TILE

- .1 Porcelain tile (washrooms): to CAN/CGSB-75.1, ANSI A118.4, Class MR (02 -3.0%), 300 x 600 x 10mm size, straight edges, smooth matte slip resistant surface, double loaded porcelain tile variegated to give appearance of limestone. Provide 3 colours for approval by DCC Representative from manufacturer's standard range. Colour as selected by DCC Representative. Colour as selected by DCC Representative.
- .2 Kitchenette Backsplash: Porcelain Mosaic tile: to CAN/CGSB-75.1, ANSI A118.4, Class MR (02 -3.0%), 100 x 50 x 10mm size, straight edges, smooth surface. Provide 3 colours for approval by DCC Representative from manufacturer's standard range. Colour as selected by DCC Representative. Colour as selected by DCC Representative

2.3 BASE TILE

- .1 Base: Porcelain tile: to CAN/CGSB-75.1, ANSI A118.4, Class MR (02 -3.0%), 100 x 600 x 10mm size, straight edges, smooth matte surface, double loaded porcelain tile variegated to give appearance of limestone. Provide 3 colours for approval by DCC Representative from

manufacturer's standard range. Colour as selected by DCC Representative.

2.4 TRIM SHAPES

- .1 Conform to applicable requirements of adjoining floor and wall tile.
- .2 Use trim shapes sizes conforming to size of adjoining field wall tile, including existing spaces, unless specified otherwise.
- .3 Provide all necessary trim and transition strips required to provide finished installation of ceramic finishes. All trim pieces to be from stainless steel unless otherwise noted.
- .4 External Corners and Edge Protection:
 - .1 Provide a stainless steel finishing and edge-protection profile for the outside corners and exposed edges of tiled surfaces c/w a trapezoid-perforated anchoring leg that is secured in the mortar bond coat beneath the tile and a reveal that forms a symmetrically rounded outer corner with 6 mm radius along the surface edge. Provide all inside/outside and connection pieces to form continuous application.
- .5 Border, Transition Divider Strip:
 - .1 Provide a stainless steel border transition strip between floor field tile and floor border strip c/w trapezoid-perforated anchoring leg, that is secured in the mortar bond coat beneath the tile, and has a 10mm wide visible surface.

2.5 MORTAR AND ADHESIVE MATERIALS

- .1 Cement: to CSA-A5, type 10.
- .2 Sand: to ASTM C144, passing 16 mesh.
- .3 Latex additive: formulated for use in cement mortar and thin set bond coat.
- .4 Water: potable and free of minerals and chemicals which are detrimental to mortar and grout mixes.
- .5 Adhesives:
 - .1 Maximum VOC limit 65g/L.

2.6 BOND COAT

- .1 Dry set cement mortar: to ANSI A108.1.

- .2 Latex Cement mortar: to ANSI A108.1, two-component universal dry-set mortar.
- .3 Epoxy bond coat: non-toxic, non-flammable, non-hazardous during storage, mixing, application, and when cured. To produce shock and chemical resistant mortars having the following physical characteristics:
 - .1 Compressive Strength: 246 kg/cm².
 - .2 Bond Strength: 53 kg/cm².
 - .3 Water Absorption: 4.0% Max.
 - .4 Ozone Resistance, 200 hours @ 200 ppm: no loss of strength.
 - .5 Smoke Contribution Factor: 0.
 - .6 Flame Contribution Factor: 0.
 - .7 Finished mortar and grout to be resistant to urine, dilute acid, dilute alkali, sugar, brine and food waste products, petroleum distillates, oil and aromatic solvents.
 - .8 Bond Coat: maximum VOC limit 65 g/L to SCAQMD Rule 1168.
- .4 Chemical-Resistant Bond Coat:
 - .1 Epoxy Resin Type: CTI A118.3.
 - .2 Furan Resin Type: CTI A118.5.
 - .3 Bond Coat: maximum VOC limit 65 g/L to SCAQMD Rule 1168.

2.7 GROUT

- .1 Colouring Pigments:
 - .1 Pure mineral pigments, lime proof and nonfading, complying with ASTM C979.
 - .2 Colouring pigments to be added to grout by manufacturer.
 - .3 Job coloured grout are not acceptable.
 - .4 Use in Commercial Cement Grout, Dry-Set Grout, and Latex Cement Grout.
- .2 Grout Colours:
 - .1 Grout colours to be selected by DCC Representative from manufacturer's full range. Maximum of two colours to be selected for use on project.
- .3 Urethane based grout:
 - .1 Chemical, Stain and Mildew Resistant.

- .2 Pre-mixed single-part product.
- .3 Pigment-free formulation.
- .4 UV stable, non yellowing.
- .5 Semi flexible, low shrinkage and high crack resistance,
 - .1 Typical Physical Properties
 - .1 Initial Set >2hrs
 - .2 Tensile Strength 3.5MPa(510 psi)
 - .3 Compressive Strength 2.9MPa(4200 psi)
 - .4 Linear Shrinkage 0.06%
 - .5 Water Absorption <1%
 - .6 Specific Gravity 1.4
 - .2 Working Properties
 - .1 Working Time 3hrs
 - .2 Tack Free Time 8hrs
 - .3 Ready for light foot traffic 24hrs
 - .4 Ready for heavy foot traffic 72hrs
 - .5 Stain Resistant 3days

2.8 ACCESSORIES

- .1 Reinforcing mesh: 50 x 50 x 1.6 x 1.6 mm galvanized steel wire mesh, welded fabric design, in flat sheets.
- .2 Divider strips:
 - .1 Laminated strips, core 32 x 3 mm black neoprene, outsides (both sides) brass 32 x 1.29 mm complete with anchors, both sides spaced at 150 mm on centre.
- .3 Cleavage plane: polyethylene film to CGSB 51-34 No. 15 asphalt saturated felt to CSA A123.3.
- .4 Metal lath: to ASTM C847 painted galvanized finish, 10 mm rib at 2.17 kg/m².
- .5 Transition Strips: purpose made metal extrusion; stainless steel type.
- .6 Reducer Strips: purpose made metal extrusion; stainless steel type; maximum slope of 1:2.
- .7 Prefabricated Movement Joints: purpose made, having a Shore A Hardness not less than 60 and elasticity of plus or minus 40 percent when used in accordance to TTMAC Detail 301EJ.
- .8 Sealant: in accordance with Section 07 92 00 - Joint Sealants.

- .9 Floor sealer and protective coating: to tile and grout manufacturers recommendations to CAN/CGSB-25.20, Type 1.
- .10 Thresholds: 100mm wide x full width of opening, honed finish to exposed surfaces, size to suit door opening and frame width.
- .11 Access Hatch:
 - .1 Brushed Stainless Steel
 - .2 Dimensions and positioning to match height of wall tile coursing.

2.9 MIXES

- .1 Cement:
 - .1 Scratch coat: 1 part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand, 1 part water, and latex additive where required. Adjust water volume depending on water content of sand.
 - .2 Slurry bond coat: cement and water mixed to creamy paste. Latex additive may be included.
 - .3 Mortar bed for floors: 1 part cement, 4 parts sand, 1 part water. Adjust water volume depending on water content of sand. Latex additive may be included.
 - .4 Mortar bed for walls and ceilings: 1 part cement, 1/5 to 1/2 parts hydrated lime to suit job conditions, 4 parts sand and 1 part water. Adjust water volume depending on water content of sand. Latex additive may be included.
 - .5 Levelling coat: 1 part cement, 4 parts sand, minimum 1/10 part latex additive, 1 part water including latex additive.
 - .6 Bond or setting coat: 1 part cement, 1/3 part hydrated lime, 1 part water.
 - .7 Measure mortar ingredients by volume.
- .2 Dry set mortar: mix to manufacturer's instructions.
- .3 Mix bond and levelling coats, and grout to manufacturer's instructions.
- .4 Adjust water volumes to suit water content of sand.

2.10 PATCHING AND LEVELLING COMPOUND

- .1 Cement base, acrylic polymer compound, manufactured specifically for resurfacing and leveling concrete floors. Products containing gypsum are not acceptable.
- .2 Have not less than the following physical properties:

- .1 Compressive strength - 25 MPa.
 - .2 Tensile strength - 7 MPa.
 - .3 Flexural strength - 7 MPa.
 - .4 Density - 1.9.
- .3 Capable of being applied in layers up to 50 mm thick, being brought to feather edge, and being trowelled to smooth finish.
- .4 Ready for use in 48 hours after application.

2.11 CLEANING COMPOUNDS

- .1 Specifically designed for cleaning masonry and concrete and which will not prevent bond of subsequent tile setting materials including patching and leveling compounds and elastomeric waterproofing membrane and coat.
- .2 Materials containing acid or caustic material are not acceptable.

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 datasheets.

3.2 WORKMANSHIP

- .1 Do tile work in accordance with TTMAC Tile Installation Manual 2016/2017, "Ceramic Tile", except where specified otherwise.
- .2 Apply tile or backing coats to clean and sound surfaces.
- .3 Fit tile around corners, fitments, fixtures, drains and other built-in objects. Maintain uniform joint appearance. Cut edges smooth and even. Do not split tiles.
- .4 Maximum surface tolerance 1:800.
- .5 Make joints between tile uniform and approximately 1.5 mm wide, plumb, straight, true, even and flush with adjacent tile. Ensure sheet layout not visible after installation. Align patterns.
- .6 Lay out tiles so perimeter tiles are minimum 1/2 size.
- .7 Sound tiles after setting and replace hollow-sounding units to obtain full bond.

- .8 Make internal angles square, external angles rounded.
- .9 Use round edged tiles at termination of wall tile panels, except where panel abuts projecting surface or differing plane.
- .10 Install divider strips at junction of tile flooring and dissimilar materials.
- .11 Allow minimum 24 hours after installation of tiles, before grouting.
- .12 Clean installed tile surfaces after installation and grouting cured.

3.3 WALL TILE

- .1 Install in accordance with TTMAC detail 306W.

3.4 FLOOR TILE

- .1 Install in accordance with TTMAC detail 310F.

3.5 BASE TILE

- .1 Install in accordance with TTMAC detail 306W.

3.6 FLOOR SEALER AND PROTECTIVE COATING

- .1 Apply in accordance with manufacturer's instructions.

3.7 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 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.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 37 13 - Diffusers, Registers and Grilles.
- .2 Section 26 50 00 - Lighting.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C423-09, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .2 ASTM E580/E580M-14 Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
 - .3 ASTM C635/C635M-13a, Standard Specifications for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - .4 ASTM C636/C636M-08, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - .5 ASTM E1264-14, Standard Classification for Acoustical Ceiling Products.
 - .6 ASTM E1414/E1414M 11ae1 Standard Test Method for Sound Attenuation between Rooms Sharing a Common Ceiling Plenum.
 - .7 ASTM E1477-98a(2013), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
 - .8 ASTM F1667-15 Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction and Amendment No. 1 1988.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .4 Underwriter's Laboratories of Canada (ULC)

- .1 CAN/ULC-S102-2003, Surface Burning Characteristics of Building Materials and Assemblies.

1.3 COORDINATION

- .1 Do not begin erection of ceiling suspension system until work above ceiling has been inspected by DCC Representative.

1.4 PRE-INSTALLATION MEETING

- .1 Convene pre-installation meeting one week prior to beginning on-site installation, with DCC Representative in accordance with Section 01 32 16.19 - Construction Progress Schedule - Bar (GANTT) Chart to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with work of other sections.
 - .4 Review manufacturer's installation instructions and warranty requirements.
 - .5 Review accepted shop drawings for installation requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00-Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for acoustical suspension, acoustic panels, acoustic tiles, and system accessories. Include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit reflected ceiling plans for special grid patterns as indicated.
 - .2 Indicate lay-out, insert and hanger spacing and fastening details, splicing method for main and cross runners, change in level details, location of access splines, access door dimensions, and locations and acoustical unit support at ceiling fixture and lateral bracing and accessories.

.4 Delegated Design Submittals:

- .1 Submit delegated design shop drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario.
- .2 Indicate components and installation methods to conform to specified seismic design and construction requirements of Contract Documents and in general accordance with ASTM E580/E580M.
- .3 Include supporting details, treatment of cross runners, main runners, and wall closures at terminal ends, suspension wire, lateral force bracing, light fixtures and services within the ceiling, seismic isolation joints and partition bracing.

.5 Samples:

- .1 Submit for review and acceptance of each component specified or necessary for complete installation. Include technical descriptive data.
- .2 Submit duplicate samples of each component proposed for use in each type of ceiling suspension system.
- .3 Submit duplicate 150 mm x 100 mm samples of each type of acoustical unit.

- .6 Gypsum board assemblies are to be stamped and signed by a P.Eng. from the province of Ontario for compliance with seismic installation and reinforcement. This is to be carried by the installation contractor and letter of compliance and certification signoff to be provided upon completion of installation.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for acoustical suspension for incorporation into manual.
- .3 Submit final certificate from design professional responsible for delegated detail design of ceiling indicating conformity with accepted shop drawings.

1.7 MAINTENANCE MATERIALS

- .1 Provide extra acoustical units in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide acoustical units amounting to 2 % of gross ceiling area for each pattern and type of acoustical panel or tile, suspension system and trim required for project, minimum 1 complete factory-sealed package of each.

- .3 Ensure extra materials are from same production run as installed materials.
- .4 Deliver extra materials for each type of acoustical unit in original unopened packages clearly identified, including colour and texture.
- .5 Deliver to DCC Representative, upon completion of the work of this section.

1.8 CERTIFICATIONS

- .1 Fire-resistance rated suspension system: certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements. Include certification of sustainable requirements.

1.9 MOCK-UPS

- .1 Construct mock-ups in accordance with Section 01 45 00-Quality Control.
- .2 Construct mock-up 10m² minimum of each type acoustical ceiling assembly including one outside corner, one inside corner. Ceiling system mock-up to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation, seismic reinforcing.
- .3 Construct mock-up where directed.
- .4 Allow 24 hours for inspection of mock-up by DCC Representative before proceeding with ceiling work.
- .5 When accepted, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of the finished work.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and 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 flat, in dry location, off ground and indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect acoustical ceiling panels and tiles suspension grid components from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Store extra materials required for maintenance, where directed by DCC Representative.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling or disposal in accordance with Section 01 74 19 - Waste Management and Disposal.

1.11 ENVIRONMENTAL REQUIREMENTS

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20 % before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Design Requirements:
 - .1 Intermediate duty system to ASTM C 635/ASTM C635M.
 - .2 Maximum deflection: 1/360th of span to ASTM C 635/ASTM C635M deflection test.

2.2 ACOUSTICAL CEILING SUSPENSION

- .1 Acoustical Ceiling Suspension system made up as follows:
 - .1 2 directional exposed tee bar grid.
 - .2 Concealed tee access spline.
 - .3 Concealed tongue and groove runner.
 - .4 Concealed H runner, tee spline and flat steel spline.
 - .5 Concealed zee runner and flat steel spline.
 - .6 Metal pan special tee system.
- .2 Basic materials for suspension system: zinc coated.
- .3 Exposed tee bar grid components: white. Components die cut. Main tee with double web, rectangular bulb and 25 mm rolled cap on exposed face. Cross tee with rectangular bulb; web

extended to form positive interlock with main tee webs;
lower flange extended and offset to provide flush
intersection .

- .4 Hanger wire: galvanized soft annealed steel wire:
 - .1 3.6 mm diameter for access tile ceilings.
- .5 Hanger inserts: purpose made.
- .6 Carrying channels: 38 x 50 mm channel, of 1.5 mm thick galvanized steel.
- .7 Accessories: splices, clips, wire ties, retainers and wall moulding flush , to complement suspension system components, as recommended by system manufacturer.
- .8 Seismic components and accessories: in accordance with accepted shop drawings .

2.3 ACOUSTICAL CEILING PANELS

- .1 **Panel Type 1**, Standard Acoustical Panel (Open Office and General Areas): to ASTM E1264 and as follows.
 - .1 Type: XX, Bonded mineral fiber with ceramic finish
 - .2 Form: N/A
 - .3 Pattern Designation: Pattern C, E & G, perforated, small holes, light texture and smooth
 - .4 Material: Mineral Fiber
 - .5 Fire Classification: Class A.
 - .1 Flame spread rating of less than 25
 - .2 Smoke developed 50 or less
 - .6 Noise Reduction Coefficient (NRC) designation of 0.50. Ceiling Attenuation Class (CAC) rating 40.
 - .7 Light Reflectance (LR) range of 0.82 ASTM E 1477
 - .8 Edge type square.
 - .9 Colour white
 - .10 Size 610 x 610 x 15.8 mm
 - .11 Shape flat.
- .1 Panel Features:
 - .1 Ceramic bonded mineral fiber designed to withstand heat, humidity, chemical fumes and steam.
 - .2 Contains a broad-spectrum antimicrobial additives.
- .2 **Panel Type 2**, High Sound Absorption Acoustical Panel (Meeting, Office and Conference Room Areas): to ASTM E1264 and as follows.
 - .1 Type: 4, Mineral base with membrane faced overlay.
 - .2 Form 1 and 2, nodular and water felted.

- .3 Pattern Designation: Pattern E and G, smooth and light texture.
- .4 Material: Mineral Fiber
- .5 Fire Classification: Class A.
 - .1 Flame spread rating of less than 25
 - .2 Smoke developed 50 or less
- .6 Noise Reduction Coefficient (NRC) designation of 0.85. Ceiling Attenuation Class (CAC) rating 35.
- .7 Light Reflectance (LR) range of 0.90 ASTM E 1477
- .8 Edge type square.
- .9 Colour white
- .10 Size 610 x 610 x 22 mm
- .11 Shape flat.
- .2 Panel Features:
 - .1 Contains a broad-spectrum antimicrobial additives.

2.4 ACCESSORIES

- .1 Touch-up paint: in accordance with manufacturer's recommendations for surface conditions:

Part 3 Execution

3.1 EXAMINATION

- .1 Verify conditions of substrates previously installed under other Sections or Contracts are acceptable for acoustical ceiling tile and track installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INTERFACE WITH OTHER WORK

- .1 Co-ordinate ceiling work to accommodate components of other sections, such as light fixtures, diffusers, speakers, sprinkler heads, to be built into acoustical ceiling components.

3.3 SUSPENSION SYSTEM INSTALLATION

- .1 Comply with manufacturer's written installation instructions and recommendations, including product technical bulletins, product carton installation instructions, and data sheets.
- .2 Install suspension system in accordance with accepted shop drawings, Certification Organizations tested design requirements and ASTM C636/C636M except where specified otherwise.
- .3 Lay out centre line of ceiling both ways, to provide balanced borders at room perimeter and system according to reflected ceiling plan with border units not less than 50% of standard unit width.
- .4 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- .5 Secure hangers to overhead structure using attachment methods acceptable to DCC Representative.
- .6 Install hangers spaced at maximum 1200 mm centres and within 150 mm from ends of main tees.
- .7 Ensure suspension system is coordinated with location of related components. Provide carrying channels as necessary to bridge at unavoidable interference between suspension system and other work above ceiling.
- .8 Install wall moulding to provide correct ceiling height.
- .9 Completed suspension system to support super-imposed loads, such as diffusers lighting fixtures, grilles and speakers.
- .10 Support at diffusers and light fixtures with additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .11 Attach cross member to main runner to provide rigid assembly.
- .12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
- .13 Install perimeter trim at floating installations securely anchored to suspension system, in accurate alignment with adjacent assemblies. Install curved trim members in smooth curves to radius indicated.

3.4 ACOUSTICAL CEILING PANEL INSTALLATION

- .1 Install lay-in acoustical panels in ceiling suspension system in accordance with manufacturer's instructions and as indicated.

- .2 In fire rated ceiling systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to Certification Organizations design requirements.

3.5 SITE QUALITY CONTROL

- .1 Arrange for periodic site visits by design professional responsible for delegated ceiling design work to review installed work for conformity to design.
- .2 Arrange for periodic site visits by manufacturer's representative to review installed work for conformity to manufacturer's installation instructions and recommendations.
- .3 Submit written site reports by designer to DCC Representative within 3 days of visit.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Touch up scratches, abrasions, voids and other defects in painted surfaces.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

3.7 PROTECTION

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

3.8 SCHEDULE

- .1 Panel Type 1, Standard Acoustical Panel (Office and General Areas):
 - .1 Corridors.
 - .2 Open office areas.
 - .3 All Rooms unless except those enclosed rooms specified for panel type 2.

- .2 Panel Type 2, High Sound Absorption Acoustical Panel
(Office, Quiet Room, Kitchenette and Conference Room Areas)

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 09 30 13 - Ceramic Tiling.
- .2 Section 26 05 00 - Common Work Results - Electrical.
- .3 Section 26 05 28 - Grounding Secondary.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM F1066-04(2010)e1, Standard Specification for Vinyl Composition Floor Tile.
 - .2 ASTM F1344-12e1, Standard Specification for Rubber Floor Tile.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
 - .2 CAN/CGSB-25.21-95, Detergent-Resistant Floor Polish.
 - .3 CAN/ULC-S102.2 Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies
- .3 ANSI/ESD
 - .1 ANSI/ESD S7.1 :Floor Materials-Resistive Characterization of Materials
 - .2 ANSI/ESD STM 97.1: Floor Materials and Footwear-Resistance in Combination with a Person
 - .3 ANSI/ESD STM 97.2: Floor Materials and Footwear Voltage Measurement in Combination with a Person
 - .4 ANSI/ESD S20.20-2014, Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

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 resilient tile flooring and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:

- .1 Submit duplicate tile in size specified, base, edge strips, treads, nosing, feature strips, 300 mm long.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials of resilient tile flooring, base and adhesive in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Extra materials from same production run as installed materials.
 - .3 Identify each container of floor tile and each container of adhesive.
 - .4 Deliver to site, upon completion of the work of this section.
 - .5 Store where directed by Consultant.
 - .6 Provide 2 additional carton per vinyl tile type. Provide additional 50 Linear feet of rubber floor base material.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions and 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 off ground, indoors and 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 Packaging Waste Management: remove for reuse and return of padding, crates, packaging materials, pallets, in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 SITE CONDITIONS

- .1 Ambient Conditions:
 - .1 Maintain air temperature and structural base temperature at flooring installation area above 20

degrees C for 48 hours before, during and for 48 hours after installation.

Part 2 Products

2.1 MATERIALS

- .1 Vinyl Composition Tile (VCT): to ASTM F1066, Composition 1 - non asbestos Class 2 - through pattern tile, 3.2 mm, 300 x 300 mm size.
 - .1 Colour and pattern from Manufactures full range selected by DCC Representative.
- .2 Static Control Flooring (SDT):
 - .1 Description: Static dissipative vinyl tile composed of polyvinyl chloride resin, plasticizers, fillers, pigments, and antistatic additive with colors and texture dispersed uniformly throughout its thickness.
 - .2 Tile shall meet size, thickness, indentation, impact, deflection, dimensional stability, resistance to chemicals, squareness, and resistance to heat requirements of ASTM F 1066 Standard Specification for Vinyl Composition Tile, Class 2, through pattern
 - .3 Provide flooring material to meet the following electrical properties when installed according to manufacturer's instructions with the required adhesive, copper strips grounding and SDT floor finish:
 - .1 ANSI/ESD S7.1 Floor Materials-Resistive Characterization of Materials results between 10^6 and 10^9 ohms, point-to-point and point-to-ground.
 - .2 ASTM F 150 Electrical Resistance of Flooring between 10^6 and 10^9 ohms, point-to-point and point-to-ground.
 - .3 ANSI/ESD STM 97.1: Floor Materials and Footwear-Resistance in Combination with a Person results between 10^6 and 10^9 ohms.
 - .4 ANSI/ESD STM 97.2: Floor Materials and Footwear Voltage Measurement in Combination with a Person - 29.3 volts (average) with dissipative footwear at 12% relative humidity.
 - .5 Static Dissipation @ 12% RH: Flooring in combination with a person wearing dissipative footwear - 1000 to 100 volts: 0.56 seconds maximum.
 - .6 Size 600 x 600mm

- .4 Colour and pattern selected by DCC Representative from manufacturers full range. Earth grounding strips: Copper, 50mm wide x 0.1mm thick per manufactures requirements to meet static dissipative range.
- .5 Conductive adhesive per manufactures recommendations to meet static dissipative requirements.
- .3 Resilient base: continuous, top set, complete with premoulded end stops and external corners:
 - .1 Type: rubber
 - .2 Style: cove.
 - .3 Thickness: 5mm.
 - .4 Height: 101.6 mm.
 - .5 Lengths: cut lengths minimum 2400 mm minimum.
 - .6 Colour: DCC Representative from manufacturer's standard range.
- .4 Primers and adhesives:
 - .1 Standard: waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.
- .5 Static Dissipative Tile Adhesive with 50mm wide x 600mm long copper ground-connection strips for under the tile as recommended by the SDT flooring manufacturer.
- .6 Sub-floor filler and leveller: white premix latex requiring water only to produce cementitious paste as recommended by flooring manufacturer for use with their product.
- .7 Metal edge strips: aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
- .8 Sealer: type recommended by flooring manufacturer to CAN/CGSB-25.20, Type 2-water based.
- .9 No-Wax Identifier: Size 300mm x 300mm, Includes incised, inlaid graphic symbol and text identifying that no wax or finishes are to be applied to this speacialzed flooring.
 - .1 Located in floor centered on entrance to room.

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 resilient tile flooring installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC 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 DCC Representative.

3.2 INSPECTION

- .1 Ensure concrete floors are dry, by using test methods recommended by tile manufacturer.

3.3 SUB-FLOOR TREATMENT

- .1 Remove existing resilient flooring.
- .2 Remove or treat old adhesives to prevent residual, old flooring adhesives from bleeding through to new flooring and/or interfering with the bonding of new adhesives.
- .3 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry.
- .4 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .5 Prime sub-floor to flooring manufacturer's printed instructions.

3.4 PREPARATION

- .1 Ensure floor areas are clean, free from debris, fully enclosed and weather tight.
- .2 Conduct moisture tests on all substrates prior to commencement of work. Maximum residual moisture for subfloors to be:
 - .1 2.5% CM for concrete
 - .2 0.5% for anhydrite screed
- .3 Prime concrete slab to resilient flooring manufacturer's printed instructions.

3.5 VCT TILE APPLICATION

- .1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after

installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.

- .2 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .3 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.
- .4 Install flooring to square grid pattern with joints aligned.
- .5 As installation progresses, and after installation, roll flooring in all directions with 50 kg minimum roller to ensure full adhesion.
- .6 Cut tile and fit neatly around fixed objects.
- .7 Install feature strips and floor markings where indicated. Fit joints tightly.
- .8 Install flooring in pan type floor access covers. Maintain floor pattern.
- .9 Continue flooring through areas to receive movable type partitions without interrupting floor pattern.
- .10 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.
- .11 Install metal edge strips at unprotected or exposed edges where flooring terminates.

3.6 STATIC DISSIPATING (SD) FLOORING APPLICATION

- .1 Install cementitious isolating barrier underlayment, minimum 3mm thick. Do not proceed until underlayment has cured.
- .2 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least 1 month following building occupation.

- .3 Apply conductive adhesive uniformly using recommended trowel. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .4 Install earthing strips with contact adhesive per manufactures drawings and recommendations.
- .5 Connect grounding system to a minimum of two points.
 - .1 Coordinate with electrical for building grounding verification.
- .6 Lay flooring with seams parallel to building lines.
- .7 As installation progresses, and after installation roll flooring with 45 kg minimum roller to ensure full adhesion.
- .8 Cut flooring around fixed objects.
- .9 Continue flooring over areas which will be under built-in furniture and equipment.
- .10 Terminate flooring at centreline of door in openings where adjacent floor finish or colour is dissimilar.
- .11 Install "No-Wax" identifier tile at entrance to room, centered on door
- .12 Install termination edge strips where ESD flooring terminates per manufacturers requirements.
- .13 Conduct static dissipative test to BS 61340-4-1. Conductive sample test for every 2m² of floor area.

3.7 BASE APPLICATION

- .1 Lay out base to keep number of joints at minimum. Base joints at maximum length available or at internal or premoulded corners.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use premoulded corner units for right angle external corners. Use formed straight base material for external corners of other angles, minimum 300 mm each leg. Wrap around toeless base at external corners.

- .8 Install toeless type base before installation of carpet on floors.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Clean flooring base surfaces to flooring manufacturer's printed instructions.
- .3 Remove excess adhesive from floor, base and wall surfaces without damage.
- .4 For non static dissipative flooring Clean, seal and wax floor and base surface to flooring manufacturer's instructions. In carpeted areas clean, seal and wax base surface before carpet installation.
- .5 For conductive installations: Do not apply any wax or emulsion floor finishes in ESD protected area as these may adversely affect the conductive properties of the floor.
- .6 Waste Management: separate waste materials for recycling and reuse 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.

3.9 PROTECTION

- .1 Protect new floors from time of final set of adhesive until final inspection.
- .2 Prohibit traffic on floor for 72 hours after installation.
- .3 Floor must not be washed for 48 hours after installation.
- .4 Use only water-based coating for linoleum.

END OF SECTION

Part 1 General**1.1 REFERENCE STANDARDS**

- .1 American Association of Textile Chemists and Colorists (AATCC)
 - .1 AATCC Test Method 16.1-2012(R2014), Colorfastness to Light: Outdoor.
 - .2 AATCC Test Method 16.2-2012(R2014), Colorfastness to Light: Carbon-Arc.
 - .3 AATCC Test Method 16.3-2012(R2014), Colorfastness to Light: Xenon-Arc
 - .4 AATCC Test Method 23-2010(R2015), Colorfastness to Burn Gas Fumes.
 - .5 AATCC Test Method 129-2010(R20156), Colorfastness to Ozone in the Atmosphere Under High Humidities.
 - .6 AATCC Test Method 134-2013(2016), Electrostatic Propensity of Carpets.
 - .7 AATCC Test Method 171-2014, Carpets: Cleaning of; Hot Water Extraction Method.
 - .8 AATCC Test Method 175-2013, Stain Resistance: Pile Floor Coverings.
 - .9 AATCC Test Method 189-2012, Fluorine Content of Carpet Fibers.
- .2 ASTM International (ASTM)
 - .1 ASTM D297-15, Standard Test Methods for Rubber Products-Chemical Analysis.
 - .2 ASTM D1335-12, Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings.
 - .3 ASTM D 1667-05(R2011), Standard Specification for Flexible Cellular Materials-Poly (Vinyl Chloride) Foam (Closed-Cell).
 - .4 ASTM D2661-14, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
 - .5 ASTM D3574-11, Standard Test Methods for Flexible Cellular Materials - Slab, Bonded, and Molded Urethane Foams.
 - .6 ASTM D3936-12, Standard Test Method for Resistance to Delamination of the Secondary Backing of Pile Yarn Floor Covering.

- .7 ASTM D 5116-10,, Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-4.2 No. 22-2004(2013), Textile Test Methods - Colourfastness to Rubbing (Crocking).
 - .2 CAN/CGSB-4.2 No.27.6-M91-(R2013), Textile Test Methods - Flame Resistance - Methemine Tablet Test for Textile Floor Coverings.
 - .3 CAN/CGSB-4.2 No. 76-94/ISO 2551: 1981 IDT (R2013), Textile Test Methods - Machine-Made Textile Floor Coverings - Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions.
 - .4 CAN/CGSB-4.2 No.77.1-94/ISO 4919: 1978 (R2012), Textile Test Methods - Carpets - Determination of Tuft Withdrawal Force.
- .4 Carpet and Rug Institute (CRI)
 - .1 CRI 104 Standard for Installation of Commercial Carpet 2015.
 - .2 CRI Green Label Plus Indoor Air Quality Testing Program.
- .5 Environmental Choice Program (ECP)
 - .1 CCD-152- 2009, Flooring Products, Commercial Non-modular Textile Flooring.
- .6 Health Canada
 - .1 C.R.C., c.923-10, Hazardous Products Act - Carpet Regulations, Part II of Schedule 1.
- .7 National Floor Covering Association (NFCA)
 - .1 National Floor Covering Specification Manual 2007.
- .8 ULC Standards(ULC)
 - .1 CAN/ULC-S102-11, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S102.2-88, Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:

- .1 Convene pre-installation meeting 1 week prior to beginning work of this Section on-site installation, with DCC Representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other construction subtrades.
 - .4 Review manufacturer's written installation instructions and warranty requirements.
- .2 Comply with manufacturer's written recommendations for sequencing construction operations.

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 each carpet protection, carpet tile, subfloor patching compound, adhesive and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS SDS in accordance with Section 01 35 43 - Environmental Procedures and 01 70 12 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Information on shop drawings to indicate:
 - .1 Nap: direction, open edges, special patterns.
 - .2 Cutouts: show locations where cutouts are required.
 - .3 Edgings: show location of edge moldings and edge bindings.
- .4 Samples:
 - .1 Submit 2 samples for review and acceptance of each accessory.
 - .2 Submit 2 samples of each type of carpet tile specified and duplicate tiles for each colour selected, divider strips, base, 150 mm length binder bars.
 - .3 Samples returned for inclusion into work.
- .5 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified

performance characteristics and criteria and physical requirements.

.6 Test and Evaluation Reports:

.1 Certified test reports showing compliance with specified performance characteristics and physical properties.

.7 Manufacturer's Instructions: submit manufacturer's installation storage instructions.

.8 Manufacturers Reports:

.1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance with specifications.

.9 Qualification Statements:

.1 Compliance: to CAN/ULC-S102.

.2 Tuft bind: meets requirements of CAN/CGSB-4.129 when tested to CAN/CGSB-4.2 No.77.1.

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 installed products for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra stock materials in accordance with:

.1 Quantity: provide minimum % of:

.1 Carpet tile: 5%

.2 Delivery, storage and protection: comply with Owner's requirements for delivery and storage of extra materials. Deliver to address and location identified by DCC Representative.

1.6 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00- Quality Control.

.2 Regulatory Requirements:

.1 Prequalification: to CAN/CGSB-4.2 No. 27.6, compliance with Health Canada regulations under "Hazardous Products Act", Part II of Schedule 1.

.3 Qualifications:

- .1 Manufacturer: capable of providing field service representation during construction and approving application method.
- .2 Flooring Installer, Contractor, Applicator :
 - .1 Experienced in performing work of this Section who has specialized in installation of work similar to that required for this project.
 - .2 Certified by carpet manufacturer prior to bid submission.
 - .3 No sub-contract labour without written approval of DCC Representative.
 - .4 Responsible for proper product installation, including floor testing and preparation as specified and in accordance with carpet manufacturer's written instructions.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions and 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, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - .3 Store and protect carpet tile, adhesive in original containers or wrapping with manufacturer's seals and labels intact.
 - .4 Store and protect carpet tile and accessories in location as directed by DCC Representative.
 - .5 Store carpet and adhesive at minimum temperature of 18 degrees C and relative humidity of maximum 65% for minimum of 48 hours before installation.
 - .6 Prevent damage to materials during handling and storage. Keep materials under cover and free from dampness.
 - .7 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS)

regarding use, handling, storage, and disposal of hazardous materials.

- .8 Replace defective or damaged materials with new.

1.8 SITE CONDITIONS

- .1 Moisture: substrate within moisture limits and alkalinity limits recommended by manufacturer. Prepare moisture testing and provide report to DCC Representative.
- .2 Temperature: maintain ambient temperature of minimum 18 degrees C from 48 hours before installation to minimum 48 hours after completion of work.
- .3 Relative humidity: maintain between 10% and 65% for 48 hours before, during and 48 hours after installation.
- .4 Ventilation:
 - .1 Ventilate area of work as directed by DCC Representative by use of approved portable supply and exhaust fans. DCC Representative will co-ordinate operation of ventilation system during installation of carpet.
 - .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities. Provide fans with HEPA filters.
 - .3 Provide continuous ventilation during and after carpet application. Run ventilation system 24 hours per day during installation; provide continuous ventilation for 7 days after completion of carpet installation.
- .5 Install carpet after:
 - .1 Space enclosed and weatherproof.
 - .2 Wet-work in space completed and nominally dry.
 - .3 Work above ceilings complete.

1.9 WARRANTY

- .1 Manufacturer's warranty: submit, for DCC Representative's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty in addition to and not limit other rights Owner may have under Contract Documents.

Part 2 Products

2.1 MATERIALS

- .1 Manufacturers:

- .1 Ensure manufacturer has experience in manufacturing components similar to or exceeding requirements of project.

2.2 PERFORMANCE

- .1 Flammability: certified for flammability to Health Canada regulations under "Hazardous Products - Carpet Regulations", Part II of Schedule 1.
- .2 Flame Spread: maximum flame spread rating 300, maximum smoke developed classification 500, when tested to CAN/ULC-S102.2.
- .3 Smoke Development: Maximum 450 to ASTM E662.
- .4 Dry Breaking Strength: to ASTM D2661, minimum acceptable tear strength in both length and width:
 - .1 11.3 kg for carpets installed by glue down installation.
- .5 Wear: maximum 10 % loss of pile face fibre by weight for 10 years.
- .6 Edge Ravel: none for 10 years.
- .7 Static Resistance: permanent static control to AATCC 134, 3000 V maximum at 20% RH and 22 degrees C.
- .8 Static Generation: less than 3.0 kV per AATCC 134 for 10 years.
- .9 Tuft Bind: Tuft Lock: to ASTM D1335 CAN/CGSB-4.129, minimum acceptable 3.6 for loop pile product 1.6 kilograms for cut pile product.
- .10 De-lamination of Secondary Backing: Lamination Strength of Secondary Backing: to ASTM D3936, minimum acceptable peel strength of 1.6 kg/25 mm.
- .11 Stain resistance: to AATCC 175, 8.
- .12 Soil Resistance: Fluorine Durability Level to AATCC 189 350 ppm fluorine minimum.
- .13 Colorfastness, dimensional stability, permanency of finishes, and ease of cleaning: to AATCC 171.
- .14 Colourfastness to light: to CAN/CGSB-4.2 No.18.3, AATCC 16.
- .15 Colourfastness to atmosphere: to AATCC 23, AATCC 129.
- .16 Colourfastness to crocking: to CAN/CGSB-4.2 No. 22.
- .17 Cleaning of Carpets with Hot Water Extraction Method: to AATCC 171.

2.3 FABRICATION

- .1 Face construction:
 - .1 Tufted.
- .2 Pile Surface Appearance:
 - .1 Textured loop.
- .3 Pile fibre: to CAN/CGSB-4.129.
 - .1 Nylon: .
 - .1 Type: Nylon 6.6.
- .4 Dyeing Method: 100solution dyed.
- .5 Pile Weight Density: 266.974.4g/m3.
- .6 Finished Pile Height: minimum 3.3 mm average.
- .7 Performance Rating: 3.0 minimum at 22,000 cycles to Vetterman test, 12,000 cycles to Hexapod test.
- .8 Dimensional Stability: maximum + 0.15% to CAN/CGSB-4.2 No. 76/ISO 2551.

2.4 ACCESSORIES

- .1 Resilient base: continuous, top set, complete with premoulded end stops and external corners:
 - .1 Type: rubber
 - .2 Style: cove.
 - .3 Thickness: 5mm.
 - .4 Height: 101.6 mm.
 - .5 Lengths: cut lengths minimum 2400 mm minimum.
 - .6 Colour: DCC Representative from manufacturer's standard range.
- .2 Binder Bars: aluminum finish.
- .3 Adhesive:
 - .1 Multi-purpose Adhesive Type: recommended by carpet tile manufacturer for direct glue down installation.
 - .2 Pressure Sensitive Type: recommended by carpet tile manufacturer for direct glue down installation of speciality backed carpet tiles.
 - .3 Mill-applied Adhesive Type: fully cured. Combination of pre-applied adhesive and tile to meet carpet only VOC emissions criteria of Carpet and Rug Institute Green Label Plus Indoor Air Quality Certification Program.
 - .4 Pre-applied Adhesive: non-transferable.

- .4 Transition Mouldings:
 - .1 Carpet edge / reducer strip: as required.
- .5 Carpet protection: non-staining heavy duty kraft paper.
- .6 Subfloor patching compound: Portland cement base filler, mix with latex to form cementitious paste.

Part 3 Execution

3.1 INSTALLERS

- .1 Experienced and qualified technicians to carry out assembly and installation of tile carpet.

3.2 EXAMINATION

- .1 Examine conditions, substrates and work to receive work of this Section.
- .2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts acceptable for carpet tile installation in accordance with manufacturer's written instructions.
 - .1 Inform DCC Representative of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions remedied and after receipt of written approval to proceed from DCC Representative.

3.3 PREPARATION

- .1 Subfloor Preparation:
 - .1 Inspect concrete and determine special care required to make it suitable for carpet installation.
 - .2 Fill and level cracks 3 mm wide or protrusions over 0.8 mm with appropriate and compatible polymer fortified, latex patching compound.
 - .3 Comply with manufacturer's written recommendations for maximum patch thickness.
 - .4 Prime large patch areas with compatible primer.
 - .5 Ensure concrete substrates cured, clean and dry.
 - .6 Ensure concrete substrates free of paint, dirt, grease, oil, curing or parting agents, and other contaminants, including sealers, that interfere with bonding of adhesive.

- .7 Where powdery or porous concrete surface encountered, apply primer compatible with adhesive to provide suitable surface for glue-down installation.
- .2 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.
 - .1 Prepare floor surfaces in accordance with CRI Carpet Installation Standard.
- .3 Tile Carpeting Preparation:
 - .1 Pre-condition carpeting following manufacturer's written instructions.

3.4 INSTALLATION

- .1 Install carpet tiles in accordance with manufacturer's written instructions, and CRI Carpet Installation Standard.
- .2 Co-ordinate tile carpeting work with work of other trades, for proper time and sequence to avoid construction delays.
- .3 Install carpet tile after finishing work is completed but before demountable office partitions and telephone and electrical pedestal outlets installed.
- .4 Install carpet tile in accordance with manufacturer's recommendation. This can include quarter-turn 90 degree format, monolithic, random, quarter turn ashlar, horizontal, herringbone or vertical ashlar.
- .5 Snugly join carpet tiles in completed installation.
 - .1 Measure distance covered by 11 carpet tiles (10 joints) and ensure distance is compliance with manufacturer specifications.
 - .2 Trapping yarn between carpet tiles is prohibited.
- .6 Apply thin film of pressure-sensitive adhesive according to manufacturer's recommendations.
- .7 Finished installation to present smooth wearing surface free from conspicuous seams, burring and other faults.
- .8 Use material from same dye lot.
 - .1 Colour, pattern and texture to match within visual areas.
 - .2 Maintain constant pile direction.
- .9 Fit around architectural, mechanical, electrical and telephone outlets, and furniture fitments, around perimeter of rooms into recesses, and around projections.
- .10 Install carpet tiles to underfloor duct system access covers.

- .11 Install carpeting in pan type floor access covers.
- .12 Extend carpet tiles into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- .13 Install carpet tiles smooth and free from bubbles, puckers, and other defects.
- .14 Protect exposed carpet tile edges at transition to other flooring materials with suitable transition strips.

3.5 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - Co-ordinate site test with Section 01 45 00 - Quality Control.
- .2 Manufacturer's Field Services:
 - .1 Co-ordinate manufacturer's services with Section 01 45 00 - Quality Control. Have manufacturer 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 Manufacturer's field services: 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:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which Work of this Section depends, complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning carried out.
 - .4 Obtain reports within 3 days of review and submit immediately to DCC Representative.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.1 Vacuum carpets clean immediately after completion of installation.

.2 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.

3.7 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Prohibit traffic on carpet for minimum period of 24 hours after installation and until adhesive is cured.

.3 Install carpet protection as directed by DCC Representative.

.4 Repair damage to adjacent materials caused by tile carpeting installation.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 07 92 00 - Joint Sealants.
- .2 Section 09 21 16 - Gypsum Board Assemblies.
- .3 Section 09 22 16 - Non-Structural Metal Framing.
- .4 Section 09 91 23 - Interior Painting.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D 256-10(2018), Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
 - .2 ASTM D 570-98(2018), Standard Test Method for Water Absorption of Plastics
 - .3 ASTM D 638-14, Standard Test Method for Tensile Properties of Plastics
 - .4 ASTM D 790-17, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - .5 ASTM D 2583-13a, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
 - .6 ASTM D 5319-17, Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels
 - .7 ASTM E 84-20, Standard Test Method for Surface Burning Characteristics of Building Materials
- .2 Canadian Food Inspection Agency (CFIA)
 - .1 Fibre Reinforced Panel, food safety acceptance.
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

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 fiber reinforced panels and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:

- .1 Submit elevations of each wall showing location of FRP paneling and trim members with respect to discontinuities in the wall elevation.
- .2 Indicate components such as fastener type, dimensions, spacing and locations at panel edges, ends and in field of panel as well as installation methods.
- .3 Indicate type of joint compound, and number of joint compound layers.
- .4 Samples:
 - .1 Submit to DCC Representative for review and selection manufacturer's full range of available colors patterns and textures.
 - .2 Submit samples for verification for each selection indicating color, texture and pattern required.
 - .1 Submit complete with specified finish
 - .2 For selected patterns show complete pattern repeat.
 - .3 Exposed Molding and Trim: Provide samples of each type, finish, and color.
- .5 Certifications:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 MSDS:
 - .1 Submit Manufacturers Material Safety Data Sheets for adhesives, sealants and other materials relating to this section.

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 and applicable standard designation.
- .3 Exercise care in unloading Fibre Reinforced Panel(FRP) materials shipment to prevent damage.
- .4 Storage and Handling Requirements in accordance with manufacturer's recommendations:
 - .1 Store panels and trim lying level, flat, indoors in dry location, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Allow panels to acclimate to room temperature 21 degrees celsius for 48 hours prior to installation.
 - .3 Store and protect FRP from nicks, scratches, and blemishes.

- .4 Protect FRP from direct exposure to rain, snow, sunlight, or other excessive weather conditions.
- .5 Protect from weather, elements and damage from construction operations.
- .6 Handle FRP to prevent damage to edges, ends or surfaces.
- .7 Replace defective or damaged materials with new.
- .5 Packaging Waste Management: remove for reuse and return of packaging materials, crates, padding, pallets.

1.5 AMBIENT CONDITIONS

- .1 Maintain ambient temperature and relative humidity within limits required by type of adhesive used and following manufacturer's for 48 hours prior to and during application of panels and joint treatment, and for 48 hours minimum after completion of joint treatment.
- .2 Apply panel and joint treatment to dry, clean, frost free surfaces.
- .3 Ventilation: 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 FRP Panels:
 - .1 Fiberglass reinforced thermosetting polyester resin panel sheets.
 - .2 Non-porous, moisture proof, suitable for food preparation applications per Canadian Food Inspection Agency (CFIA) accepted.
 - .3 Dimensions:
 - .1 Thickness: 2.29mm minimum.
 - .2 Width: 1220mm
 - .3 Length: 2440mm
 - .4 Finish:
 - .1 Texture: Smooth.
 - .2 Colour: As selected by DCC Representative from manufactures full range.
 - .5 Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
 - .1 Flexural Strength to ASTM D 790, - 10,000 psi.
 - .2 Flexural Modulus to ASTM D 790, - 3.1×10^5 psi.
 - .3 Tensile Strength to ASTM D 638, - 7,000 psi.
 - .4 Tensile Modulus to ASTM D 638 - 3.1×10^5 psi.

- .5 Elongation to ASTM D 638 - 1.80%.
- .6 Water Absorption to ASTM D 570, 0.72% (21°C @ 72 hrs).
- .7 Barcol Hardness to ASTM D 2583, 35.
- .8 Izod Impact Strength to ASTM D 256, of 7.16 ft. lbs./in
- .9 Coefficient. of Linear Thermal Expansion to ASTM D 696, 2.39×10^{-5}
- .10 Abrasion Resistance TABER: 0.391 % WT Loss
- .11 Fire Rating: Class A.
 - .1 Flame Spread: ≤ 25
 - .2 Smoke Generation: < 450
 - .3 Flash Ignition Temperature to ASTM 1929, 400 °C
 - .4 Self Ignition Temperature to ASTM 1929, 430 °C
- .2 Moldings and Trim:
 - .1 Material: Aluminum trim, heavy weight extruded. Factory finished.
 - .2 Color: Clear Satin Anodized.
 - .3 Trim profiles as per manufactures system to provide continuously protected and sealed edges and seams.
- .3 Accessories:
 - .1 Fasteners: Non-staining nylon drive rivets.
 - .1 Match panel colors.
 - .2 Length to suit project conditions
 - .2 Adhesive: To ASTM C 557 Flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.
 - .1 As recommended by FRP panel manufacture for application and substrates.
 - .3 Sealant:
 - .1 Silicone per Section 07 92 00 - Joint Sealants.
 - .2 Clear or colour matched to panel system.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for fiber reinforced panels installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.

- .2 Inform DCC 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 DCC Representative.

3.2 APPLICATION

- .1 Comply with manufacturer's recommended procedures and installation sequence.
- .2 Cut sheets to meet supports allowing 3 mm clearance for every 2.4m of panel.
 - .1 Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
 - .2 Pre-drill fastener holes 3mm oversize with high speed drill bit.
 - .1 Space at 200mm maximum on center at perimeter, approximately 25mm from panel edge.
 - .2 Space at in field in rows 400mm on center, with fasteners spaced at 300mm maximum on center.
- .3 Apply panels to substrates, above base, vertically oriented with seams plumb and aligned with adjoining panels.
 - .1 Install panels with manufacturer's recommended gap for panel field and corner joints.
 - .1 Adhesive trowel and application method to conform to adhesive manufacturer's recommendations.
 - .2 Drive fasteners for snug fit. Do not over-tighten.
- .4 Apply panel moldings to all panel edges and seams using silicone sealant providing for required clearances.
 - .1 All moldings must provide for a minimum 3mm of panel expansion at joints and edges, to insure proper installation.
 - .2 Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

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

- .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 FRP installation.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 06 40 00 - Architectural Woodwork.
- .2 Section 07 92 00 - Joint Sealant.
- .3 Section 08 11 00 - Metal Doors And Frames.
- .4 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCE STANDARDS

- .1 Environmental Protection Agency (EPA)
 - .1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, EPA Method 24 - Surface Coatings.
 - .2 SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .3 Master Painters Institute (MPI)
 - .1 The Master Painters Institute (MPI)/Architectural Painting Specification Manual (ASM) - current edition.
 - .2 Maintenance Repainting Manual - current edition.
- .4 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada 2015 (NFC).
- .5 Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Submit work schedule for various stages of painting to DCC Representative for review. Provide schedule minimum of 48 hours in advance of proposed operations.
 - .2 Obtain written authorization from DCC Representative for changes in work schedule.
 - .3 Schedule new additions to existing building coordinate painting operations with other trades.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's instructions, printed product literature and data sheets for paint and paint products and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Identify on product submission which system the product is being submitted under and the relevant MPI approved product API #.
 - .3 Submit 2 copies of WHMIS SDS in accordance with Section 01 70 12 - Health and Safety Requirements.
 - .4 Confirm products to be used are in MPI's approved product list.
- .3 Upon completion, provide records of products used. List products in relation to finish system and include the following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 Manufacturer's Material Safety Data Sheets (SDS).
 - .5 MPI approved product API#
- .4 Samples:
 - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
 - .2 Submit 200 x 300 duplicate mm sample panels of each paint finish or clear coating with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
 - .1 Plate steel 3 mm for finishes over metal surfaces.
 - .2 13 mm birch or plywood for finishes over wood surfaces.
 - .3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
 - .4 Gypsum board 13 mm for finishes over gypsum board and other smooth surfaces.

- .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
- .5 Test reports: Provide certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Lead, cadmium and chromium: presence of and amounts.
 - .2 Mercury: presence of and amounts.
 - .3 Organochlorines and PCBs: presence of and amounts.
- .6 Certificates: Provide certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties. MPI Gateway #.
- .7 Manufacturer's Instructions:
 - .1 Provide manufacturer's installation application instructions.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: Provide operation and maintenance data for painting materials for incorporation into manual.
- .3 Include:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Submit one 1 litre can of each type and colour of primer, stain, finish coating. Identify colour and paint type in relation to established colour schedule and finish system.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Contractor: to have proven satisfactory experience. When requested, provide list of comparable jobs including, job name and location, specifying authority, and project manager.

- .2 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
- .3 Conform to latest MPI requirements for exterior painting work including preparation and priming.
- .4 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.
- .5 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested by DCC Representative.
- .6 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Ceilings and Bulkheads: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .2 Mock-Ups:
 - .1 When requested by DCC Representative or Paint Inspection Agency, prepare and paint designated surface, area, room or item to requirements specified herein, with specified paint or coating showing selected colours, number of coats, gloss/sheen, textures and quality of work to MPI Painting Specification Manual standards for review and approval.
 - .2 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .1 Mock-up will be used:
 - .1 To judge quality of work, substrate preparation, operation of equipment and material application and skill to MPI Architectural Painting Specification Manual standards.
 - .2 Locate where directed.
 - .3 Allow 48 hours for inspection of mock-up before proceeding with Work.
 - .4 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

1.8 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.
 - .1 Labels: to indicate:
 - .1 Type of paint or coating.
 - .2 Compliance with applicable standard.
 - .3 Colour number in accordance with established colour schedule.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors and in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Observe manufacturer's recommendations for storage and handling.
 - .3 Store materials and supplies away from heat generating devices.
 - .4 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
 - .5 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of DCC Representative. After completion of operations, return areas to clean condition to approval of DCC Representative.
 - .6 Remove paint materials from storage only in quantities required for same day use.
 - .7 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
 - .8 Fire Safety Requirements:
 - .1 Provide two 9 kg Type ABC fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada (NFC).
- .4 Packaging Waste Management: remove for reuse and return of packaging materials, padding, pallets, crates, in

accordance with Section 01 74 19 - Waste Management and Disposal.

1.9 SITE CONDITIONS

.1 Ambient Conditions:

.1 Heating, Ventilation and Lighting:

- .1 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.
- .2 Provide continuous ventilation for 7 days after completion of application of paint.
- .3 Co-ordinate use of existing ventilation system with DCC Representative and ensure its operation during and after application of paint as required.
- .4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
- .5 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .6 Temperature, Humidity and Substrate Moisture Content Levels:

- .1 Unless pre-approved written approval by Specifying body, Paint Inspection Agency and, applied product manufacturer, perform no painting when:
 - .1 Ambient air and substrate temperatures are below 10 degrees C.
 - .2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is under 85 % or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the

- ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.
- .5 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
 - .2 Perform painting work when maximum moisture content of the substrate is below:
 - .1 12 % for concrete and masonry (clay and concrete brick/block). Allow new concrete and masonry to cure minimum of 28 days.
 - .2 15 % for hard wood.
 - .3 17 % for soft wood.
 - .4 12 % for plaster and gypsum board.
 - .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
 - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
 - .7 Surface and Environmental Conditions:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.
 - .8 Additional interior application requirements:
 - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
 - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of DCC Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

Part 2 Products**2.1 PERFORMANCE REQUIREMENTS**

- .1 Environmental Performance Requirements:
 - .1 Provide paint products meeting MPI "Environmentally Friendly" ratings based on VOC (EPA Method 24) content levels.

2.2 MATERIALS

- .1 All paint MPI systems and materials listed in the MPI Approved Products List (APL) are to MPI premium grade unless otherwise specified for use on this project. Alternate systems may be used only on approval of the DCC Representative.
- .2 Provide paint materials for paint systems from single manufacturer.
- .3 Conform to latest MPI requirements for interior painting work including preparation and priming.
- .4 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising there from, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).
- .5 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .6 Water-borne surface coatings and recycled water-borne surface coatings must have flash point of 61.0 degrees C or greater.
- .7 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
 - .1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
 - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
- .8 Recycled water-borne surface coatings must not contain:

- .1 Lead in excess of 600.0 ppm weight/weight total solids.
- .2 Mercury in excess of 50.0 ppm weight/weight total product.
- .3 Cadmium in excess of 1.0 ppm weight/weight total product.
- .4 Hexavalent chromium in excess of 3.0 ppm weight/weight total product.
- .5 Organochlorines or polychlorinated biphenyls (PCBS) in excess of 1.0 ppm weight/weight total product.
- .9 The following must be performed on each batch of consolidated post-consumer material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.
 - .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
 - .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
 - .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

2.3 COLOURS

- .1 Colour schedule will be based upon selection of 5 base colours and 3 accent colours. No more than 8 colours will be selected for entire project and no more than 3 colours will be selected in each area.
- .2 Selection of colours will be from manufacturers full range of colours.
- .3 Where specific products are available in restricted range of colours, selection based on limited range.
- .4 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats, if requested by DCC Representative.
- .5 For deep and ultra deep colours; 4 coats required.

2.4 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from DCC Representative for tinting of painting materials.

- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity. Strain as necessary.

2.5 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

Gloss @ 60 degrees	Sheen @ 85 degrees	
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

- .2 Gloss level ratings of painted surfaces as indicated.

2.6 INTERIOR PAINTING SYSTEMS

- .1 Structural Steel and Metal Fabrications: exposed columns, beams, joists and miscellaneous metal.
 - .1 RIN 5.1B-W.B. Light Industrial Coating G5 finish.
 - .1 Primer: MPI#107
 - .2 Topcoats: MPI #153
 - .2 INT .1B-W.B. Light Industrial Coating G5 finish.
 - .1 Primer: MPI#107
 - .2 Topcoats: MPI #153
- .2 Galvanized Metal: High contact/high traffic areas (doors, frames, railings and handrails, bollards, etc.).

- .1 RIN 5.3J - High Performance Architectural Latex G5 finish.
 - .1 Primer: MPI#134
 - .2 Topcoats: MPI #141
- .2 INT 5.3M - High Performance Architectural Latex G5 finish.
 - .1 Primer: MPI#134
 - .2 Topcoats: MPI #141
- .3 Dressed Lumber: doors, door and window frames, casings, mouldings, etc.:
 - .1 INT 6.3A - High Performance architectural Latex, G5 finish.
 - .1 Primer: MPI#39
 - .2 Topcoats: MPI #141
 - .2 INT 6.3EE - Polyurethane Varnish over (WB Stain), G4 finish.
 - .1 Semi-Transparent Stain: MPI#186
 - .1 Provide stain tinting and shading as required for adjacent exposed door faces so they appear similar such that they are not noticeably dissimilar in color, grain, figure, and or natural character markings.
 - .2 Polyurethane Varnish: MPI #57
- .4 Wood Paneling IT/ Electrical Rooms:
 - .1 INT 6.4PP - Fire Retardant, Pigmented. W.B. G5 finish. coating (ULC rated). MPI #64
- .5 Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock" type material, etc.
 - .1 RIN 9.2B - High Performance Architectural Latex, G4 (Walls) and G3 (Ceilings) finish
 - .1 Primer: MPI#50 or #137
 - .2 Topcoats: MPI #139 or #140 pending gloss level.
 - .2 INT 9.2B - High Performance Architectural Latex, G4 (Walls) and G3 (Ceilings) finish
 - .1 Primer: MPI#50
 - .2 Topcoats: MPI #139 or #140 pending gloss level.

2.7 SOURCE QUALITY CONTROL

- .1 Perform following tests on each batch of consolidated post-consumer material before surface coating is reformulated

and canned. Testing by laboratory or facility which has been accredited by Standards Council of Canada.

- .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
- .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
- .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

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 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable to be painted in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.
- .2 Interior repainting work: inspected by MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor to notify Paint Inspection Agency minimum of one week prior to commencement of work and

provide copy of project repainting specification and Finish Schedule.

- .3 Interior surfaces requiring repainting: inspected by both painting contractor and Paint Inspection Agency who will notify DCC Representative in writing of defects or problems, prior to commencing repainting work, or after surface preparation if unseen substrate damage is discovered.
- .4 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .5 Maximum moisture content as follows:
 - .1 Stucco, plaster and gypsum board: 12 %.
 - .2 Concrete: 12 %.
 - .3 Clay and Concrete Block/Brick: 12 %.
 - .4 Hard Wood: 15 %.
 - .5 Soft Wood: 17%.

3.4 PREPARATION

- .1 Protection (not applicable to new painting work):
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by DCC Representative.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
 - .4 Protect passing pedestrians, building occupants and general public in and about the building.
- .2 Surface Preparation (not applicable to new painting work):
 - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
 - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

- .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of DCC Representative.
- .3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
 - .2 Wash surfaces with a biodegradable detergent and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly.
 - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
 - .6 Use trigger operated spray nozzles for water hoses.
 - .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pre-treatment as soon as possible after cleaning and before deterioration occurs.
- .5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
- .6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .7 Carried out during shop priming: clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted

by blowing with clean dry compressed air, vacuum cleaning and brushing with clean brushes.

- .8 Touch up of shop primers with primer as specified.
- .9 Do not apply paint until prepared surfaces have been accepted by DCC Representative.

3.5 EXISTING CONDITIONS

- .1 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test" and report findings to DCC Representative. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .2 Maximum moisture content as follows:
 - .1 Stucco: 12 %.
 - .2 Concrete: 12 %.
 - .3 Clay and Concrete Block/Brick: 12 %.
 - .4 Hard Wood: 15 %.
 - .5 Soft Wood: 17% .

3.6 APPLICATION

- .1 Method of application to be as approved by DCC Representative. Apply paint by air sprayer, brush, roller or airless sprayer to provide smooth even finish coat as recommended by manufacturer. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Paint entire wall ceiling surfaces to nearest wall, ceiling, or floor intersections.
- .3 Brush and Roller Application:
 - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .4 Spray application:

- .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
- .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
- .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
- .4 Brush out immediately all runs and sags.
- .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
- .5 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .6 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .7 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .8 Sand and dust between coats to remove visible defects.
- .9 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .10 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .11 Finish closets and alcoves as specified for adjoining rooms.
- .12 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .13 Wood, drywall, plaster, stucco, concrete, concrete masonry units and brick; if sprayed, must be back rolled.

3.7 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.

- .2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Do not paint over nameplates.
- .5 Keep sprinkler heads free of paint.
- .6 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .7 Paint fire protection piping red.
- .8 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .9 Paint natural gas piping yellow.
- .10 Paint both sides and edges of backboards 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.
- .11 Do not paint interior transformers and substation equipment.

3.8 SITE TOLERANCES

- .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
- .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.9 FIELD QUALITY CONTROL

- .1 Interior painting and decorating work to be inspected by a MPI Accredited Paint Inspection Agency (inspector) acceptable to specifying authority and local Painting Contractor's Association. Painting contractor will notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.
- .2 Interior surfaces requiring painting to be inspected by Paint Inspection Agency who will notify DCC Representative

and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.

- .3 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer will provide as part of this work, certification of 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 DCC Representative.
- .4 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .5 Field inspection of painting operations to be carried out by independent inspection firm as designated by DCC Representative.
- .6 Advise DCC Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .7 Cooperate with inspection firm and provide access to areas of work.
- .8 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by DCC Representative.

3.10 CLEANING

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

3.11 RESTORATION

- .1 Clean and re-install hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashing's on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of DCC Representative. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by DCC Representative.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 08 11 00 - Metal Doors and Frames.

1.2 REFERENCE STANDARDS

- .1 Aluminum Association (AA)
 - .1 AA DAF 45-03(R2009), Designation System for Aluminum Finishes.
- .2 ASTM International
 - .1 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A653/A653M-13, Standard Specification for Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
 - .3 ASTM B32-08, Standard Specification for Solder Metal.
 - .4 ASTM B456-11e1, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 31-GP-107Ma-90, Non-Inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
 - .2 CGSB 41-GP-6M-1983, Sheets, Thermosetting Polyester Plastics, Glass Fibre Reinforced.
- .4 CSA Group
 - .1 CSA W47.2-11, Certification of Companies for Fusion Welding of Aluminum.
 - .2 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
 - .3 CSA W59.2 M1991(R2013), Welded Aluminum Construction.
- .5 Canadian Sheet Steel Building Institute (CSSBI)
 - .1 CSSBI SSF 6-2012, Sheet Steel Facts #6, Metallic Coated Sheet Steel for Structural Building Products.
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).
- .7 Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - current edition.

.1 MPI #76, Quick Dry Alkyd Metal Primer.

.2 MPI #96, Quick Dry Enamel Gloss.

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 signage and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit catalogue sheets Full size templates.

.2 Indicate materials, thicknesses, sizes, finishes, colours, construction details, removable and interchangeable components, mounting methods, schedule of signs.

.3 Submit drawn-to-scale details for individually fabricated or incised lettering indicating word and letter spacing.

.4 Samples:

.1 Submit representative sample of each type sign, sign image and mounting method including, but not limited to: graphics, cast letters, sign box installation method, channel letters, and wall plates fixed mounting installation method.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

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 off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Acrylic sheet: polymethylmethacrylate (PMMA) cast sheet suitable for intended use in sign fabrication, colours as selected by DCC Representative from manufacturers full range.
- .2 Engraving sheet: lamicoid 3.2 mm thick plastic sheet, colour as selected by DCC Representative from manufacturers full range core to be contrasting in black or white.
- .3 Self-stick foam tape: 2.4mm thick, 352.4 kg/m³ density polyurethane open-cell foam tape for sign purposes, with synthetic self-stick adhesive on both sides.
 - .1 Width: to suit sign sizes.
- .4 Adhesives, paints, sealants and solvents for acrylic sheet: type recommended by sheet manufacturer for applicable condition.

2.2 SIGN GRAPHICS

- .1 Engraving: apply sign images using pantograph mechanical engraving machine to obtain incised letters to match DCC Representative's sample.

2.3 ROOM IDENTIFICATION

- .1 Provide wall plate/room identification plates for each room in contract.
 - .1 Where multiple access points are provided to each room provide duplicate plate.
- .2 Interchangeable mounting:
 - .1 Supply wall plates with approved type, semi-concealed, retaining holders that permit quick but vandal-resistant interchange of sign face.
 - .2 Exposed fasteners not permitted.
 - .3 Exposed portions to match sign face.

- .3 Fabricate wall plates for room identification of engraving sheet.
 - .1 Size: 75 x 200mm
- .4 Engrave 9.5 mm high, single or double line numerals incised to expose contrasting coloured core.
- .5 Room identification schedule to be provided by DCC Representative.

2.4 DOOR NUMBER PLATES

- .1 Provide door number plates for each door in contract.
- .2 Fabricate number plates for doors of engraving sheet.
 - .1 Size: 40 x 100mm
- .3 Engrave 9.5 mm high, single line numerals incised to expose contrasting coloured core.
 - .1 Maximum five alpha-numeric characters per plate
- .4 Room number and identification schedule to be provided by DCC Representative.

2.5 PICTOGRAPHIC IDENTIFICATION

- .1 Provide door mounted pictographic identification plates for each room in contract as follows:
 - .1 Restrooms:
 - .1 Female: Female representative figure c/w accessible wheelchair symbol, white with black background. Barrier free compliant with raised braille lettering.
 - .2 Male: Male representative figure c/w accessible wheelchair symbol, white with black background. Barrier free compliant with raised braille lettering.
 - .3 225mm high x 150mm wide.
 - .2 Mechanical Room: Gear graphic symbol white with black background.
 - .1 100mm high x 100mm wide.
 - .3 Electrical Room: Lightning Bolt graphic symbol white with black background.
 - .1 100mm high x 100mm wide.
 - .4 Janitor Closet: Broom and Bucket graphic symbol white with black background.
 - .1 100mm high x 100mm wide.

- .5 Where multiple access points are provided to each room provide duplicate plate.
- .2 Confirm required pictographic room identification with DCC Representative prior to fabrication and installation.

2.6 FABRICATION

- .1 Fabricate signs in accordance with details, specifications and shop drawings.
- .2 Build units square, true, accurate to size, free from visual or performance defects.
- .3 Fit and securely join sections to obtain tight, closed joints.
- .4 Allow for thermal movement without distortion of components.
- .5 Exposed inconspicuous fasteners of same finish and colour as base material where approved by DCC Representative.
- .6 Polish exposed edges of plastic to smooth, slightly convex profile.

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 signage installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Manufacturer's Instructions: compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.
- .2 Erect and secure signs plumb and level at elevations as directed by DCC Representative.

- .3 Comply with sign manufacturer's installation instructions and approved shop drawings.
- .4 Mechanical attachment:
 - .1 To concrete or solid masonry: use lag screws and expansion bolts or screws and fibre plugs, as appropriate for stresses involved.
 - .2 To hollow masonry: use toggle bolts or equivalent.
 - .3 To steel: use bolts with nut and lock washers, self-tapping screws.
 - .4 To wood: use screws.
 - .5 Secure into framing members behind stud walls or above ceilings.
 - .6 Mechanical fasteners on exterior: non-staining, non-ferrous type.
 - .7 Fabricate special fasteners as required for installation conditions.
 - .8 Mechanical fasteners and methods of attachment subject to DCC Representatives approval.
 - .1 Obtain DCC Representative's approval before fixing to structural steel.
- .5 Adhesive attachment:
 - .1 Use self-stick adhesive foam tape to manufacturer's instructions to fix sign and prevent "rocking".
 - .2 Keep tape maximum 1.6 mm from edges.

3.3 **CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave signs clean.
 - .2 Remove debris from interior of sign boxes.
 - .3 Touch up damaged finishes.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 09 30 13 - Ceramic Tiling.
- .2 Section 10 28 00 - Toilet and Bath Accessories.
- .3 Section 22 42 01 - Plumbing Specialties and Accessories.
- .4 Section 22 42 03 - Commercial Washroom Fixtures.
- .5 Section 22 42 16 - Commercial Lavatories and Sinks.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A480/A480M -14a, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting, Sheet, and Strip.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-71.20-M88, Adhesive, Contact, Brushable.
- .3 CSA Group
 - .1 CSA B651-18, Accessible Design for the Built Environment.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (SDS).

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 plastic toilet compartments 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 Ontario, Canada.
 - .2 Indicate barrier-free compliant options in compliance with CSA-B651-18, where applicable.
- .4 Indicate fabrication details, plans, elevations, hardware,

and installation details.

.5 Samples:

- .1 Submit duplicate 300 x 300 mm samples of panel showing finish on both sides, two finished edges and core construction.
- .2 Submit duplicate representative samples of each hardware item, including brackets, fastenings and trim.

1.4 QUALITY ASSURANCE

.1 Manufacturer's Field Services:

- .1 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.

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, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse by manufacturer and return of padding, pallets, packaging materials as specified in 01 74 19- Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Stiles, Panels, Doors and Screens:
 - .1 All surfaces shall be water resistant solid plastic (HDPE) uniform colour throughout
 - .1 Fire resistance rating: NFPA Class B

- .1 Flame Spread Index: 26 - 75
 - .2 Smoke Developed Index: 0 - 450
 - .2 19mm minimum finished thickness.
 - .3 Colour and pattern to be approved by DCC Representative from manufacture's full range.
- .2 Hardware:
 - .1 All hardware to be 18-8, type-304 stainless steel with satin finish.
 - .2 All hardware shall be concealed inside compartments with the exception of out-swinging doors.
 - .3 Tamper resistant fasteners to be used throughout installation.
 - .4 Hardware of chrome-plated "Zamac" is unacceptable.
- .3 Latch:
 - .1 Sliding door latch to be from 18-8, type-304 stainless steel with satin finish.
 - .2 Sliding door latch shall require less than 22N (5lbs) force to operate.
 - .3 Twisting latch operation will not be acceptable.
 - .4 Attach latch to door with tamper resistant fasteners.
 - .5 Latch shall allow door to be lifted over 1.6mm (16-gauge) keeper for emergency access.
 - .6 To comply with CSA-B651-18 and DND C-98-007-000/AF-Z01.
- .4 Hinges:
 - .1 Hinges to be from 18-8, type-304 stainless steel with satin finish.
 - .2 Cam shall be adjustable in field to permit door to be fully closed or partially open when compartment is unoccupied.
 - .3 Hinges shall be attached to door and stile by theft-resistant, one-way stainless steel machine screws into factory-installed metal inserts. Fasteners secured directly into the core are not acceptable.
- .5 Coat Hook:
 - .1 Coat hook to be
 - .2 Provide one coat hook per stall door.
 - .3 Mount coat hook on rear of door. Ensure hook does not project more than 30mm from face of door.

.6 Door Pulls:

- .1 "D" type pulls from 18-8, type-304 stainless steel with satin finish.
 - .1 140mm centre to centre minimum.
 - .2 To comply with CSA-B651-18 and DND C-98-007-000/AF-Z01.

.7 Mounting Brackets:

- .1 Mounting brackets to be from 18-8, type-304 stainless steel with satin finish.
- .2 Mounted to inside of compartment.

.8 Headrails:

- .1 Overhead braced, 32 x 44mm x 1.5mm thick extruded aluminum anodized satin finish with anti-grip profile.

.9 Levelling/Floor Anchor Device:

- .1 12 gauge 13x 25mm steel channel welded to 10x25mm zinc chromate plated steel bar.

.10 Stile Shoe:

- .1 102mm high, 18-8, type 304, 22 gauge stainless steel with satin finish. Top shall have 90° return to partition stile. Fasten by clip to stiles starting at wall line.

.11 Attachments and Fasteners:

- .1 Stainless steel tamper proof type screws and bolts.

2.2 FABRICATION

- .1 Doors, panels and screens: 25 mm thick, solid plastic 1397 mm high and to sizes indicated. Edge finish fine radius edges.
- .2 Pilasters: 25 mm thick, constructed same as door, 2083 mm high and to sizes indicated.
- .3 Finish edges:
 - .1 Fine radiused edges.

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 plastic toilet compartments installation in accordance with manufacturer's written

instructions.

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Ensure supplementary anchorage, if required, is in place.
- .2 Do work in accordance with CSA B651 -18.

3.3 ERECTION

- .1 Partition erection:
 - .1 Install partitions secure, plumb and square.
 - .2 Leave 12 mm space between wall and panel or end pilaster.
 - .3 Anchor mounting brackets to masonry or concrete surfaces using screws and shields: to hollow walls using bolts and toggle type anchors, to steel supports with bolts in threaded holes.
 - .4 Attach panel and pilaster to brackets with through type sleeve bolt and nut.
 - .5 Provide for adjustment of floor variations with screw jack through steel saddles made integral with pilaster. Conceal floor fixings with stainless steel shoes.
 - .6 Provide templates for locating threaded studs through finished ceilings.
 - .7 Equip each door with hinges, latch set, and each stall with coat hook mounted on door, mounting heights as indicated. Install door bumper full open mounted, type wall door.
 - .8 Equip out swinging doors with door pulls on outside and inside of door in accordance with CSA B651-18.
 - .9 Install hardware grab bars.
- .2 Floor supported and overhead braced partition erection:
 - .1 Attach pilasters to floor with pilaster supports and level, plumb, and tighten installation with levelling device.
 - .2 Secure pilaster shoes in position.
 - .3 Secure headrail to pilaster face with not less than

two fasteners per face.

- .4 Set tops of doors parallel with overhead brace when doors are in closed position.
- .3 Floor supported partition erection:
 - .1 Secure pilasters to floor with pilaster supports anchored with minimum 50 mm penetration in structural floor.
 - .2 Level, plumb and tighten installation with levelling device.
 - .3 Secure pilaster shoes in position.
 - .4 Set tops of doors level with tops of pilasters when doors are in closed position.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling, reuse 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 RELATED REQUIREMENTS**

- .1 Section 10 21 13.19 - Plastic Toilet Compartments.
- .2 Section 22 42 01 - Plumbing Specialties and Accessories.
- .3 Section 22 42 03 - Commercial Washroom Fixtures.
- .4 Section 22 42 16 - Commercial Lavatories and Sinks.

1.2 REFERENCE STANDARDS

- .1 ASTM International (ASTM)
 - .1 ASTM A167-99(2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM B456-03, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - .3 ASTM A653/A653M-09, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 ASTM A924/A924M-09, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.81-M90, Air Drying and Baking Alkyd Primer for Vehicles and Equipment.
 - .2 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
 - .3 CGSB 31-GP-107MA-90, Non-inhibited Phosphoric Acid Base Metal Conditioner and Rust Remover.
- .3 CSA Group (CSA)
 - .1 CAN/CSA-B651-04, Accessible Design for the Built Environment.
 - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

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 data sheets 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 Ontario, Canada.
 - .2 Indicate size and description of components, base material, surface finish inside and out, hardware and locks, attachment devices, description of rough-in-frame, building-in details of anchors for grab bars.
 - .3 Provide solid wood blocking for all accessories and grab bars.
- .4 Samples:
 - .1 Submit 1 sample for review of all toilet and bath accessories.
 - .2 Samples will be returned for inclusion into work.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Tools:
 - .1 Provide special tools required for assembly, disassembly or removal for toilet and bath accessories in accordance with requirements specified in Section 01 78 00 - Closeout Submittals.
 - .2 Deliver special tools to DCC Representative.

1.6 QUALITY ASSURANCE

- .1 Source Requirements: Provide products specified in this section from a single manufacturer and product line to the greatest extent.
- .2 Mock-ups: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - .1 Install mock-up of washroom accessories as designated by DCC Representative.
 - .1 Coordinate mock-up with work of Section 10 21 13.19 - Plastic Toilet Compartments and Section 09 30 13 - Ceramic Tiling.

- .2 Do not proceed with remaining work until installation and workmanship are approved by DCC Representative.
- .3 Rebuild mock-up area as required to produce acceptable work.
- .4 Once accepted mock-up may remain as part of finished work.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials, off ground, in dry location and indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect toilet and bathroom accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Sheet steel: to ASTM A653/A653M with ZF001 designation zinc coating.
- .2 Stainless steel sheet metal: to ASTM A167, Type 305 with brushed
- .3 Stainless steel tubing: Type 305 1.2 mm wall thickness.
- .4 Fasteners: concealed screws and bolts hot dip galvanized, exposed fasteners to match face of unit. Expansion shields to be fibre, lead or rubber as recommended by accessory manufacturer for component and its intended use.

2.2 COMPONENTS

- .1 All finishes satin brushed stainless steel where available.
- .2 Toilet tissue dispenser: Supplied by facilities. Installed by Contractor.
- .3 Combination Paper Towel Dispenser and Waste Receptacle: Supplied by facilities. Installed by Contractor.

- .4 Soap dispenser: Supplied by facilities. Installed by Contractor.
- .5 Femine napkin/tampon dispenser: Surface mounted, satin-finished stainless-steel unit, minimum capacity of 20 napkins and 30 tampons, free operation, key locked, continuous hinged front panel.
- .6 Feminine napkin disposal bin: Supplied by facilities. Installed by Contractor.
- .7 Grab bars: 38 dia. x 1.6mm wall tubing of stainless steel, 76 mm diameter wall flanges, concealed screw attachment, flanges welded to tubular bar, provided with steel back plates and all accessories. Knurl bar at area of hand grips. Grab bar material and anchorage to withstand downward pull of 2.2 kN.
- .8 Hook: stainless steel with 30-50 mm projection, installed on the interior of all toilet partitions.
- .9 Mirror: wall mounted unit, fixed framed mirror 6 mm, stainless steel frame.
- .10 Shelf surface mounted, 125 deep, 405 wide, stainless steel.

2.3 FABRICATION

- .1 Weld and grind joints of fabricated components 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 without scratches or dents.
- .5 Back paint components where contact is made with building finishes to prevent electrolysis.
- .6 Hot dip galvanize concealed ferrous metal anchors and fastening devices to CAN/CSA-G164.
- .7 Shop assemble components and package complete with anchors and fittings.
- .8 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.
- .9 Provide steel anchor plates and components for installation on studding and building framing.

2.4 FINISHES

- .1 Stainless steel; brushed type 304.

Part 3 Execution**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrates and surfaces to receive toilet and bathroom accessories previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to toilet and bathroom accessories installation.
- .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from DCC Representative.

3.2 INSTALLATION

- .1 Install and secure accessories rigidly in place as follows:
 - .1 Stud walls: install solid wood blocking behind drywall finishes. Provide plate with threaded studs or plugs.
 - .2 Hollow masonry units, existing plaster or drywall: use toggle bolts drilled into cell or wall cavity.
 - .3 Solid masonry, marble, stone or concrete: use bolt with lead expansion sleeve set into drilled hole.
 - .4 Toilet compartments: use male to female through bolts.
- .2 Install grab bars on built-in anchors provided by bar manufacturer.
- .3 Use tamper proof screws/bolts for fasteners.
- .4 Fill units with necessary supplies shortly before final acceptance of building.

3.3 ADJUSTING

- .1 Adjust toilet and bathroom accessories components and systems for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and reuse 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 toilet and bathroom accessories installation.

3.6 SCHEDULE

- .1 Locate accessories as follows. Exact locations determined by DCC Representative.
- .2 Toilet tissue dispenser: one in each toilet compartment mounting height 600mm.
- .3 Combination towel dispenser/waste receptacles:
 - .1 One in each washroom area.
 - .2 Maximum height of dispenser and operable parts from floor 1200 mm.
- .4 Soap dispenser: one at each wash basin and kitchen sinks.
- .5 Feminine napkin disposal bin: one in each female toilet compartment.
- .6 Hand dryer: one in each washroom area . Maximum height of dispenser and operable part from floor 1200 mm.
- .7 Grab bar: two in each handicapped toilet compartment. Height of grab bar from floor 750 mm. Side grab bar: maximum distance from rear wall 300 mm, minimum distance passed front edge of toilet 450 mm.
- .8 Shelf:
 - .1 One in each toilet compartment, mounting height from floor 1100mm max.

.2 One in each wash basin area.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 06 08 99 - Rough Carpentry for Minor Works.

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-44.40-01, Steel Clothing Locker.
- .2 CSA International
 - .1 CAN/CSA-B651-12, Accessible Design for the Built Environment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00-Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets for metal lockers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings: type and class of locker, thicknesses of metal, fabricating and assembly methods, assembled banks of lockers, tops, rods, hooks, shelves bases, trim, numbering, filler panels, end/back panels, doors handles locking method, ventilation method, finishes.
- .4 Samples:
 - .1 Submit duplicate 50 x 50 mm samples of colour and finish on actual base metal.
 - .2 Colour: as approved by DCC Representative from manufactures standard range.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .1 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, indoors and off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metal lockers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of padding, packaging materials, pallets, crates, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Lockers: to CAN/CGSB-44.40-01,
 - .1 Pilot Locker Room (Rm 2056B):
 - .1 High-Security storage locker, steel welded construction. Intended to provide secure storage solution for vital equipment, gear, and supplies.
 - .2 Type 1-Single full-height locker Class 2 - A bank of two or more lockers.
 - .3 Individual Locker Size: 610 mm wide x 560 mm deep x 1830 mm high.
 - .4 Construction:
 - .1 All component welded together.
 - .2 Locker bodies, 16 gauge steel
 - .3 Locker Back, 18 gauge steel
 - .4 Doors: 14 gauge steel c/w full height welded stiffener and continuous piano hinges. Provide ventilation slots top and bottom.
 - .1 Provide rubber door silencers for all doors.
 - .5 Door Handles: Handle integrated with three-point high security turn latching with heavy-duty 10mm diameter lock rods.
 - .6 Locking system: steel hasp system for padlocks. Nickel-plated.

- .7 Interior: two single back hooks, one coat road, one upper shelf welded, one adjustable shelf.
- .8 Top: sloped, 20 gauge. Colour to match locker units.
- .5 Filler strips for recessed units' width as required. Colour to match locker units.
- .6 Base: 100mm high. Colour to match locker units.
- .7 Quantities and configurations as indicated.
- .8 Colour selected from manufactures full range by DCC Representative. Colour may be different in each area.
- .2 Cell Phone Lockers:
 - .1 Corridor 2000:
 - .1 Provide high-security cell phone and storage locker compartments.
 - .2 Total storage capacity of two hundred (200) individual lockers to store cell phones, wallets and keys.
 - .1 Provide 10% of storage lockers sized to accommodate tablets and laptops.
 - .2 Tablet storage from same manufacturer and product line as cell phone storage.
 - .3 Construction:
 - .1 Material: steel construction.
 - .2 Finish powder coated. Colour from manufactures full range, as selected by DCC Representative.
 - .3 Provide floor mounted banks of lockers, 4 units wide x 6 units tall minimum.
 - .4 Phone storage compartment minimum interior dimensions: 173mm wide x 173mm high x 225mm deep.
 - .1 Tablet storage minimum interior dimensions: 141mm wide x 292mm high x 254mm deep.
 - .5 Each bank of units to be accessible via a master keyed front access panel.
 - .1 Access panel to be mounted on continuous piano hinge.
 - .6 Locks:
 - .1 All units key locked.

- .1 Master keyed to allow access to all compartments.
 - .1 Provide total of four (4) master keys for entire installation.
 - .2 Turn over all master keys to DCC Representative for distribution.
- .2 Individual compartment locks complete with key retention when open.
 - .1 Provide two (2) individual keys per compartment lock.
 - .2 Keys to identify corresponding locker number on them.

2.2 ACCESSORIES

- .1 Number Plates: Provide each locker with a polished aluminum number plate riveted to door face with black numerals 13mm high.
 - .1 Numbers will be sequential read from left to right in each area.
 - .2 Numbers do not repeat and are sequential for entire project scope for each locker type.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates and surfaces to receive metal lockers previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to metal locker installation.
- .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from DCC Representative.

3.2 INSTALLATION

- .1 Assemble and install lockers in accordance with manufacturer's written instructions.
- .2 Securely fasten lockers to grounds and nailing strips.
- .3 Install wall trim around recessed locker banks.
- .4 Install filler panels (false fronts) where indicated and where obstructions occur.
- .5 Install finished end, back panels to exposed ends backs of locker banks.
- .6 Install locker numbers.

3.3 ADJUSTING

- .1 Adjust metal lockers for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling and reuse 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 metal locker installation.

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 23 05 00 - Common Work Results for HVAC.
- .2 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature and datasheet and include product characteristics, performance criteria, physical size, finish and limitations including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
 - .4 Equipment connections and capacities.
 - .2 Submit two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 70 12 - Health and Safety Requirements
- .3 Quality control submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Rating certificates: provide catalogued or published ratings obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards.
 - .2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
 - .3 Manufacturer's Field Reports: submit manufacturer's written reports within 5 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.
- .4 Closeout Submittals:

- .1 Provide operation and maintenance data for Commercial Laundry Equipment systems for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Pre-Installation Meetings: convene pre-installation meeting one week prior to beginning on-site installation, with DCC Representative in accordance with Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM) to verify project requirements.
- .2 Manufacturer Qualifications: Equipment shall be manufactured in a facility which is registered with ISO 9001 quality system.
- .3 Installer Qualifications: Factory trained and approved for installation of equipment specified.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse, recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

1.6 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:
 - .1 Filters
 - .2 Bearings and seals.
- .3 Provide list of addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.7 WARRANTY

- .1 Provide manufacturer's standard two year parts and labor warranty.

Part 2 Products**2.1 MANUFACTURERS**

- .1 All equipment and accessories furnished under this section to be by single manufacture from same product line and series.

2.2 COMMERCIAL WASHING MACHINE

- .1 Form Factor: Front Load, Non-Coin Operated, Pedestal Mounted. Front service accessibility.
- .2 Cabinet: heavy galvanized steel with porcelain finish.
 - .1 Finish and colour selected from manufactures full range by DCC Representative.
 - .2 Adjustable leveling legs.
- .3 Controls: digital display with pre-set and customizable programs for common washing applications as well as set-up and diagnostics.
- .4 Door: Viewing glass front, 135 degree opening c/w heavy duty die-cast hinges.
- .5 Drum Capacity: 88 liters (3.1ft³)
- .6 Modified Energy Factor (MEF):2.2
- .7 Water Factor: 4 maximum.
- .8 Water supply pressure supply: 1-8 bar (20-100 psi).
- .9 Motor: Variable Speed, Reversible, thermoprotected, high-efficiency with controlled induction.
 - .1 Size: .07 kW (.09HP)
- .10 Electrical Requirements:
 - .1 Voltage/Hz: 120V/60Hz
 - .2 Amperage: 15 amp.
- .11 Inlet and drain hoses:
 - .1 Provided by manufacture.
 - .2 Inlet (DHW, DCW) hose length: 1220mm minimum.
 - .3 Drain hose: 1800mm minimum.

2.3 COMMERCIAL DRYER

- .1 Form Factor: Front Load, Non-Coin Operated, Pedestal Mounted. Front service accessibility.
- .2 Cabinet: heavy galvanized steel with porcelain finish.

- .1 Finish and colour selected from manufactures full range by DCC Representative.
- .2 Adjustable leveling legs.
- .3 Controls: digital display with pre-set and customizable programs for common drying applications as well as set-up and diagnostics.
- .4 Door: Viewing glass front, reversible c/w heavy duty die-cast hinges.
- .5 Drum Capacity: 190 liters (6.7ft³)
- .6 Electric Heating Element: 5,600 watts.
- .7 Motor: Single Phase, thermoprotected, auto reset.
 - .1 Size: .25 kW (1/3HP)
- .8 Electrical Requirements:
 - .1 Voltage/Hz: 240V/60Hz
 - .2 Amperage: 30 amp.
- .9 Exhaust Outlet: 100mm diameter.

2.4 ACCESSORIES

- .1 Provide factory manufactured accessory pedestal units for each washing machine and dryer supplied and installed under this contract.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Do not begin installation until rough-in provisions have been properly prepared.
- .2 Prepare surfaces using the methods recommended by the manufacturer in printed installation instructions for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.

3.4 FIELD QUALITY CONTROL**.1 Manufacturer's Field Services:**

- .1** 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 PROTECTION

- .1** Protect installed products until completion of project.
- .2** Touch-up, repair or replace damaged products before Substantial Completion.

3.6 CLEANING

- .1** Clean in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General**1.1 REFERENCE STANDARDS**

- .1 ASTM International
 - .1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A167-99 (2009), Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .3 ASTM A500/A500M-10a, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - .4 CSA standards CSA Z-91, CSA Z-259.1 and CSA Z-271.
- .2 ANSI
 - .1 ANSI/ASSP Z359 Fall Protection and Arrest Standards Package
- .3 CSA International
 - .1 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
 - .3 CSA W55.3-08, Certification of Companies for Resistance Welding of Steel and Aluminum.
- .4 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #101, Primer, Epoxy, Anti-Corrosive, for Metal.
- .5 The Society for Protective Coatings (SSPC)
 - .1 SP -2-04, Hand-Tool Cleaning.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with contract requirement submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for roof anchors and safety restraints and include product characteristics,

performance criteria, physical size, finish, and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.1 Indicate component profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

.2 Indicate welded connections using standard welding symbols include net weld lengths.

.2 Submit design data and calculations.

1.3 QUALITY ASSURANCE

.1 Design systems and components and complete installation under direct supervision of Professional Structural Engineer experienced in design of this Work and licensed in the Province of Ontario

.2 All equipment called for under this section shall be supplied by a single source. The Fall Protection System supplier shall assume the responsibility for proper and complete installation.

.3 Certifications:

.1 Welder's qualification: welder's certification to CSA W55.3

.1 Employ qualified and licensed welders possessing certificates for each procedure to be performed.

.2 Each welder to possess identification symbol issued by authority having jurisdiction.

.2 Welding company certification: certified for fusion welding of steel structures to CSA W47.1

1.4 DELIVERY, STORAGE, AND HANDLING

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

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled 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 roof anchors and safety restraints from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Personal Restraint Assembly: Posts, steel rope loops, and attachments to resist lateral forces of 3 kN at any point and in all directions, without damage or permanent set.
- .2 Examine framing and substrate and verify conditions comply with structural requirements for proper system performance.

2.2 MATERIALS

- .1 Steel Sections and Plates: CSA G40.20M/G40.21.
- .2 Steel Tubing: ASTM A500/A500M, Grade B.
- .3 Steel Rings: forged steel, ring thickness determined by imposed loads.
- .4 Steel Cable (between post travel restraints): minimum 9 mm diameter, spiral wound multi-strand stainless steel aircraft cable.
- .5 Bolts, Nuts, and Washers for Stainless Steel: stainless steel, matte finish.
- .6 Gaskets Under Anchors: neoprene pads, compatible with roof membrane, cut to size.
- .7 Welding Materials: CSA W47.1 for materials being welded.
- .8 Shop Primer: MPI #101, 2 coats.
- .9 System Components: to ANSI/ASSP Z359

2.3 FABRICATION

- .1 Fit and shop assemble items in largest practical sections, for delivery to site.
- .2 Fabricate items with joints tightly fitted and secured.
- .3 Continuously seal joined members by intermittent welds and plastic filler.
- .4 Grind exposed joints flush and smooth with adjacent finish surface.

- .1 Make exposed joints butt tight, flush, and hairline.
- .2 Ease exposed edges to small uniform radius.
- .5 Exposed Mechanical Fastenings: screws or bolts; consistent with design of component.
- .6 Furnish and install components required for anchorage of fabrications.
- .7 Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FABRICATION TOLERANCES

- .1 Squareness: 3 mm maximum difference in diagonal measurements.
- .2 Maximum Deviation from Plane: 1.5 mm from 1 m.

2.5 FINISHES

- .1 Prepare uncoated steel (restraint post) surfaces: SSPC-SP 2, no more than 4 hours before applying epoxy primer.
- .2 Concealed steel anchors, clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- .3 Do not prime surfaces in direct contact with concrete or where field welding is required.
- .4 Concealed Structural Components and Anchors: galvanize after fabrication to ASTM A123/A123M to minimum 600 g/sq m galvanized coating.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roof anchors and safety restraint installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

- .2 Verify dimensions, tolerances, and method of attachment with other work.

3.2 PREPARATION

- .1 Supply and install steel items required to be attached to steel framing as clean uncoated metal, with setting templates to appropriate sections.

3.3 ERECTION TOLERANCES

- .1 Maximum Variation from Plumb Level: 3 mm.

3.4 INSTALLATION

- .1 Install items plumb and level, accurately fitted, free from distortion or defects.
- .2 Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- .3 Field weld components as indicated on shop drawings.
- .4 Obtain approval from DCC Representative prior to site cutting or making adjustments not scheduled.
- .5 After erection, apply primer in accordance with MPI Painting Manual to welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.
- .6 Thread aircraft cable through eye-lets at top of post, to linear roof coverage of post restraints; pressure crimp cable ends.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with contract requirement.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance as per contract requirement.

3.6 PROTECTION

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

END OF SECTION

Part 1 General**1.1 RELATED REQUIREMENTS**

- .1 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM D1784-20, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

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 printed product literature and data sheets for roller shades and black out blinds and include product characteristics, performance criteria, physical size, profiles, finishes and material descriptions.
- .3 Shop Drawings:
 - .1 Indicate on drawings dimensions in relation to window jambs, operator details, head and sill anchorage details, operational clearances, hardware and accessories details.
 - .2 Maintenance Data: Instructions and precautions for cleaning shade cloth material, operating hardware and controls.
- .4 Samples:
 - .1 Fabric: Submit 2 samples, minimum 203 x 279 mm (8 x 11 inches), representing actual products specified for shade and blind materials.
 - .2 Submit one representative working sample of each type roller shade and blind.
 - .3 Submit duplicate samples of manufacturer's standard colours for selection by DCC Representative.
 - .4 After approval samples will be returned for incorporation into Work.

1.4 QUALITY ASSURANCE

- .1 Source Requirements: Provide products specified in this section from a single manufacturer.
- .2 Mock-ups: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - .1 Install mock-up of solar shade and blind in window sill as designated by DCC Representative.
 - .2 Do not proceed with remaining work until workmanship, color, and sheen are approved by DCC Representative.
 - .3 Rebuild mock-up area as required to produce acceptable work.
 - .4 Once accepted mock-up may remain as part of finished work.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors, in dry location, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect solar shades and blinds from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse by manufacturer packaging materials.

1.6 PROJECT CONDITIONS AND COORDINATION

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- .2 Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
 - .1 Building shall be enclosed; windows, frames and sills shall be installed and glazed.

- .2 Wet work shall be complete and dry; including but not limited to concrete, masonry, plaster, stucco, terrazzo, sheet rock, spackling, and taping (including sanding).
- .3 Ceilings, window pockets, electrical and mechanical work above window treatments shall be complete.

1.7 WARRANTY

- .1 Manufacturer's Warranty: Provide manufacturer's standard limited warranty against manufacturing defects in materials and workmanship.
 - .1 Shade: 10 years after completion of installation.
 - .2 Fabric: For intended use - interior for 10 years, exterior for 5 years from date of shipment.

Part 2 Products

2.1 DESIGN CRITERIA

- .1 Design roller shade and blinds to following requirements:
 - .1 Allow wear susceptible parts to be replaceable by either user or manufacturer.
 - .2 Guarantee of at least five-years of available replacement parts following discontinue of products manufacture.
 - .3 Include instructions for replacing or repairing worn parts, including inventory numbers for parts and procedures for ordering replacement parts.
 - .4 Permit effective disassembly of components in for recycling of materials.
 - .5 Include stamps on major plastic components indicating composition code to facilitate recycling efforts.

2.2 MATERIALS AND FABRICATION

- .1 Manual Roller Shade Systems:
 - .1 Custom fabricated to size, color and material as indicated and required to provide light and privacy control.
 - .2 System shall be a smooth operating chain and sprocket roller shade system sunscreen or opaque roll, or double type contained in a factory assembled shade cassette unit.
 - .3 Configuration: Individual shades.
 - .4 Roll Type:

- .1 Regular Single Roll: all windows excluding Change rooms and rooms requiring dual band shade system.
- .5 Manual chain drive for each roll.
 - .1 Equip with manual chain drive height adjustment and lock.
- .6 Clutch: Operate bi-directionally using an endless control loop. Sized to provide force to resist weight of shade and maintain shade position.
- .7 Control Loop: Control shall be on right side as facing the shade unless indicated otherwise.
- .8 Mounting: Brackets are configured to be ceiling mounted.
- .9 Tube: Extruded aluminum sized per system selected for application.
- .10 Fabric Attachment: The fabric shall be heat-welded to a soft vinyl interconnect and press-fit into a keyway, allowing for simple field adjustability, or change of shade band materials.
- .11 Hem Bar: The aluminum bar is inserted into the hem pocket and the fabric heat-welded at the top and sides of the bar to provide a refined unobtrusive appearance.
- .12 Battens: Where required to maintain shade fabric flatness battens shall be placed at manufacturer's option.
 - .1 Batten Placement: Align battens to horizontal window frame mullions or related architectural elements. All shades in a single elevation or room shall have battens if one or more require a batten.
- .13 Valance: Extruded aluminum, clear satin finish, end caps to match front fascia finish.
- .14 Light Gap: All Cassette sunshade units must maintain equivalent and symmetrical light gaps on both sides. Gap width to be 19mm (3/4 inch).
- .15 Solar shade fabric:
 - .1 Fabric made from composition of PVC coated fibreglass yarns.
 - .1 Composition: 37% fiberglass, 63% vinyl on fiberglass.
 - .2 Colour and pattern to be selected by DCC Representative from manufacturers' standard range.
 - .1 Charcoal gray tones
 - .3 Fabric weight: 403 g/m² (11.8 oz/yd²)

- .4 Fabric Thickness 0.43mm (.017")
- .5 Average Openness: $\pm 5\%$
- .6 UV Blockage: 95%

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates and surfaces intended to receive roller shades and blinds previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's instructions prior to shade and blinds installation.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from DCC Representative.

3.2 INSTALLATION

- .1 Install roller shades and blinds at exterior windows on all elevations and floors at windows.
- .2 Include centre brackets where necessary to prevent deflection of headrail.
- .3 Adjust to provide for operation without binding.
- .4 Use non-corrosive metal fasteners for installation, concealed in final assembly.

3.3 ADJUSTING

- .1 Adjust roller shades and blinds components for correct function and operation in accordance with manufacturer's written instructions.
- .2 Lubricate moving parts to operate smoothly and fit accurately.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse, 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 roller shade installation.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

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 inclusion in O&M manual.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, 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 inclusion in O&M manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, DCC Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.

- .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
- .4 Operation instruction for systems and component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93- Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted unless directed by DCC Representative.
 - .2 Make changes as required and re-submit as directed by DCC 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 DCC Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

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

1.4 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 and in accordance with Section 01 78 00- Closeout Submittals.
- .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 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 materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of padding, packaging materials, crates, pallets, as specified in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 As per NFPA requirements.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 99 - Painting for Minor Works.
- .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 DCC Representative 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, troubleshooting 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 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.

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 REFERENCE STANDARDS

- .1 National Fire Prevention Association (NFPA)
 - .1 NFPA 13-2019, Standard for the Installation of Sprinkler Systems.
 - .2 NFPA 25-2023, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
 - .3 FMD 4003 2020 - Fire Protection and Life Safety Engineering Design.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN4 S543-M984, Standard for Internal Lug Quick Connect Couplings for Fire Hose.

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, 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 Ontario of Canada.
 - .2 Indicate:
 - .1 Materials.
 - .2 Finishes.
 - .3 Method of anchorage
 - .4 Number of anchors.
 - .5 Supports.
 - .6 Reinforcement.
 - .7 Assembly details.
 - .8 Accessories.
- .4 Samples:
 - .1 Submit samples of following:
 - .1 Each type of sprinkler head.
 - .2 Signs.

- .5 Test reports:
 - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .7 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
- .8 Field Quality Control Submittals:
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 00- Closeout Submittals in accordance with ANSI/NFPA 20.
- .2 Manufacturer's catalogue Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Sprinkler heads.
 - .3 Pipe hangers and supports.
 - .4 Mechanical couplings.
- .3 Drawings:
 - .1 Sprinkler heads and piping system layout.
 - .1 Prepare 760mm by 1050mm detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
 - .2 Show data essential for proper installation of each system.
 - .3 Show details, plan view, elevations, and sections of systems supply and piping.
 - .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.
 - .2 Electrical wiring diagrams.
- .4 Design Data:
 - .1 Calculations of sprinkler system design.

- .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
- .5 Field Test Reports:
 - .1 Preliminary tests on piping system.
- .6 Records:
 - .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
 - .2 Submit 760mm by 1050mm drawings on reproducible Mylar film with title block similar to full size contract drawings.
- .7 Operation and Maintenance Manuals:
 - .1 Provide detailed hydraulic calculations including summary sheet, and Contractors Material and Test Certificate for underground aboveground piping and other documentation for incorporation into manual in accordance with NFPA 13.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in wet sprinkler systems with documented experience.
- .2 Supply grooved joint couplings, fittings, valves, grooving tools and specialties from a single manufacturer. Use date stamped castings for coupling housings, fittings, valve bodies, for quality assurance and traceability.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 00- Closeout Submittals.
 - .2 Provide spare sprinklers and tools in accordance with NFPA 13.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance 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 Storage and Protection:
 - .1 Store materials in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse and return of padding, packaging materials, crates, pallets, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over design area pipe schedules for light hazard occupancy.
- .2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.
- .4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers.
- .5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .6 Design systems for earthquake protection for buildings in seismic zones applicable to building.
- .7 Location of Sprinkler Heads:
 - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13 for light hazard occupancy.
 - .2 Uniformly space sprinklers on branch.
- .8 Water Distribution:
 - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
 - .2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density.
- .9 Density of Application of Water:

- .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.
- .2 Application to horizontal surfaces below sprinklers shall be as per NFPA 13
- .10 Sprinkler Discharge Area:
 - .1 Area: hydraulically most remote
- .11 Friction Losses:
 - .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.
- .12 Water Supply:
 - .1 Hydrant flow test to be conducted by contractor.
 - .2 Base hydraulic calculations on static pressure from hydrant flow test.

2.2 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop; field welding will be permitted.
- .3 Conceal piping in areas with suspended ceiling.

2.3 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA 13.
 - .2 Copper tube: to NFPA 13.
- .2 Fittings and joints to NFPA 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.
 - .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
 - .2 Copper tube: screwed, soldered, brazed, grooved.
 - .3 Provide , threaded, fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded.
 - .4 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.

- .5 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32mm and larger.
- .6 Fittings: ULC approved for use in wet pipe sprinkler systems.
- .7 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
- .8 Side outlet tees using rubber gasketed fittings are not permitted.
- .9 Sprinkler pipe and fittings: metal.
- .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Gate valves: open by counterclockwise rotation.
 - .3 Provide wall indicator OS & Y rising stem valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.
 - .4 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 10cm and larger.
 - .5 Provide gate valve in piping protecting elevator hoistways, machine rooms, machinery spaces.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services in accordance with NFPA.

2.4 SPRINKLER HEADS

- .1 General: to NFPA 13 and ULC listed for fire services.
- .2 Sprinkler Head Type:
 - .1 Type A: upright bronze.
 - .2 Type C: pendant chrome glass bulb type.
- .3 Provide nominal 1.2cm orifice sprinkler heads.
 - .1 Release element of each head to be of intermediate temperature rating or higher as suitable for specific application.
 - .2 Provide polished chromium-plated pendent chromium-plated finish on copper alloy ceiling plates, stainless steel ceiling plates sprinklers below suspended ceilings.
 - .3 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.
 - .4 Deflector: not more than 75mm below suspended ceilings.

- .5 Ceiling plates: not more than 25mm deep.
- .6 Ceiling cups: not permitted.

2.5 PRESSURE GAUGES

- .1 ULC listed and to Section 23 05 19.01- Thermometers and Pressure Gauges - Piping Systems.
- .2 Maximum limit of not less than twice normal working pressure at point where installed.

2.6 PIPE SLEEVES

- .1 Provide pipe sleeves where piping passes through floors, walls, roofs.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of roofs floors, walls, .
- .4 Provide 2.5cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
 - .1 Firmly pack space with mineral wool insulation.
 - .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass, provide mechanically adjustable segmented elastomeric seal.
 - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material.
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide hot-dip galvanized steel, ductile-iron, cast-iron sleeves.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
- .6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide 0.61mm thick galvanized steel sheet.

2.7 ESCUTCHEON PLATES

- .1 Provide one piece type metal plates for piping passing through ceilings floors, walls, in exposed spaces.
- .2 Provide polished stainless steel plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

2.8 INSPECTOR'S TEST CONNECTION

- .1 Locate inspector's test connection at hydraulically most remote part of each system, provide test connections approximately 3m above floor for each sprinkler system or portion of each sprinkler system equipped with alarm device.
- .2 Provide test connection piping to location where discharge will be readily visible and where water may be discharged without property damage.
- .3 Provide discharge orifice of same size as corresponding sprinkler orifice.

2.9 SIGNS

- .1 Attach properly lettered Bilingual and approved metal signs to each valve and alarm device to NFPA 13.
- .2 Permanently fix hydraulic design data nameplates to riser of each system.

2.10 SPARE PARTS CABINET

- .1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

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, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

3.3 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.

- .4 Inspect piping before placing into position.

3.4 ELECTRICAL CONNECTIONS

- .1 Provide electrical work associated with this section under Section 26 05 00- Common Work Results for Electrical.
- .2 Provide control and fire alarm wiring, including connections to fire alarm systems, in accordance with National Electrical Code.
- .3 Provide wiring in rigid metal conduit or intermediate metal conduit.

3.5 DISINFECTION

- .1 Disinfect new piping and existing piping.
- .2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.
- .3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.
- .4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.6 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

- .1 Notify Contracting Officer in writing at least 15 days prior to connection date.
- .2 Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure.
- .3 Bolt sleeves around main piping.
- .4 Bolt valve to branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service.
- .5 Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labour as required.

3.7 FIELD PAINTING

- .1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.

- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
- .4 Immediately after cleaning, provide metal surfaces with 1coat of pretreatment primer applied to minimum dry film thickness of 0.3ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0ml.
- .5 Shield sprinkler heads with protective covering while painting is in progress.
- .6 Upon completion of painting, remove protective covering from sprinkler heads.
- .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.
- .8 Provide primed surfaces with following:
 - .1 Piping in Finished Areas:
 - .1 Provide primed surfaces with 2coats of paint to match adjacent surfaces.
 - .2 Provide valves and operating accessories with 1coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0mil.
 - .3 Provide piping with self-adhering red plastic bands 50 mm wide red enamel bandsspaced at maximum of 6m intervals throughout piping systems.
 - .2 Piping in Unfinished Areas:
 - .1 Provide primed surfaces with onecoat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0mil in mechanical equipment room, crawl spaces, pipe chases, spaces where walls or ceiling are not painted or not constructed of a prefinished material spaces above suspended ceilings, attic spaces,.
 - .2 Provide piping with self-adhering red plastic bands 50 mm wide red enamel bandsspaced at maximum of 6m intervals.

3.8 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
 - .1 Perform test to determine compliance with specified requirements in presence of DCC Representative.
 - .2 Test, inspect, and approve piping before covering or concealing.
 - .3 Preliminary Tests:

- .1 Hydrostatically test each system at 200psig for a 2hour period with no leakage or reduction in pressure.
- .2 Flush piping with potable water in accordance with NFPA 13.
- .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
- .4 Test alarms and other devices.
- .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections made, submit signed and dated certificate in accordance with NFPA 13.
- .4 Formal Tests and Inspections:
 - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
 - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
 - .3 Repeat required tests as directed.
 - .4 Correct defects and make additional tests until systems comply with contract requirements.
 - .5 Furnish appliances, equipment, instruments, connecting devices, personnel for tests.
 - .6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.
- .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 Site Tests:
 - .1 Field test each fire pump, driver and controllers in accordance with NFPA 20. Testing shall include:
 - .1 Verification of proper installation fine tuning adjustment system initiation.

- .2 Verification of the sequence of alarm systems operations.
- .2 Testing to be witnessed by authority having jurisdiction .
- .3 Develop, with DCC Representative assistance, detailed instructions for O & M of this installation.

3.9 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 reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

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

1.2 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for inclusion in O&M manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, DCC Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.

- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93- Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted unless directed by DCC Representative.
 - .2 Make changes as required and re-submit as directed by DCC 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 DCC Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.

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

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .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 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 materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of crates, padding, packaging materials pallets, as specified in Section 01 74 19 - Waste Management and Disposal.

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 Contracts are acceptable.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 99 - Painting Minor Works.
- .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 DCC Representative 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 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.

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 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-06, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-01, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-01, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 ASTM International Inc.
 - .1 ASTM A307-07b, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM A536-84(2004)e1, Standard Specification for Ductile Iron Castings.
 - .3 ASTM B88M-05, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
 - .1 ANSI/AWWA C111/A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .7 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.
- .8 National Research Council (NRC)
 - .1 National Plumbing Code of Canada 2020 (NPC).
- .9 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 Packaging Waste Management: remove for reuse and return of padding, packaging materials, crates, pallets, as specified in accordance with Section 01 74 19 - Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic in designated containers.
- .3 Handle and dispose of hazardous materials in accordance with , TDGA , Regional and Municipal CEPAre regulations.

Part 2 Products

2.1 PIPING

- .1 Potable domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.
 - .2 Buried or embedded: copper tube, soft annealed, type L: to ASTM B88M, in long lengths and with no buried joints.

- .2 Non-Potable domestic cold systems, within building.
 - .1 Above ground: PVC Schedule 80 pipes are certified to ASTM D1785, NSF 14, and/or CSAB137.0/B137.3; ULC S102.2-M88; NSF-PW; ASTM D1785.

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: ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
- .6 NPS 1 ½ and smaller: cast copper to ANSI/ASME B16.18 wrought copper to ANSI/ASME B16.22; with 301stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380kPa.
- .7 PVC Schedule 80:
 - .1 Schedule 80 socket fittings certified ASTM D2467 and threaded fittings to ASTM D2464.
 - .2 All fittings must be third-party certified to NSF 14.
 - .3 All Schedule 80 fabricated fittings shall be reinforced with fiberglass reinforced plastic (FRP).
 - .4 All PVC fittings shall be molded or fabricated from PVC compound compatible with pipe material.
 - .5 Only Schedule 80 pipe will be threaded and the pressure rating reduced by 50%. Belled end pipe socket dimensions shall conform to ASTM D2672 or F480. All pipe, fittings, and valves shall be compatible with and produced by one manufacture.

2.3 JOINTS

- .1 Rubber gaskets, latex-free 1.6mm thick: to AWWA C111.
- .2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.
- .3 Solder: tin copper alloy 95/5.
- .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.

2.4 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.

2.5 BALL VALVES

- .1 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, chrome plated brass stainless steel ball, PTFE adjustable packing, brass gland and Bunan PTFEseat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01- Valves - Bronze.
- .2 PVC Schedule 80 pipe, fittings, and valves shall be compatible with and produced by one manufacture.

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 local authority having jurisdiction .
- .2 Install pipe work in accordance with Section 23 05 05- Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI 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.

3.3 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves.
- .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 copper to 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 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction approval of DCC Representative.
- .2 Upon completion, provide laboratory test reports on water quality for DCC Representative approval.

3.8 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 Commission water conditioning specified Section 22 31 13- Residential Domestic Water Softeners.
 - .4 Bring HWS storage tank up to design temperature slowly.
 - .5 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
 - .6 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.9 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 oneoutlet 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- General Commissioning (Cx) Requirements: Reports, using report forms as specified in Section 01 91 13- General

Commissioning (Cx) Requirements: Report Forms and Schematics.

- .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

3.10 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including, cleaning and maintenance of specified materials and products with Section 23 05 05- Installation of Pipework.
- .2 Operational requirements in accordance with Section 01 47 19- Sustainable Requirements: Operation, include:
 - .1 Cleaning materials and schedules.
 - .2 Repair and maintenance materials and instructions.

3.11 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and 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 Inc.
 - .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 Canadian Standards Association (CSA International).
 - .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 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2020 (NPC).
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature 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.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of crates packaging materials pallets padding

in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary storm 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: tin-lead, 50:50, type 50A , to ASTM B32.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Above ground sanitary storm 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 05- Installation of Pipework.
- .2 Install in accordance with local authority having jurisdiction National Plumbing Code.

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.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 ASTM International
 - .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 International
 - .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 Efficiency Valuation Organization (EVO)
 - .1 International Performance Measurement and Verification Protocol (IPMVP).
 - .1 IPMVP 2007Version.
- .5 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2020 (NPC).
- .6 Plumbing and Drainage Institute (PDI)
 - .1 PDI-G101-R2010, Testing and Rating Procedure for Grease Interceptors with Appendix of Installation and Maintenance.
 - .2 PDI-WH201-R2010, Water Hammer Arresters 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 plumbing products and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 70 12 - Health and Safety Requirements. Indicate VOC's:
- .3 Shop Drawings:
 - .1 Indicate on drawings to indicate number of anchors, method of anchorage, construction and assembly details dimensions finishes, materials, accessories for following: soap dispensing system.
- .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.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for 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.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location, indoors 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 Type FD: general duty; Refer to schedules.
- .3 Type FFD: combination funnel floor drain; Refer to schedules.

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 square cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: rectangular cast iron body and frame with adjustable secured nickel bronze top and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: nickel bronze square, gasket, vandal-proof screws.
 - .3 Cover for Tile and Linoleum Floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
 - .4 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 Copper construction, piston type: to PDI-WH201.

2.4 TRAP SEAL PRIMERS

- .1 Brass, with integral vacuum breaker, NPS 1/2 solder ends, NPS 1/2 drip line connection.

2.5 STRAINERS

- .1 860kPa, 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 DCC Representative.
 - .2 Inform DCC 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 DCC 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 National Plumbing Code of Canada (NPC) and local authority having jurisdiction.
- .2 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 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 DCC Representative.
- .3 Install soft copper tubing to floor drain.

3.7 STRAINERS

- .1 Install with sufficient room to remove basket for maintenance.

3.8 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13- General Commissioning (Cx) Requirements: General Requirements, 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.

3.9 TESTING AND ADJUSTING

- .1 General:
 - .1 Test and adjust plumbing specialties and accessories in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: General Requirements, 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 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .8 Cleanouts:
 - .1 Verify covers are gas-tight, secure, yet readily removable.
- .9 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrester.
- .10 Strainers:
 - .1 Clean out repeatedly until clear.
 - .2 Verify accessibility of cleanout plug and basket.
 - .3 Verify that cleanout plug does not leak.

3.10 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.

3.11 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 REFERENCE STANDARDS

- .1 CSA Group
 - .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 Green Seal (GS)
 - .1 GS-36-2013, Adhesives for Commercial Use.
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2020(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 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, indoors 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.

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 Water closets:
 - .1 WC-1: Wall mounted, concealed flush valve, back spud ultra-low flush, maximum 4.8 litres/flush.
 - .1 Bowl: vitreous china, syphon jet, elongated rim.
 - .2 Refer to schedule.
 - .2 WC-2: Wall mounted, concealed flush valve, back spud ultra-low flush, maximum 4.8 litres/flush.
 - .1 Bowl: vitreous china, syphon jet, elongated rim.
 - .2 Refer to schedule.
 - .3 Barrier free.
- .8 Water Closet Seats.
 - .1 Seat: white , elongated , open front, moulded solid plastic, less cover, stainless steel check hinges, stainless steel insert post.

.9 Washroom Lavatories:

.1 L-1: counter top:

- .1 Porcelain-on-steel, self-rimming, with front overflow, soap depressions, gasket, swivel clamps, semi-oval or rectangular bowl, supply openings on 200mm centres. Sizes: 475 x 400mm outside, 400 x 250mm nominal inside.

.2 Refer to schedule.

.10 Washroom Lavatory Electronic Trim:

.1 Barrier-free electronic faucet:

- .1 Infra-red motion sensor activated by hand motion in lavatory.
- .2 Sensor: waterproof, incorporated in body of unit, with impact-resistant plastic lens and anti-scratch coating, inside spout, sensitivity adjustable from 100 mm to 450 mm.
- .3 Water conservation: 30 0-60second maximum run time.
- .4 Controls: vandal-proof, interchangeable receptacles for stainless steel sheathed sensor and modular plug-type solenoid connections, 12 VDC double slow-closing commercial solenoids for 860 kPa, 85 degrees C.
- .5 Transformer: 120/12 VDC Class 2, UL and CSA listed, hard wire box type, sized for up to 8solenoids.
- .6 Spout: Chrome plated, with integral flow control aerator rated at 8.35l/minute at 413 kPa maximum.
- .7 Under-counter temperatures mixing controls.

.11 Fixture piping:

.1 Hot and cold water supplies to fixtures:

- .1 Chrome plated flexible supply pipes with handwheel stop, reducers, escutcheon.

.2 Waste:

- .1 Brass P trap with clean out on fixtures not having integral trap.
- .2 Chrome plated in exposed places.

.12 Chair carriers:

- .1 Factory manufactured floor-mounted carrier systems for wall-mounted fixtures.

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 DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to manufacturer's recommendations.
 - .2 Wall-hung fixtures: as indicated.
 - .3 Barrier-free: to most stringent NBC 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 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: 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 and reuse in accordance with Section 01 74 21- Construction/Demolition 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 Canadian Standards Association (CSA International)
 - .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 2020 (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.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of padding, packaging materials, pallets, crates in accordance with Section 01 74 19- Waste Management and Disposal.

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 Stainless steel counter top sinks.
 - .1 SC-1: single compartment, ledge back:
 - .1 Refer to schedule.
- .8 Stainless steel tube
 - .1 SC-2: Single compartment
 - .1 Refer to schedule.
 - .2 SC-3: Double compartment.
 - .1 Refer to schedule.
- .9 Fixture piping:
 - .1 Hot and cold water supplies to each fixture:
 - .1 Chrome plated flexible supply pipes each with handwheel stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with clean out on each fixture not having integral trap.
 - .2 Chrome plated in all exposed places.
- .10 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 reuse and recycling in accordance with Section 01 74 19- Waste Management and Disposal.

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 inclusion in O&M manual.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, 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 inclusion in O&M manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, DCC Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.

- .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
- .4 Operation instruction for systems and component.
- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93- Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to DCC Representative for approval. Submission of individual data will not be accepted unless directed by DCC Representative.
 - .2 Make changes as required and re-submit as directed by DCC 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 DCC Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

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

1.3 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .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 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 materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of padding, packaging materials, crates, pallets, as specified in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

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

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 51 99- Painting Works.
- .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 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 DCC Representative 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 11- 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.

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 Section Includes:

- .1 Use of mechanical systems during construction.

1.2 USE OF SYSTEMS

.1 Use of existing and new permanent ventilating heating systems for supplying temporary ventilation heat is permitted only under 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 2 weeks 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 DCC 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 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B139-04, Installation Code for Oil Burning Equipment.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-11-2008, 2nd Edition, Environmental Standard for Paints and Coatings.
- .4 National Research Council Canada (NRC)
 - .1 National Fire Code of Canada 2020 (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 QUALITY ASSURANCE

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of padding, packaging materials, crates, pallets, 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 Primer: maximum VOC limit 250g/L.
 - .2 Paints: maximum VOC limit 150g/L to Standard GS-11.
- .2 Sealants:
 - .1 Sealants: maximum VOC limit.
- .3 Sealants: maximum VOC limit.
- .4 Adhesives: maximum VOC limit.
- .5 Fire Stopping: in accordance with Section 07 84 00- Fire Stopping.

Part 3 Execution

3.1 APPLICATION

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

3.2 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.3 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and National Fire Code of Canada and CSA B139.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer 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 automatic air vents to in piping systems at high points.
- .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 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 butterfly gate 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 plug cocks ball valves for glycol service.
 - .10 Use chain operators on valves NPS 2 1/2 and larger where installed more than 2400mm above floor in Mechanical Rooms.
- .16 Check Valves:
 - .1 Install silent check valves in vertical pipes with downward flow 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: 6mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: terminate flush with finished surface.
 - .2 Other floors: terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere:
 - .1 Provide space for firestopping.
 - .2 Maintain fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.9 ESCUTCHEONS

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

3.10 PREPARATION FOR FIRE STOPPING

- .1 Install firestopping within annular space between pipes, ducts, insulation and adjacent fire separation in accordance with Section 07 84 00- Fire Stopping.
- .2 Uninsulated unheated pipes not subject to movement: no special preparation.
- .3 Uninsulated heated pipes subject to movement: wrap with non-combustible smooth material to permit pipe movement without damaging fires topping material or installation.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barriers.

3.11 FLUSHING OUT OF PIPING SYSTEMS

- .1 Flush system in accordance with Section 23 08 02- Cleaning and Start-up of Mechanical 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 DCC Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pework: 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 DCC Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. DCC Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by DCC Representative .

3.13 EXISTING SYSTEMS

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

3.14 CLEANING

- .1 Clean in accordance with Section 01 74 00- Cleaning.
 - .1 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 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
 - .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 MSDS - Material Safety Data Sheets in accordance with Section 02 81 01- Hazardous Materials.
- .3 Shop Drawings:
 - .1 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 10valves each size, minimum 1.
 - .2 Discs: one for every 10valves, each size. Minimum 1.
 - .3 Stem packing: one for every 10valves, each size. Minimum 1.
 - .4 Valve handles: 2of each size.
 - .5 Gaskets for flanges: one for every 10flanged 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 for reuse by manufacturer and return of crates, pallets, padding, packaging materials 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: solder ends grooved ends to ANSI/ASME B16.18.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10keys of each size: malleable iron cadmium plated.
- .4 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 6composition 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 no. 6 composition PTFErotating 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.
- .5 Ball Valves:
 - .1 NPS 2 and under:

- .1 Body and cap: cast high tensile bronze to ASTM B62.
- .2 Pressure rating: Class125.
- .3 Connections: screwed ends to ANSI B1.20.1 and with hexagonal shoulders solder ends to ANSI.
- .4 Stem: tamperproof ball drive.
- .5 Stem packing nut: external to body.
- .6 Ball and seat: replaceable stainless steel hard chrome solid ball and Teflon seats.
- .7 Stem seal: TFE with external packing nut.
- .8 Operator: removable lever handle.

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 and reuse 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 B31.1-07, Power Piping.
- .2 ASTM International
 - .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 2020(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 Ontario, 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 DCC Representative 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 manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of padding, packaging materials, crates, pallets, 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 Performance Requirements:
 - .1 Design supports, platforms, catwalks, hangers to withstand seismic events.

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 after manufacture.
 - .2 Use hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are 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: 13 mm FM approved.
 - .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 FM approved.
- .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, FM approved 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 FM approved.
- .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 6mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed FM approved 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 22mm or 28mm rod.
- .6 Pipe attachments: material to MSS SP58:
 - .1 Attachments for steel piping: carbon steel galvanized.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .7 Adjustable clevis: material to MSS SP69 UL listed FM approved, 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: galvanized.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black epoxy coated galvanized, 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: galvanized carbon steel to MSS SP58, type 42, FM approved UL listed.
- .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/m³ 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 2springs 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 SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23- Structural Steel for Buildings. Submit calculations with shop drawings.

2.9 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

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

2.10 HOUSE-KEEPING PADS

- .1 Provide 100 mm high concrete housekeeping pads for base-mounted equipment; size pads 50mm 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 4minimum 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 National Plumbing Code of Canada (NPC) 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 300mm of each elbow.

Maximum Pipe Size : NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.4 m	1.8 m
1-1/2	3.0 m	2.4 m
2	3.0 m	2.4 m
2-1/2	3.7 m	3.0 m
3	3.7 m	3.0 m
3-1/2	3.7 m	3.3 m
4	3.7 m	3.6 m
5	4.3 m	
6	4.3 m	
8	4.3 m	
10	4.9 m	
12	4.9 m	

- .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 reuse and 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 Vibration isolation materials and components, seismic control measures and their installation.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2019, Standard for the Installation of Sprinkler Systems.
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2020 (NBC).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00- Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00- Submittal Procedures.
- .2 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 Ontario, Canada.
 - .2 Provide separate shop drawings for each isolated system complete with performance and product data.
 - .3 Provide detailed drawings of seismic control measures for equipment and piping.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00- Submittal Procedures.

- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
 - .1 DCC Representative will make available 1 copy of systems supplier's installation instructions.
- .3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 70 12 - 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 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse recycling in accordance with Section 01 74 19- Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Colour code springs.

2.3 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, moulded with rod isolation bushing which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .5 Type H4 - stable spring, elastomeric element with precompression washer and nut with deflection indicator.

2.4 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.5 HORIZONTAL THRUST RESTRAINT

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

2.6 SEISMIC CONTROL MEASURES

- .1 General:
 - .1 Seismic control systems to work in every direction.
 - .2 Fasteners and attachment points to resist same maximum load as seismic restraint.
 - .3 Drilled or power driven anchors and fasteners not permitted.
 - .4 No equipment, equipment supports or mounts to fail before failure of structure.
 - .5 Supports of cast iron or threaded pipe not permitted.
 - .6 Seismic control measures not to interfere with integrity of firestopping.
- .2 Static equipment:
 - .1 Anchor equipment to equipment supports. Anchor equipment supports to structure.
 - .2 Suspended equipment:

- .1 Use one or more of following methods depending upon site conditions:
 - .1 Install tight to structure.
 - .2 Cross brace in every direction.
 - .3 Brace back to structure.
 - .4 Cable restraint system.
- .3 Seismic restraints:
 - .1 Cushioning action gentle and steady.
 - .2 Never reach metal-like stiffness.
- .3 Vibration isolated equipment:
 - .1 Seismic control measures not to jeopardize noise and vibration isolation systems. Provide 6 to 9 mm clearance during normal operation of equipment and systems between seismic restraint and equipment.
 - .2 Incorporate seismic restraints into vibration isolation system to resist complete isolator unloading.
 - .3 As indicated.
- .4 Piping systems:
 - .1 Fire protection systems: to NFPA 13.
 - .2 Piping systems: hangers longer than 300 mm; brace at each hanger.
 - .3 Compatible with requirements for anchoring and guiding of piping systems.
- .5 Bracing methods:
 - .1 Approved by DCC Representative.
 - .2 Structural angles or channels.
 - .3 Cable restraint system incorporating grommets, shackles and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
Incorporate neoprene into cable connections to reduce shock loads.

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 Seismic control measures to meet requirements of NBC.
- .2 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .3 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .4 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to NPS4: first 3 points of support. NPS5 to NPS8: first 4 points of support. NPS10 and Over: first 6 points of support.
 - .2 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .5 Where isolation is bolted to floor use vibration isolation rubber washers.
- .6 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Twice during the installation, at 25% and 60% completion stages.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports to DCC Representative within 3 days of manufacturer representative's review.
 - .4 Make adjustments and corrections in accordance with written report.

.2 Inspection and Certification:

- .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93- Testing, Adjusting and Balancing for HVAC.
- .2 Provide DCC Representative with notice 24 hours in advance of commencement of tests.
- .3 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
- .4 Submit complete report of test results including sound curves.

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 Seismic restraint systems for statically supported and vibration isolated equipment and systems; including laboratory fume hoods, BSC's, incinerators, kitchen equipment, electrical light fixtures, transformers, MCC's, UPS, diesel generators, standby power, fire protection, communications,, equipment and systems, both vibration isolated and statically supported.

1.2 REFERENCE STANDARDS

- .1 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 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2020 (NBC).

1.3 DEFINITIONS

- .1 Priority Two (P2) Buildings: buildings in which life safety is of paramount concern. It is not necessary that P2 buildings remain operative during or after earthquake activity.
- .2 SRS: acronym for Seismic Restraint System.

1.4 DESCRIPTION

- .1 SRS fully integrated into, and compatible with:
 - .1 Noise and vibration controls specified elsewhere.
 - .2 Structural, mechanical, electrical design of project.
- .2 Systems, equipment not required to be operational during and after seismic event.
- .3 During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
- .4 Designed by Professional Engineer specializing in design of SRS and registered in Province of ONTARIO

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.
- .2 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .3 Submit design data including:
 - .1 Full details of design criteria.
 - .2 Working drawings (prepared to same standard of quality and size as documents forming these tender documents), materials lists, schematics, full specifications for components of each SRS to be provided.
 - .3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
 - .4 Separate shop drawings for each SRS and devices for each system, equipment.
 - .5 Identification of location of devices.
 - .6 Schedules of types of SRS equipment and devices.
 - .7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
 - .8 Installation procedures and instructions.
 - .9 Design calculations including restraint loads to NBC and Supplement.
 - .10 Detailed work sheets, tables Simplified, Detailed work sheets, tables.
 - .11 Detailed design of SRS including complete working drawings prepared to same standard of quality and size as Contract Documents, materials lists, design calculations, schematics, specifications.
- .4 Submit additional copy of shop drawings and product data to Structural Engineer for review of connection points to building structure.
- .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 DCC Representative will make available 1copy of systems supplier's installation instructions.

- .6 Closeout Submittals:
 - .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 00- Closeout Submittals.

1.6 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 70 12 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00- Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling + reuse in accordance with Section 01 74 19- Waste Management and Disposal.

Part 2 Products

2.1 SRS MANUFACTURER

- .1 SRS from one manufacturer regularly engaged in SRS production.

2.2 GENERAL

- .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to restrain seismic forces in every direction.
- .3 Fasteners and attachment points to resist same load as seismic restraints.
- .4 SRS of Piping systems compatible with:
 - .1 Expansion, anchoring and guiding requirements.
 - .2 Equipment vibration isolation and equipment SRS.
- .5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
- .6 Attachments to RC structure:

- .1 Use high strength mechanical expansion anchors.
- .2 Drilled or power driven anchors not permitted.
- .7 Wet pipe sprinkler systems: refer to Section 21 13 13- Wet Pipe Sprinkler Systems.
- .8 Seismic control measures not to interfere with integrity of firestopping.

2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS

- .1 Floor-mounted equipment, systems:
 - .1 Anchor equipment to equipment supports.
 - .2 Anchor equipment supports to structure.
 - .3 Use size of bolts scheduled in approved shop drawings.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Install tight to structure.
 - .2 Cross-brace in every direction.
 - .3 Brace back to structure.
 - .4 Slack cable restraint system.
 - .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
 - .3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Floor mounted equipment, systems:
 - .1 Use one or combination of following methods:
 - .1 Vibration isolators with built-in snubbers.
 - .2 Vibration isolators and separate snubbers.
 - .3 Built-up snubber system approved by DCC Representative , consisting of structural elements and elastomeric layer.
 - .2 SRS to resist complete isolator unloading.
 - .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
 - .4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.
- .2 Suspended equipment, systems:
 - .1 Use one or combination of following methods:

- .1 Slack cable restraint system.
- .2 Brace back to structure via vibration isolators and snubbers.

2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)

- .1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.
- .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .3 Hanger rods to withstand compressive loading and buckling.

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 Attachment points and fasteners:
 - .1 To withstand same maximum load that seismic restraint is to resist and in every direction.
- .2 Slack Cable Systems (SCS):
 - .1 Connect to suspended equipment so that axial projection of wire passes through center of gravity of equipment.
 - .2 Use appropriate grommets, shackles, other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
 - .3 Piping systems: provide transverse SCS at 10 m spacing maximum, longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.
 - .4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not reverse.
 - .5 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), tie back to structure at maximum of 45 degrees to structure.
 - .6 Adjust restraint cables so that they are not visibly slack but permit vibration isolation system to function normally.

- .7 Tighten cable to reduce slack to 40 mm under thumb pressure. Cable not to support weight during normal operation.
- .3 Install SRS at least 25 mm from equipment, systems, services.
- .4 Miscellaneous equipment not vibration-isolated:
 - .1 Bolt through house-keeping pad to structure.
- .5 Co-ordinate connections with other disciplines.
- .6 Vertical tanks:
 - .1 Anchor through house-keeping pad to structure.
 - .2 Provide steel bands above center of gravity.
- .7 Horizontal tanks:
 - .1 Provide at least two straps with anchor bolts fastened to structure.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Arrange with manufacturer's representative to review work of this Section and submit written reports to verify compliance with Contract Documents.
 - .2 Manufacturer's Field Services: consisting of product use recommendations and periodic site visits to review installation, scheduled as follows:
 - .1 After delivery and storage of Products.
 - .2 After preparatory work is complete but before installation commences.
 - .3 Twice during the installation, at 25% and 60% completion stages.
 - .4 Upon completion of installation.
 - .3 Submit manufacturer's reports to DCC Representative within 3days of manufacturer representative's review.
- .2 Inspection and Certification:
 - .1 SRS: inspected and certified by Seismic Engineer upon completion of installation.
 - .2 Provide written report to DCC Representative with certificate of compliance.
- .3 Commissioning Documentation:
 - .1 Upon completion and acceptance of certification, hand over to DCC Representative complete set of construction documents, revised to show "as-built" conditions.

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 requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.
 - .2 Sustainable requirements for construction and verification.

1.2 REFERENCE STANDARDS

- .1 Canadian Gas Association (CGA)
 - .1 CSA/CGA B149.1-20, 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 13-2019, Standard for the Installation of Sprinkler 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 70 12 - 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 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling + reuse 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 DCC Representative .
 - .3 Do not dispose of unused paint + coating 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, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

- .1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

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

.4 Locations:

- .1 Terminal cabinets, control panels: use size # 5.
- .2 Equipment in Mechanical Rooms: use size # 9.

.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 DCC Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Natural gas: to CSA/CGA B149.1 and authority having jurisdiction.
 - .2 Sprinklers: to NFPA 13.

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 cloth 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 DCC Representative.
 - .2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

- .3 Background colour marking and legends for piping systems:

Contents	Background colour marking	Legend
** Add design temperature		

++ Add design temperature and pressure		
City water	Green	CITY WATER
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Safety valve vent	Yellow	STEAM VENT
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Natural gas	to Codes	
Sprinklers	Red	SPRINKLERS

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.

- .2 Use one nameplate and label for each language both languages.

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 has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC _____ CSA registration plates as required by respective agency.
- .3 Identify systems, equipment to conform to PSPC PMSS.

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 DCC 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 DCC Representative within 90days 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 DCC Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to DCC Representative in writing proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.7 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 DCC Representative for verification of TAB reports.

1.9 START OF TAB

- .1 Notify 7 DCC Representative 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 HVAC systems: plus 5%, minus 5%.
- .2 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 DCC Representative list of instruments used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3months of TAB. Provide certificate of calibration to DCC Representative.

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 DCC Representative , prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 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 6copies of TAB Report to DCC Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.16 VERIFICATION

- .1 Reported results subject to verification by DCC Representative .

- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results as directed by DCC Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of DCC Representative .

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of DCC Representative , replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.18 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by DCC Representative .

1.19 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of SMACNA AABC, NEBB, ASHRAE.
- .2 Do TAB of systems, equipment, components, controls specified Division 23
- .3 Qualifications: personnel performing TAB qualified to standards of AABC and NEBB.
- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of AABC and NEBB.
- .5 Measurements: to include as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: to include as appropriate:
 - .1 Inlet and outlet of dampers, filter, coil, 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).

1.20 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.
- .2 Laboratory fume hoods:
 - .1 Standard: Canada Labour Code Treasury Board of Canada Handbook of Occupational Health and safety, 4th editionstate applicable Provincial or other standard.
 - .2 TAB procedures: as described in standard.
- .3 Building pressure conditions:
 - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.

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 Materials and methods for pressure testing ducts over 5m in length, forming part of a supply, return or exhaust ductwork system directly or indirectly connected to air handling equipment.
 - .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .3 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - .1 SMACNA HVAC Air Duct Leakage Test Manual, 1985.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties. Include pressure test information and results as follows:
 - .1 Submit proposed report form and test report format to DCC Representative for approval at least three months before proposed date of first series of tests. Do not start tests until approval received in writing from DCC Representative.
 - .2 Prepare report of results and submit to DCC Representative within 24hours of completion of tests. Include:
 - .1 Schematic of entire system.
 - .2 Schematic of section under test showing test site.
 - .3 Required and achieved static pressures.
 - .4 Orifice differential pressure at test sites.
 - .5 Permissible and actual leakage flow rate (L/s) for test sites.
 - .6 Witnessed certification of results.
 - .3 Include test reports in final TAB report.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with

specified performance characteristics and physical properties.

- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's field reports specified.

1.3 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 70 12 - Health and Safety Requirements.

Part 2 Products

2.1 TEST INSTRUMENTS

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

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 TEST PROCEDURES

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

3.3 SITE TOLERANCES

- .1 System leakage tolerances specified are stated as percentage of total flow rate handled by system. Pro-rate specified system leakage tolerances. Leakage for sections of duct systems: not to exceed total allowable leakage.
- .2 Leakage tests on following systems not to exceed specified leakage rates.
 - .1 Small duct systems up to 250 Pa: leakage 2%.
 - .2 VAV box and duct on downstream side of VAV box: leakage 2%.
 - .3 Large low pressure duct systems up to 500 Pa: leakage 2%.
 - .4 HP duct systems up to 1000 Pa pressure classification, including upstream side of VAV boxes: leakage 1%.
- .3 Evaluation of test results to use surface area of duct and pressure in duct as basic parameters.

3.4 TESTING

- .1 Test ducts before installation of insulation or other forms of concealment.
- .2 Test after seals have cured.
- .3 Test when ambient temperature will not affect effectiveness of seals, and gaskets.
- .4 Flexible connections to VAV boxes.

3.5 FIELD QUALITY CONTROL

- .1 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 Manufacturer's Field Services: 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 3days of review, and submit, immediately, to DCC Representative.
- .5 DCC Representative to witness tests and to verify reported results.
- .6 To be certified by same TAB agency approved by DCC Representative to undertake TAB on this project.

3.6 CLEANING

- .1 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 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 Inc.
 - .1 ASTM B209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
 - .2 ASTM C335-05a¹, 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)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.

- .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
- .7 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 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 successful experience in this size and type of project, member of TIAC qualified to standards.

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 reuse and return by manufacturer of padding pallets crates packaging materials 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 220gm/m²cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C921.
- .2 Lagging adhesive: compatible with insulation.
 - .1 Maximum VOC limit 200 GSES GS-36.
- .3 Aluminum:
 - .1 To ASTM B209 with moisture barrier as scheduled in PART 3 of this section.
 - .2 Thickness: 0.50mm sheet.
 - .3 Finish: Smooth Corrugated.
 - .4 Jacket banding and mechanical seals: 19 mm wide, 0.5 mm thick stainless steel.
 - .1 Stainless steel:
 - .5 Type: 316 304.
 - .6 Thickness: 0.50 0.25mm sheet.
 - .7 Finish: Corrugated Stucco embossed Smooth.
 - .8 Jacket banding and mechanical seals: 19 12mm wide, 0.5 mm thick stainless steel.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
 - .1 Maximum VOC limit 170g/L GSES GS-36.
- .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 220gm/m²cotton, plain weave, untreated 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/m².
- .6 Tape: self-adhesive, aluminum, reinforced, 50mm wide minimum.
- .7 Contact adhesive: quick-setting

- .1 Maximum VOC limit 200g/L GSES GS-36.
- .8 Canvas adhesive: washable.
 - .1 Maximum VOC limit 200g/L GSES GS-36.
- .9 Tie wire: 1.5mm stainless steel.
- .10 Banding: 19mm wide, 0.5mm thick stainless steel.
- .11 Facing: 25mm galvanized steel hexagonal wire mesh stitched on one face of insulation with expanded metal lath on other face.
- .12 Fasteners: 4mm diameter pins with 35mm diameter square 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:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	50
Round cold and dual temperature supply air ducts	C-2	yes	50
Supply, return and exhaust ducts exposed in space being served	none		
Exhaust duct between dampers and louvres	C-1	no	25
Rectangular ducts outside	C-1	special	50
Round ducts outside	C-1	special	50
Acoustically lined ducts	none		

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: conform to following table:

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

3.5 CLEANING

.1 Clean in accordance with Section 01 74 00- Cleaning.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 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 American Society for Testing and Materials 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) Jacketting 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 (MSDS).
- .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 (MSDS) in accordance with Section 01 33 00- Submittal Procedures.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00- Submittal Procedures.
- .4 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 DCC Representative 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 successful experience in this size and type of project, qualified to standards of TIAC.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 70 12 - 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, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.
- .3 Waste Management and Disposal:

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling 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.
- .4 Dispose of unused adhesive material at official hazardous material collections site approved by DCC 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.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code C-2: mineral fibre blanket faced without 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.
- .5 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-S702.
 - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5mm diameter stainless steel.
- .5 Bands: stainless steel, 19mm wide, 0.5mm 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/m².

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: White.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
- .2 ABS Plastic:
 - .1 One-piece moulded type and sheet with pre-formed shapes as required.
 - .2 Colours: White.
 - .3 Minimum service temperatures: -40 degrees C.

- .4 Maximum service temperature: 82 degrees C.
- .5 Moisture vapour transmission: 0.012 perm.
- .6 Thickness: 0.75mm.
- .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.

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, flanges and unions at equipment and primary flow measuring elements.
- .2 Design: to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

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: SS bandsat 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-6.
 - .1 Insulation securements: SS bandsat 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
- .4 TIAC Code: with C-2 vapour retarder jacket.
 - .1 Insulation securements: SS bandsat 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .5 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

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 & over
Hot Water Heating	60 - 94	A-1	25	38	38	38	38

Hot Water Heating	up to 59	A-1	25	25	25	25	38
Glycol Heating	60 - 94	A-1	25	38	38	38	38
Glycol Heating	up to 59	A-1	25	25	25	25	38
Domestic HWS		A-1	25	25	25	38	38
Domestic CWS with vapour retarder		C-2	25	25	25	25	25
Refrigerant hot gas suction liquid	4 - 13	A-6	25	25	25	25	25
Refrigerant suction hot gas liquid	below 4	A-6	25	25	38	38	38
Steam	Up to 175c	A-1	50	65	75	90	90
Cooling coil condensate drain		C-2	25	25	25	25	25

.6 Finishes:

- .1 Exposed indoors: PVC.
- .2 Exposed in mechanical rooms: PVC jacket.
- .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 ABS jacket.
- .6 Finish attachments: SS screws, at 150mm on centre. Seals: wing.
- .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 American Society for Testing and Materials 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 Maximum heating demand.
 - .3 Maximum cooling demand.

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.

1.5 GLYCOL SYSTEMS

- .1 Test to prove concentration will prevent freezing to minus 40degrees C Test inhibitor strength and include in procedural report. Refer to ASTM E202.

1.6 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.

1.7 POTABLE WATER SYSTEMS

- .1 When cleaning is completed and system filled:
 - .1 Verify performance of equipment and systems as specified elsewhere in Division 23.
 - .2 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 recharge air chambers. Repeat for each outlet and flush valve.
 - .3 Confirm water quality consistent with supply standards, verifying that no residuals remain resulting from flushing and/or cleaning.
- .2

1.8 WET AND DRY PIPE SPRINKLER SYSTEM, STANDPIPE AND HOSE SYSTEMS

- .1 Cleaning, testing, start-up, performance verification of equipment, systems, components, and devices is specified elsewhere in Division 23.
- .2 Verification of controls, detection devices, alarm devices is specified Division 26.
- .3 Demonstrate that fire hose will reach to most remote location regardless of partitions, and obstructions.

1.9 SANITARY DRAINAGE SYSTEMS

- .1 Ensure that traps are fully and permanently primed.

- .2 Ensure that fixtures are properly anchored, connected to system.
- .3 Operate flush valves, tank and operate each fixture to verify drainage and no leakage.
- .4 Cleanouts: refer to Section 22 42 00- Plumbing Fixtures.
- .5 Roof drains:
 - .1 Refer to Section 22 42 00- Plumbing Fixtures.
 - .2 Remove caps as required.

1.10 REPORTS

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

1.11 TRAINING

- .1 In accordance with Section 01 91 13- General Commissioning (Cx) Requirements: 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 American Society for Testing and Materials 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 (MSDS).

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 DCC Representative will make available 1copy 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 70 12 - 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 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling and reuse 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 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 82 degrees C minimum maximum design. 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.
 - .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 slowly over a 48 hour period.
 - .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 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.
 - .15 Check operation of drain valves.
 - .16 Adjust valve stem packings as systems settle down.
 - .17 Fully open balancing valves (except those that are factory-set).
 - .18 Check operation of over-temperature protection devices on circulating pumps.
 - .19 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 American Society for Testing and Materials 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 Canadian Standards Association (CSA International)
 - .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.
 - .2 CAN/CSA B149.2-00, Propane Storage and Handling Code.
- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

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 MSDS in accordance with Section 02 81 01- Hazardous Materials. Indicate VOC's for adhesive and solvents during application and curing.
- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .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 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 70 12 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for recycling reuse 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 polystyrene, plastic, corrugated cardboard paper packaging material in appropriate on-site bins for recycling.
 - .4 Separate for reuse, recycling and place in designated containers Metal, Steel and Plastic waste.

- .5 Divert unused metal materials from landfill to metal recycling facility.

Part 2 Products

2.1 MATERIALS

- .1 Materials and products in accordance with Section 01 47 15-Sustainable Requirements: Construction.

2.2 PIPE

- .1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
 - .1 NPS 1/2 to 2, screwed.
 - .2 NPS 2 1/2 and over, plain end.
- .2 Copper tube: to ASTM B837.

2.3 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.

2.4 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.

2.5 VALVES

- .1 Provincial Code approved, lubricated plug type.

2.6 REGULATOR

- .1 ANSI Z21.18/CSA 6.3 Gas Appliance Pressure Regulators.
- .2 National Code approved, lubricated plug type, iron-bodied brass-plug cocks.
- .3 Valve ends shall be flanged. For Valves sizes 50mm or below, threaded ends are allowed.
- .4 Pressure regulator valves shall be provided with overpressure protection device (relief valve) as per CAN/CAS B149.1-20.

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 applicable Provincial/Territorial Codes, 23 05 05- Installation of Pipework, 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 DCC Representative.
- .2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 GAS REGULATOR

- .1 Install as per manufacturer's instructions.
- .2 Install as per CAN/CSA-B149.1 latest Edition.
- .3 Provide with pressure relief valve piped to the exterior as per CAN/CSA-B149.1 latest Edition.

3.5 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 DCC Representative.
- .4 Performance Verification:
 - .1 Refer to Section 23 08 01- Performance Verification of Mechanical Piping Systems.

3.6 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.

3.7 CLEANING

- .1 Cleaning: in accordance with Section CAN/CSA B149.1,
Section 23 08 02- Cleaning and Start-Up of Mechanical
Piping Systems , supplemented as specified.
- .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 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
 - .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 (MSDS).
- .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 2copies of WHMIS MSDS in accordance with Section 01 70 12 - Health and Safety Requirements 01 35 43- Environmental Procedures.
- .3 Shop Drawings:
 - .1 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.

1.4 MAINTENANCE MATERIALS 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 CEPA, CEAA, TDGA, .

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 off ground, in dry location, indoors 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: flanged 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.
 - .2 NPS 2 1/2 and over:
 - .1 rising Mechanical Rooms: stem, split wedge disc, bronze trim, as specified Section 23 05 23.02- Valves - Cast Iron.
 - .2 Elsewhere: Non-rising stem, solid wedge disc, bronze trim, as specified Section 23 05 23.02- Valves - Cast Iron.
- .3 Drain valves: gate, Class 23 05 23.01- Valves - Bronze 125.
- .4 Swing check valves:
 - .1 NPS 2 and under:
 - .1 Class 125, swing, with composition disc, as specified Section 23 05 23.01- Valves - Bronze.
 - .2 NPS 2 1/2 and over:
 - .1 Grooved Flanged ends: as specified Section 23 05 23.02- Valves - Cast Iron.
- .5 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 DCC Representative.
 - .2 Inform DCC 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 DCC 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 ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .3 Install swing check valves in horizontal lines on discharge of pumps and as indicated.
- .4 Install chain operators on valves NPS 2 1/2 and over where installed more than 2400 mm above floor in Mechanical Equipment Rooms Boiler Rooms.
- .5 Install plug cocks for glycol service.

3.5 FLUSHING AND CLEANING

- .1 Flush and clean in presence of DCC Representative
- .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 DCC Representative's approval.

3.6 FILLING OF SYSTEM

- .1 Refill system with clean water adding water treatment as specified and glycol.

3.7 FIELD QUALITY CONTROL

- .1 Testing:
 - .1 Test system in accordance with Section 21 05 01- Common Work Results for Mechanical.
 - .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.
- .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 DCC Representative.

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 reuse 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 ASTM International
 - .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
 - .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.

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.

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 off ground, in dry location, indoors 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 Vertical galvanized steel pressurized diaphragm type expansion tank.
- .2 Capacity: Refer to schedules.
- .3 Diaphragm sealed in EPDM suitable for 115 degrees C operating temperature.
- .4 Working pressure: 520 kPa.
- .5 Air precharged to 84kPa (initial fill pressure of system).
- .6 Base mount for vertical installation.
- .7 Supports: provide supports with hold down bolts and installation templates incorporating seismic restraint systems.
- .8 Renewable diaphragm.

2.2 HYDRONIC SYSTEM FEEDER

- .1 System shall include 64 litre storage/mixing tank with molded-in liquid level gauge, 100mm fill/access opening and cover; pump suction hose with inlet strainer; pressure pump with fuse protection; low fluid level pump cut-out float switch; manual diverter valve for purging air and agitation contents of storage tank; digital pressure switch adjustable from 0 kPa to 310 kPa cut-out pressure, factory cut-out pressure set to 115kPa, digital pressure display, visual alarm on low level, low level alarm comes with remote dry contacts (NO or NC). Unit c/w UL listed and fused power supply adapter with LED power indicator light,

120-240VAC/50-60Hz/1 to 24 VD, supplied loose for field installation.

- .2 Feeder shall be compatible with glycol solutions of up to 50% concentration. Pump shall be capable of running dry without damage. Unit shall be completely assembled.
- .3 Low Level Alarm panel provides selectable Audible Alarm and additional remote monitoring dry contacts (DMF digital pressure switch c/w NO or NC remote monitoring dry contacts).

2.3 AIR SEPARATOR - IN-LINE

- .1 Working pressure: 860kPa
- .2 Size: as indicated on drawings.

2.4 AUTOMATIC AIR VENT

- .1 Standard float vent: brass body and NPS 1/8 connection and rated at 620 kPa working pressure.
- .2 Float: solid material suitable for 115 degrees C working temperature.

2.5 COMBINATION SEPARATORS/STRAINERS

- .1 Steel, tested and stamped in accordance with ASME BPVC, for 860kPa operating pressure, with galvanized steel integral strainer with 5mm perforations, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.6 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

- .1 Adjustable pressure setting: 206kPa relief, 55to 172kPa reducing.
- .2 Low inlet pressure check valve.
- .3 Removable strainer.

2.7 PIPE LINE STRAINER

- .1 NPS 1/2 to 2: bronze body to ASTM B62, screwed connections, Y pattern.
- .2 Blowdown connection: NPS 1.
- .3 Screen: brass stainless steelwith 1.19mm perforations.
- .4 Working pressure: 860kPa.

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 DCC Representative.
 - .2 Inform DCC 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 DCC 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 DCC 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.

3.5 AIR VENTS

- .1 Install at high points of systems.
- .2 Install gate valve on automatic air vent inlet. Run discharge to nearest drain.

3.6 EXPANSION TANKS

- .1 Adjust expansion tank pressure to suit design criteria.

- .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 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 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
 - .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 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.

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 off ground, in dry location, indoors 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 GENERAL

- .1 Approved manufacturers shall adhere to the specifications and drawings. Units shall be completely factory wired, tested and name-plated before shipment. Pump manufacturer shall be ISO-9001 certified.
- .2 All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings. Refer to schedules for unit performance.
- .3 Units shall be specifically designed for chilled water and hot water heating systems as indicated on the drawings. Complete unit shall be ETL- Canada listed.
- .4 Ensure pump operation at specified system fluid temperatures without vapor binding and cavitation, is non-overloading in parallel or individual operation. Pumps shall conform to ANSI/HI 9.6.3.1-2012 standard for Preferred Operating Region (POR).

2.2 WET ROTOR PUMP WITH ELECTRONICALLY COMMUTATED MOTOR (ECM)

- .1 The pumps shall be a wet rotor inline pump, in cast iron or lead-free bronze body construction specifically designed for quiet operation. Suitable standard operations at 230° F and 175 PSIG working pressure. The pump internals shall be capable of being serviced without disturbing piping connections.
- .2 The pump internals shall be capable of being serviced without disturbing piping connections.

- .3 Pump volute shall be of a cast iron design for heating systems or lead-free bronze for domestic water systems. The connection style on the cast iron and bronze pumps shall be flanged.
- .4 Motor shall be a synchronous, permanent-magnet (PM) motor and tested with the pump as one unit. Conventional induction motors will not be acceptable.
- .5 Each motor shall have an Integrated Variable Frequency Drive tested as one unit by the manufacturer.
- .6 Pump shall have MODBUS or BACnet connections built into the VFD as standard options.
- .7 Analog inputs, such as 0-10V and 4-20mA, are standard inputs built into the VFD.
- .8 Pumps shall be UL 778 listed and bear the UL Listed Mark for USA and Canada with on-board thermal overload protection.
- .9 Pumps shall be UL 778 listed and bear the UL Listing Mark for USA and Canada with on-board thermal overload protection.
- .10 Each pump shall be factory performance tested before shipment.

2.3 OPERATING MODES

- .1 Proportional Pressure - The differential pressure will continuously increase or decrease along a linear curve based on the flow demand.
- .2 Constant Pressure - The pump maintains a constant differential pressure set by the user at any flow demand until the maximum speed is reached.
- .3 Constant Speed - The pump maintains a constant speed at any flow rate
- .4 Night Set Back - The pump will recognize a 10°C water temperature reduction and will switch to nighttime operation.
- .5 T-Constant - This control will use a PI algorithm to vary the speed of the pump in order to maintain a constant temperature of the fluid media.
- .6 Delta-T Constant - This control mode will use a PI algorithm to vary the speed of the pump in order to maintain a constant differential temperature between the built-in temperature sensor and external temperature sensor.

- .7 Delta-P-T - This control mode is paired with proportional or constant pressure mode. The nominal differential pressure setpoint will vary according to the fluid temperature.
- .8 Delta-P-Delta-T - This control mode is paired with proportional or constant pressure mode. The nominal differential pressure setpoint will vary according to the differential temperature between the built-in temperature sensor and external temperature sensor as supplied by the pump 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 hydronic pump installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform Consultant DCC 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 DCC 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 All electrical wiring and accessories, including power wiring from motor control centers and/or motor starter or VFD's to driven motor, shall be installed in accordance with the requirements specified by Division 26 and the local electrical authority.
- .3 Pipe drain tapping to floor drain.
- .4 Install volute venting pet cock in accessible location.
- .5 Check rotation prior to start-up.
- .6 Install pressure gauge test cocks.

3.4 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13- General Commissioning (Cx) Requirements: 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- General Commissioning (Cx) Requirements: 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 (Cx) Requirements.
- .3 Where procedures do not exist, discontinue PV, report to DCC 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- General Commissioning (Cx) Requirements 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 (Cx) 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 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 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
 - .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
 - .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 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 2copies of WHMIS MSDS in accordance with Section 01 35 43- Environmental Procedures 01 70 12 - Health and Safety Requirements. Indicate VOC's for adhesive and solvents during application and curing.

- .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .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 refrigerant piping for incorporation into manual.

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 refrigerant piping, fittings and equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of crates, pallets, padding, packaging materials as in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B280, type 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 2070kPa and temperature 121degrees C.
- .2 Brazed:
 - .1 Fittings: wrought copper to ASME B16.22.
 - .2 Joints: silver solder, copper-phosphorous, 95% Cu-5%P or 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 DCC Representative .
 - .2 Inform DCC 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 DCC 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 General:
 - .1 Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified.
 - .2 Small riser: size for 5.1 m³/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 13degrees C for at least 12hours 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 DCC 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 DCC 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 3days of review, and submit, immediately, to DCC 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 reuse + recycling in accordance with Section 01 35 21- LEED Requirements 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
 - .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 Green Seal Environmental Standards (GS)
 - .1 GS-36-11, Standard for Adhesives for Commercial Use.
- .4 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.
- .5 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.
- .6 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
 - .1 SCAQMD Rule 1168-A2005, Adhesives and Sealants Applications.

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 Ontario, 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 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 metal ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse by manufacturer and return of pallets, crates, padding, packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa	SMACNA Seal Class
500	C
250	C
125	C
125	Unsealed

- .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.
- .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 30degrees C to plus 93degrees C.

2.3 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50mm 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: standard radius or short radius with single thickness turning vanes centre line radius: 1.5 times width of duct.
 - .2 Round: smooth radius five piece, centre line radius: 1.5times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400mm: with single double thickness turning vanes.
 - .2 Over 400mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with 45 degrees entry on branch, radius 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: 20degrees maximum included angle.

- .2 Converging: 30degrees maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows.
- .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 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A653/A653M, Z90zinc coating.
- .2 Thickness, fabrication and reinforcement: to SMACNA + ASHRAE.
- .3 Joints: to SMACNA + ASHRAE. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29- Hangers and Supports for HVAC Piping and Equipment.
 - .1 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.
 - .1 Maximum size duct supported by strap hanger: 500.
 - .2 Hanger configuration: to SMACNA + ASHRAE.
 - .3 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE SMACNA following table:

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

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp.
 - .3 For steel beams: manufactured beam clamps:

Part 3 Execution

3.1 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 DCC Representative.
 - .2 Inform DCC 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 DCC Representative .

3.2 GENERAL

- .1 Do work in accordance with SMACNA and ASHRAE.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct.
- .3 Support risers in accordance with SMACNA and 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 ASHRAE + SMACNA + as follows:

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

3.4 SEALING AND TAPING

- .1 Apply sealant in accordance with to manufacturer's recommendations SMACNA.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers 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 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 30m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance 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 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 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 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 air duct accessories from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials crates, pallets, padding, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

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

2.2 FLEXIBLE CONNECTIONS

- .1 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40degrees C to plus 90degrees C, density of 1.3kg/m2.

2.3 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene.
- .4 Hardware:
 - .1 Up to 300 x 300mm: two sash locks complete with safety chain.
 - .2 301 to 450mm: four sash locks complete with safety chain.
 - .3 451 to 1000mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

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

2.5 INSTRUMENT TEST

- .1 1.6mm 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 DCC Representative.
 - .2 Inform DCC 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 DCC 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: 100mm.
 - .3 Minimum distance between metal parts when system in operation: 75mm.
 - .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 DCC Representative .
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning Vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

- .1 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 + 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 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 dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials padding, pallets, crates, in accordance with Section 01 74 19 - Waste Management and Disposal.

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 Double 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 100 mm.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside bronze nylonend 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 100 mm.
- .4 Bearings: self-lubricating nylon.
- .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 DCC Representative .
- .2 Inform DCC 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 DCC 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 DCC Representative .

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 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 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 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 fire and smoke dampers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, packaging materials padding, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type A B C, listed bear label of ULC, meet requirements of authorities having jurisdiction, CFFM provincial fire authority, Fire Commissioner of Canada (FCC). 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: 1-1/2hour 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; curtain 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 3mm 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 of 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.

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- .1 ULC- or cUL-listed and labelled, Class I maximum air leakage.
- .2 Combination fire and smoke dampers to be ULC or UL 555 listed and labelled.
- .3 Factory Installed Momentary Test Switch (MTS)
- .4 With factory furnished actuator, provides fail-safe operation (the damper automatically goes to the desired fail-safe position when fire interrupts power)
- .5 Groove blade ultra low leakage class I combination fire and smoke damper bear the Underwriters Laboratories labels for both Fire Dampers and Smoke Dampers.
- .6 Combined Actuator: Electrical control system actuated from smoke sensor or smoke detection system and from fusible link.

2.3 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 74degrees 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 DCC Representative .
 - .2 Inform DCC 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 DCC 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 Co-ordinate with installer of 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 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 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .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 Installation of Warm Air Heating and Air-Conditioning Systems.
- .3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2005.
- .4 Underwriters' Laboratories (UL)
 - .1 UL 181-2005, Standard for Factory-Made Air Ducts and Air Connectors.
- .5 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S110-2007, Standard Methods of Tests for Air Ducts.

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 flexible ducts and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Indicate:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.
- .3 Test and Evaluation Reports:
 - .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 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 flexible ducts from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials pallets, crates, padding, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 GENERAL

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

2.2 METALLIC - UNINSULATED

- .1 Type 1: spiral wound flexible aluminum, as indicated.
- .2 Performance:
 - .1 Factory tested to 2.5kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

2.3 METALLIC - INSULATED

- .1 Type 2: spiral wound flexible aluminum with factory applied, 37mm thick flexible glass fibre thermal insulation with vapour barrier and vinyl aluminum reinforced mylar/neoprene laminate jacket, as indicated.
- .2 Performance:

- .1 Factory tested to 2.5kPa without leakage.
- .2 Maximum relative pressure drop coefficient: 3.

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 flexible ducts installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 DUCT INSTALLATION

- .1 Install in accordance with: SMACNA CAN/ULC-S110.

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 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 REFERENCE STANDARDS

- .1 ASTM International
 - .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 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 duct liners from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of crates, pallets, packaging materials padding, in accordance with Section 01 74 19 - Waste Management and Disposal.

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 CAN/ULC-S102.
 - .3 Recycled Content: Eco Logo certified with minimum 35 by weight recycled content.
 - .4 Fungi resistance: to ASTM G21 + ASTM C1338.
- .2 Rigid:
 - .1 Use on flat surfaces.
 - .2 25mm thick, to ASTM C1071Type 2, fibrous glass rigid board duct liner.

- .3 Density: 48kg/m³ minimum.
- .4 Thermal resistance to be minimum 1.15 (m².degrees C)/W for 38 mm thickness 0.76 (m². degrees C)/W for 25 mm thickness 1.53 (m².degrees C)/W for 50 mm thickness when tested in accordance with ASTM C177, at 24 degrees C mean temperature.
- .5 Maximum velocity on faced air side: 20.3 m/s.
- .6 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C423.

2.2 ADHESIVE

- .1 Adhesive: to ASTM C916 and NFPA 90A and NFPA 90B.
- .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 2.0mm diameter, length to suit thickness of insulation. Metal retaining clips, 32mm square.

2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50mm 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 DCC Representative .
 - .2 Inform DCC 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 DCC Representative.

3.2 GENERAL

- .1 Do work in accordance with SMACNA HVAC Duct Construction Standard + NAIMA AH116 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 100 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, 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.
- .2 In systems, where air velocities exceeds 20.3m/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 2coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of DCC Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15mm 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 reuse + recycling in 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 210-2007/(ANSI/ASHRAE 51-07), Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .2 International Organization of Standardization (ISO)
 - .1 ISO 3741-2010, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .4 Underwriter's Laboratories (UL)
 - .1 UL 181-2005(R2008), Factory-Made Air Ducts and Air Connectors.

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 terminal units and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test and Evaluation Reports:
 - .1 Test data: to ANSI/AMCA Standard 210.

- .1 Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity.
- .2 Sound power level with minimum inlet pressure of 0.5 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency.
- .3 Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

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 terminal units for incorporation into manual.

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 indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect air terminal units from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of padding, crates, pallets, packaging materials as specified in Waste Reduction Work plan in accordance with Section 01 74 19 - Waste Management and Disposal.

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 certified ADC

(Air Diffusion Council) testing agency signifying adherence to codes and standards.

2.2 MANUFACTURED UNITS

- .1 Terminal units of the same type to be product of one manufacturer.

2.3 ELECTRONIC VARIABLE AIR VOLUME BOXES

- .1 Pressure independent, reset to air flow between zero and maximum air volume.
- .2 At inlet velocity of 10m/s, differential static pressure for unit with attenuator section not to exceed 25Pa.
- .3 Air velocity sensor pitot rack resistance wire as standard to manufacturer.
- .4 Signals between temperature sensing device, velocity controller, velocity sensor and damper actuator digital as indicated. Shielded or twisted wire requirements is not acceptable.
- .5 Electronic thermostat furnished by terminal unit manufacturer and have set points and velocity adjustments located in thermostat. Heating and cooling set point range 13 to 30 degrees C. Set points not overlapping.
- .6 Electronic control package factory calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:
 - .1 Metre taps for balancing with digital DC voltmeter.
 - .2 Adjustable flow settings at thermostat.
- .7 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.
- .8 Terminal unit to be CSA certified.
- .9 Casing: . 25kg density fibrous glass, to 0.7. Mount control components inside protective metal shroud. NFPA 90A + UL 181
- .10 Sizes and capacity: 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 air terminal units installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of DCC Representative .
- .2 Inform DCC 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 DCC Representative .

3.2 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install with at least 1000 mm of flexible inlet ducting and minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate controls, dampers and access panels for easy access.

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 reuse + 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.

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 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, indoors, 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.

- .4 Packaging Waste Management: remove for reuse and return of pallets, packaging materials crates, padding, in accordance with Section 01 74 19 - Waste Management and Disposal.

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 and as specified where set into plaster or gypsum board.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: standard as directed by DCC Representative .

2.3 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

2.4 SUPPLY GRILLES AND REGISTERS

- .1 General: with opposed blade dampers.
- .2 Refer to schedule.

2.5 RETURN AND EXHAUST GRILLES AND REGISTERS

- .1 General: with opposed blade dampers.
- .2 Refer to schedule.

2.6 DIFFUSERS

- .1 General: volume control dampers with flow straightening devices and blank-off quadrants and gaskets.
- .2 Refer to schedule.

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 DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Install with flat head stainless steel 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.

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 Ontario, 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 CEPA, CEAA, TDGA, and applicable Provincial regulations.
- .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 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect chimneys and stacks from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SPECIAL GAS VENT

- .1 Vent shall be factory-built special gas type, double wall, engineered and designed for use on Category I, II, III, and IV appliances, or as specified by the equipment manufacturer.
- .2 Maximum continuous flue gas temperature not to exceed 550°F (288°C) for gas burning appliances. Maximum temperature for appliances approved to vent with Type L-Vent (gas or oil) is 570°F (299°C).

- .3 Vent shall be constructed with an inner conduit constructed of AL29-4C® or 29-4 (S44735) superferritic stainless steel with a minimum thickness of .015" for diameters 3"-8", .020" for diameters 10"-16", .025" for diameters 18"-24", and .035" for 26" and greater.
- .4 Vent shall be listed for an internal static pressure of 15" w.g. and tested to 37" w.g.
- .5 All inner wall conduit components shall be manufactured from AL29-4C® or 29-4 (S44735). The joint closure system shall be an Inner Wall Mechanical Locking Strap design. Joints shall not use screws or fasteners that penetrate the inner conduit.
- .6 Vent shall be constructed with a factory installed gasket used to seal the joint for diameters 4"-16". Use of gasket lube, available from the factory, should be used for maximizing gasket life and ease of installation. For diameters 18"- 32", joints shall be sealed with factory supplied RTV sealant.
- .7 Inner wall joints shall be designed with a male and female overlapping metal-metal connection to maintain condensate on the AL29-4C stainless steel. Proper ¼" per foot pitch must be maintained at all times and condensate should flow back toward the appliance to the required number of drains.
- .8 The outer wall casing shall be constructed of 430 stainless steel that shall not require additional surface preparation, such as painting, in order to withstand the outdoors or high humidity environments.
- .9 Inner conduit and outer wall casing shall be constructed with a one-inch air space between them and in such a fashion that prevents cross-alloy contamination. Optional 1" fiber insulation is available to maintain higher flue temperatures, but does not reduce clearances beyond the standard clearances tested for 1" airspace model CI Plus.
- .10 Tees and elbows shall provide a pressure drop less than 15 feet equivalent horizontal vent.
- .11 Fittings that increase or decrease vent diameter shall be asymmetric in construction with a flat wall that maintains a straight line with adjoining parts in order to facilitate the unobstructed flow of all condensate.
- .12 All parts shall be compatible with other single wall and double wall products of the same manufacturer.
- .13 System is to be sized in accordance with the appliance manufacturer's specifications, NFPA 54-National Fuel Gas Code (ANSI Z223.1), ASHRAE recommendations, and other applicable codes.

2.2 ACCESSORIES

- .1 Cleanouts: bolted, gasketed type, full size of breeching, as indicated.
- .2 Barometric dampers: single or double acting, 70% of full size of breeching area.
- .3 Hangers and supports: in accordance with recommendations SMACNA.
- .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 DCC Representative.
 - .2 Inform DCC 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 DCC 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 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 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code, 2010.
- .2 CSA International
 - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 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 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.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.

- .2 Operation and Maintenance Data: submit operation and maintenance data for heat exchangers for incorporation into manual.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Submit in accordance with Section 01 78 00- Closeout Submittals.

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 off ground, in dry location, indoors 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 GENERAL

- .1 Approved manufacturers shall adhere to the specifications and drawings. Heat exchanger manufacturer shall be ISO-9001 certified.
- .2 Heat exchangers shall meet types, sizes, capacities, and characteristics as noted on the Equipment Schedule or drawings.
- .3 Units shall be specifically designed for chilled or hot water heating, and steam systems as indicated on the drawings. Heat exchangers used for domestic water applications shall have double wall construction.
- .4 Plate and frame heat exchangers shall be AHRI 400 certified.
- .5 Effective surface areas indicated on the schedules must be met. Units not meeting the design requirements, including minimum effective surface area, will not be accepted.

2.2 EQUIPMENT

.1 Plate Heat Exchanger:

- .1 Units shall be of single pass design unless otherwise noted.
- .2 All connections shall be located on the fixed head frame plate, allowing the movable head pressure plate, to slide back. Assembly shall permit plates to be added, removed, or replaced from the plate pack without disturbing the connections or associated piping.
- .3 The unit shall be provided with an aluminum OSHA splash shield.
- .4 The frame plate and pressure plate shall be carbon steel SA 516 grade 70 with sufficient thickness to meet the ASME design pressure. Stiffeners or support brackets are not allowed.
- .5 Carbon steel frame components shall be painted with grey epoxy paint.
- .6 Units with 3-inch or greater connections shall be unlined or alloy lined studed ports to mate with raised face or flat faced ANSI flanges. Rubber liners will not be permitted. Units with smaller than 3-inch connections shall have carbon steel female tapped NPT or male NPT connections
- .7 Units with connections greater than 2-inch require that the thermal plates be supported by the carry bar, top bar. The carry and guide bar plate contact surfaces shall be stainless steel. Units with connections smaller than 2-inch shall allow the plates to be supported by the guide bar, bottom bar. Carry and guide bars are to be steel with a zinc chromate coating.
- .8 Tightening bolts shall be zinc plated carbon steel SA193 B7 with captive working nuts at the pressure plate, and rear head such that the unit can be opened and closed with one wrench from the front of the unit.
- .9 Plates shall use an integral rolled edge hanging system to provide a rigid hanger device between the plate, carry bar and guide bar. Welded hanging brackets or stiffeners are not acceptable.
- .10 The plate pack shall use a positive plate to plate alignment system to ensure proper plate to gasket seals throughout the plate pack. The positive alignment system shall be a gasket lug which fits within a plate recess on the proceeding plate (tongue in groove) to align successive plates, or an extended rolled edge hanger which nests successive plates

through direct contact around the entire plate hanger. Plate designs which only offer alignment through contact with the carry and guide bar are unacceptable.

- .11 Gaskets shall be a one-piece construction with a double gasket barrier at the port region. The area isolated by the double gasket shall be vented to the atmosphere, so that a gasket failure is detected by leakage to the exterior prior to any possible cross contamination. All gaskets except the gasket on the first plate shall be identical.
- .12 Standard units shall be designed to operate under 150 PSIG working pressure on both sides of the heat exchanger.

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 DCC Representative.
 - .2 Inform DCC 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 DCC 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 vacuum breaker, 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 Install pressure gauge on steam inlet.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Perform tests as directed by DCC Representative to ensure heat exchangers are functional.
 - .2 Obtain reports within 3 days of review and submit immediately to DCC Representative.
- .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 testing, construction of field joints and critical periods of installation.
 - .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- General Commissioning (Cx) Requirements: 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 Check supports, seismic restraint systems.
- .7 General: perform performance verification in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
- .8 Timing: only after TAB of hydronic systems have been successfully completed.
- .9 Primary side:
 - .1 Measure flow rate, pressure drop, and water temperature at heater inlet and outlet.
 - .2 Control valve: verify proper operation without binding, slack in components. 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- General Commissioning (Cx) Requirements: 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 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.

3.7 DEMONSTRATION

- .1 Training: provide training in accordance with Section 01 91 13- General Commissioning (Cx) 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 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- .1 Anchor bolts: size anchor bolts to withstand seismic acceleration and velocity forces. Contractor to provide shop drawings stamped by professional engineer licensed in Ontario.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM A48/A48M-03(2012), Standard Specification for Grey Iron Castings.
 - .2 ASTM A123/A123M-2012, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A153/A153M-09, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - .4 ASTM B117-11, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - .5 ASTM C67-12, Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
 - .6 ASTM D520-00(2011), Standard Specification for Zinc Dust Pigment.
- .2 CSA Group
 - .1 CSA B52-05, Mechanical Refrigeration Code.
 - .2 CAN/CSA-Z809-08, Sustainable Forest Management.
- .3 Cooling Technology Institute (CTI)
 - .1 CTI-ATC-105-00, Acceptance Test Code.
 - .2 CTI-STD-201-11, Standard for the Certification of Commercial Water Cooling Tower Thermal Performance.
- .4 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .5 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA MG 1-2011, Motors and Generators.
- .6 Sustainable Forestry Initiative (SFI)
 - .1 SFI-2010-2014Standard.
- .7 Underwriters Laboratories of Canada (ULC)

- .1 CAN/ULC-S102.2-10, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

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 condensers, coolers and cooling towers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2copies of WHMIS MSDS in accordance with Section 01 70 12 - Health and Safety Requirements.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Connections, piping, fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring as assembled and schematically.
 - .3 Dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads.
 - .4 Vibration and seismic control measures.
 - .5 Manufacturers recommended clearances.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .5 Manufacturer's Field Reports:
 - .1 Submit manufacturer's 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 condensers for incorporation into manual.
- .3 Include:
 - .1 Description of equipment giving manufacturers name, type, model year, capacity.
 - .2 Start-up and commissioning procedures.
 - .3 Details of operation, servicing and maintenance.

.4 Recommended spare parts list.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Materials:

.1 Include with data complete list of parts and supplies, with current unit prices, source of supply, recommended spare parts list for 1 year of operation, and list of parts recommended by manufacturer to be replaced on routine basis.

1.6 QUALITY ASSURANCE

.1 Qualifications:

.1 Installer: company or person specializing in condensers installations approved by manufacturer.

.2 Regulatory Requirements: work to be performed in compliance with CEPA, CEAA, applicable Provincial/Territorial regulations TDGA,.

1.7 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, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect condensers and cooling equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 GENERAL

.1 Air cooled condensing unit(s) shall be CSA approved and U.L. listed.

.2 The unit shall meet the performance detailed in the schedule. Construction and ratings shall be in accordance with latest ARI Standard and ANSI/ASHRAE 15.

.3 Provide and install as shown on the plans, factory-assembled air-cooled scroll compressor, R32 condensing

units. Units shall be shipped with a holding charge of dry nitrogen.

2.2 CABINET

- .1 The unit shall be assembled on a rugged steel base. Unit casing and all structural members and rails shall be fabricated of pre-painted steel designed to withstand a 1000-hour ASTM B117 salt spray test.
- .2 The condensing section shall be open on the sides and bottom to allow airflow through the coils. Single circuited units under 20 tons shall be equipped with full-face louvers for added protection and safety.
- .3 On dual circuited units over 20 tons, provide factory installed vandal guards around the compressor section.

2.3 REFRIGERATION

- .1 Compressors shall be heavy duty scroll type, refrigerant gas cooled. Compressors shall be complete with thermal overload protection, low and high pressure control safeties and a liquid line shut off valve.
- .2 On dual circuited units over 20 tons, each compressor shall also include gauge ports, an oil sight glass, crank case heater, anti-slug protection, and a time delay to prevent short cycling and simultaneous starting of compressors following a power failure.
- .3 Provide liquid and suction line service valves.
- .4 Compressors shall be mounted on resilient rubber isolators to decrease noise transmission.
- .5 Provide spring vibration isolators for field installation by others
- .6 Provide hot gas bypass for unit operation to 10% of load on one (both) refrigerant circuits.

2.4 CONDENSER

- .1 Condenser fans shall be direct drive, propeller type designed for low tip speed, vertical air discharge, and include service guards. Fan blades shall be constructed of steel and riveted to a steel center hub. Condenser fan motor shall be direct drive, permanently lubricated motors with inherent thermal overload.
- .2 On dual circuited systems, one condenser fan shall be controlled to maintain positive head pressure and an ambient thermostat shall be supplied to prevent the refrigeration system from operating below 45°F ambient.

- .3 On dual circuited units, factory install a VFD fan speed controller on the last fan of each refrigeration circuit to provide cooling operation down to an ambient temperature of 0° F.

2.5 ELECTRICAL AND CONTROLS

- .1 All wiring shall comply with UL requirements. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring.
- .2 Power and starting components shall include: circuit breaker for each compressor; fusing for the control circuit; compressor starting contactors; unit power terminal block for field connection to a single power supply and control power transformer.
- .3 Provide unit with 24V terminal strip for connection to field installed controls.
- .4 Supply a non-fused disconnect switch with a through-the-door handle.
- .5 Unit SCCR rating to be 10kAIC.
- .6 Supply a factory wired 115 V convenience outlet.

2.6 STARTUP SERVICE AND WARRANTY

- .1 Furnish the services of a factory trained representative to supervise the installation, starting and testing in accordance with the manufacturer's instructions. Upon completion of the installation, the manufacturer shall provide, to the owner, a written report on the start-up of these units.

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 condensers, coolers and cooling tower installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 GENERAL

- .1 Mount on structural supports as indicated and vibration isolators and to manufacturer's recommendations.
- .2 Ensure clearance for servicing and maintenance as recommended by manufacturer.
- .3 Manufacturers field service representative to approve installation, to supervise start up and to instruct operators.

3.3 INSTALLATION

- .1 Install condensing units in accordance with the manufacturer's instructions.
- .2 Co-ordinate with electrical division all field wiring from condensing unit to alarms, sensors, etc. Co-ordinate with 15900 field installed controls for condensing unit.
- .3 All refrigerant piping shall be reviewed by manufacturer before installation.
- .4 Install proper charge of refrigerant and oil.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Test under actual operating conditions in accordance with CTI-ATC-105 to verify specified performance.
- .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.

3.5 ADJUSTING

- .1 Lubricate bearings with oil or grease as recommended by manufacturer.
- .2 Tighten belts to manufacturer's specified tension.

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 Wipe equipment clean, and remove traces of oil, dust, dirt, or
paint spots.
- .3 Maintain system in clean condition until final acceptance.
- .4 Final Cleaning: upon completion remove surplus materials,
rubbish, tools and equipment in accordance with Section
01 74 00- Cleaning.
- .5 Waste Management: separate waste materials for reuse and
recycling in accordance with Section 01 74 19-
Construction/Demolition 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 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.
- .2 Green Seal (GS)
 - .1 GS-11-11, Standard for Paints and Coatings.
- .3 Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .1 MPI #18.
- .4 National Fire Protection Association (NFPA)
 - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)

1.2 DEFINITIONS

- .1 Catalogued or published ratings: ratings obtained from tests carried out by manufacturer or manufacturer's designated independent testing agency which signify adherence to codes and standards in force.

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, insulation, filters, and paints and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:

- .1 Actual cooling and heating fluid entering and leaving conditions for stated air side requirements.

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 air handling equipment for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, in dry location, indoors 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 Field assembled components to form unit supplying air at design conditions as indicated.
- .2 The following manufacturers are approved in principle subject to meeting the specifications. Manufacturers are responsible for all co-ordination issues arising from dimensional variances between plans and site conditions
- .3 Air handling units shall be ETL-Canada safety listed to conform to UL Standard 1995 and CAN/CSA Standard C22.2 No. 236. Air handling unit water heating & cooling coils shall be certified in accordance with the forced circulation air

cooling and air heating coils certification program, which is based on ARI Standard 410.

2.2 CASING

- .1 Fabricate unit with 16 gauge nominal channel posts and panels secured with mechanical fasteners. All panels and access doors shall be sealed with bulb-type gasket.
- .2 Panels and access doors shall be constructed as a 2-inch (50-mm) nominal thick, thermal broke double wall assembly, injected with foam insulation for an R-value of not less than R-13. The outer casing shall be constructed of heavy gauge G60 galvanized steel painted with baked on enamel).
- .3 The inner liner shall be constructed of G90 galvanized steel. Panel deflection shall not exceed L/240 at 125% of design static pressure, minimum +/- 6". Deflection shall be measured at the midpoint of the panel height.
- .4 The casing leakage rate shall not exceed 0.5 cfm per square foot of cabinet area at 6 inches of negative static pressure or 5 inches of positive static pressure.
- .5 Access doors shall be flush mounted to the cabinetry and secured with heavy-duty stainless steel hinges. The door latch handle assembly shall be provided with a full-size grip handle and roller pall for smooth operation. The assembly shall be gasketed and sealed to prevent thermal bridging. All access doors shall open against pressure. (Provide inspection window for each access door).
- .6 Construct drain pans from stainless steel with cross break and pitch to drain connection. Provide drain pans under cooling coil section. Drain connection centerline shall be a minimum of 3'' above the base rail to aid in proper condensate trapping. Drain connections that protrude from the base rail are not acceptable. There must be a full 2'' thickness of insulation under drain pan.
- .7 Provide unit with a factory installed 6 inch high full perimeter channel base rail.
- .8 Floor plate shall be constructed of G90 galvanized steel Aluminum tread plate .125 inch thick, 3.2mm.

2.3 MIXING SECTION & ECONOMIZER SECTION

- .1 Provide mixing box sections with factory mounted low leak airfoil outside and return air dampers of galvanized steel in galvanized frame. Dampers shall be hollow core airfoil blades, fully gasketed. Provide continuous vinyl seals between damper blades. Provide stainless steel end seals along end of dampers. Provide linkage and ABS plastic end caps provided.

- .2 Provide economizer section with factory mounted low leak hollow core airfoil blade outside, and return dampers, and exhaust damper. Dampers shall be constructed of galvanized steel in galvanized frame. Provide fully gasketed outside exhaust, and return dampers. Provide continuous vinyl seals between damper blades. Provide stainless steel end seals along end of dampers. Provide linkage and ABS plastic end caps.
- .3 Damper leakage rate shall be less than two tenths of one percent leakage at 2 inches static pressure differential. Leakage rate shall be tested in accordance with AMCA Standard 500.

2.4 FILTERS

- .1 Provide filter box section with filter guides, hinged and latching access doors on one side, for side loading of filters.
- .2 Filter media shall be UL 900 listed, Class I or Class II.
- .3 Provide extended surface filter box with holding frames suitable for 2" pleated panel prefilter and final filter, media and blank-off sheets, extended surface cartridge media filters with MERV 14 efficiency. Cartridge filter media shall be 12" deep.
- .4 Provide Minihelic filter gauges for each filter bank flush mounted into unit casing with factory mounted probes.

2.5 FANS

- .1 Acceptable return fan assembly shall be a double width, double inlet, class I, belt-drive type housed forward curved fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Copper lubrication lines shall be provided and extend from the bearings and attached with grease fittings to the fan base assembly near access door. If not supplied at the factory, contractor shall mount copper lube lines in the field. Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door.
- .2 Acceptable supply fan assembly shall be a single width, single inlet, class II, direct-drive type plenum fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the manufacturer on all three planes. Provide access to motor and fan assembly through hinged access door.

- .3 Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on 2" deflection spring vibration type isolators inside cabinetry.
- .4 Bearings and Drives
 - .1 Provide bearings with basic load rating computed in accordance with AFBMA - ANSI Standards, L-50 life at 200,000 hours and shall be heavy duty pillow block type, self-aligning, grease-lubricated ball bearings.
 - .2 Provide solid, hot rolled steel, ground and polished shaft, protectively coated with lubricating oil.
- .5 Provide open drip proof premium efficiency motors.
- .6 Inverter duty rated motors shall be supplied with a factory installed shaft grounding kit. The kit shall consist of brushes or conductive rings with micro fibers which divert unwanted shaft currents away from the bearings to the ground.

2.6 COILS

- .1 Provide access to coils from connection side of unit for service and cleaning. Enclose coil headers and return bends fully within unit casing. Fabricate coil connections, vents and drains to extend beyond unit casing including grommets for an airtight unit casing. Coils shall be removable through side panels and/or top panels of unit without removal and disassembly of entire section.
- .2 Provide stainless steel drain pan located underneath and extending downstream of the cooling coil sections.
- .3 Coil performance shall be as per schedule. Coil performance data shall be certified in accordance with ARI Standard 410 where applicable.
- .4 Construction:
 - .1 Tubes: Copper.
 - .2 Fins: Aluminum mechanically bonded to tubes.
 - .3 Headers: Seamless copper with vent and drain connections.
 - .4 Casing: 16 gauge, galvanized steel channels with 16 gauge center and end supports.
- .5 Water cooling and heating coils shall be circuited drainable with a vent connection at the highest point and a drain connection at the lowest point. Coil headers shall be copper with steel male pipe connections.

- .6 Refrigerant cooling coils shall be designed for use with Refrigerant R32. Sweat type copper suction connections shall be located at the bottom of the suction headers for gravity oil drainage. Multiple circuited coils shall be interlaced.

2.7 ACCESS

- .1 Access to all sections shall be through a minimum 18" door. Provide access doors of galvanized steel flush mounted, with gasket, latch and handle assembly.

2.8 UNIT ELECTRICAL

- .1 Unit manufacturer shall provide wiring from each fan motor to an external junction box. All other controls and wiring shall be provided by the BAS and Electrical contractors.
- .2 The air handler(s) shall be ETL and ETL-Canada listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.
- .3 VFDs shall be provided with the unit to be mounted externally by Electrical contractor.

2.9 VIBRATION ISOLATION

- .1 Flexible connections in accordance with Section 23 33 00- Air Duct Accessories.
- .2 Vibration isolators on each fan section in accordance with Section 23 05 48- Vibration and Seismic Controls for HVAC Piping and 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 air handling equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Install unit flat and level on house keeping pad and in accordance with manufacturer's installation literature.
- .2 Provide piping connections to coils such that individual coils can be isolated, drained and removed. Provide valved pressure gauge connections and thermometer wells on the entering and leaving piping.
- .3 Provide valved drain connections with hose end, cap and chain for all coils.
- .4 Pipe all drain pan connections the nearest floor drain with appropriately sized trap.

3.3 FANS

- .1 Provide sheaves and belts required for final air balance.
- .2 Suspension for hung units: install four part hanger type, ceiling flange, top hanger, bottom hanger and vibration isolator with takeup for levelling.
- .3 Install flexible connections at fan inlets and outlets as indicated.
 - .1 Ensure metal bands of connectors are parallel and not touching.
 - .2 Ensure that fan outlet and duct are aligned when fan is running.

3.4 DRIP PAN

- .1 Install deep deal P trap and trap seal primer on drain lines.
 - .1 Depth of water seal to be 1.5 minimum 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 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 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 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 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 finned tube radiation heaters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials padding, pallets, crates, in accordance with Section 01 74 19 - Waste Management and Disposal.

Part 2 Products

2.1 CAPACITY

- .1 As indicated.

2.2 FINNED TUBE RADIATION

- .1 Heating elements: NPS 1 1/4, 3/4, 1 seamless copper tubing, 1.2mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced aluminum fins, 100 x 100mm nominal, 130 fins per metre suitable for sweat fittings.
- .2 Heating elements: NPS 1 1/4 steel tube 3.1mm minimum wall thickness, mechanically expanded into flanged collars of evenly spaced steel fins 100 x 100mm nominal fins, 105 fins per metre.
- .3 Element hangers: ball bearings cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900mm centres maximum.
- .4 Standard enclosures: 2.0 1.2 1.6mm 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 vents. Finish cabinet with factory applied baked primer coat.
- .5 Special enclosures: as indicated.
- .6 Dimensions for enclosures: measure site conditions. Do not scale from drawing.
- .7 Provide for noiseless expansion of components.

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 DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

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 DCC Representative if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow DCC Representatives 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 automatic air vent 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.

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 humidifiers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate project layout, dimensions and extent of humidification system.
- .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.

1.2 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00- Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for humidifiers for incorporation into manual.

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, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.
 - .3 Provide following: one complete set of renewable evaporator media.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 GENERAL

- .1 Humidifier grid shall provide absorption characteristics that preclude water accumulation on any in-duct surfaces within the scheduled downstream distance from the humidifier. The absorption distance shall be at duct temperatures and relative humidity as scheduled. Provide computer verification of the absorption distance certified by the manufacturer.
- .2 Each humidifier shall have a two (2) year from date of startup not to exceed 27 months from date of shipment replacement parts warranty.

2.2 STEAM GENERATING HUMIDIFIERS

- .1 Size all Steam Generating Humidifiers to produce an amount of steam equal to or greater than the actual humidification load and any steam that condenses within distribution piping and steam injection grids.

2.3 HIGH EFFICIENCY CONDENSING HUMIDIFIERS

- .1 Humidifier shall use natural gas or liquid propane to create steam for humidification through the use of a heat exchanger. Unit shall be CSA and CGA approved.
- .2 Tank and primary heat exchanger shall be constructed from 14-gauge 304 stainless steel with water side welded seams for all water-submerged welds.

- .3 Humidifier shall include a 316 stainless steel secondary heat exchanger to pre-heat inlet water and combustion air using exhaust gasses exiting the primary heat exchanger.
- .4 Tank bottom shall be slanted with drain port at bottom of tank to ensure complete draining.
- .5 Humidifier and burner assembly shall be CSA/ETL certified and tested. Gas train assembly shall be complete with burner/mixing tube assembly, igniter, sight glass, flame rod electrode, gas manifold, integral gas valve and venturi. Each burner shall freely modulate with a gas input turndown ratio of at least 5:1.
- .6 Humidifier shall be of a condensing design utilizing a secondary heat exchanger to achieve average thermal of over 93%
- .7 System shall consist of a microprocessor mounted and wired in the control cabinet and a modulating (duct) (wall) mounted transmitter having an operating range of 20% to 80% R.H., shipped loose for field mounting. The system shall modulate the humidifier output from 0% to 100% of maximum capacity.
- .8 Humidifier shall include adaptable fittings to utilize PVC, CVPC, polypropylene inlet and flue venting material as required by local codes
- .9 Provide a condensate neutralizer to treat condensate that forms in flue piping and the humidifiers secondary heat exchanger. Neutralizer to contain media that neutralizes the condensate water, raising the pH to near neutral. It shall be piped so to drain both flue and heat exchanger condensate to the neutralizer inlet. Neutralizer life shall be sized to perform a minimum of one year at 30% humidifier run hours, to be replaced when discharge condensate pH falls below 5.0

2.4 STEAM DISTRIBUTION

- .1 Hose and Tube Kits
- .2 Furnish and install where indicated on the drawings hose and tube kits. Each kit shall consist of one ten-foot section reinforced vapor hose, two stainless steel hose clamps, a two-piece escutcheon plate and one 304 (316) stainless steel duct dispersion tube of length that will span the width of the duct. Duct tube shall be fitted with row of high temperature thermoplastic tubelets arranged to discharge the steam vertically. Each tubelet shall extend through the dispersion tube and incorporate a properly sized calibrated orifice. Dispersion tube shall have a

1/2" condensate drain when capacity exceeds 30 lbs per tube/per hour. Tube and hose sizes shall be as scheduled.

2.5 CONDENSATE TEMPERING

- .1 Provide condensate tempering device to cool a maximum of 6 USGPM of condensate from 212° F to 140° F when provided with 6 USGPM of 70°F or cooler city water at 20 psig or more.
- .2 Mixing chamber and fittings shall be constructed of 304 stainless steel with welded seams. Include a self-contained brass body tempering valve with temperature adjustment and charged bulb.

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 humidifiers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Install humidifier in accordance with manufacturers' instructions.
- .2 Install all accessories provided with humidifiers in accordance with manufacturer's instructions.
- .3 Co-ordinate with electrical division, all field power and control wiring to humidifier and from humidifier to all control accessories.
- .4 Provide instrumentation and interconnecting electrical wiring for control strategies as detailed in sequences of operation, plans and specifications.
- .5 Install flexible hose or rigid pipe between humidifier outlet and steam distribution pipe(s). Insulate the complete length of pipe.

- .6 Provide and install condensate piping from condensate separator to nearest floor drain.
- .7 Provide isolating valve, strainer and connection to steam supply. Interlock steam jacket solenoid valve with supply fan starter.
- .8 Provide and install condensate traps and drains on steam distribution grids.
- .9 Provide flue gas venting as per manufacturers recommendations.
- .10 Provide heat exchanger condensate piping to nearest floor drain with condensate neutralizing unit.
- .11 Locate steam generator close to and below distribution grids.
- .12 Provide natural gas supply between 4.5" WG and 14" WG. Provide isolation valves pressure regulators and piping specialties as required by local gas code.
- .13 Provide ½" type "L" copper water supply piping with shut off valve and back flow preventer (as directed by local codes) for steam generators.
- .14 Provide drain piping for overflow and drain on steam generators sloped 1 in 25, terminating over floor drain with an air gap.

3.3 FIELD QUALITY CONTROL

- .1 Start-up:
 - .1 General: in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
 - .2 Verify:
 - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
 - .2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.
 - .3 Visually check distribution manifold to ensure:
 - .1 Even distribution of vapour.
 - .2 Freedom from water deposits.
- .2 Commissioning Reports:
 - .1 General: in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: reports, supplemented as specified. Include:
 - .1 PV results on approved PV Report Forms.
 - .2 Product Information Report Forms.

3.4 DEMONSTRATION

- .1 Training: in accordance with Section 01 91 13- General Commissioning (Cx) Requirements: Training of O&M Personnel.

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 and reuse 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 SUMMARY

- .1 New equipment controls to be compatible with existing REL Controls BAS.
- .2 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 DCC Representative 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 01330 - Submittal Procedures.
- .2 Final Report: submit report to DCC Representative .
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor
 - .3 Report format to be approved by DCC 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 DCC Representative 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 DCC Representative 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- General Commissioning (Cx) Requirements.
- .2 Carry out commissioning under direction of DCC Representative and in presence of DCC Representative .
- .3 Inform, and obtain approval from, DCC Representative in writing at least 14days 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 DCC Representative 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 and PSPC Commissioning Manager DCC Representative.

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 2months 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 Manager DCC Representative .
- .3 Commission integrated systems using procedures prescribed by DCC Representative Commissioning Manager.

- .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 General: consists of field tests of equipment just prior to installation.
 - .2 Testing may be on site or at Contractor's premises as approved by DCC Representative .
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 DP switches used for dirty filter indication and fan status.
 - .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500Pa, to hold steady at any setting and with direct output to milli-amp metre at source and to BECC.
 - .7 After setting, test zero and span in 10% increments through entire range while both increasing and decreasing pressure.
 - .8 DCC Representative to mark instruments tracking within 0.5% in both directions as "approved for installation".
 - .9 Transmitters above 0.5% error will be rejected.
 - .10 DP switches to open and close within 2% of setpoint.
- .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 700kPa.
 - .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 DCC Representative. 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 DCC Representative and PSPC Commissioning Manager and provide:
 - .1 2technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 DCC Representative'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 DCC 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 30day 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 30consecutive 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 DCC Representative Commissioning Manager to verify reported results.

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by DCC Representative , set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

- .1 Demonstrate to Commissioning Manager DCC Representative 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 DCC Representative 30 days 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 Phase 2 Phase 1 training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

- .1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 DCC Representative 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 6month period.
- .2 Phase 1: 2day program to begin before 30 day test period at time mutually agreeable to Contractor, and DCC Representative .
 - .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: 5day program to begin 8weeks 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 2days training within 5day 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 2days training within 5day period in following subjects in approximate percentages of total course shown:

Software and architecture: 10%	Logiciel et architecture : 10%
Application programs: 15%	Programmes d'application : 15%
Controller programming: 50%	Programmation du contrôleur : 50%
Trouble shooting and debugging: 10%	Dépannage et mise au point : 10%
Colour graphic generation: 15%	Génération de graphiques en couleur : 15%

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 DCC Representative 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 International).
 - .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 (MSDS).
- .9 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 ACRONYMS AND ABBREVIATIONS

- .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 25character 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 short forms or acronyms. Database must provide 25character field for each point identifier.
 - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of short form or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32character 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.
- .2 New components to be compatible with existing REL Controls BAS.
- .3 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.
- .4 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 DCC Representative prior to installation.
- .3 Location of controllers as reviewed by DCC Representative 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.
- .5 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 French.
 - .3 Operating system executive: provide primary hardware-to-software interface specified as part of hardware purchase with associated documentation to be in French English.
 - .4 System manager software: include in French English 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 field related changes 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 English French 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 25 05 02- EMCS: Shop Drawings, Product Data and Review Process 01 33 00- Submittal Procedures.

- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 47 15- Sustainable Requirements: Construction.
- .3 Submit for review:
 - .1 systems manufacturers Equipment list within 10days after award of contract.
- .4 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 DCC 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 DCC Representative.
 - .8 Existing devices intended for re-use: submit test report.

1.7 QUALITY ASSURANCE

- .1 Contractor shall be responsive, in a timely manner, to provide instructions and emergency responses during construction.

.2 Contractor shall have experience with similar installations utilizing computer-based systems.

.3 Have access to local supplies of essential parts and provide 7year 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 70 12 - Health and Safety Requirements.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide DCC Representative with schedule within 2weeks after award of Contract.

.2 Waste Management and Disposal:

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

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

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

.4 Separate for recycling reuse and place in designated containers Steel Plastic Metal waste in accordance with Waste Management Plan.

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

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

.7 Label location of salvaged material's storage areas and provide barriers and security devices.

.8 Ensure emptied containers are sealed and stored safely.

.9 Divert unused metal materials from landfill to metal recycling facility as approved by DCC Representative .

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

1.9 EXISTING- CONTROL COMPONENTS

- .1 Utilize piping existing control wiring 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 DCC Representative .
 - .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 30days of award of contract, and prior to installation of new devices.
 - .1 Furnish test report within 40days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by DCC Representative .
 - .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 DCC Representative 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 DCC Representative.
 - .1 Be responsible for items repaired or replaced by DCC Representative .
 - .2 Be responsible for repair costs due to negligence or abuse of equipment.
 - .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by DCC Representative .
- .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 Data Communication Protocol Control Network Protocol: to CEA 709.1 ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of bid 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.
- .2 Existing manufacturer: REL Controls.

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 Proprietary Communications Protocol BACnet Lontalk.

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 document within 5 working days after contract award, for review by DCC 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 WordPerfect latest version Microsoft Word latest version format, structured using menu format for easy loading and retrieval on OWS.

PRELIMINARY SHOP DRAWING REVIEW

1.5

- .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 Pneumatic schematics and schedules.
 - .5 Complete Point Name Lists.
 - .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .7 Software and programming details associated with each point.
 - .8 Manufacturer's recommended installation instructions and procedures.
 - .9 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 air water systems with point identifiers and textual description of system, and typical floor plans as specified.
 - .8 Complete system CDL's including companion English 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 45working 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 DCC Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to DCC 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 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 acryonyms 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 As-built drawings Operation and Maintenance Manual Record Documents to DCC Representative in English French.
- .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: Shop Drawings, Product Data 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 DCC Representative .
- .3 Provide before acceptance 4Hard and 1soft 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 2complete 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 subroutines, 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 International).
 - .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 French English.

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 DCC Representative 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, 3mm thick Melamine, matt white finish, blackcore, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67mm minimum.
- .3 Lettering: minimum 7mm high, black.
- .4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by plastic tie chain.
- .2 Sizes: 50 x 100mm minimum.
- .3 Lettering: minimum 5mm 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 DCC 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 DCC 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 DCC 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 General

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
 - .1 CSA C22.1-12,
 - .2 CAN/CSA-C22.3 No. 7-10, Underground Systems.
 - .3 CSA C22.2 No. 45.1-07(R2012), Electrical Rigid Metal Conduit.
 - .4 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .5 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 wiring diagrams included as part of flow diagrams.
- .2 Mechanical:
 - .1 Pipe Taps Required For EMCS equipment will be supplied and installed by Division 23 EMCS Contractor.
 - .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by EMCS Contractor Division 23.

.3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by EMCS Contractor Division 23. 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 00- Execution supplemented as specified herein.

.2 Repair all surfaces damaged during execution of work.

.3 Turn over to DCC Representative existing materials removed from work not identified for re-use.

Part 2 Products

2.1 SPECIAL SUPPORTS

.1 Structural grade steel, primed and painted after construction and before installation.

2.2 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 20 AWG stranded twisted pair.

- .4 Analog input and output: shielded #20 minimum stranded twisted pair #18 minimum solid copper. 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.

2.3 CONDUIT

- .1 As per requirements of Division 26.
- .2 Electrical metallic tubing to CSA C22.2 No. 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 No. 56. Rigid steel threaded conduit to 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.

2.4 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.

2.5 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.
- .4 Finish for starters:
 - .1 Exterior: in accordance with Section 26 05 00- Common Work Results for Electrical.
 - .2 Interior: white.

2.6 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 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 fire rating integrity.
 - .3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.
- .8 Pressure tests:

- .1 Pressure test all piping systems modified under this contract to 1 1/2 times maximum working pressure or 860 kPa (whichever is greater) for 4 hours without loss of pressure. Test all piping systems modified under this contract by means of visual inspection of each connection.
- .2 Isolate equipment, components, not designed to withstand test pressure.
- .9 Introduce system pressure carefully into new piping.

3.3 SUPPORTS

- .1 Install special supports as required and as indicated.

3.4 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.

3.5 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 DCC 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 steam or 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 DCC 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 DCC 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 terminal blocks or strips indicated in cabinets.
- .17 Install bonding conductor for 120 volt and above in conduit.

3.6 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 DCC 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.

3.7 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.

3.8 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.

3.9 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.

3.10 TESTS

- .1 General:
 - .1 Perform following tests in addition to tests specified Section 25 08 20- EMCS: Warranty and Maintenance.
 - .2 Give 14days written notice of intention to test.

- .3 Conduct in presence of DCC Representative and authority having jurisdiction.
- .4 Conceal work only after tests satisfactorily completed.
- .5 Report results of tests to DCC 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 DCC Representative and authority having jurisdiction.

3.11 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 International).
 - .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 DCC Representative.
- .3 Submit detailed inspection reports to DCC Representative.
- .4 Submit dated, maintenance task lists to DCC 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 DCC Representative , after
inspection indicating that planned and systematic
maintenance have been accomplished.
- .7 Revise and submit to DCC Representative 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 DCC 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 DCC Representative .

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 DCC 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 Calibrate each field input/output device in accordance with Canada Labour Code - Part I CSA Z204.
 - .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 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with DCC Representative 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 International).

- .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 802.3TM-, 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 TBITS 6.9 CSA T530 CSA T529 TIA/EIA-569-A TIA/EIA-568.
 - .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 OWSSs communicate with each other directly on peer to peer basis in accordance with IEEE 802.3/Ethernet Standard.
 - .2 EMCS-LAN to: Proprietary Protocol BACnet,.
 - .3 Each EMCS-LAN to be capable of supporting at least 50 devices.
 - .4 Support of combination of MCUs and OWSSs 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 10Megabits per second minimum.
 - .6 Detection and accommodation of single or multiple failures of either OWSSs, 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 OWSSs, 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: twisted cable, fibre optic cable shielded twisted cable, 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 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 International).
 - .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.
- .4 Public Works and Government Services Canada (PSPC)/Real Property Branch/Architectural and Engineering Services.
 - .1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English:
<ftp://ftp.pwgsc.gc.ca/rps/docentre/mechanical/me214-e.pdf>

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 DCC 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 10bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4 - 20mA;
 - .2 0 - 10V DC;
 - .3 100/1000 ohm RTD input;
 - .3 Meet IEEE C37.90.1 surge withstand capability.
 - .4 Have common mode signal rejection greater than 60dB to 60Hz.
 - .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 8bit digital-to-analog resolution.
 - .2 Provide for following output signal types and ranges:
 - .1 4 - 20mA.
 - .2 0 - 10V 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 2kHz.
- .7 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5amps at 24V AC.
 - .2 Switch up to 5amps at 220V 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 DCC Representative 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 Proprietary 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 16bit 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 5secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72hour operation in event of power failure.

- .5 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01- EMCS: Site Requirements, Applications and System Sequences of Operation.
 - .1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by DCC Representative.
 - .2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.
 - .3 Display simultaneously minimum of 16point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in French English.
 - .4 Functions to include, but not be limited to, following:
 - .1 Start and stop points.
 - .2 Modify setpoints.
 - .3 Modify PID loop parameters.
 - .4 Override PID control.
 - .5 Change time/date.
 - .6 Add/modify/start/stop weekly scheduling.
 - .7 Add/modify setpoint weekly scheduling.
 - .8 Enter temporary override schedules.
 - .9 Define holiday schedules.
 - .10 View analog limits.
 - .11 Enter/modify analog warning limits.
 - .12 Enter/modify analog alarm limits.
 - .13 Enter/modify analog differentials.
 - .5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.
 - .6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
 - .7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
 - .8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at

OWS's for access of points at OT to eliminate cross-reference or look-up tables.

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 DCC 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. Owner 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 DCC 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 1min or less for analog inputs.
 - .5 Totalization to provide calculations and storage of accumulations up to 99,999.9units (eg. kWh, litres, tonnes, etc.).
 - .6 Store event totalization records with minimum of 9,999,999events 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 1place 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.

2.6 POINT NAME SUPPORT

- .1 Controllers (MCU, LCU) to support PSPC point naming convention as defined in Section 25 05 01- EMCS: General Requirements.

Part 3 Execution

3.1 LOCATION

- .1 Location of Controllers to be approved by DCC Representative.

3.2 INSTALLATION

- .1 Install Controllers in secure locking enclosures as indicated as directed by DCC Representative .
- .2 Provide necessary power from local 120V 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): dampers, meters, controls, transducers, damper operators, transmitters, valve actuators, valves, switches, low voltage current transformers sensors, .
 - .2 Related Sections:
 - .1 Section 01 73 00- Execution Requirements.
 - .2 Section 07 84 00- Firestopping.
 - .3 Section 25 01 11- EMCS: Start-Up, Verification and Commissioning.
 - .4 Section 25 05 01- EMCS: General Requirements.
 - .5 Section 25 05 02- EMCS: Shop Drawings, Product Data and Review Process.
 - .6 Section 25 05 54- EMCS: Identification.
 - .7 Section 25 90 01- EMCS: Site Requirements Applications and Systems Sequences of Operation.
 - .8 Section 26 05 00- Common Work Results for Electrical.
 - .9 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 Canadian Standards Association (CSA International).
- .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: Shop Drawings, Product Design and Review Process.
- .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by DCC Representative, for testing before installation. Replace devices not meeting specified performance and accuracy.
- .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 00- Execution Requirements supplemented as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to DCC 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- 32degrees 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 4enclosures.
- .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 200degrees C and over.
 - .2 RTD's: 100 or 1000 ohm at 0degrees C (plus or minus 0.2ohms) platinum element with strain minimizing construction, 3integral anchored lead wires. Coefficient of resistivity: 0.00385ohms/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 10degrees C.
 - .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 150 100mm as indicated.
- .2 Room temperature sensors and display wall modules.
 - .1 Temperature sensing and display wall module.
 - .1 LCD display to show space temperature ed and temperature setpoint.
 - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
 - .3 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit contractor supplied palm compatible handheld device for access to zone bus.
 - .4 Integral thermistor sensing element 10,000ohm at 24degrees.

- .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 brushed stainless steel brushed aluminum finish, with guard as indicated.
 - .2 Element 10-50mm long RTD with ceramic tube or equivalent protection or thermistor, 10,000ohm, accuracy of plus or minus 0.2degrees 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 6000mm. Bend probe at field installation time to 100mm radius at point along probe without degradation of performance.
- .4 Outdoor air temperature sensors:
 - .1 Outside air type: complete with probe length 100 - 150mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13mm 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 0degrees C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575ohms. Power supply effect less than 0.01degrees C per volt change.
 - .3 Output signal: 4 - 20mA into 500ohm 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 25mA.
 - .8 Integral zero and span adjustments.

- .9 Temperature effects: not to exceed plus or minus 1.0% of full scale/ 50degrees C.
- .10 Long term output drift: not to exceed 0.25% of full scale/ 6months.
- .11 Transmitter ranges: select narrowest range to suit application from following:
 - .1 Minus 50degrees C to plus 50degrees C, plus or minus 0.5degrees C.
 - .2 0 to 100degrees C, plus or minus 0.5degrees C.
 - .3 0 to 50degrees C, plus or minus 0.25degrees C.
 - .4 0 to 25degrees C, plus or minus 0.1degrees C.
 - .5 10 to 35degrees C, plus or minus 0.25degrees C.

2.4 HUMIDITY SENSORS

- .1 Room and Duct Requirements:
 - .1 Range: 5- 90% RH minimum.
 - .2 Operating temperature range: 0- 60degrees 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 10m/s.
 - .5 Maximum sensor non-linearity: plus or minus 2%RH with defined curves.
 - .6 Room sensors: locate in air stream near RA grille wall mounted as indicated.
 - .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- 50degrees 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- 20mA onto 500ohm 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/ 6months.
- .8 Long term output drift: not to exceed 0.25% of full scale output/ 6months.

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- 20mA into 500ohm 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/ 50degrees 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- 20mA into 500ohm 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/ 50degrees 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: 160Pa at 10m/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- 20mA linear into 500ohm 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: 37Pa at 1000m/s.
 - .3 Accuracy: plus or minus 1% of actual duct velocity.

2.11 VELOCITY PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4- 20mA linear into 500ohm 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 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 24 V DC 120V, 15 amps AC.
 - .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.

2.13 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 1degrees C.
 - .4 Snap action rating: 120V, 15 amps 24V DCas required. Switch to be DPST for hardwire and EMCS connections.
 - .5 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with without protective guard as indicated.
 - .2 Duct, general purpose: insertion length = 460mm.

- .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100mm.
- .4 Low temperature detection: continuous element with 6000mm insertion length, duct mounting, to detect coldest temperature in any 30mm length.
- .5 Strap-on: with helical screw stainless steel clamp.

2.14 CURRENT / PNEUMATIC (I/P) TRANSDUCERS

- .1 Requirements:
 - .1 Input range: 4to 20mA.
 - .2 Output range: proportional 20-104kPa 20-186kPa as applicable.
 - .3 Housing: dustproof or panel mounted.
 - .4 Internal materials: suitable for continuous contact with industrial standard instrument air.
 - .5 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 2% of full scale over entire range.
 - .6 Integral zero and span adjustment.
 - .7 Temperature effect: plus or minus 2.0% of full scale/ 50degrees C or less.
 - .8 Regulated supply pressure: 206kPa maximum.
 - .9 Air consumption: 16.5ml/s maximum.
 - .10 Integral gauge manifold c/w gauge (0-206 kPa).

2.15 AIR PRESSURE GAUGES

- .1 Diameter: 38mm minimum.
- .2 Range: zero to two times operating pressure of measured pressure media or nearest standard range.

2.16 ELECTROMECHANICAL RELAYS

- .1 Requirements:
 - .1 Double voltage, DPDT, plug-in type with termination base.
 - .2 Coils: rated for 120V AC 24V DC. Other voltage: provide transformer.
 - .3 Contacts: rated at 5amps at 120V 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 0.5amps 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, 152mm wide, 1219mm long, maximum. Modular maximum size, 1219mm wide x 1219mm high. Three or more sections to be operated by jack shafts.
- .2 Materials:
 - .1 Frame: 2.03mm 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-Dratings.
 - .1 Size/Capacity: refer to damper schedule
 - .2 25L/s/m2maximum allowable leakage against 1000Pa static pressure for outdoor air and exhaust air applications.
 - .3 Temperature range: minus 40degrees C to plus 100degrees 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 manufacturers 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: 5VA 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 120seconds.

2.22 CONTROL VALVES

- .1 Body: globe style, characterized ball.
 - .1 Flow characteristic as indicated on control valve schedule: linear, quick opening equal percentage,.
 - .2 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
 - .3 Normally open Normally closed, as indicated.
 - .4 Three Twoport, 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 50:1minimum.
 - .11 NPS 2½ and larger:
 - .1 Flanged connections.
 - .2 Valves to ANSI Class 150or 250as indicated, valves to bear ANSI mark.
 - .3 Rangeability 100:1minimum.
- .2 Butterfly Valves NPS 2 and larger:

- .1 Body: for chilled water ANSI Class 150 cast iron wafer body lugged body installed in locations as indicated. For steam and heating water ANSI Class 150 carbon steel wafer body lugged body.
- .2 End connections to suit flanges that are ANSI Class 150.
- .3 Extended stem neck to provide adequate clearance for flanges and insulation.
- .4 Pressure limit: bubble tight sealing to 170 kilopascals.
- .5 Disc/vane: 316 stainless steel, aluminum bronze to ASTM B148.
- .6 Seat: for service on chilled water PTFE (polytetrafluoroethylene), EPDM (ethylene propylene diene monomer). For service on steam and heating water PTFE, RTFE (reinforced PTFE).
- .7 Stem: 316 stainless steel.
- .8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
- .9 Flow characteristic linear.
- .10 Maximum flow requirement as indicated on control valve schedule.
- .11 Maximum pressure drop as indicated on control valve schedule: pressure drop not to exceed one half of inlet pressure.
- .12 Normally open Normally closed, as indicated.
- .13 Valves are to be provided complete with mounting plate for installation of actuators.

2.23 ELECTRONIC / ELECTRIC VALVE ACTUATORS

- .1 Requirements:
 - .1 Construction: steel, cast iron, aluminum.
 - .2 Control signal: 0-10V DC or 4-20 mA DC.
 - .3 Positioning time: to suit application. 90sec 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 15minute intervals.

2.25 PANELS

- .1 wall mounted Free-stand in genamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required indicated to handle requirements with additional space to accommodate 25% additional capacity as required by DCC Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.26 WIRING

- .1 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .2 Wiring must be continuous without joints.
- .3 Sizes:
 - .1 Field wiring to digital device: #18AWG 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded #20 minimum stranded twisted pair #18 minimum solid copper.

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- Firestopping. Maintain fire rating integrity.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00- Common Work Results for Electrical.
 - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
 - .3 Refer to electrical control schematics included as part of control design schematics on drawings 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 DCC Representative before beginning Work.
 - .4 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
 - .5 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.
 - .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. DCC 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 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 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 MAGNEHELIC PRESSURE INDICATORS

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by DCC Representative .
- .2 Locations: as indicated as specified.

3.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
 - .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.6 I/P TRANSDUCERS

- .1 Install air pressure gauge on outlet.

3.7 AIR PRESSURE GAUGES

- .1 Install pressure gauges on pneumatic devices, I/P, pilot positioners, motor operators, switches, relays, valves, damper operators, valve actuators.
- .2 Install pressure gauge on output of auxiliary cabinet pneumatic devices.

3.8 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54-EMCS: Identification.

3.9 AIR FLOW MEASURING STATIONS

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.10 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 Public Works and Government Services Canada (PSPC) / Real Property Branch / Architectural and Engineering Services.
 - .1 MD13800-September 2000, Energy Management and Control Systems (EMCS) Design Manual. English:
ftp://ftp.pwgsc.gc.ca/rps/doccentre/mechanical/me214-e.pdf

1.3 SEQUENCING

- .1 Present sequencing of operations for systems, in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.

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 CSA Group
 - .1 CSA C22.1-24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 CAN/CSA-C22.3 No.1-10, Overhead Systems.
 - .3 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

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 electrical equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit for review single line electrical diagrams in glazed frames and locate as indicated.
 - .1 Electrical distribution system in main electrical room.
- .4 Submit for review fire alarm riser diagram, plan and zoning of building in glazed frame at fire alarm control panel and annunciator.
- .5 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

- .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
- .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .5 Submit two (2) copies of 600 x 600 mm minimum size drawings to inspection authorities.
- .6 If changes are required, notify DCC Representative of these changes before they are made.
- .6 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
 - .3 Submit test results of installed electrical systems and instrumentation.
 - .4 Permits and fees: in accordance with General Conditions of contract.
 - .5 Submit certificate of acceptance from inspection authority upon completion of Work to DCC Representative.

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 electrical equipment for incorporation into manual.
 - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
 - .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.

- .4 Procedures to be followed in event of equipment failure.
- .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

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 off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect electrical equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates for control items in English.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from inspection authorities before delivery to site.
- .3 Factory assemble control panels and component assemblies.

2.3 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of inspection authorities.
- .2 Decal signs, minimum size 175 x 250 mm.

2.5 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: lamicoid, 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates labels to be approved by DCC Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. _____" as directed by DCC Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

2.7 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.8 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 5 cm wide prime colour and 1 cm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Telephone	Green	
OM3 multimode fiber	Green	Red
RDS	Green	Red/Green
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

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 electrical equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.3 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.

- .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to center line of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 300 mm.
 - .5 Fire alarm stations: 1050 mm to 1150 mm from center.
 - .6 Fire alarm bells: 2100 mm.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; 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 Provide upon completion of work, load balance report, phase and neutral currents on panelboards, dry-core transformers and motor control centers, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.

- .1 Power distribution system including phasing, voltage, grounding and load balancing.
- .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 and telecommunications.
- .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .3 Carry out tests in presence of DCC Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.9 SYSTEM STARTUP

- .1 Instruct DCC Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with aspects of its care and operation.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 This Section includes requirements for selective demolition and removal of electrical communications and safety and security components including removal of conduit, junction boxes, and panels to source (home run removal) and incidentals required to complete work described in this Section.

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures

1.3 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 DCC Representative 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 Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for DCC Representative's continued occupancy requirements during selective demolition and schedule staged occupancy and worksite activities as a defined Critical Path in Section 01 32 16.16 - Construction Progress Schedule - Critical Path Method (CPM).

1.5 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
 - .1 Federal Workers' Compensation Service
 - .2 Provincial/Territorial Occupational Health and Safety Standards and Programs

1.6 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition on date that tender is accepted.
- .2 Existing Hazardous Substances: DCC Representative performed a hazardous substances assessment and it is not expected that hazardous substances will be encountered in Work area.
 - .1 If encountered, hazardous substances will be removed by a hazardous abatement specialist engaged by DCC Representative before start of Work.
- .3 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in Work; immediately notify DCC Representative if materials suspected of containing hazardous substances are encountered and perform following activities:
 - .1 Refer to Section 01 41 00 - Regulatory Requirements for directives associated with specific material types.
 - .2 Hazardous substances will be as defined in Hazardous Products Act.
 - .3 Stop work in area of 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 DCC Representative under a separate contract or as a change to Work.
 - .6 Proceed only after written instructions have been received from DCC Representative.

1.7 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 DCC Representative's property.
- .2 Carefully remove materials and items designated for salvage and store in a manner to prevent damage or devaluation of materials.
 - .1 Leave main electrical distribution panel in place; panel can be used for temporary construction power for this and subsequent contracts; coordinate temporary power connections with DCC Representative.

Part 2 Products

2.1 MATERIALS

- .1 Electrical Repair Materials: Use only new materials, CSA or ULC labelled as appropriate and matching components remaining after work associated with components identified for removal or demolition are completed.
- .2 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 by thoroughly examining plans, specifications, and site condition images provided to become familiar with conditions that may affect the work of this Section before tendering the Bid."

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 DCC 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 will remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the DCC Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering safe access to and egress from occupied buildings.
 - .2 Notify DCC 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 Demolition and Removal: Requirements of this Section as follows:
 - .1 Disconnect electrical circuits and panel feeders; maintain electrical service and main distribution panel as is, ready for subsequent Work.
 - .2 Remove existing luminaires, electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
 - .3 Disconnect and remove existing fire alarm system including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
 - .4 Disconnect and remove communication systems including associated conduits, boxes, cabling, and similar items unless specifically noted otherwise.
 - .5 Disconnect and remove telephone outlets, associated conduit, cabling and sub terminal backboards and related accessories; maintain telephone service and main terminal backboard as is.
 - .6 Perform demolition work in a neat and workmanlike manner:
 - .1 Remove 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.

- .7 Disconnect panel feeders back to main distribution panel and re-label respective circuit breaker as "SPARE".
- .8 Place weatherproof blank cover plates on exterior outlet boxes remaining after demolition and removal activities.
- .9 Remove existing conduits, boxes, cabling and wiring associated with removed luminaires, electrical devices and equipment.
- .10 Grind off conduits and make flush with surface of concrete where conduits are cast into concrete; seal open ends of conduit with silicone sealant and leave in place.
- .11 Seal open ends of conduit with silicone sealant and leave in place where they are inaccessible or cannot be removed without damaging adjacent construction.

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.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA-C22.2 No.18-18, Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No.65-18, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 National Electrical Manufacturers Association (NEMA)

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 wire and box connectors 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 wire and box connectors for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable, TECK cable, flexible conduit, as required to: CAN/CSA-C22.2 No.18.

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 wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials,
 rubbish, tools and equipment in accordance with Section
 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.
- .3 Copper conductors: size as indicated, with thermoplastic insulation type T90 Nylon rated at 600 V.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Teck 90 cable length shall be limited to 3m length maximum.
- .3 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .4 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 600 V.
- .5 Inner jacket: polyvinyl chloride material.
- .6 Armour: galvanized steel.
- .7 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .8 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1500 mm centers.

- .3 Threaded rods: 6 mm diameter to support suspended channels.
- .9 Connectors:
 - .1 Watertight approved for TECK cable.

2.3 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from galvanized steel strip.
- .4 Connectors: anti-short connectors.
- .5 Armoured cabling to be limited to 3m maximum length.

2.4 CONTROL CABLES

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: thermoplastic.
 - .2 Sheath: thermoplastic jacket.
- .2 Type: low energy 300 V control cable: solid annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
 - .1 Insulation: polyethylene.
 - .2 Shielding: braid over conductors.
 - .3 Overall covering: polyethylene jackets.
- .3 Type: 600 V stranded annealed copper conductors, sizes as indicated:
 - .1 Insulation: polyethylene RW90 (x-link)
 - .2 Shielding: braid over conductors.
 - .3 Overall covering: thermoplastic jacket.
- .4 All low voltage cabling to be run in EMT conduit as per section 26 05 34.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of DCC Representative and local authority having jurisdiction over installation.

- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by straps.
- .3 Teck 90 cable length shall be limited to 3m length maximum.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.
- .2 Armoured cabling to be limited to 3m maximum length.

3.6 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Ground control cable shield.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-14, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA Group (CSA)
 - .1 CSA Z32-15, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

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 grounding equipment 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 grounding equipment for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .3 Insulated grounding conductors: green, copper conductors, size as indicated.
- .4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .5 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 Bonding jumpers, straps.
 - .5 Pressure wire connectors.

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 grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.

- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Install separate ground conductor to outdoor lighting standards.
- .10 Connect building structural steel and metal siding to ground.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end and load end.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.4 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with there own individual conductor bare stranded copper connections size #2/0 AWG provided for electrical rooms individual green jacketed conductor size #6 AWG for communication equipment room respectfully.

3.5 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, fire alarm, security systems, intercommunication systems as indicated.

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of DCC Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

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.

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 hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

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 hangers and supports installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of DCC Representative.
- .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of DCC Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

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.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.1-24, Canadian Electrical Code, Part 1, 26th Edition.

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 datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

Part 2 Products

2.1 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: connection blocks to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat covers.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Mount plumb, true and square to building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating voltage and phase or as indicated.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.1-24, Canadian Electrical Code, Part 1, 26th Edition.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished plaster tile walls.

2.3 FLOOR BOXES

- .1 Low profile over floor raceway system brushed aluminum painted electro-galvanized sheet steel floor boxes finish with brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Maximum height: 51 mm for over carpet raceway minimum height : 102 mm receptacles and communication outlets.
- .2 Adjustable, watertight, raceway three track openings 51 mm to accommodate power and multiple communication wiring.

2.4 CONDUIT BOXES

- .1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.5 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.6 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for one (1) duplex receptacles. Bottom plate with two knockouts for centered or offset installation.
- .2 Pedestal type 'low tension' fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate one (1) amphenol jack connectors.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CAN/CSA C22.2 No. 18-18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 45.1-04, Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-07(R2017), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3-15, Nonmetallic Mechanical Protection Tubing (NMPT).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Instructions: submit manufacturer's installation instructions.

Part 2 Products

2.1 CABLES AND REELS

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.

2.2 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel, threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

2.3 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
 - .1 Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.
- .5 Refer to division 27 for Type 2 communication installations.

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Polypropylene.

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 datasheets.

3.2 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 unfinished areas.
- .3 Surface mount conduits except when conduits can be installed inside walls to reach outlets and devices.
- .4 Use rigid galvanized steel threaded conduit except where specified otherwise.
- .5 Use electrical metallic tubing (EMT) except in cast concrete, and above 2.4 m not subject to mechanical injury.
- .6 Use rigid pvc conduit underground.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .8 Install conduit sealing fittings in hazardous areas.
 - .1 Fill with compound.
- .9 Minimum conduit size for lighting and power circuits: 19 mm.
- .10 Install EMT conduit from branch circuit panel to junction box in sub-floor immediately below panel.
- .11 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Mechanically bend steel conduit over 19 mm diameter.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install fish cord in empty conduits.
- .15 Run 2-25 mm spare conduits up to ceiling space and 2-25 mm spare conduits down to ceiling space from each flush panel.
 - .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space.
- .16 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.

- .17 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.6 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 On 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 low voltage control system designed to provide remote switching of lighting loads by use of:
 - .1 Low voltage momentary contact switches.
 - .2 Manual switch control.

1.2 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 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.
 - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 00 - Closeout Submittals.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Test reports:

- .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 MATERIALS

- .1 Control system: by one manufacturer and assembled from compatible components.

2.2 CONTROL SWITCHES

- .1 Single pole, double throw, momentary contact, standard duty, rated 15 A, 125 V, centre pivot rocker action.

2.3 LOW VOLTAGE RELAYS

- .1 Electrically operated by momentary impulse, mechanically latched until activated.
- .2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.
- .3 Operating voltage: 24 V, rectified AC.
- .4 Load contacts: 20 A, 120 V, AC.
- .5 Auxiliary contacts for pilot light.
- .6 Coloured pre-stripped leads.

2.4 CONTROL TRANSFORMER

- .1 Low voltage power Class 2, input 120 V, AC, 60 Hz, output 35 VA at 24 V.

2.5 MANUAL CONTROL

- .1 Eight circuit manual master selector switch mounted in 100mm square box with:
 - .1 Master lock-out switch.
 - .2 Individual red pilot lights.
- .2 Manual dial-type master selector.
- .3 Photocell control switches as indicated allows for perimeter day light dimming.
- .4 Dimming Room Controller; 0-10V manual dial-type dimming selector.
- .5 Vacancy selector switch, sensor powers off after 20min inactivity.

2.6 DEVICE CONNECTION COPPER CABLE

- .1 Four pair, UTP (unshielded twisted pair) Copper Cable:
- .2 Description: to ANSI/TIA 568-C.2 compliant Category 5e cable, designed for horizontal network applications.
- .3 Communications Plenum rated (CMP/FT6).
- .4 Cable sheath is to be Blue in colour.
- .5 CSA approved.

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 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Actuate control units in presence of DCC Representative to demonstrate lighting circuits are controlled as designated.

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 CSA Group (CSA)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th 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 network lighting controls and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate on drawings:
 - .1 Complete assembly.
 - .2 Contact surfaces.
 - .3 Construction features.
 - .4 Wiring diagrams.

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 network lighting controls for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

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

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect network lighting controls from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 COMPONENTS

- .1 Components: to CSA C22.1.
- .2 Designed for lighting control up to and including 347 V, 20 A.
- .3 Integrally moulded thermoplastic, colour coded black for normal and red for emergency circuits.
- .4 Certified to make or break under full rated load.
- .5 Quick change frames with pre-assembled relays, transformer rectification, multi-recessed control ports, and one power-in plug and five power-out receptacles.
- .6 Cable sets consisting of starter cables, joiner cables, and control cables.
- .7 Low Voltage Switch Kit.
- .8 Occupancy Sensor Kit.
- .9 Ambient Light Sensor Kit.
- .10 Mechanical Control Kits.
- .11 Central Control or Building Automation System Kits.

2.2 ENCLOSURES

- .1 Design enclosures for ceiling or wall mounting with stand-off uni-directional brackets.
 - .1 Hinged fail safe cover with interceptor openings.
 - .2 Constructed of metal with safety blue paint, ventilated back with side air inlets, and complete with sixteen receptacle knockouts.

2.3 FRAMES

- .1 Pre-install quick change frames into enclosure and complete with 6 maximum control ports, one power-in plug and five power-out receptacles.

- .1 Power-out receptacles 4 of 5 are controlled by internal low voltage relays connected to the control ports.
- .2 One power out receptacles is for circuit feeding unswitched.
- .3 Each of 4 power-out receptacles is controlled using one low voltage switch kit and/or one occupancy sensor kit.
- .4 Remaining 2 control ports are for connection to central computer.

2.4 CABLE SETS

- .1 Two to nine conductor - No. 12 to 18 stranded armoured cable c/w integrally moulded male and/or female caps.
- .2 Factory assembled and integrally moulded.
- .3 Four metre minimum lengths. Allow 2 metre extra cable for relocation of fixtures and equipment where required.
- .4 Starter cables: complete with 1 end prepared for field installation and other end complete with integrally moulded female cap.
 - .1 Field prepared end: armour removed 150 mm and complete with locknutless connector and suitable for circuit connection to standard outlet box.
- .5 Joiner cables: integrally moulded male cap on one end and integrally moulded female cap on the other end.
- .6 Low voltage cables: one end prepared for field installation with locknutless box connector and six inch tails with mini-quick connector prepared for connection to low voltage switch kit or occupancy sensors kit. Other end complete with mini quick-connector for connection to the Smart-Light enclosure control ports.

1.1 DEVICE CONNECTION CABLE

- .1 Four pair, UTP (unshielded twisted pair) Copper Cable:
- .2 Description: to ANSI/TIA 568-C.2 compliant Category 5e cable, designed for horizontal network applications.
- .3 Communications Plenum rated (CMP/FT6).
- .4 Cable sheath is to be Blue in colour.
- .5 CSA approved.

2.5 LOW VOLTAGE SWITCH KIT

- .1 Complete with low voltage push button switch, three position backplate, and single cover plate.

- .1 Low voltage switch is provided with six inch tails and mini quick-connector ready for connection to low voltage cable.

2.6 SENSOR KIT

- .1 Complete with bar hanger and outlet box pre-assembled for insertion of low voltage cable locknutless box connector into outlet box.
 - .1 Ceiling mounting occupancy sensor with mini quick-connector for connection through 7/8 tile hole to low voltage control cable inserted in outlet box.

2.7 MECHANICAL CONTROL KIT

- .1 Complete with one end connected with mini quick-connector to Smart-Light Enclosure control port. Other end complete with locknutless box connector and prepared with 6 inch tails or mini plugs for connection to mechanical devices or other equipment

2.8 CENTRAL CONTROL

- .1 Complete with one end connected with mini quick-connector for connection to Smart-Light enclosure control port. Other end complete with locknutless box connector and prepared with 36 inch tails for connection to central control panel.

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 network lighting controls installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 All wiring and cabling to be installed in conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

- .2 Install system and components in accordance with manufacturer's instructions.
- .3 Install starter cables to circuit outlet boxes and connect to power circuit and energize.
- .4 Install Smart-Light enclosures as shown on drawings and connect starter cable to power-in plug.
- .5 Connect joiner cables to each of power-out receptacles to first luminaire of controlled circuit as shown.
- .6 Install joiner cables between interceptors in fixtures or equipment. Allow extra cable to facilitate removal and relocation of fixtures or equipment.
- .7 Install blanking plugs in unconnected receptacles.
- .8 Integrally moulded thermoplastic components to match colour identification system (i.e. black for normal power, red for emergency power).
- .9 Install low voltage switch kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.
- .10 Install sensor kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.
- .11 Install central control kit from each or grouped Smart-Light enclosure to central control panel as shown on drawings.
 - .1 Connect to control port of Smart-Light as indicated.
 - .2 Connections within central control panel as instructed by control manufacturer.

3.3 FIELD QUALITY CONTROL

- .1 On completion of installation, manufacturer representative shall be notified to carry out site inspection and report any inconsistencies to the DCC Representative. Corrections are to be implemented to comply with manufacturer's report.

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.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C13-M83(R2004), Instrument Transformers.

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 control and signal transformers 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 control and signal transformers for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect control and signal transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 POTENTIAL TRANSFORMERS

- .1 Potential transformers: to CSA C13, dry type for indoor use, with following characteristics:
 - .1 Nominal voltage class: as indicated.
 - .2 Rated frequency: 60 Hz.
 - .3 Basic impulse level: 5 kV.
 - .4 Voltage ratio: as indicated.
 - .5 Accuracy rating: $\pm 4\%$.
- .2 Potential transformers fused with separate fuse block.
Fuses: as indicated.

2.2 CURRENT TRANSFORMERS

- .1 Current transformers: to CSA C13, dry type for indoor use with following characteristics:
 - .1 Nominal voltage class: as indicated.
 - .2 Rated frequency: 60 Hz.
 - .3 Basic impulse level: 5 kV.
 - .4 Rated primary and secondary current: as indicated.
- .2 Positive action automatic short-circuiting device in secondary terminals.

2.3 MOUNTING BRACKETS

- .1 Potential transformers with channel type mounting brackets.
- .2 Fabricate brackets and channels from electrogalvanized code gauge painted steel.

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 control and signal transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Install instrument transformers and ensure accessibility.

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.

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Specification Section 26 05 00 - Common Work Results for Electrical

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 service equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 service equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 EQUIPMENT

- .1 Fused disconnect switch: in accordance with Section 26 28 23 - Disconnect Switches - Fused and Non-Fused, rating as indicated.
- .2 Enclosed circuit breaker: in accordance with Section 26 28 16.02 - Moulded Case Circuit Breakers, rating as indicated.

- .3 Panelboard Breaker type: in accordance with Section 26 24 16.01 - Panelboards Breaker Type. Fusible type: in accordance with Section 26 24 16.02 - Panelboards Switch and Fuse Type, rating 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 service equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Install service equipment.
- .2 Connect to incoming service.
- .3 Connect to outgoing load circuits.
- .4 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.
- .5 Make provision for power supply authority's metering.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.29-15, Panelboards and Enclosed Panelboards.

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 panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

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 panelboards 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 off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect panelboards from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250V panelboards: bus and breakers rated for 10kA.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: air dried enamel.
- .11 Isolated ground bus.
- .12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02- Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

- .4 Lock-on devices for 10% of 15A to 30A breakers installed as indicated. Turn over unused lock-on devices to DCC Representative.
- .5 Lock-on devices for receptacles, fire alarm, emergency, door supervisory, stairway, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00- Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

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 panelboards installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00- Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.
- .6 Where panels of different systems (i.e. Standard and Vital Power) supply a common patient care area, ground busses in

panels to be interconnect with a minimum #6 AWG ground conductor.

3.3 CLEANING

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

3.4 PROTECTION

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-15, Special Use Switches.
 - .4 CSA C22.2 No.111-18, General-Use Snap Switches (Bi-national standard, with UL 20).

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 wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, 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 wiring devices for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:

- .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect wiring devices from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SWITCHES

- .1 15 A, 120 V, single pole, three-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Suitable for back and side wiring.
 - .4 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads or heating loads.
- .4 Switches of one manufacturer throughout project.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 IT Equipment receptacles, CSA type L5-30 R, 125 V, 30 A, ground, to: CSA C22.2 No.42 with following features:
 - .1 Black urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Three side wiring screws.
 - .4 Triple wipe contacts and rivetted grounding contacts.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel cover plates, for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Power source and circuit identification to be shown on each receptacle faceplate.

2.4 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

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 wiring devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 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 in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

- .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

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.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size above 15A.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00- Submittal Procedures.
 - .2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet.

1.3 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00- Closeout Submittals.
- .2 Three (3) spare fuses of each type and size installed, whatever the size.

Part 2 Products

2.1 FUSES - GENERAL

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.

2.2 FUSE TYPES

- .1 Class J fuses.
 - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
- .2 Class R fuses.

- .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.

2.3 FUSE STORAGE CABINET

- .1 Fuse storage cabinet, manufactured from 2.0mm thick aluminum, 750mm high, 600mm wide, 300mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00- Common Work Results for Electrical.

Part 3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
 - .1 Install rejection clips for Class R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .5 Install spare fuses in fuse storage cabinet.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No. 5-13, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMJ-J-266-ANCE-2010).

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 circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit two (2) copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to DCC Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.

- .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
- .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title: _____
 - .2 End user's reference number: _____
 - .3 List of circuit breakers: _____

1.3 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 circuit breakers off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Circuit breakers: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Plug-in moulded case circuit breakers: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .4 Common-trip breakers: with single handle for multi-pole applications.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .6 Circuit breakers to have minimum 10kA SCCI.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 OPTIONAL FEATURES

- .1 Include:
 - .1 Under-voltage release.
 - .2 On-off locking device.
 - .3 Handle mechanism.

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 DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

3.3 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA-C22.2 No.4-04(R2014), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
 - .2 CSA C22.2 No.39-13(R2017), Fuseholder 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 disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: 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 disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible, Non-fusible disconnect switch in CSA enclosure, to CAN/CSA-C22.2 No.4, size.
- .2 Provision for padlocking in 'off' switch position by 3 locks.

- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

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 disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Provide weather proof device/enclosure when installed outdoors.

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.

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.14-18, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-2000 (R2005), Controllers, Contactors and Overload Relays Rated 600 V.

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 contactors 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 contactors for incorporation into manual.
- .3 Include operating information required for start-up, synchronizing and shut-down of generating units.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 CONTACTORS

- .1 Contactors: to CSA C22.2 No.14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled.
- .3 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .4 Mount in NEMA 1 Enclosure unless otherwise indicated.
- .5 Control transformer: in accordance with Section 26 29 03 - Control Devices, factory wired and installed in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Size 4 nameplate indicating name of load controlled.

Part 3 Execution

3.1 INSTALLATION

- .1 Install contactors and connect power wires and auxiliary control devices.
- .2 Identify contactors with nameplates or labels indicating panel and circuit number.
- .3 Test contactors in accordance with 26 05 00 - Common Work Results for Electrical.

3.2 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.

3.3 PROTECTION

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

National Defence
8 Wing Trenton
Job No. L-T81-3019/2

CONTACTORS

Section 26 29 01
Page 3 of 3
2025-02-24

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA C22.2 No.14-18, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

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 control devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Include schematic, wiring, interconnection diagrams.

1.3 QUALITY ASSURANCE

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

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 control devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

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

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect control devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No.14.
- .2 Universal pole type: electrically held with 2 poles, convertible from NO to NC by changing wiring connections. Coil rating: 120 V, 1800 VA. Contact rating: 120 V, 15 A.

2.2 CONTROL AND RELAY PANELS

- .1 CSA Type 1 sheet steel enclosure with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

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 control devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of DCC Representative.
 - .2 Inform DCC 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 DCC Representative.

3.2 INSTALLATION

- .1 Install control devices, as per manufacturer's recommended installation.
- .2 Identify the power source for each device in the field as per Section 26 05 00 - Common Work Results for Electrical.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

3.4 CLEANING

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

END OF SECTION

Part 1 General

1.1 REFERENCE STANDARDS

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 CSA Group (CSA)
- .3 ICES-005, Issue 5 (2019), Radio Frequency Lighting Devices.
- .4 Underwriters' 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, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by DCC Representative.
 - .3 Photometric data to include: spacing criterion.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials 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 Divert unused metal materials from landfill to metal recycling facility.
- .4 Disposal and recycling of fluorescent lamps as per local regulations.
- .5 Disposal of old PCB filled ballasts.

Part 2 Products

2.1 LAMPS

- .1 LED lamps as indicated.
- .2 LED lamp-life hour is approximately 50,000 hours.
- .3 Lumen levels to be as indicated in the lighting fixture schedule.

2.2 LED DRIVER

- .1 LED driver shall be installed in an electrical enclosure.
- .2 Wiring inside enclosure shall comply 600V/105 degrees rating or higher.
- .3 LED driver shall comply with UL standard UL1012.
- .4 LED driver shall have Class A sound rating.
- .5 LED driver shall be UL certified for use in a dry or damp location.
- .6 LED driver shall tolerate sustained open circuit and short circuit output conditions without damage.
- .7 LED driver shall comply with the requirements of the FCC rules and regulations, Title 47 CFR Part 15 Non-Consumer (Class A).

2.3 LIGHT EMITTING DIODE (LED) FIXTURES

- .1 Luminaires shall be controlled by photocells or automatic profile dimming & motion response override as required by the design.
- .2 Luminaire shall have door frame and lens with LED arrays and integral airflow ventilation system.
- .3 The light distribution pattern of the luminaires shall be suitable for a S/H ratio of approximately 1.8.
- .4 For the lighting system selected, complete illumination calculations are required to be submitted to show performance and lighting levels, which will be reviewed for compliance.

2.4 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.5 OPTICAL CONTROL DEVICES

- .1 As indicated in luminaire schedule.

2.6 LUMINAIRES

- .1 As indicated in luminaire schedule.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.
 - .1 In an environment where T-bar grid ceilings are installed, light fixtures shall be tightly secured to the building frame.

3.2 WIRING

- .1 Connect luminaires to lighting circuits:
 - .1 Install flexible or rigid conduit for luminaires as indicated.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations, support luminaires from ceiling grid in accordance with local inspection requirements.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line, or as indicated on drawings.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA):
 - .1 CSA C22.2 No.141-10, Emergency Lighting Equipment
 - .2 CSA C860-11(R2016), Performance of Internally-Lighted Exit Signs
- .2 International Organization for Standardization (ISO):
 - .1 ISO 3864-1:2011, Graphical symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings
 - .2 ISO 7010:2011, Safety colours and safety signs - Registered safety signs
- .3 National Fire Protection Association (NFPA):
 - .1 NFPA 101-2015, Life Safety Code

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS SDS - Safety Data Sheets.
- .4 Quality Assurance Submittals: Submit the following in accordance with Section 01 43 00 - Quality Assurance.

1.4 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

2.1 STANDARD UNITS

- .1 Exit Lights: To CSA C22.2 No.141 and CSA C860
- .2 Housing: extruded aluminum housing, brush aluminum finish.
- .3 Face and back Plates: extruded aluminum.
- .4 Lamps: One - LED-4.4W V 50 000 hours.
- .5 Graphics: Green pictogram and white graphical symbol and directional arrows to ISO 3864-1. Dimensions to ISO 7010.
- .6 Face plate to remain captive for relamping.

Part 3 Execution

3.1 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements

- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Lock exit light circuit breaker in on position.

3.2 CLEANING

- .1 Perform in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 All of Division 26 as applicable.
- .2 All of Division 27 as applicable.

1.2 RDS INSTALLATION STANDARDS AND BEST PRACTICES

- .1 These secure installation practices are based on the following:
 - .1 National Defence Security Instructions
 - .2 National Defence Security Policy
 - .3 INFOSEC 601
 - .4 CSE ITSG-11
 - .5 Classified IT Installation Design Authority Installation Practices
 - .6 2102-136 (Dir IM Secur 6-5) 28 June 2011
 - .7 ADM(IE) Standard 1606-4000
 - .8 Canadian Electrical Code
 - .9 ANSI/TIA/EIA-569-A
 - .10 Treasury Board Information Technology Standard 6.9
 - .11 NSTISSI No. 7003, 1996
 - .12 CAN/CSA-C22.2, 2006
 - .13 CAN/CSA-T530, 2002
 - .14 CAN/CSA-T527-94 (R1999)
 - .15 CAN/CSA-S136-12
 - .16 National Defence Security ITSS-06
 - .17 Fire Protection and Prevention Act, 1997

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 CONDUITS

- .1 Conduit used to construct an RDS shall be thin walled EMT.
- .2 Only metal couplings and connectors will be used with EMT.
- .3 Standard sizes are 1-inch (27 mm), 2-inch (54 mm), 3-inch (75mm) and 4-inch (100 mm).
- .4 Conduit smaller than 1-inch (25 mm) is not permitted for Red cabling.
- .5 Conduit shall be securely attached to hangers or to a solid surface with the maximum spacing of the points of support not greater than:
 - .6 2 meters (6 feet 8 inches) for 27mm (1-inch) trade size conduit; and
 - .7 3 meters (10 feet) for 54mm (2-inch) trade size conduit and larger.
- .8 Where EMT conduits of mixed sizes are run in a group, the conduit supports shall be so arranged that the maximum support spacing will be that shown for the smallest conduit.
- .9 EMT shall be installed as a complete system and shall be securely fastened in place within 1 m (3 feet) of each outlet box, pull box, cabinet, coupling, or fitting, and the spacing shall be in accordance with those specified in the previous paragraph.
- .10 To maintain proper bend radii in fibre optic cables, conduit shall always exit from a pull box in the direction of pull and shall not exit the sides, bottom, or top of the pull box.
- .11 No section of conduit shall be longer than 30m (100ft) between pull points. No section of conduit shall contain more than two 90 degree bends, or equivalent, between pull points, e.g., outlet boxes, telecommunications closets or pull boxes. For sections of conduit between pull boxes, kicks shall be considered 90 degree bends.

- .12 Conduits shall be reamed to eliminate sharp edges. Metallic conduit shall be terminated with an insulated bushing.
- .13 The inside radius of a bend in conduit shall be at least six (6) times the internal diameter. When the conduit size is greater than 50 mm (2-inch), the inside radius shall be at least ten
- .14 (10) times the internal diameter of the conduit. For optical fibre cable, the inside radius of a bend shall always be at least ten (10) times the internal diameter of the conduit.
- .15 LB, LL, LR and other conduit fittings are not permitted, as these connectors do not allow for proper bend radius of the fibre optic cables.
- .16 Conduit runs shall attempt to follow building grid lines.
- .17 The cable distribution system should be installed to provide unimpeded inspection and cleared of any obstruction of device which encroaches upon the system to facilitate tampering. For this reason, conduit will not be installed inside of walls.
- .18 Cable fill capacities of any multi cable conduit, or tray shall not be greater than 40 percent.
- .19 A pull cord or fish tape shall be installed in all newly installed conduits and tied at each end.
- .20 Metallic conduits must be grounded to the facility electrical safety ground in accordance with the Canadian Electrical Safety Code.

2.2 PULL BOXES

- .1 Pull boxes shall not have pre-punched knockouts.
- .2 Pull boxes shall be constructed of at least 16 gauge steel and shall have a rust resistant finish.
- .3 Boxes, cabinets, and fitting supports shall be fastened securely in place.
- .4 Pull boxes shall be placed in a straight section of conduit and shall not be used in lieu of a bend. The corresponding conduit ends should be aligned with each other.
- .5 Pull boxes shall be installed in such a way as to ensure the sides that require conduit connections are in no way obstructed, that future conduit connections are in no way

obstructed, and that the minimum Bend radius of maximum expected conduit size can be achieved. Future conduit connections shall be considered the size and quantity of the largest conduits entering a box, exiting the opposite side of box and making 90 degree bends to either side.

- .6 When conduits enter or exit a pull box they shall be installed in such a way as to not obstruct the face of the pull box.
- .7 Wherever space permits, pull box sizing for RDS applications is based on industry standards. Where this is not possible, the size shall be determined by the number of conduits feeding into the box. For example:
 - .8 Three 1-inch (25 mm) conduits [up to 30 fibres] requires an 8-inch x 8-inch x 6-inch (200 mm x 200 mm x 150 mm) box;
 - .9 Two 2-inch (50 mm) conduits [up to 80 fibres] requires a 12-inch x 12-inch x 8-inch (300 mm x 300 mm x 200 mm) box;
 - .10 Four 2-inch (50 mm) conduits [up to 160 fibres] requires a 16-inch x 16-inch x 8- inch (400 mm x 400 mm x 200 mm) box; and
 - .11 Four 4-inch (100 mm) conduits [up to 500 fibres] requires a 24-inch x 24-inch x 10- inch (600 mm x 600 mm x 250 mm) box.

2.3 I-BEAMS

- .1 When the space above the false ceiling is I-beam construction, appropriate beam clamps must be used to install RDS components. Note that any fire retardant material that is displaced during installation must be re-applied.
- .2 Under no circumstances will holes be drilled into the I-beams.

2.4 CABLE TRAY

- .1 Cable tray does not offer the protection provided by conduit. For this reason, the use of cable tray for RDS is limited, typically to the confines of a single room.
- .2 Tray may not be used above a false ceiling unless authorized by the Design Authority.
- .3 Tray may be used under a raised floor in areas deemed an Operations Zone or higher. The tray must be configured to facilitate easy inspection during a TCI. Covered tray is preferable.

- .4 Cable tray used for RDS must be identified with the standard red-on-green markings.
- .5 The minimum clearances for cable trays shall be:
 - .1 150 mm (6 inches) vertical clearance, excluding depth of the cable trays between cable trays installed in tiers except, where cables of 50 mm (2 inches) diameter or greater may be installed, the clearance shall be 300 mm (12 inches);
 - .2 300 mm (12 inches) vertical clearance from the top of the cable tray to all ceilings, heating ducts, and heating equipment and 150 mm (6 inches) for short length obstructions; and
 - .3 600 mm (24 inches) horizontal clearance on one side of cable trays mounted adjacent to one another or to walls or other obstructions.
- .6 The inside of the cable tray shall be free of burrs, sharp edges or projections which could damage cable insulation.
- .7 The maximum design and support spacing shall not exceed the ratings specified by the manufacturer.
- .8 Provisions for bonding:
 - .1 Where metal supports for metal cable trays are bolted to the tray and are in good electrical contact with the grounded structural metal frame of the building, the tray shall be deemed to be bonded to ground.
 - .2 Where the conditions above do not apply, the metal cable tray shall be adequately bonded at intervals not exceeding 15 m (50 feet) and the size of bonding conductors shall be based on the maximum rating or setting of an over current device in the circuits carried by the cable tray in accordance with the requirements of CE Code 10-814.
- .9 Proper manufactured accessories and fittings such as elbows, reducers, crossovers, tees, and risers shall be used for any change in direction, height, or size of cable tray.

2.5 SERVICE EXTENSION POLES

- .1 Service extension poles (Jiffy poles, Pack poles) intended for RDS are to be used for red cables only. Shared use of a split or multi chamber service extension pole is not authorized.
- .2 Service extension poles are to be fitted with a box above the false ceiling to facilitate a secure connection to the RDS conduit or flexible conduit. A pole designed specifically for the furniture is preferred. Where the pole

design does not include an integral box, a suitable box shall be attached, typically with small right-angle brackets. A connector shall be mounted on top of the box to secure the conduit. Snap bushings are fitted on the inside of the box where it enters the pole to prevent damage to the cables. Standard red on green tape is applied to the box cover.

2.6 CUBICLE STYLE FURNITURE

- .1 The cable pathway through furniture often requires that Red and Black cables run together. This is permitted so long as at least the Red or Black is on fibre. In cases where there is more than one channel in the furniture, Red/Black cable separation must be maintained.
- .2 Red fibre will be terminated in snap-in modules; either in furniture mounts or flush mount boxes attached near the furniture cable channel.
- .3 Care must be taken to maintain a proper bend radius in cubicle style furniture.

2.7 OUTLET BOXES

- .1 Outlet boxes and associated RDS shall normally be surface mounted on walls. Boxes and RDS that must be embedded in walls require prior approval from the Design Authority. The RDS must be inspected by representative of Design Authority as the wall is enclosed and painted, as well as when the connection to a box above the false ceiling is made. The conduit must be one continuous run into the false ceiling where it is connected permanently to a box, which in turn is connected to the building RDS.
- .2 When furniture is open to the wall, outlet boxes shall be installed in line with existing outlet boxes.
- .3 When furniture has a modesty panel that prevents access to the outlet box, it is to be mounted just above desktop height, approximately 8cm (3 in) above the desk as measured to bottom of box.
- .4 Where furniture extends from the floor past the desktop height, the outlet box may be mounted above or at the side of the furniture. The installer is to select the nearest possible location.
- .5 Outlet boxes must be visible and easily inspectable.
- .6 Faceplates for outlets associated with RDS are to be angled, are to accept four keystone modules, be supplied with mounting screws, and label holder/screw cover.

- .7 Surface mount boxes to accept four keystone modules, and to be supplied with mounting screws, adhesive backing, cable ties and label holder/screw cover.
- .8 Surface mount boxes are to have measurements as follows: overall length of 114.3mm, overall width of 73.6mm, and overall height of 27mm.

2.8 FIBRE OPTIC CABLE

- .1 New installations should use 50/125µm laser optimized multimode fibre (OM3) for horizontal distribution (unless the application it is intended to carry is not supported on this cable).
- .2 Cables are to have a stress loop in the outlet box and a service loop inside the patch panel.
- .3 RDS cables, including fibre, are to be marked within 15 cm (6 inches) of the ends with a 1 cm (½-inch) wide red stripe.
- .4 Cables drops from an RDS should not exceed 2 meters (6 Ft). A cable drop is the length of cable from the conduit (outlet Box) to the actual equipment.

2.9 MARKINGS AND LABELLING

- .1 Pull boxes will be identified as part of a RDS by marking the cover with a 1 cm (1/2-inch) red stripe centered over a 5 cm (2-inch) green stripe centered on the cover and perpendicular to the Electrical Metallic Tubing (EMT).
- .2 Pull box locations shall be identified by labelling the ceiling tile grid below the box with the box identifier as per installation drawing, e.g. "RDS PB 12".
- .3 RDS conduits must be identified with a 1 cm (1/2-inch) stripe of red tape centered over a 5 cm (2-inch) stripe of green tape within 15 cm (6 inches) of entering a pull box, bulkhead or ceiling and every 3 metres (10 feet) in between. Marking should be applied around the conduit circumference.
- .4 RDS service extension (jiffy) poles must be marked with standard red-on-green stripes approximately 15 cm (6 inches) below the false ceiling.
- .5 Outlet box faceplates, or the outlet box that the faceplate is mounted on, must be clearly marked with 1 cm (1/2-inch) stripe of red tape centered over a 5 cm (2-inch) strip of green tape.
- .6 Horizontal RDS cables shall be clearly labelled with a cable identifier. The format for horizontal cable labels is "AA/11/BB/22" where:

- .1 AA = room numbers and or letters;
 - .2 11 = rack identifier number;
 - .3 BB = patch panel letter; and
 - 22 22 = cable pair number.
- .7 Outlet boxes shall be clearly labelled with the RDS cable identifier. The format for outlet box labels is "AA/11/BB/22" where:
 - .1 AA = room numbers and or letters;
 - .2 11 = rack identifier number;
 - .3 BB = patch panel letter; and
 - .4 22 = cable pair number.
- .8 Riser cables shall bear a source and a destination label. The format for riser cable labels is "11/AA/22/BB/ to 11/AA/22/BB" where:
 - .1 11 = floor;
 - .2 AA = room number;
 - .3 22 = rack; and
 - .4 BB = cable pair number.
- .9 The RDS system shall be identified using pre-engineered tape consisting of a 1cm (1/2- inch) red stripe centered over a 5 cm (2-inch) green stripe manufactured by an approved supplier.
- .10 Where pull boxes are installed above a false ceiling, the ceiling tile below the pull box shall be identified with a Brady labeller or equivalent.

PART-3 Execution

2.10 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Use electrical metallic tubing (EMT) except in cast concrete.

- .3 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .4 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .5 Install fish cord in empty conduits.
- .6 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .7 Dry conduits out before installing wire.
- .8 Non-communications systems shall not share the same conduit system or be racked on the same support structure.
- .9 Deviations from the proposed pathway of more than 300 mm must be approved by the design authority prior to implementation.
- .10 Where furniture is to be installed in such a manner as it will impede inspection of the RDS pathway it shall have any modesty panel that prevents access to the pathway removed, when this is not possible the pathway is to be re-terminated in an outlet box just above desktop height, approximately 8 cm (3 inches) above the desk as measured to bottom of box at no cost.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CLEANING

- .1 Proceed in accordance with Cleaning requirements.

END OF SECTION

Part 1 General

1.1 SYSTEM DESCRIPTION

- .1 Cabling system and subsystem components including cable, termination hardware, supporting hardware, and miscellaneous associated components to install a complete telecommunications system supporting Unified Communications systems.

1.2 RELATED SECTIONS

- .1 Section 27 05 26 - BONDING AND GROUNDING FOR COMMUNICATIONS.
- .2 Section 27 05 28 - PATHWAYS FOR COMMUNICATIONS.
- .3 Section 27 01 10 - RDS.
- .4 All of Division 26.
- .5 SSC - CAT6 TECHNICAL INSTALLATION PRACTICES (TIPS).

1.3 CODES AND STANDARDS

- .1 Installation must comply with the latest version of National Building Code, the National Fire Code and the Canadian Electrical Code. Provincial building codes must apply to design and construction projects when they are more stringent than national codes.
- .2 Installation of the systems to comply with, and adhere to the latest edition (most current version) of the following codes, standards and local authorities at time of tender including all pertinent addendums and appendices:
 - .1 Municipal By-Laws and Building codes.
 - .2 Canadian Electrical Code.
 - .3 National Building Code.
 - .4 National, Provincial and Municipal Fire Codes.
 - .5 Telecommunications Industry Association (TIA):
 - .1 ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure (and all associated addendums).
 - .2 ANSI/TIA-607-C, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

- .3 ANSI/TIA 568.0-D, Generic Telecommunications Cabling for Customer Premises.
- .4 ANSI/TIA-568.1-D, Commercial Building Telecommunications Infrastructure Standard.
- .5 ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard (and all associated addendums).
- .6 ANSI/TIA-568-C.3 Optical Fibre Cabling Components Standard (and all associated addendums).
- .7 ANSI/TIA-526-14-C, Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; Modification of IEC 61280-4-1 edition 2, Fiber-Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement.
- .8 ANSI/TIA-569-D, Telecommunications Pathways and Spaces.
- .9 ANSI/TIA-598-D, Optical Fiber Cable Color Coding.
- .10 Building Industry Consulting Services International (BICSI):
 - .1 BICSI Telecommunications Distribution Methods Manual (Latest Edition).
 - .2 BICSI Information Transport Systems Installation Manual.
 - .3 BICSI Customer Owned Outside Plant Manual (Latest Edition).
 - .4 BICSI-Network Design Reference Manual.
 - .5 BICSI-Wireless Design Reference Manual.
 - .6 ANSI/NECA/BICSI 568-2001 Installing Commercial Telecommunications Cabling.

1.4 SUBMITTALS

- .1 Provide shop drawings of all products used in the completion of the structured cabling system for approval by the Departmental Representative.
- .2 Submit 1 additional copy of shop drawings to Departmental Representative and/or Designated Technical Authority.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver new materials undamaged in manufacturers clearly labelled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.

- .2 Coordinate 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, including temperature limitations.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged materials.
- .6 The job site Constructor will advise on material delivery and storage locations.

1.6 PROJECT CONDITIONS

- .1 Do not use materials that are damaged or do not pass on-site testing.
- .2 Verify existing conditions before starting work. Correct unsatisfactory conditions before proceeding.

END OF SECTION

Part 1 General

1.1 SYSTEM DESCRIPTION

- .1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.
- .4 New Telecommunications grounding and bonding system will only be required for all new conduits, cable trays, and furniture poles, as well as within the new RDS Telecommunications Room, Room # 2036.

1.2 RELATED SECTIONS:

- .1 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS.
- .2 27 05 28 - PATHWAYS FOR COMMUNICATIONS.
- .3 All of Division 26.

1.3 DEFINITIONS

- .1 PBB (Primary Bonding Busbar - formerly known as a TMGB). A Copper Ground reference busbar, typically installed in the entrance facility or Main Telecom Room (MTR), and is bonded to the service equipment ground (power) ground by the interconnecting bonding conductor.
- .2 GE (Grounding Equalizer). The Conductor that interconnects elements of the Telecommunications Grounding Infrastructure.
- .3 SBB (Secondary Bonding Busbar - formerly known as a TGB). A Copper Ground reference busbar, typically installed in Telecommunications Rooms (TR) and is bonded to the PBB by the TBB. The SBB references metallic entities in the TR space to ground.
- .4 TBB (Telecommunications Bonding Backbone) An insulated copper conductor that interconnects the PBB to the SBB's.

- .5 TBT (Telecommunications Bonding Conductor): A conductor that interconnects the telecommunications bonding infrastructure to the buildings service equipment ground.
- .6 TEBC (Telecommunications Equipment Bonding Conductor) A insulated copper conductor that bonds metallic items and equipment to the PBB and SBB (including raceways and cable trays).
- .7 AWG (American Wire Gauge).

1.4 BONDING INSTRUCTIONS

- .1 Bond to ground all racks, metallic backboards, cable sheaths, metallic hardware, metallic strength members, splice cases, cable trays, communication conduits (in use or left empty), etc. entering or residing in the Telecom Room or distribution points to the respective SBB using a minimum #6 AWG "green-jacketed" stranded copper bonding conductor and irreversible compression connectors.
- .2 Install all grounding conductors in as straight a path as possible, with any bends respecting the bend radius minimum requirement of 10 times the diameter of the conductor.
- .3 Perform grounding and bonding in accordance with the Canadian Electrical Code latest version.
- .4 Coordinate bonding of PBB to Building Service ground with electrical contractor.

Part 2 Products

2.1 PRIMARY BONDING BUSBAR (PBB)

- .1 An insulated pre-drilled, electro tin plated copper bus bar, minimum dimensions of 6mm thick x 100mm wide x 300mm long, shall be installed on the wall of the MTR adjacent to the cable entrance conduits, 150mm from the corner of the MTR and 150mm AFF. This bus bar is known as the Primary Bonding Busbar (PBB) and shall be insulated from its support by a minimum of 50mm.

2.2 SECONDARY BONDING BUSBAR (SBB)

- .1 An insulated pre-drilled, electro tin plated copper bus bar, minimum dimensions of 6mm thick x 50mm wide x 255mm long, shall be installed on the wall of each TR, adjacent

to the cable entrance sleeves, 150mm from the corner of the TR and 150mm AFF. These bus bars are known as the Secondary Bonding Busbars (SBBs) and shall be insulated from its support by a minimum of 50mm.

2.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 Bonding Conductor for Telecommunications (BCT):
 - .1 Green insulated copper bonding conductor, size as required by CEC.
 - .2 The BC to be, as a minimum, the same size as the TBB.
- .2 Telecommunications Bonding Backbone (TBB):
 - .1 Green insulated copper conductor, minimum size of No. 6 AWG. The TBB shall be sized at 2 kcmil per linear foot of conductor length up to a maximum size of 3/0 AWG. Insulation shall meet fire ratings of its pathway.
 - .2 Table 1: Sizing of the TBB

TBB/BBC linear length m (ft)	Conductor size (AWG)
less than 4 (13)	6
4 - 6 (14 - 20)	4
6 - 8 (21 - 26)	3
8 - 10 (27 - 33)	2
10 - 13 (34 - 41)	1
13 - 16 (42 - 52)	1/0
16 - 20 (53 - 66)	2/0
20 - 26 (67 - 84)	3/0
26 - 32 (85 - 105)	4/0
32 - 38 (106 - 125)	250 kcmil
38 - 46 (126 - 150)	300 kcmil
46 - 53 (151 - 175)	350 kcmil

53 - 76 (176 - 250)	500 kcmil
76 - 91 (251 - 300)	600 kcmil
Greater than 91 (301)	750 kcmil

.3 Telecommunications Equipment Bonding Conductor (TEBC)

- .1 The TEBC shall be a continuous copper conductor that is sized not less than a 6 AWG or as the largest size equipment grounding conductor in the ac branch power circuit(s) serving the racks/cabinet lineup.

2.4 BONDING CONDUCTOR TERMINALS

- .1 Two-Hole compression lugs, long barrel type, sized as per AWG of cable.
- .2 High conductivity wrought copper.
- .3 Electro tin plated.
- .4 Hole spacing as per PBB and SBB.

2.5 IRREVERSIBLE COMPRESSION TAP

- .1 For copper-to-copper tapping, splicing, or pig-tailing.
- .2 Irreversible compression tap sized to accommodate #6 AWG conductor run from PBB or SBB and #6 AWG rack bonding conductor.
- .3 Made from high conductivity wrought copper.
- .4 UL Listed and CSA Certified to 600 V and temperature rated to 90°C when crimped manufacturer's specified crimping tools and dies.
- .5 Provide manufacturer approved plastic cover for all compression taps.

2.6 BONDING AND GROUNDING CLAMP

- .1 All ground wires originating at the PBB or SBB to be clamped to the plywood backboard "B" ground wire clamps.
- .2 Mechanically galvanized to ASTM B695.
- .3 Hole diameter: 5.6mm.

2.7 LABELS

- .1 Non-metallic warning labels in English and French to: TIA-607-C.
- .2 GROUND SAFETY LABELS:
 - .1 Pre-manufactured labels 50mm high x 75mm long.
 - .2 Yellow Colour, Green text, non-Adhesive backed, Rigid Plastic Tag.
 - .3 Printed with the following text in BOLD "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CONTACT THE BUILDING TELECOMMUNICATIONS MANAGER"
 - .4 Font Size: Minimum 6mm.
- .3 GROUNDING BUSBAR LABELS:
 - .1 Machine printed labels 50mm high x 75mm long.
 - .2 White Colour with Black text, Adhesive backed, Polyester type.
 - .3 Font Size: Minimum 6mm.
- .4 GROUNDING CABLE RISER LABELS:
 - .1 Machine printed labels 12.7mm high x 50mm long.
 - .2 White Colour with Black text, non-Adhesive backed, polyester polycarbonate data plate.
 - .3 Font Size: Minimum 6mm.

Part 3 Execution

3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Install all Bonding Conductors as per CEC and manufacturers recommended installations procedures.

3.2 INSTALLATION OF TELECOMMUNICATIONS GROUNDING SYSTEM

- .1 Install PBB in Telecommunications Room (TR) # 2036.
- .2 Bonding conductors to be continuous unbroken and routed in a direct route to point of termination.
- .3 Bonding conductors not to be bent less than 10 times the outside diameter of the conductor.
- .4 Clean PBB and SBB's prior to terminating conductors.

- .5 Label all telecommunications bonding conductors as close as possible to their termination point.
- .6 Bond the PBB to the service equipment ground, using the most direct route to minimize conductor length using conductor size indicated for the BC.
- .7 Bond all SBB's to PBB using conductor size indicated for the TBB or GE.
- .8 All bonding conductors that originate at the PBB or SBB to be connected via a 2- hole compression lug on each end to ground the metallic parts.
- .9 Bond the following with the conductor size as indicated for EC to the PBB or SBB located in telecom space that the PBB or SBB is in:
 - .1 Telecommunications panel boards directly to the alternating current equipment ground bus.
 - .2 Building structural steel.
 - .3 Metallic equipment racks.
 - .4 Cable shields.
 - .5 Primary protection module cases.
 - .6 All metallic raceways and cable tray for Telecommunications cabling extending from the same room or space where the PBB or SBB is located.
 - .7 Each metallic conduit or sleeve individually connecting to the ground bushing with a 2-hole compression lug.
 - .8 CATV Systems.
 - .9 Other metallic parts as required by the CEC.
 - .10 TBB shall be continuous and unbroken; an irreversible crimp connector shall be used to service SBB's in the vertical plane.
 - .11 Ground secondary telecommunications system to PBB/SBB.

3.3 LABELLING

- .1 Apply warning labels to telecommunications bonding and grounding conductors.

END OF SECTION

Part 1 General

1.1 SYSTEM DESCRIPTION

- .1 Telecommunications conduit and raceways systems consists of outlet boxes, cover plates, distribution cabinets, conduits, pull boxes, cable trays, sleeves with caps, and fish wires.
- .2 The pathway provides a facility for the placement of telecommunications cabling.

1.2 RELATED SECTIONS

- .1 To adhere to all requirements as described in related Division 27 sections:
 - .1 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS.
 - .2 27 05 26 - BONDING AND GROUNDING FOR COMMUNICATIONS.
 - .3 All of Division 26.
 - .4 27 01 10 - RDS.
 - .5 SSC - CAT6 TIPS

1.3 PERFORMANCE REQUIREMENTS

- .1 Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- .2 Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 QUALITY ASSURANCE

- .1 All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacturer.
- .2 Supply all equipment and accessories new and free from defects.
- .3 All items of a given type to be the products of the same manufacturer.

Part 2 Products

2.1 STRUT TYPE SUPPORT CHANNEL

- .1 Shape.
- .2 Size: 41mm x 41mm.
- .3 Thickness: 2.5mm.

- .4 Parts and hardware: Zinc coat or provide equivalent corrosion protection.
- .5 Multiple conduit (trapeze) hangers: Not less than 38mm x 38mm (1 1/2 x 1 1/2 inch), 12-gauge steel, cold formed, lipped channels; with not less than 9mm (3/8 inch) diameter steel hanger rods.
- .6 Solid Masonry and Concrete Anchors: Self drilling expansion shields, or machine bolt expansion.

2.2 INDIVIDUAL CONDUIT HANGERS

- .1 Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.

2.3 METAL CONDUIT AND TUBING

- .1 Electrical Metallic Tubing (EMT): to CSA C22.2 No. 83- M1985 (R2013) with fittings as follows:
- .2 Fitting material for 25mm size conduit and smaller: zinc alloy or zinc coated steel.
- .3 Fitting material for conduit larger than 25mm: zinc coated steel.
- .4 Type: compression or set screw.
- .5 Miscellaneous Fittings: locknuts, bushings, reducers, chase nipples, 3 piece unions, split couplings, plugs, and expansion fittings specifically designed for their particular application. All connectors must have an insulated throat or busing installed.
- .6 Fish wire: polypropylene type.

2.4 OUTLETS, JUNCTION AND PULL BOXES

- .1 Pull and junction boxes: to CSA C22.2 No. 40-M1989 (R2014), Cutout, Junction and Pull Boxes and as follows.
- .2 Material: Code gauge steel
- .3 Cover: Screw-on.
- .4 Outlet boxes: to CSA C22.2 No. 18-92 and as follows:
- .5 Type: ANSI/NEMA OS 1 type, conduit boxes double gang size (100x100x54mm) c/w single gang 12.5mm plaster ring.
- .6 Sheet steel boxes: pressed sheet steel, galvanized, blanked for conduit, integral locating lugs.

2.5 BASKET TYPE CABLE TRAY

- .1 The minimum standard of acceptance for wire mesh basket tray is Cablofil Part # CF-105/300 (BL powder coat finish), Wire Basket Tray Part # WBT4X12-S (BL powder coat finish), or Flextray Part # FT4X12X10-EG (BLE powder coat finish).
- .2 Basket type tray sections and components:
- .3 Provide wire basket of types and sizes indicated; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces in compliance with applicable standards.
- .4 Wire basket cable tray shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.
- .5 Type of Wire Basket Support System:
- .6 All straight section longitudinal wires to be constructed with a continuous top wire safety edge. Safety edge must be kinked and T-welded on all tray sizes.
- .7 Wire basket to be made of high strength steel wires and formed into a standard 50mm by 100mm wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.
- .8 Wire basket sizes to conform to the following nominal criteria:
- .9 Straight sections to be furnished in standard 2997mm lengths.
- .10 Wire diameter to be 5mm minimum on all mesh sections.
All fittings to be field formed, from straight sections, in accordance with manufacturer's instructions.
- .11 All splicing assemblies to be ULC/CSA approved as an equipment ground conductor (EGC). When using powder coated wire basket as an EGC, the paint must be completely removed at all contact points of splice/ground bolt attachment.
- .12 Wire basket supports to be trapeze hangers or wall brackets provided by manufacturer.
- .13 Trapeze hangers to be supported by 9.5mm diameter rods.
- .14 All cable trays shall be bonded together and to the Telecommunications Main Grounding Busbar (TMGB) ora Telecommunications Building Ground (TBG).

- .15 Accessories and fittings such as elbows, splices, reducers, crossovers, tees, and risers shall be used for any change in direction, height or size of the cable tray and shall be manufactured by the cable tray manufacturer.
- .16 Special accessories shall be furnished as required to protect, support, and install a wire basket support system.

2.6 LABELS

- .1 Conduit Labels:
- .2 Machine printed labels 25mm high x 50mm long.
- .3 White Colour with Black text, Adhesive backed, Polyester type.
- .4 Font Size: Minimum 6mm.

2.7 TRAY LABELS

- .1 Machine printed labels 50mm high x 75mm long.
- .2 White Colour with Black text, Adhesive backed, Polyester type.
- .3 Font Size: Minimum 6mm.

Part 3 Execution

3.1 GENERAL

- .1 Except where otherwise required by Canadian Electrical Code, provide conduit of types specified in Conduit Installation Schedule and sizes indicated on drawings or specified.
- .2 Cable tray and ladder racking must be installed to meet the National and local Building codes, CEC C22.1-12 (or latest edition) standards. Inaccessible ceiling areas such as lock-in type ceiling tiles, drywall or plaster shall not be used as distribution pathways.
- .3 Cable trays shall be located to suit the application. Also, it shall be accessible for future changes to both the cable tray and cabling system.
- .4 Install cable trays at least 300mm away from fluorescent luminaries and cross power cables at right angles.
 - .1 The minimum clearances for cable trays shall be in accordance with Canadian Electrical Code C22.1-09
 - .1 150mm vertical clearance excluding depth of cable trays, between cable trays installed in tiers except where cables of 50mm diameter or greater are installed then the clearance shall be 300mm, and

- .2 300mm vertical clearance from the top of cable trays to all ceilings, heating ducts, and heating equipment and 150mm for short length obstructions.
- .3 600mm horizontal clearance on one side of cable tray mounted adjacent to one another or to walls or other obstructions.
- .5 Support cable trays are to suit loading and recommended support requirements in the Canadian Electrical Code, Part 1, for the applicable class. A support shall be placed within a maximum of 610mm on either side of any connection to a fitting.
- .6 Comply with CEC for application of hangers and supports for telecommunications systems except if requirements in this Section are stricter.
- .7 Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT required by CEC. Minimum rod size to be 9.5mm in diameter.
- .8 Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
- .9 Secure raceways and cables to these supports with two-bolt conduit clamps.
- .10 Support Cable tray of approved types of wall brackets, trapeze supports. Plumbers perforated straps are not permitted means of support.
- .11 Construct rack using steel channel, provide space on each for 25 percent additional conduits or cable trays.
- .12 Cable tray support systems shall be securely and adequately installed to preclude movement of cable tray during pulling operations.
- .13 No other systems can be attached to the telecommunications cable tray system supports.
- .14 Power or mechanical controls shall not be attached to the telecommunications cable tray system supports.

3.2 HANGER AND SUPPORT INSTALLATION

- .1 Comply with Canadian Electrical Code, Part 1, for installation requirements except as specified in this Article.
- .2 Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 90 kg.

- .3 Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
- .4 To Wood: Fasten with lag screws or through bolts.
- .5 To New Concrete: Bolt to concrete inserts.
- .6 To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
- .7 To Existing Concrete: Expansion anchor fasteners.
- .8 Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard- weight concrete 100 mm thick or greater. Do not use for anchorage to light weight aggregate concrete or for slabs less than 100mm thick.
- .9 To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
- .10 Support cable tray to suit loading and recommended support requirements in the Canadian Electrical Code, Part 1, for the applicable class. A Support shall be placed within a maximum of 610mm on either side of any connection to a fitting and 1524mm on center as recommended by the cable tray manufacturer.

3.3 GENERAL CONDUIT INSTALLATION

- .1 Install empty raceway system, including overhead distribution system, fish wire, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable troughs, service poles, miscellaneous and positioning material to constitute complete system.
- .2 The inside radius of a bend in a conduit shall be not less than six times the internal diameter when the conduit is less than 50 mm in diameter and ten times the internal diameter when conduit is 50 mm in diameter or larger.
- .3 All conduits shall originate and be physically connected to the telecom backboards in the MTR or Telecommunication Room, cable tray and pull box.
- .4 All metallic parts of the cable distribution supporting system shall be bonded together mechanically, including at all transition points (i.e. cable tray and distribution conduit not mechanically connected) using a 6 AWG green jacketed stranded copper ground wire. The metallic components of the cable distribution system shall be bonded together at the MTR and TR's and then bonded to their respective telecom ground bus bars and as per Section 27 05 26, Grounding and Bonding for Communications Systems.

- .5 All fittings, connectors and couplings are to be steel.
- .6 All conduits/sleeves that enter the MTR or any TR shall be fitted with an approved ground bushing c/w ground lug and bonded together mechanically (one continuous piece preferred). This shall be connected to the approved building ground by means of a No. 6 AWG to the grounding bus bar.
- .7 All conduits entering or exiting through the ceiling or walls of the MTR or TR shall protrude into the room 25-50mm.
- .8 Riser sleeves in the Main Telecom Room and Telecommunication Rooms shall protrude through the floor 50-75mm above finished floor (AFF).
- .9 All conduit runs shall follow building grid lines and shall be concealed where possible.
- .10 All conduits shall be thin wall EMT, reamed, and bushed at both ends and bonded to the distribution system. Rigid PVC or flexible metallic, or PVC conduits are NOT acceptable.
- .11 Unless otherwise specified, all conduit runs shall be a maximum of 30 meters (100 ft) in length with a maximum of two 90-degree bends between pull points.
- .12 A pull box shall be placed in conduit runs where the sum of the bends exceeds 180 degrees, where the overall length of the conduit run is more than 30m, or if there is a reverse bend in the run.
- .13 Pull boxes shall be constructed and sized in accordance with Canadian Electrical Code and TIA standards of code gauge steel and shall have a rust resistant finish. Locations and sizes of all pull boxes shall be as indicated on the design submission.
- .14 In all instances pull boxes shall be placed in straight sections of conduit run and shall not be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other. Conduit fittings or pull elbows fittings shall not be used in place of pull boxes or bends.
- .15 Pull boxes shall be installed at a reasonable height, in an exposed location and such that access for installation of cables is not prohibited. Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged access panel.
- .16 Conduit must enter the outlet boxes from the top or bottom.
- .17 All conduit shall be installed in accordance with Canadian Electrical Code, Part 1 Section 12, applicable building codes and in accordance with TIA 569.
- .18 The minimum size (inside diameter) for EMT conduit at an outlet location is twenty-five millimeters (25 mm).

- .19 The maximum horizontal cable run distance not to exceed 90 metres. The cable length from the mechanical termination in the TR and MTR rooms to the Telecommunications outlet. Where the horizontal distance exceeds 90 meters, provide additional rooms as required.
- .20 Cable fill capacities of conduit, cable tray and raceways shall not be greater than 40%.
- .21 A pull cord or fish tape shall be installed in all conduits.
- .22 The telecommunications outlet conduit system shall be labelled green.
- .23 Place pull boxes in readily accessible locations only.
- .24 The use of C, LB, LL, LR and T type fittings or elbows fittings is not permitted.
- .25 Conduits ending in the vicinity of a cable tray shall be terminated at a height of no less than 100mm and no more than 150mm from the top of the cable tray. Conduit runs shall not be punched through the side of the cable tray. Conduit ends are to be bonded to the cable tray. Installer is to ensure that the bonding cable is secured to the outside of the cable tray.

3.4 OUTLET BOXES

- .1 Outlet Box installation requirements
 - .1 Flush mounted in all areas.
 - .2 Outlet boxes shall be installed in locations identified
The outlet box shall be installed at 300mm AFF or at the same height and within 300mm of the adjacent electrical duplex receptacles, unless otherwise noted on the building plans.
 - .3 Wherever possible, the face of the plastic ring should be installed flush with the finished wall.
 - .4 Back to back outlet boxes shall not be used.
 - .5 Outlet boxes must be equipped with a plaster ring to accommodate the installation of telecommunication face plates.
 - .6 Plaster rings will be specified as single or double gang to accomodate requirements.
 - .7 Plaster rings or raised adapter plates shall not reduce the size of the outlet such that two additional outlets could not be added in the future.

3.5 GENERAL - CABLE TRAY

- .1 Cable tray and ladder racking must be installed to meet the national and local building codes, CEC and CSA T530-99, Commercial building Standard for Telecommunications Pathways and Spaces standards. Inaccessible ceiling areas such as lock-in type ceiling tiles, drywall or plaster shall not be used as distribution pathways.
- .2 Support cable trays are to suit loading and recommended support requirements in the Canadian Electrical Code, Part 1, for the applicable class. A support shall be placed within a maximum of 610mm on either side of any connection to a fitting.

3.6 CABLE TRAY INSTALLATION

- .1 Support Cable tray with approved types of wall brackets, trapeze supports. Plumbers perforated straps are not permitted means of supports.
- .2 Spine type and center hung cable trays are not authorized for use for Telecommunication cable networks.
- .3 All metal cable trays shall be bonded together and to the PBB (Primary Bonding Busbar) or a SBB (Secondary Bonding Busbar).
- .4 Shall be coated to prevent rust or galvanic action.
- .5 Accessories and fittings such as elbows, splices, reducers, crossovers, tees and risers shall be used for any change in direction, height or size of the cable tray and shall be manufactured by the cable tray manufacturer.
- .6 Install cable trays at least 300mm away from fluorescent luminaries and cross power cables at right angles.
- .7 The minimum clearances for cable trays shall be in accordance with Canadian Electrical Code C22.1-09
- .8 150mm vertical clearance excluding depth of cable trays, between cable trays installed in tiers except where cables of 50mm diameter or greater are installed then the clearance shall be 300mm.
- .9 300mm vertical clearance from the top of cable trays to all ceilings, heating ducts, and heating equipment and 150mm for short length obstructions.
- .10 600mm horizontal clearance on one side of cable tray mounted adjacent to one another or to walls or other obstructions.

- .11 Support cable trays to suit loading and recommended support requirements in the Canadian Electrical Code, Part 1, for the applicable class. A support shall be placed within a maximum of 610mm on either side of any connection to a fitting.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Industry Canada - Terminal Attachment Program:
 - .1 CS-03, Compliance Specification.
- .2 National Fire Protection Association (NFPA):
 - .1 NFPA 72, National Fire Alarm and Signaling 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 public address and mass notification systems and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Drawings:
 - .1 Asbuilt drawings and diagrams, to be provided to Technical Authority upon completion and commissioning of Public Address System installation work.

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 public address and mass notification systems for incorporation into manual.
- .3 Include in Manual:
 - .1 Operation instructions.
 - .2 Description of system operation.
 - .3 Description of each subsystem operation.
 - .4 List showing each piece of equipment in system or subsystem by its original manufacturer name and model number.
 - .5 Part list showing parts used in equipment by identification numbers that are standard to electronics industry.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with project requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect public address systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Public address loudspeaker system to incorporate:
 - .1 Voice paging.
 - .2 Integrate seamlessly with phone system to be provided by others.
 - .3 Be an extension of and integrate with existing PA system installed at facility.
 - .4 Additional features as specified.
- .2 Operations:
 - .1 Paging:
 - .1 Voice paging from telephone set overrides broadcast or recorded music reproductions.
 - .2 Selective area page to areas as indicated.
 - .3 Emergency page to all areas.
 - .3 Systems in various configurations to be rack mounted (if and as required in conjunction with) existing PA system equipment installed on Telecommunications Rack #4 located within the Main Telecommunications Room on the ground floor.
 - .4 Public address system to integrate with and be an extension of existing zones within the facility and new construction area, with the ability to page to different zones from any input location.

2.2 MATERIALS

- .1 Conduits: in accordance with Division 26.
- .2 Communication Conductors: as indicated, supply and install conductors and wiring in accordance with manufacturer's recommendations in order to integrate and extend existing PA system as indicated.

2.3 COMPONENTS

- .1 Continuous duty cycle.
- .2 Modular system design.
- .3 Solid state, and suitable for rack mounting.
- .4 Maximum operating temperature: 65 degrees C.
- .5 Grounding conductor for system components.

2.4 EQUIPMENT RACK

- .1 Equipment (if required) is to integrate with existing and be mounted on Telecommunications Rack #4 location within the Main Telecommunications Room rack on the ground floor as indicated.
- .2 Existing PA system equipment located on Telecommunications Rack #4 within the Main Telecommunications Room on the ground floor may contain but not necessarily limited to the following components requiring integration:
 - .1 Monitor panel.
 - .2 Tuner.
 - .3 Relay assembly.
 - .4 Page/music selection panel.
 - .5 Timer: program time system with battery backup.
 - .6 Telephone paging interface equipment.
 - .7 Patch bay.
 - .8 Pre-amplifier mixer.
 - .9 Power amplifiers.
 - .10 Power supplies.
 - .11 Installation and service connections to various panels by plug-in type terminal blocks with barriers and screw type terminals.

2.5 PRE-AMPLIFIER MIXER

- .1 Integrate new speakers and zones as required with existing Bogen Gold Series GS250D PA Amplifier equipment located on Telecommunications Rack #4 within the Main Telecommunications Room on the ground floor.

2.6 PATCH BAY

- .1 Integrate new speakers and zones as required with existing Bogen Patch Bay equipment located on Telecommunications Rack #4 within the Main Telecommunications Room on the ground floor.
- .2 Each jack wired for 'normalled' configuration.

2.7 TELEPHONE PAGING EQUIPMENT WITH POWER SUPPLY UNITS

- .1 Lets authorized person select and page any area or all areas from their telephone.
- .2 Decodes typical dual tone multi-frequencies (DTMF) for selection of area or areas for paging.
- .3 Has facility to let emergency announcement override page in zones being paged.
- .4 Automatically starts page when it detects typical telephone ring signal.
- .5 Automatically ends page when it detects absence of voice signal for specific length of time.
- .6 Compatible power supply unit.
- .7 Certified by Industry Canada to CS-03 for direct connection to telephone network provided by others.

2.8 POWER BOOSTER AMPLIFIER

- .1 Integrate new speakers and zones and connect to existing power booster amplifier equipment installed on Telecommunications Rack #4 located within the Main Telecommunications Room on the ground floor.

2.9 POWER SUPPLY

- .1 Integrate new speakers and zones and connect to existing power supply equipment installed on Telecommunications Rack #4 located within the Main Telecommunications Room on the ground floor.

2.10 ADDITIONAL FEATURES

- .1 Tone signal generator for time and alarm signals.
- .2 Interface with telephone system to be provided by others.

2.11 SOUND REPRODUCERS

- .1 Sound reproducers to be compatible with existing Bogen system which utalizes Bogen Model CS1EZ ceiling speaker.
- .2 Ceiling mounting.
- .3 Finish colour: Semi-gloss white enamel.
- .4 Indoor enclosure.
- .5 Product Weight: 3 lb.
- .6 Power Rating (RMS): 1 watt continuous
- .7 8" cone speaker and pre-assembled steel ceiling grille.
- .8 Screw terminal connections type.
- .9 Line transformer: 70V matching transformer, single tap design.
- .10 Frequency response: 50 Hz to 12 kHz.
- .11 Dimensions: 13" Diameter by 3-1/4" Depth.
- .12 Impedance: 4900 ohms (for use on 70V amplifier outputs).
- .13 Sound Pressure Level: 95 dB at 4 feet with a 1-watt input on axis.
- .14 Tile bridge shall be capable to support the weight of the speaker. Existing system utilizes Bogen Model TB8.
- .15 Heavy-duty, wire-wound volume control with knob.

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 public address systems installation in accordance with manufacturer's written instructions.
- .2 Visually inspect substrate in presence of Technical Authority.
- .3 Inform Technical Authority of unacceptable conditions immediately upon discovery.

- .4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Technical Authority.

3.2 INSTALLATION

- .1 Install equipment in accordance with manufacturer's instructions, and as indicated.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Division 26.
- .2 Conduct intelligibility test.

3.4 CLOSEOUT ACTIVITIES

- .1 Manufacturer's factory service engineer to instruct:
- .2 Maintenance personnel in maintenance of system.
- .3 Operating personnel in use of system.

3.5 PROTECTION

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

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The work includes the supply, installation, configuration, programming, commissioning, integration, warranty and support of an Access Control System (ACS) for Hanger 6, CFB Trenton.
 - .2 This specification prescribes the technical requirements for hardware, software, equipment, installation and support as they relate to the implementation of the ACS.
 - .3 The purpose of this specification is to provide the Security Contractor with sufficient technical, commercial and project detail to submit a price and project plan to successfully deliver the work.

1.2 RELATED DOCUMENTS

- .1 The documents listed in this section are provided to the Security Contractor to illustrate the systems and equipment to be supplied and/or installed as per this specification.
 - .1 Single Line Drawings
 - .2 Security Component Layouts - Access Control
 - .3 Device Schedules
 - .4 Door Elevations

1.3 SCOPE OF TECHNOLOGY

- .1 The scope of work shall involve the following technologies and systems:
 - .1 Access Control System (ACS) Server
 - .2 Access Control; System (ACS) Software
 - .3 Access Panels, Card Readers
 - .4 Power Supplies
 - .5 Communications Devices
 - .6 Fibre, Copper Cabling and Connectors and associated equipment and components
- .2 Unless otherwise specified, the Security Contractor shall supply, install, integrate, commission, warrant and maintain all equipment listed in Part 2.
- .3 The Security Contractor shall integrate all equipment listed in Part 2 into a functioning system.

1.4 PROVIDED BY OTHERS

- .1 The following equipment and services will be provided by OTHERS:
 - .1 Access Control System (ACS) Application Server Hardware, including operating system and database management system
 - .2 Access Control System (ACS) Signal processor
 - .3 Riser Cable Runs
 - .4 Horizontal CAT-6 cabling from a POE+ network switch in the Telecommunication Rooms to the Access Control Panels.
 - .5 Network Switches
 - .6 UPS and Emergency Power

1.5 SYSTEM DESCRIPTION

- .1 The Access Control System is an Electronic System, or network of integrated systems designed to manage the control through select doors.
- .2 The ACS shall be capable of supporting up to 500 card reader controlled doors without the requirement for additional software or firmware changes at the distributed or central processors.
- .3 The ACS shall be installed within a separate independent conduit system.
- .4 Each component of the ACS shall be non-proprietary and not exclusive to any installing dealer. All components shall be off the shelf and available from any of at-least four full service dealers.

Part 2 Products

2.1 ACCESS CONTROLLERS

- .1 The Access Controllers shall:
 - .1 Be based on an open architecture hardware platform
 - .2 Include embedded crypto memory chips and data at rest encryption
 - .3 Support OSDB Protocols for reader connectivity
 - .4 Support 2 readers, 8 inputs (unsupervised/supervised, standard EOL: 1k/1k ohm 1%, ¼ watt) and 4 outputs

- (Four relays, Form C, NO 5 A @ 30 Vdc resistive, NC 3 A @ 30 Vdc resistive)
- .5 Support the following security and network capabilities
 - .1 IPv4/v6
 - .2 Host communications protected by TLS 1.2/1.1 or AES-256/128
 - .3 Controller/IO Expansion connection protected by AES
 - .4 Generate and load custom peer certificates for TLS
 - .5 Port based network access control using 802.1X
 - .6 FIPS 140-2 user of OpenSSL
 - .6 Support the following card reader functions:
 - .1 multiple card formats, paired and alternate readers, elevator, turnstile and biometric devices
 - .2 Anti-passback support (area, reader and time based)
 - .3 Programmable keypad user commands
 - .4 Threat level and operating mode
 - .7 Support up to 240,000 cards, 50,000 transactions, one RS-485 IO protocols; 255 access levels per cardholder, 64 bit cardholder ID
 - .8 Use 12 to 24 VDC +/- 10%, 500mA maximum
 - .9 Contain a 3 Volt Lithium on-board battery
 - .10 Communicate on 10-Base-T/100-Base-TX ethernet or 2-wire RS-485
 - .11 Comply with: UL294 Recognized, FCC Part 15 Class A, CE Compliant, RoHS (2011/65/EU & 2015/863), EU REACH (1907/2006), California Proposition 65, NIST Certified Encryption
 - .2 The Access Controllers shall be the Genetec SY-LP1502, Axis A1610-B Network Door Controller or ICT Protege GX Controller

2.2 SINGLE READER CONTROLLER

- .1 The Single Reader Controller shall:
 - .1 Be based on an open architecture hardware platform
 - .2 Include embedded crypto memory chips and data at rest encryption
 - .3 Support OSDB Protocols for reader connectivity
 - .4 Meet the following requirements:
 - .1 UL 294 recognized, CE compliant, FCC, RoHS

- .2 Supports OSDP Communications
 - .3 RS-485 connectivity
- .5 Meet the following specifications:
 - .1 POE powered
 - .2 Host Communication: RS-485, 2-wire, 4,000' (twisted pair with shield, Belden 9841)
 - .3 Reader Ports: 1 Reader Port
 - .4 Reader Power: Pass-through or 12 Vdc regulated 300mA
 - .5 LED: One-wire bi-color LED or two-wire LED
 - .6 Buzzer: Only with 'one-wire' LED
 - .7 Product Compliance: UL294 Recognized
- .2 TThe Single Reader Controller shall be the Genetec SY-MR50, Axis A1210-B Network Door Controller or ICT Protege WX DIN Rail Controller

2.3

CARD READER

- .1 The Card Reader shall:
 - .1 Support the following read ranges by card type:
 - .2 iCLASS Seos: 1.2" (3 cm)
 - .3 iCLASS: 4.7" (12 cm)
 - .4 MIFARE Classic: 4.7" (12 cm)
 - .5 MIFARE DESFire EV1/EV2: 2.0" (5 cm)
 - .6 iCLASS: 2.4" (6 cm)
 - .7 MIFARE Classic: 2.0" (5 cm)
 - .8 HID Prox: 2.8" (7 cm)
 - .9 Indala Prox: 2.0" (5 cm)
 - .10 EM4102 Prox: 4.3" (11 cm)
 - .11 HID Prox: 2.0" (5 cm)
 - .12 Indala Prox: 1.2" (3 cm)
 - .13 EM4102 Prox: 2.8" (7 cm)
 - .2 Support mounting on a single-gang switch box
 - .3 Be sized as follows: 8.4 cm x 12.2 cm x 2.4 cm
- .2 Meet the following certifications: UL294/cUL (US), FCC Certification (US), IC (Canada), CE (EU), C-tick (Australia, New Zealand), SRRC (China), MIC (Korea)4, NCC (Taiwan)4, iDA (Singapore)4, RoHS
- .3 The Card Reader shall be the HiD multi-CLASS SE RP40, WaveLynx Ethos™ EHR40 or Identiv uTrust TS Reader.

2.4 RECESSED DOOR CONTACT

- .1 The Recessed Door Contact shall:
 - .1 Provide a recessed application of door position switches
 - .2 1inch in size
 - .3 Closed loop with up to $\frac{3}{4}$ " gap in steel
 - .4 The Recessed Door Contact shall be the GRI MS184-12-G., Interlogix Sentrol 1076C-N or Adams Rite AR1090-01

2.5 PIR REQUEST TO EXIT

- .1 The PIR Request to Exit device shall:
 - .1 Provide a method of using motion (hands free) to trigger a request for exit on an access controlled door
 - .2 Support horizontal and vertical detection zone targeting and Digital Signal Processing
 - .3 Utilize infrared detection coupled with DSP sampling
 - .4 Provide a detection range of 10 feet (narrow) or 20 feet (whole body)
 - .5 Contain red/green detection lights
- .2 The PIR Request to Exit shall be the Kantech T-REX w/Backplate, HID REX-M Motion Sensor or Securitron XMS Motion Exit Sensor.

2.6 ACCESS CONTROL POWER SUPPLY

- .1 The Access Control Power Supply shall:
 - .1 Provide a facility for powering access control and intrusion devices
 - .2 Be integrated with Mercury hardware to streamline panel installation
 - .3 Provide a 12V and 24V DC dual voltage network managed access power system
 - .4 Provide remote monitoring and control of live voltage, remote battery load, power cycling, AC faults
 - .5 Contain an on-board fire alarm interface
 - .6 Support input power at 120/230 VAC 50/60Hz; 170 Watts (1.41 Amps)
 - .7 Provide overload and short circuit protection, over temperature protection and polarized AC power supply disconnect

- .8 Provide 4A@12V and 4A@240V DC, 150W maximum combined output power with continuous and resettable outputs, 8 managed outputs (3A each) and 8 auxiliary outputs (at 2.5A each)
- .9 Meet the following standards: UL294, UL603, UL1076, ULC S318, ULC S319, CSA C22.2 #107.1, CSA 22.2 #60950, CSFM / FCC Part 15, Subpart B, CE
- .2 The Access Control Power Supply shall be the LifeSafety Power FPO150-B100D8PM8NL4E4M,, Altronix Trove2M2 with eFlow104NB and LINQ8PD or Honeywell PW7K1IC with PW7K1ICE Enclosure Kit

2.7 END OF LINE DEVICES

- .1 End of line supervisory devices shall be mounted on a plate complete with a nameplate identifying appropriate zone/circuit identification at a control unit.
- .2 Suitable for single gang standard electrical box mounting.
- .3 Steel construction with lamacoid label

Part 3 Execution

3.1 GENERAL

- .1 The Security Contractor shall be responsible for the installation design, installation, site supervision, project management, test, commissioning and documentation of the Access Control System into a fully functioning system, including but not limited to:
 - .1 Transportation of equipment to site
 - .2 Storage of equipment on-site (suitable on-site space will be provided for the Security Contractor)
 - .3 Supply and installation of all signal cabling between the Access Control Panel and all peripheral devices, including but not limited to: readers, request-to-exit devices, door position switches, electronic locks
 - .4 Installation of equipment
 - .5 Programming and configuration of all hardware being installed or integrated to operate to client standards and expectations, including, but not limited to:
 - .1 ACS Server, CMCS, Workstations
 - .2 Access Control Panels
 - .3 Readers, Doors
 - .2 Programming and configuration of all server and receiver parameters to support the ACS devices and functionality.

- .3 Development of Shop Drawings
- .4 Development of Commissioning Forms
- .5 Development of As-Built Documentation
- .2 The Security Contractor's work shall meet TIA/EIA #569 Standard for Pathways and Spaces for equipment and services it installs and integrates.
- .3 The Security Contractor's work shall meet follow TIA/EIA #606 Standard for Labelling for equipment and services it installs and integrates.
- .4 The Security Contractor's work shall meet TIA/EIA #607 Standard for Grounding and Bonding for equipment and services it installs and integrates.
- .5 The Security Contractor's work shall meet TIA/EIA #568 Standard for Telecommunication Cabling for equipment and services it installs and integrates.

3.2 LOCATION

- .1 The Security Contractor shall provide the services included in this specification at Hanger 6 at CFB Trenton

3.3 TOOLS

- .1 The Security Contractor shall provide all tools, equipment and testing devices to implement all aspects of the installation.
- .2 The Security Contractor shall provide all ladders, lifting devices and scaffolding as required to install equipment.
- .3 The Security Contractor shall provide transportation of the installation team and small equipment for the duration of the onsite work.

3.4 HOURS OF WORK

- .1 Normal business hours are from 7:00 a.m. to 6:00 p.m., Monday through Friday.
- .2 The Security Contractor shall coordinate on-site delivery and installation with the Project Manager and shall provide a minimum of three weeks' notice for the commencement of work on-site.
- .3 The Construction Manager will provide access to the site until completion of the contract.
- .4 All commissioning tasks shall be completed prior to "going live" with the new Access Control System.
- .5 The client shall not be responsible for any overtime hours, work done outside of normal business hours as outlined

above, or any additional manpower required to meet the project schedule.

3.5 SECURITY

- .1 The Security Contractor shall be responsible for security of all personal items as well as supplied equipment and materials until installed into final locations, and accepted by the Project Manager.
- .2 The Security Contractor shall return all keys, codes and authorization media to the Project Manager upon completion of the project.

3.6 PROJECT MANAGEMENT

- .1 The Security Contractor shall:
 - .1 Coordinate, convene and provide minutes for a pre-installation meeting, once the shop drawings are approved, to plan equipment delivery, trade coordination, installation and configuration of system devices and components.
 - .2 Provide the Project Manager and the Contract Authority with weekly progress reports detailing progress to date and the work planned for the week ahead.
 - .3 Attend progress review meetings as directed by the Project Manager.
 - .4 Immediately update the Project Manager with any issues that requires a decision by the Project Manager to facilitate the installation.
 - .5 Work through the Contract Authority and in agreement with the Project Manager on any issues that would modify this contract.
 - .6 All site arrangements will be communicated to the Construction Manager by the site contact.

3.7 DELIVERY, STORAGE AND HANDLING

- .1 The Security Contractor shall:
 - .1 Deliver and store materials in manufacturer's original packaging labelled to illustrate name, brand, type, and grade.
 - .2 Store materials in a protected dry location above the ground in accordance with manufacturer's instructions.
 - .3 Not open packaging or remove labels until time for installation.
 - .4 Remove all packaging from the site and recycle as appropriate.

- .5 Protect all equipment from damage and construction debris until substantial completion is acknowledged by the Project Manager.
- .6 Protect adjacent work areas against the spread of dust and dirt beyond the work areas.
- .7 Protect operatives and other users of the site from all hazards.
- .2 Any products or equipment stored on site is the responsibility of the Security Contractor. The client shall not be responsible for theft or damage done to any stored products or material.

3.8 EQUIPMENT SUPPLY AND INSTALLATION

- .1 The Work shall be carried out in accordance with the drawings and specifications and their intent. The Security Contractor shall provide all miscellaneous materials (such as connectors, fasteners, brackets, cable wrap, etc.) necessary to complete the work.
- .2 The Work shall include all materials, equipment, labour, devices, tools and other items found necessary to complete, perfect, integrate, test, warrant and maintain any portion of the equipment in a substantial manner and in compliance with the requirements of the drawings and specifications without any additional charge to the client and shall include the supply and installation of all devices and any other work required to provide a fully functional system.
- .3 The Security Contractor shall install all equipment in accordance with the manufacturer's specifications and instructions.
- .4 All references to manufacturers' or suppliers' model numbers and other pertinent information provided in the specification are intended to establish minimum standards of performance, function and quality.
- .5 Should any dispute arise as to the quality or fitness of products, the decision rests strictly with the Project Manager based upon requirements of the Contract Documents.
- .6 For equipment for which substitutions are permitted, the Security Contractor shall supply proof that such substitute equipment meets or exceeds the features, functions, performance and quality of the specified equipment. If, in the opinion of the client, the substitute equipment does not meet the specification, the Security Contractor shall furnish the specified equipment at its own expense.
- .7 For equipment specified as NO SUBSTITUTION that is not available, the Security Contractor shall advise the Project Manager in writing.

- .8 All products shall bear the seal of approving agencies as required by the authorities having jurisdiction.
- .9 All products of one type shall be by the same manufacturer.
- .10 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.

3.9 WORKMANSHIP AND QUALITY ASSURANCE

- .1 The Security Contractor shall:
 - .1 Be solely responsible for quality control of the Work.
 - .2 Examine site and conditions likely to affect the work and be familiar and conversant with existing conditions.
 - .3 Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, Provincial, and Municipal authorities having jurisdiction.
 - .4 Perform all work in accordance with the National Building Code of Canada (NBC) 2010, National Fire Code of Canada (NFC) 2010 and the Ontario Building Code (OBC) 2012, including all amendments up to the closing date of the procurement.
 - .5 Obtain (and pay for) the necessary permits and approvals from all such authorities as required, including but not limited to: the City having jurisdiction, and the Electrical Safety Authority (ESA).
 - .6 Pay all costs associated with the transportation of products (to and from the site) required in the performance of the work.
 - .7 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials; and regarding labelling and the provision of Material Safety Data Sheets (MSDS) acceptable to Human Resources and Skills Development Canada, Labour Program. Ensure that any chemicals (if applicable) used in product assembly are accompanied with MSDS (Material Safety Data Sheets) and ready for viewing if applicable building authority (i.e. OSH Committee) requires it.
 - .8 Review the designated substance report and take the necessary precautions to protect the health and safety of the workers and the environment. Such report shall be provided to the Security Contractor by the Project Manager.

- .9 Provide and erect common-use signs related to traffic control, information, instruction, use of equipment, public safety devices, etc. in both official languages or by the use of commonly-understood graphic symbols to the approval of the Project Manager.
- .10 Utilize on-site manufacturer-trained and ULC-certified installers during the course of the installation.
- .11 Ensure that the installation is conducted in a neat and professional manner and ensure the highest level of quality is maintained.
- .12 Visit the site during the pathway installation to ensure the conduit and wiring is installed as per ULC and manufacturer's requirements.
- .13 Provide certified test reports from approved independent testing laboratories indicating compliance with specifications for special performance characteristics and physical property; such certificates shall be signed by the manufacturer that materials comply with specified performance characteristics and physical properties.
- .14 Submit ULC /UL Product Certificates.
- .2 All Products shall be new, of high commercial standard and quality and free from any defects. All equipment shall be installed to present no safety hazards to the public, operating personnel or other trades. Ensure that all equipment client purchased to be installed is new, does not include refurbished equipment and is of current manufacture. Any missing or damaged products must be replaced by the manufacturer. Ensure that all parts supplied by the Contractor in performing the maintenance, repair or replacement services as per Warranty arrangements are new.
- .3 The Security Contractor shall carry out all work using qualified, factory-certified technicians.
- .4 Smoking is not permitted in the building. Obey smoking restrictions on the property.
- .5 The Security Contractor shall:
 - .1 Provide protection for finished and partially finished building finishes and equipment during performance of the work.
 - .2 Provide necessary screens, covers and hoardings.
 - .3 Be responsible for damage incurred due to lack of or improper protection.
 - .4 Cut existing surfaces as required to accommodate the new work.
 - .5 Remove all items so shown or specified.

- .6 Patch and make good surfaces cut, damaged or disturbed, to the approval of the Project Manager.
- .7 Match existing material, colour, finish and texture.
- .8 Wash and polish glass, ceramic tile, aluminium, chrome, stainless steel, baked or porcelain enamel, plastic laminate and other surfaces, floors, hardware and fixtures. All cleaning shall be undertaken at least equal to that previously existing and to the approval of the Project Manager.
- .6 The Security Contractor shall provide on-site support for the day during which the work is expected to be completed after successful acceptance testing and performance verification is completed. Such support shall include sufficient Security Contractor technical and business resources.

3.10 SHOP DRAWINGS

- .1 Within 15 days of receipt of an order to proceed, the Security Contractor shall provide six sets of Shop Drawings. Shop Drawings shall be provided in a three-ringed binder and shall be divided into sections to provide for easy review. As well, a DVD copy of all electronic files shall be provided in native file format and .pdf. Shop Drawings shall include, at a minimum, the following:
 - .1 Technical Data Sheets
 - .2 Floor plan drawings indicating device installation locations
 - .3 Single Line Drawings
 - .4 System interconnection diagrams and power requirements
 - .5 Device schedules
 - .6 Equipment Lists
 - .7 Project Plan and Schedule
 - .8 Contractor's Project Manager Name and Workforce Loading Schedule
 - .9 Commissioning Plan, Schedule and Forms
 - .10 Statement of Compliance with Specification
 - .11 Training Plan
- .2 Where applicable, the Security Contractor shall also provide wiring, single line and schematic design, drawings and diagrams illustrating interconnections with the work of other Contractors.
- .3 Shop Drawings shall be signed by an authorized representative of the Security Contractor and shall include a transmittal sheet.

- .4 Shop Drawings must be reviewed and signed by the Project Manager and Commissioning Manager before any work affected by the submittal proceeds.
- .5 Adjustments made on the shop drawings by the Project Manager are not intended to change the Contract Price. If adjustments affect the value of the work, such adjustment shall be described in writing to the Project Manager prior to proceeding with the work.

3.11 WORK SITE CONDITIONS

- .1 The Security Contractor shall be responsible for the security and protection of all equipment supplied and installed as part of this work before, during and after installation.
- .2 The Security Contractor shall perform final cleaning of all electrical and security components.
- .3 All areas shall be cleaned with a vacuum cleaner at the end of each working day. All public areas shall be vacuumed and broom swept during working hours to avoid build-up of debris.
- .4 The Security Contractor shall examine work areas prior to commencing work. The Security Contractor shall remedy conditions detrimental to the proper and timely completion of the work where possible and advise the Project Manager regarding conditions that are the responsibility of others.

3.12 IMPLEMENTATION

- .1 The Security Contractor shall be responsible for the supply and installation of all additional signal and power cabling required for a complete and functional Access Control System. Such cable shall conform to manufacturers' specifications and be installed to meet industry best practices.
- .2 Unless otherwise indicated in specifications, the Security Contractor shall:
 - .1 Install or erect products in accordance with manufacturer's instructions
 - .2 Not rely on labels or enclosures provided with the products
 - .3 Obtain written instructions directly from the manufacturer
 - .4 Notify the Project Manager, in writing, of conflicts between specifications and manufacturer's instructions, so that the Project Manager may establish a course of action

- .3 Should the Security Contractor improperly install or erect the products due to failure in complying with the manufacturers' instructions, the Security Contractor authorizes the Project Manager to remove and re-install the products at no increase in the Contract Price or Contract Time.
- .4 When breaking into or connecting to existing services or utilities, the Security Contractor shall execute the work at times directed by the Project Manager, local governing authorities or the client, with minimum disturbance to work and/or building occupants and pedestrian and vehicular traffic.
- .5 The Security Contractor shall submit a written request in advance of any cutting or alteration which affects:
 - .1 Structural integrity of any element of the 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
 - .5 Work of Project Manager, Security Consultant or separate contractor.
- .6 Such written request shall include:
 - .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 Alternatives to cutting and patching
 - .6 Effect on work of the Client or separate contractor
 - .7 Written permission of affected separate contractor
 - .8 Date and time work will be executed
- .7 In preparation for carrying out the work, the Security Contractor shall:
 - .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching
 - .2 After uncovering, inspect conditions affecting performance of work
 - .3 Provide supports to assure structural integrity of surrounding
 - .4 Provide devices and methods to protect other portions of project from damage

- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water
- .8 The Security Contractor shall:
 - .1 Execute cutting, fitting, and patching to complete the work
 - .2 Remove and replace defective and non-conforming work
 - .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 are not allowed on masonry work without prior approval
 - .6 Restore work with new products in accordance with requirements of Contract Documents
 - .7 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces
 - .8 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with fire-stopping material to the full thickness of the construction element
 - .9 Refinish surfaces to match adjacent finishes; refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing the entire unit
 - .10 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise

3.13 MARKINGS AND LABELLING

- .1 The Security Contractor shall label all cable and equipment as per drawings.
- .2 The label standard is to have self-adhesive, elasticized clear labels with black writing on white surface.
- .3 Labels shall be affixed to both ends of the cable.
- .4 The writing shall be machine made.
- .5 The cable number shall follow a schema approved by the Project Manager.
- .6 The label shall be approximately 4 inches from the termination, with its least significant digit nearest to the connector.
- .7 Labels shall remain accessible at all time and in all conditions.

- .8 Label shall be a Brady type.
- .9 Prior to installation, the contractor shall submit a sample of equipment and cable labels for approval by the Project Manager.

3.14 HEALTH AND SAFETY

- .1 The Security Contractor shall:
 - .1 Submit a site-specific Health and Safety Plan within 7 days of Notice to Proceed and prior to commencement of work. The Health and Safety Plan must include: results of site specific safety hazard assessment and results of safety and health risk or hazard analysis for site tasks and operation.
 - .2 Submit copies of incident and accident reports, if required
 - .3 Submit Material Safety Data Sheets (MSDS) to the Project Manager
 - .4 Schedule and administer a Health and Safety Meeting with the Project Manager prior to commencement of the work
 - .5 Be responsible for the health and safety of persons on-site, safety of property on site and for protection of persons adjacent to the site and environment to the extent that they may be affected by the conduct of the work
 - .6 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial and local statutes, regulations and ordinances and with the site-specific Health and Safety Plan
 - .7 Comply with the Ontario Health and Safety Act and Regulations for Construction Projects
 - .8 Comply with the Occupational Health and Safety Regulations, 1996.
 - .9 Comply with the Canada Labour Code, Canada Occupational Safety and Health Regulations
 - .10 Employ and assign to work, a competent and authorized representative as a Health and Safety Coordinator. Such Health and Safety Coordinator must:
 - .1 Have site-related work experience specific to the activities associated with work similar to this project
 - .2 Have working knowledge of occupational health and safety regulations
 - .3 Be responsible for completing the Contractor's Health and Safety training sessions and ensuring

that personnel not successfully completing the required training are not permitted to enter the work site or perform work on the site

- .4 Be responsible for implementing, enforcing and monitoring site-specific contractor's health and safety plan
- .5 Be on-site during the execution of the work and report directly to, and be under direction of, a supervisor
- .6 Immediately address health and safety non-compliance issues identified by the Project Manager or the authority having jurisdiction
- .7 Provide the Project Manager with a written report of action taken to correct non-compliance of health and safety issues identified
- .8 Use powder actuated devices only after receipt of written permission from the Project Manager
- .11 The Project Manager may stop work on the project if non-compliance of health and safety regulations is not corrected

3.15 COMMISSIONING REQUIREMENTS

- .1 This section includes general requirements relating to commissioning of the system and to verifying the components, equipment, sub-systems, systems, and integrated systems.
- .2 Commissioning is a planned program of tests, procedures and checks carried out systematically on the system. Commissioning is performed after the security devices are completely installed, functional and the Security Contractor's Performance Verification responsibilities have been completed and approved. The objectives of commissioning are:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
 - .2 Ensure appropriate documentation is provided to the client.
 - .3 Effectively train client staff.
- .3 Design Criteria: The system shall meet the included functional and operational requirements.
- .4 Should the system, system components, and associated controls be incorrectly installed or malfunction during commissioning, the Security Contractor shall correct deficiencies, re-verify equipment and components within the un-functional system, including related systems as deemed

- required by the Project Manager to ensure effective performance.
- .5 Costs for corrective work, additional tests and inspections to determine acceptability and proper performance of such items to be borne by the Security Contractor. These costs are to be in form of progress payment reductions or hold-back assessments.
 - .6 Before Commissioning begins the Security Contractor shall ensure that:
 - .1 The installation of related components, equipment, sub-systems, and systems is complete.
 - .2 The Security Contractor fully understands the commissioning requirements and procedures.
 - .3 The commissioning documentation is shelf-ready.
 - .4 The design criteria and intent and special features are fully understood by the Security Contractor.
 - .5 Complete start-up documentation has been submitted to the Project Manager.
 - .6 Commissioning schedules are up to date.
 - .7 As-built system schematics are available.
 - .7 All conflicts shall be reported to the Project Manager before start-up to obtain clarification. Failure to report a conflict and obtain clarification will result in application of the most stringent of requirements.
 - .8 No later than four weeks after contract award, the Security Contractor shall submit the name of the Security Contractor's commissioning agent, draft commissioning documentation and a preliminary commissioning schedule. Note that the commissioning schedule shall include timelines for commissioning report approval, verification of reported results, repairs/retesting/re-commissioning/ re-verification and training.
 - .9 The Security Contractor shall assume the liability and cost associated with inspections. This shall include disassembly and re-assembly after approval, starting, testing and adjusting, including the supply of testing equipment.
 - .10 The Project Manager, Commissioning Manager and Security Consultant shall witness the commissioning.
 - .11 The Security Contractor shall:
 - .1 Coordinate the time and location of the testing.
 - .2 Provide testing documentation for approval by the Project Manager and Commissioning Manager.

- .3 Arrange for the Commissioning Manager to witness the tests.
- .4 Obtain written approval of the test results and documentation from the Commissioning Manager.
- .5 Compare completed installation with the manufacturer's published data, record discrepancies and review with the manufacturer.
- .6 Modify procedures detrimental to equipment performance and review same with the manufacturer before start-up.
- .7 Use manufacturers trained start-up personnel, if applicable.
- .8 Verify with the manufacturer that the testing as specified will not void the warranty.
- .9 Be experienced in the design, installation and operation of the security system and its devices.
- .10 Be able to interpret test results accurately.
- .11 Be able to report results in a clear, concise and logical manner.
- .12 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and commissioning.
- .13 Conduct start-up and testing in following distinct phases:
 - .12 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .13 Start-up: follow accepted start-up procedures.
 - .14 Operational testing: document equipment performance.
 - .15 System PV: include repetition of tests after correcting deficiencies.
 - .16 Post-substantial performance verification: to include fine-tuning.
 - .17 Correct deficiencies and obtain approval the Commissioning Manager after distinct phases have been completed and before commencing next phase.
 - .18 Document required tests on approved PV forms.
 - .19 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by the Commissioning Manager. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

- .1 Minor equipment/systems: implement corrective measures approved by the Project Manager
- .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by the Project Manager.
- .3 If evaluation report concludes that major damage has occurred, the Project Manager shall reject equipment.
- .4 Rejected equipment to be removed from site and replaced with new.
- .5 Subject new equipment/systems to specified start-up procedures.
- .20 Assemble start-up documentation as follows:
 - .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 the Commissioning Manager to repeat start-up at any time.
- .21 Operate and maintain the equipment, after start-up, as directed by the manufacturer.
- .22 Develop a written maintenance program and submit same to the Project Manager for approval.
- .23 Operate and maintain the system for the length of time required for commissioning to be completed.
- .24 After completion, operate and maintain the systems until issuance of a certificate of substantial performance.
- .25 Repair, replace or repeat the starting and/or PV procedures if the start-up, testing and or PV produce unacceptable results, until acceptable results are achieved.
- .26 Provide manpower and materials and assume all costs for re-commissioning.
- .27 Notify the Project Manager at least 21 days prior to the start of commissioning.
- .28 Start commissioning after elements of the building affecting start-up and performance verification of the systems have been completed.
- .29 Submit to the Project Manager a complete list of all instruments proposed to be used, including serial number, current calibration certificate, calibration date, expiry date and accuracy of all test equipment.

- .30 Come prepared with all tools/facilities required for such commissioning (e.g., ladders, 2-way radios, etc.)
- .31 The Project Manager, Security Consultant and Commissioning Manager shall witness the commissioning.
- .32 Where specified start-up, testing or commissioning procedures duplicate verification requirements of an authority having jurisdiction, the Security Contractor shall arrange for the authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility. The Security Contractor shall obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction and shall provide copies to the Project Manager within five days of test and with the commissioning report.
- .33 The Security Contractor shall assume costs incurred by the client for third and subsequent verifications where the verification of reported results fail to receive the Commissioning Managers' approval and where repetition of second verification again fails to receive approval and where the Commissioning Manager deems that the Security Contractor's request for second verification was premature.
- .34 The Security Contractor shall correct deficiencies found during start-up and commissioning to the satisfaction of the Project Manager and report problems, faults or defects affecting commissioning to the Project Manager in writing. All commissioning activities shall cease until problems are rectified. The Security Contractor shall only proceed with written approval from the Project Manager.
- .35 Upon completion of the commissioning, the Security Contractor shall leave the systems in normal operating mode. Except for warranty and seasonal verification activities specified in the commissioning specifications, complete commissioning prior to issuance of Certificate of Completion. Commissioning is to be considered complete when contract commissioning deliverables have been submitted and accepted by the Project Manager.

3.16 COMMISSIONING PLAN

- .1 The Project Manager shall monitor the Security Contractor's performance against the commissioning schedule.
- .2 Upon completion of the commissioning to the satisfaction of the Commissioning Manager and the Project Manager, the Security Contractor shall lock the systems into their final positions, indelibly mark settings and include such in the commissioning reports.

3.17 COMMISSIONING FORMS

- .1 Three copies of the Commissioning Forms shall be provided by the Security Contractor and completed for all equipment, systems and integration elements of this project.
- .1 The Security Contractor shall develop Commissioning Forms including the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 The Security Contractor shall use checklists for the installation of the security devices. A document describing the checks that have been made and verifying same shall be delivered to the Project Manager and Commissioning Manager before operational commissioning is undertaken.
- .3 The Security Contractor shall provide Product Information (PI) forms which compile gathered data on items of equipment produced by the security device manufacturer, including nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that are necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation shall be submitted to the Project Manager at the completion of work. And prior to Performance Verification (PV).
- .4 The Security Contractor shall perform performance verification using Performance Verification (PV) reports which are used for checks, running dynamic tests making adjustments to the devices to ensure correct, efficient and independent operation.
- .5 To facilitate the commissioning of the new security devices, the Security Contractor shall develop PV forms which will be noted in the test and sign-off documents as acceptable or not acceptable (deficiency).
- .6 Commissioning Forms are used to verify the installation and to record performance when starting the systems and equipment. The strategy for the use of the commissioning forms is reflected in the Security Contractor's responsibilities which are to:
 - .1 Provide project-specific Commissioning forms with Specification data included.

- .2 Provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
- .3 Confirm operation as per design criteria and intent.
- .4 Identify variances between design and operation and reasons for variances.
- .5 Verify operation in specified normal and emergency modes and under specified load conditions.
- .6 Record analytical and substantiating data.
- .7 Verify reported results.
- .8 Bear signatures of recording technician and the Project Manager and Commissioning Manager.
- .9 Submit immediately after tests are performed.
- .10 Provide the Project Manager and Commissioning Manager with originals of completed forms.
- .11 Maintain copy on site during start-up, testing and commissioning period.
- .12 Provide in both hard copy and electronic format with typed written results.
- .7 Physical Unit Installation
 - .1 Level
 - .2 Plumb
 - .3 All Dimensions Match
 - .4 Appearance
 - .5 Cleanliness
 - .6 Finish as per Specification
 - .7 Floor/Wall Patch/Repair/Clean Complete
- .8 Operational System Checks
 - .1 Operational System Checks/Commissioning tests shall be developed by the Security Contractor and approved by the Project Manager and shall address, at a minimum:
 - .1 Valid Card Operation
 - .2 Invalid Card Operation
 - .3 Event Logging
 - .4 24 Hour Battery Test

3.18 AS-BUILT DOCUMENTATION

- .1 The Security Contractor shall submit three copies of as-built documentation (and one CD containing all electronic files) annotated with the changes made during installation of the Work such that a complete set of "as installed"

plans, wiring diagrams and documents can be prepared by others.

- .2 The format of such as-built documentation shall:
 - .1 Be organized in the form of an instruction manual
 - .2 Use vinyl, hard-covered 3 "d" ringed binders, loose leaf, 219mm x 279 mm with spine and face pockets
 - .3 Correlate data into related consistent groupings, identifying contents on each spine, when multiple binders are used
 - .4 Include a cover identifying each binder contents
 - .5 Be arranged by systems
 - .6 Be tabbed for each section
 - .7 Include all drawings as noted in this section below
- .3 Final acceptance of the Project will be predicated on receipt and approval of As-Built Documentation.
- .4 The Security Contractor shall record, as work progresses, all equipment, cabling and conduit locations, including wiring schedules (however limited).
- .5 As-Built Documentation shall provide confirmed installation locations, quantities and from-to schedules for all equipment and devices included in the Works. At a minimum, As-Built Documentation shall include:
 - .1 Technical Data Sheets
 - .2 Floor plan drawings indicating device installation locations
 - .3 Single Line Drawings
 - .4 System interconnection diagrams and power requirements
 - .5 Device Schedules
 - .6 Equipment Lists
 - .7 System Interconnection Diagrams, Wiring Schematics and Power Distribution
 - .8 Commissioning Results
 - .9 Programming and Configuration Data
 - .10 Naming Convention Guide
 - .11 Training Manuals
 - .12 Special tools: provide special tools to the client in quantities as required for timely and professional maintenance and troubleshooting of the projects
 - .13 Internal wiring schematics for security devices
 - .14 Manufacturer Operation and Maintenance Manuals
 - .15 Materials and Finishes Schedule, including:

- .16 Building products, applied materials, and finishes:
include product data, with catalogue number, size,
composition, and colour and texture designations
- .17 Information for re-ordering custom manufactured products
- .18 Instructions for cleaning agents and methods, precautions
against detrimental agents and methods, and recommended
schedule for cleaning and maintenance
- .6 System configuration data (for all software programming,
configuration and settings performed during the works, even if
performed by others).
- .7 Upon final acceptance of the As-Built Drawings, the Security
Contractor shall return all site specific data related to the
project and delete such data from any of its own storage
devices.

3.19 WARRANTY

- .1 This Section describes the Security Contractor's
responsibilities in relation to the provision of warranty
services for the works included in this Section.
- .2 The Security Contractor shall furnish a one year written
warranty in form stipulated by the DCC Representative, signed by
the Security Contractor agreeing to repair or replace any of the
work which has failed as a result of defects in materials or
workmanship during the term of the warranty.
- .3 The Security Contractor shall provide warranty services in
accordance with the requirements listed in this Section. The
warranty services are to be provided to keep the equipment
in, or restore the equipment to, good working order. Two
primary services shall be provided during the warranty
period: Remedial Services.
 - .1 Remedial Services: The Security Contractor shall respond
to warranty service requests and deliver repair and
replacement products and services in a timely manner.
Such remedial services shall be carried out in accordance
with the Security Contractors' responsibilities as
described in this Section.
- .4 All warranty services shall be performed in a workmanlike
manner in accordance with manufacturer standard practices and
shall be completed in accordance with a mutually agreed upon
schedule.
- .5 The Security Contractor shall be available to provide warranty
services in a timely manner.

- .6 Items NOT covered include: damage caused by misuse, abuse, accident, disaster, fire, flood, water, wind, lightning, and Acts of God; items designed to fail in order to protect the equipment, such as power and/or lightning suppressors; damage caused to conduit, cable & wiring resulting in cuts, shorts or un-traceable loss of voltage or communications; and all security panel Gel-cell batteries.
- .7 The Security Contractor shall provide a detailed Error Log and written analysis of the cause of each error including all steps taken to resolve the error. This Error Log shall be created by the Security Contractor and maintained and monitored on-line. The Error Log shall also be available to DND at any time, as requested and determined by DND.
- .8 Within the warranty period, the Security Contractor shall install any and all software and firmware updates, bug fixes and maintenance releases provided by the relevant system manufacturers during the term of the contract. While the installations shall be performed by the Security Contractor, the purchase of these updates is not the responsibility of the Security Contractor.
- .9 The Security Contractor shall not use any subcontractors to provide the services described in this Section without the express written approval of the DND.
- .10 The Security Contractor shall perform a site visit six months after substantial completion to confirm operation of the security equipment and devices at the performance level at the time of installation in accordance with manufacturer's specifications. In addition, the Security Contractor shall perform all oiling, lubricating and mechanical maintenance checks, as per manufacturer's specifications.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 The work includes the supply, installation, configuration, programming, commissioning, integration, warranty and support of an Intrusion Alarm System (IAS) for Hanger 6, CFB Trenton.
 - .2 This specification prescribes the technical requirements for hardware, software, equipment, installation and support as they relate to the implementation of the IAS.
 - .3 The purpose of this specification is to provide the Security Contractor with sufficient technical, commercial and project detail to submit a price and project plan to successfully deliver the work.

1.2 RELATED DOCUMENTS

- .1 The documents listed in this section are provided to the Security Contractor to illustrate the systems and equipment to be supplied and/or installed as per this specification.
 - .1 Single Line Drawings
 - .2 Security Component Layouts - Intrusion Alarm
 - .3 Device Schedules
 - .4 Door Elevations

1.3 SCOPE OF TECHNOLOGY

- .1 The scope of work shall involve the following technologies and systems:
 - .1 Intrusion Alarm System (IAS) Server
 - .2 Intrusion Alarm System (IAS) Software
 - .3 Intrusion Alarm Sensors
 - .4 Intrusion Alarm Panels and Keypads
 - .5 Power Supplies
 - .6 Communications Devices
 - .7 Fibre, Copper Cabling and Connectors and associated equipment and components
- .2 Unless otherwise specified, the Security Contractor shall supply, install, integrate, commission, warrant and maintain all equipment listed in Part 2.

- .3 The Security Contractor shall integrate all equipment listed in Part 2 into a functioning system.

1.4 PROVIDED BY OTHERS

- .1 The following equipment and services will be provided by OTHERS:
 - .1 Intrusion Alarm System (IAS) Application Server Hardware, including operating system and database management system
 - .2 Intrusion Alarm System (IAS) Signal processor
 - .3 Central Monitoring and Control Station (CMCS)
 - .4 Intrusion Alarm System (IAS) Workstations, including operating system and database management system
 - .5 Intrusion Alarm System (IAS) Application Software
 - .6 Riser Cable Runs
 - .7 Horizontal CAT-6 cabling from a POE+ network switch in the Telecommunication Rooms to the Intrusion Alarm Panels.
 - .8 Network Switches
 - .9 UPS and Emergency Power

1.5 SYSTEM DESCRIPTION

- .1 The Intrusion Alarm System is an Electronic System, or network of integrated systems designed to monitor alarms in Hanger 6 CFB Trenton. The Intrusion Alarm System shall consist of a series of alarm devices and a number of 24 hour and secure areas within each building which shall be monitored by a central monitoring station by means of a continuously supervised communications link.
- .2 The IAS shall be capable of supporting up to 1000 alarm inputs without the requirement for additional software or firmware changes at the distributed or central processors. The IAS shall monitor for intrusion attempts only and operate completely separately from all other systems, including access control, Fire Alarm, energy management systems, and Emergency Communications Systems.
- .3 The IAS shall be installed within a separate independent conduit system.
- .4 Each component of the IAS shall be non-proprietary and not exclusive to any installing dealer. All components shall be off the shelf and available from any of at-least four full service dealers.
- .5 All components and central monitoring station must comply with the latest edition of CAN/ULC-S304.

- .6 All intrusion alarm enclosures containing electronic components shall be equipped with a tamper switch. This also includes all receptacle back boxes for motion detectors and door contacts, power supplies, panel enclosures and junction boxes.
- .7 All necessary features to comply with the latest edition of CAN/ULC-S304 shall be provided at no additional cost to the client.

Part 2 Products

2.1 INTRUSION ALARM PANEL

- .1 The Intrusion Alarm Panel shall have a base capacity of 16 fully supervised and programmable zones with integral power supply and supervised battery charger, auxiliary power for powering security detection devices integral supervised digital alarm communicator, two general purpose program controllable outputs which can be programmed as general purpose outputs or as Addressable loops and a supervised bell/siren output.
- .2 The panel shall be expandable to a maximum of 128 zones by adding standard hardwired 8 and/or 16 zone modules connected to the base panel via a supervised four-wire power/communication bus, by adding up to 112 addressable detection devices to one or both of the addressable loops on the base panel or by adding 64 zone 433 MHz. Narrow Band wireless receivers (to expand coverage area, up to 8 receivers shall be supported) to the four-wire communication bus. The system shall be capable of expansion using hardwired, addressable and wireless simultaneously in any mix that suits the application. The system shall support hardwired seismic sensors and programmable scheduled testing of these seismic sensors.
- .3 The system shall accommodate up to 16 LCD keypads which are powered from the base panel via the four-wire communications bus. LCD keypads shall have a display capacity of at least 32 alphanumeric characters with the display having brightness and contrast control. Control keys shall be backlit for low light level ease of use. The keypads shall include individual "Armed", "Ready" and "Trouble" indicators and five programmable 'function' buttons and three keypad activated alarm buttons. Keypads shall have the capability to operate in a power-save mode in the event of a power failure.
- .4 The Intrusion Alarm Panel shall be capable of network (LAN/WAN) and Internet communications according to ULC Level5 and/or UL-AA (Highline Security) standards. The

Network communicator shall utilize 128-bit AES encryption over 10/100 base-T networks and support static or dynamic IP addressing. The IP communicator shall be capable of sending alarm events to a primary and backup IP receiver address and up to two standard email addresses. The internet communicator shall perform full alarm reporting directly to the central monitoring station as well as performing full system configuration programming and viewing system status using remote upload/download software over encrypted connection. For security purposes, the internet communicator shall be capable of end-to-end supervision and hardware substitution detection.

- .5 The Intrusion Alarm Panel shall be contained in a cabinet which can be surface mounted, with a hinged door with keylock and tamper switch.
- .6 Space shall be provided for two 12V 7AH lead-acid rechargeable batteries.
- .7 The Intrusion Alarm Panel shall support an operating environment of 0 to 50 degrees C; 90% RH non-condensing
- .8 Four(4) minutes audible alarm activation following an intrusion alarm condition (applicable for any intrusion alarm).
- .9 Allows for the supervision of an AC power failure, low battery signal, a failure of communication link and auxiliary power failure etc.
- .10 The Intrusion Alarm Panel shall be listed and be subject to the following approvals:
 - .1 IC (Industry Canada)
 - .2 UNDERWRITERS LABORATORY CANADA (ULC)
 - .1 ULC-S527 - "Central Station Fire Alarm System Units"
 - .2 ULC-S3013 - "Local Alarm Units Burglary"
 - .3 ULC-S304 - "Central & Monitoring Station Burglar Alarm System Units"
 - .4 ULC-S310 - "Household Burglar Alarm"
 - .5 ULC-S545 - "Household Fire Warning"
 - .6 UL-294 - "Access Control"
 - .7 ULC Level 5
- .11 The Intrusion Alarm Panel shall come complete with requisite transformer and two 12V 7AH lead-acid rechargeable batteries.
- .12 The Intrusion Alarm Panel shall be manufactured by Digital Security Controls (DSC), Digital Monitoring Product (DMP) or Honeywell.

2.2 KEYPAD

- .1 The Keypad shall provide a plain language interface using a 32 character LCD display with adjustable brightness and contrast.
- .2 The Keypad shall:
 - .1 Support the performance of all system programming and user operations
 - .2 Be connected to the Intrusion Alarm Panel using a 4-wire system communications bus to provide power for the keypad and a communications channel.
 - .3 Support a two-line, 32 character LCD display
 - .4 Support both display contrast and brightness.
 - .5 LCD display and Keys backlit for low light viewing.
 - .6 Provide individual LED indicators for trouble, armed and ready states
 - .7 Provide a piezo buzzer for audible feedback for correct/incorrect key entries, entry/exit alerts and system trouble conditions
 - .8 Provide three dedicated keys for keypad activated alarms: fire, panic and auxiliary
 - .9 Provide five individual programmable function keys
 - .10 Provide tamper feature.
 - .11 Have an operating environment of 0 to 50 degrees C; 90% RH non-condensing
 - .12 Be ULC listed.
- .3 The Keypad shall be manufactured by Digital Security Controls (DSC), Digital Monitoring Product (DMP) or Honeywell.

2.3 ZONE EXPANDERS (ZE) INPUT/OUTPUT MODULES (I/O MODULE)

- .1 The Zone Expander I/O Module shall provide 8 programmable hardwired zones and be housed as an integral element of the Intrusion Alarm Panel.
- .2 The Zone Expander/ I/O Module shall:
 - .1 Provide zone supervision
 - .2 Support up to 30 programmable zone types and 8 zone options
 - .3 Connect up to 305M from the control panel (if required)
 - .4 Have a current draw of 30mA (from Combustion)
 - .5 Have an operating environment of 0 to 50 degrees C; 90% RH non-condensing

The Zone Expander/IO Module shall be manufactured by Digital Security Controls (DSC), Digital Monitoring Product (DMP) or Honeywell.

2.4 INTRUSION ALARM PANEL COMMUNICATIONS MODULE

- .1 The Intrusion Alarm Panel Communications Module shall be compatible with the Intrusion Alarm Panel
- .2 The Intrusion Alarm Panel Communications Module shall:
 - .1 Provide IP connectivity to the Intrusion Alarm Panel using 128-bit AES encryption (NIST approved)
 - .2 Support DHCP (dynamic IP addresses)
 - .3 Utilize low network bandwidth
 - .4 Be compatible with 10/100 BaseT networks
 - .5 Report events to two different receiver IP addresses
 - .6 Provide polling and hardware substitution protection
 - .7 Provide instant, always-on communication
 - .8 Be compatible with Sur-Gard I/II/III/IV monitoring station receivers
 - .9 Provide standard and encrypted line security
 - .10 Have an operating environment of 0 to 49 degrees C; 93% RH non-condensing
- .3 The Intrusion Alarm Panel Communications Module shall be manufactured by Digital Security Controls (DSC), Digital Monitoring Product (DMP) or Honeywell.

2.5 POWER SUPPLY CHARGERS

- .1 The Power Supply Charger shall contain:
 - .1 12VDC or 24VDC selectable output.
 - .2 12VDC @ 4 amp or 24VDC @ 3 amp supply current.
 - .3 Class 2 Rated power limited output.
 - .4 Input 120VAC / 60Hz, 1.45 amp.
 - .5 Input fuse rated @ 3.5 amp/250V.
 - .6 Filtered and electronically regulated output.
 - .7 Short circuit and thermal overload protection.
 - .8 Built-in charger for sealed lead acid or gel type batteries.
 - .9 Maximum charge current .7 amp.

- .10 Automatic switch over to stand-by battery when AC fails (zero voltage drop).
- .11 AC fail supervision (form "C" contacts).
- .12 Low battery supervision (form "C" contacts).
- .13 Battery presence supervision (form "C" contacts).
- .14 AC input and DC output LED indicators.
- .15 Enclosure: Combination knockouts are 1/2" and 3/4" and accommodate up to two (2) 12VDC/7AH batteries.
- .2 The Power Supply Charger shall be the Altronix AL400ULX, Bosch AL400U, or DMP 505-12.

2.6 CORNER MOTION DETECTOR

- .1 The Corner Motion Detector shall provide area motion coverage using both microwave technology and PIR technologies.
- .2 It shall provide a range of 11m x 12m, operate on 7.5 - 16VDC power and contain an energized Form C relay.
- .3 The unit shall measure 11.9 cm x 7.1 cm x 4.2 cm.
- .4 The Security Contractor shall be equipped with compatible mount bracket, as required for each application.
- .5 The Corner Motion Detector shall be the Honeywell DT7435 Dual Tec Motion Sensor, DSC LC104 Dual-Tech Motion Sensor or Bosch OD850-F1.

2.7 360 DEGREE MOTION DETECTOR

- .1 The 360 Degree Motion Detector shall be microcontroller-based, ceiling mounted and dual technology.
- .2 The 360 Degree Motion Detector shall utilize and continually monitor PIR signals and microwave or optic signals, contain built-in diagnostics and supervision, provide for a ceiling mount flush or surface mount design, include a trouble output and support a detection range of 15m diameter.
- .3 The 360 Degree Motion Detector shall be the DT6360STC Dual Tec Motion Sensor from Honeywell, AP669 Dual Optic Technology Ceiling Mount PIR from UTC or Bosch DS939 360° Ceiling Mount Motion Sensor.

2.8

DOOR CONTACT

- .1 The Door Contact shall contain an armoured cable with triple-biased reeds which are resistant to defeat by external magnets.

- .2 The Door Contact shall include a magnetic field tamper and pry tamper as standard features and an SPDT switch, a 3/16" to 5/8" gap size and a 3 foot stainless steel armoured cable.
- .3 The Door Contact shall be a UTC/Sentrol 2707A-L Series Magnetic Contact.
- .4 The Door Contact shall be installed as per manufactures specifications and be installed using only approved mounting brackets and spacers.

2.9 VIBRATION SENSOR

- .1 The Vibration Sensor shall detect attempted entries into spaces using modern tools such as diamond-tipped drills, mechanical and hydraulic pressure tools, flame cutters, thermal-lances or water jets.
- .2 The Vibration Sensor shall have the following characteristics:
 - .1 5m/80m2 operating radius/coverage area
 - .2 3 mA/5mA quiescent/alarm power consumption at 12 VDC
 - .3 Tamper protection
 - .4 -40 Degrees C to +70 Degrees C operating temperature
- .3 The Vibration Sensor shall be the Siemens GM760 A5Q00005840 Seismic Detector with associated GMXP0 277273 Mounting plate, Bosch ISN-SM50 or Honeywell SC100.

2.10 END OF LINE DEVICES

- .1 End of line supervisory devices shall be mounted on a plate complete with a nameplate identifying appropriate zone/circuit identification at a control unit.
- .2 Suitable for single gang standard electrical box mounting.
- .3 Steel construction with lamacoid label

2.11 TRAINING

- .1 Training on the general operation of the Intrusion Alarm system will be conducted at the unit level by appointed Security Officer. Those authorised to have access to armed areas will be given instruction of the general operation of Keypad for the Arming/Disarming of areas.
- .2 Typical user usage shall follow Manufacturers recommendations and Unit SOPs.
- .3 All programming of the system will be conducted by certified system technicians and appointed unit personnel only.

Part 3 Execution

3.1 GENERAL

- .1 The Security Contractor shall be responsible for the installation design, installation, site supervision, project management, test, commissioning and documentation of the Intrusion Alarm System into a fully functioning system, including but not limited to:
 - .1 Transportation of equipment to site
 - .2 Storage of equipment on-site (suitable on-site space will be provided for the Security Contractor)
 - .3 Supply and installation of all signal cabling between the Intrusion Alarm Panel and all peripheral devices, including but not limited to: keypads, alarm sensors, remote modules, etc.
 - .4 Installation of equipment
 - .5 Programming and configuration of all hardware being installed or integrated to operate to client standards and expectations, including, but not limited to:
 - .1 IAS Server, CMCS, Workstations
 - .2 Intrusion Alarm Panels
 - .3 Alarm Sensors, Keypads
 - .6 Programming and configuration of all server and receiver parameters to support the IAS devices and functionality.
 - .7 Development of Shop Drawings
 - .8 Development of Commissioning Forms
 - .9 Development of As-Built Documentation

- .2 The Security Contractor's work shall meet TIA/EIA #569 Standard for Pathways and Spaces for equipment and services it installs and integrates.
- .3 The Security Contractor's work shall meet follow TIA/EIA #606 Standard for Labelling for equipment and services it installs and integrates.
- .4 The Security Contractor's work shall meet TIA/EIA #607 Standard for Grounding and Bonding for equipment and services it installs and integrates.
- .5 The Security Contractor's work shall meet TIA/EIA #568 Standard for Telecommunication Cabling for equipment and services it installs and integrates.

3.2 LOCATION

- .1 The Security Contractor shall provide the services included in this specification at Hanger 6 at CFB Trenton

3.3 TOOLS

- .1 The Security Contractor shall provide all tools, equipment and testing devices to implement all aspects of the installation.
- .2 The Security Contractor shall provide all ladders, lifting devices and scaffolding as required to install equipment.
- .3 The Security Contractor shall provide transportation of the installation team and small equipment for the duration of the onsite work.

3.4 HOURS OF WORK

- .1 The Security Contractor shall coordinate on-site delivery and installation with the DCC Representative and shall provide a minimum of three weeks' notice for the commencement of work on-site.
- .2 The Construction Manager will provide access to the site until completion of the contract.
- .3 All commissioning tasks shall be completed prior to "going live" with the new Intrusion Alarm System.
- .4 The client shall not be responsible for any overtime hours, work done outside of normal business hours as outlined above, or any additional manpower required to meet the project schedule.

3.5 SECURITY

- .1 The Security Contractor shall be responsible for security of all personal items as well as supplied equipment and

materials until installed into final locations, and accepted by the DCC Representative.

- .2 The Security Contractor shall return all keys, codes and authorization media to the DCC Representative upon completion of the project.

3.6 PROJECT MANAGEMENT

- .1 The Security Contractor shall:
 - .1 Coordinate, convene and provide minutes for a pre-installation meeting, once the shop drawings are approved, to plan equipment delivery, trade coordination, installation and configuration of system devices and components.
 - .2 Provide the DCC Representative and the Contract Authority with weekly progress reports detailing progress to date and the work planned for the week ahead.
 - .3 Attend progress review meetings as directed by the DCC Representative.
 - .4 Immediately update the DCC Representative with any issues that requires a decision by the DCC Representative to facilitate the installation.
 - .5 Work through the Contract Authority and in agreement with the DCC Representative on any issues that would modify this contract.
 - .6 All site arrangements will be communicated to the DCC Representative by the site contact.

3.7 DELIVERY, STORAGE AND HANDLING

- .1 The Security Contractor shall:
 - .1 Deliver and store materials in manufacturer's original packaging labelled to illustrate name, brand, type, and grade.
 - .2 Store materials in a protected dry location above the ground in accordance with manufacturer's instructions.
 - .3 Not open packaging or remove labels until time for installation.
 - .4 Remove all packaging from the site and recycle as appropriate.
 - .5 Protect all equipment from damage and construction debris until substantial completion is acknowledged by the DCC Representative.
 - .6 Protect adjacent work areas against the spread of dust and dirt beyond the work areas.
 - .7 Protect operatives and other users of the site from all hazards.
- .2 Any products or equipment stored on site is the responsibility of the Security Contractor. The client shall not be responsible for theft or damage done to any stored products or material.

3.8 EQUIPMENT SUPPLY AND INSTALLATION

- .1 The Work shall be carried out in accordance with the drawings and specifications and their intent. The Security Contractor shall provide all miscellaneous materials (such as connectors, fasteners, brackets, cable wrap, etc.) necessary to complete the work.
- .2 The Work shall include all materials, equipment, labour, devices, tools and other items found necessary to complete, perfect, integrate, test, warrant and maintain any portion of the equipment in a substantial manner and in compliance with the requirements of the drawings and specifications without any additional charge to the client and shall include the supply and installation of all devices and any other work required to provide a fully functional system.
- .3 The Security Contractor shall install all equipment in accordance with the manufacturer's specifications and instructions.
- .4 All references to manufacturers' or suppliers' model numbers and other pertinent information provided in the

specification are intended to establish minimum standards of performance, function and quality.

- .5 Should any dispute arise as to the quality or fitness of products, the decision rests strictly with the DCC Representative based upon requirements of the Contract Documents.
- .6 For equipment for which substitutions are permitted, the Security Contractor shall supply proof that such substitute equipment meets or exceeds the features, functions, performance and quality of the specified equipment. If, in the opinion of the client, the substitute equipment does not meet the specification, the Security Contractor shall furnish the specified equipment at its own expense.
- .7 For equipment specified as NO SUBSTITUTION that is not available, the Security Contractor shall advise the DCC Representative in writing.
- .8 All products shall bear the seal of approving agencies as required by the authorities having jurisdiction.
- .9 All products of one type shall be by the same manufacturer.
- .10 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.

3.9 SEQUENCE OF OPERATIONS

- .1 Configuration of the system shall be defined through consultation with the client and how each device is displayed or alarmed including scheduling. The Security Contractor shall program the system to meet the criteria contained in this Section.
- .2 Alarm Arm/Disarm
 - .1 Upon entering an "armed" area through a designated access point, the local audible alert signal and an entry delay period timer shall be initiated.
 - .2 Entry into an "armed" area through non-designated access points shall generate an immediate intrusion alarm at the Central monitoring station.
 - .3 If the entry delay period expires before a valid code is entered, an intrusion alarm shall be generated at the Central monitoring station and recorded in the event logger.
 - .4 At the keypad, the user shall be given 3 (three) opportunities to enter a valid PIN during the entry delay period before an intrusion alarm is generated at the Central monitoring station.

- .5 The sensors shall remain disarmed until a subsequent PIN entry operation.
- .6 The Control Unit shall ignore area alarm and sensor activation during the exit delay period.
- .7 It shall be possible for the system administrator to independently adjust the entry and exit alert time period.
- .8 It shall be possible to set entry/exit delay up to 2 (two) minutes.
- .9 It shall be possible to assign specific alarm points to each keypad within the same Control Unit. Arming and disarming alarm points assigned to one keypad shall have no effect on the alarm points assigned to another keypad.
- .3 Event Logger Messages
 - .1 Event logger messages shall contain at a minimum the following information:
 - .1 Event number
 - .2 Time of Day for each event in hours minutes and seconds
 - .3 Date of each event in days months and years
 - .4 Type of event, entry, exit
 - .5 Event action
 - .6 Building Location and Name, Door number or Room Number and display and sensor type
 - .2 Each Alarm event shall be graphically represented on the site plan and an audible alarm at the Security Communications Centre.
 - .3 The CMCS control operator station shall allow for the system administrator to silence alarms.
 - .4 The Security Contractor shall program the logger messages to integrate with security personnel requirements and existing system functionality.
- .4 Programming of the system
 - .1 The Security Contractor shall program the system to include all operational parameters as required by the client.
- .5 Intrusion Alarm Zones
 - .1 The Security Contractor shall liaise with the client for operation of zones but generally follow the common configurations contained in this section.
 - .2 Alarm Zones shall be as described in the drawings listed in Section 1.2

3.10 WORKMANSHIP AND QUALITY ASSURANCE

- .1 The Security Contractor shall:
 - .1 Be solely responsible for quality control of the Work.
 - .2 Examine site and conditions likely to affect the work and be familiar and conversant with existing conditions.
 - .3 Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, Provincial, and Municipal authorities having jurisdiction.
 - .4 Perform all work in accordance with the National Building Code of Canada (NBC) 2020, National Fire Code of Canada (NFC) 2020 and the Ontario Building Code (OBC) 2024, including all amendments up to the closing date of the procurement.
 - .5 Obtain (and pay for) the necessary permits and approvals from all such authorities as required, including but not limited to: the Electrical Safety Authority (ESA).
 - .6 Pay all costs associated with the transportation of products (to and from the site) required in the performance of the work.
 - .7 Provide and erect common-use signs related to traffic control, information, instruction, use of equipment, public safety devices, etc. in both official languages or by the use of commonly-understood graphic symbols to the approval of the DCC Representative.
 - .8 Utilize on-site manufacturer-trained and ULC-certified installers during the course of the installation.
 - .9 Ensure that the installation is conducted in a neat and professional manner and ensure the highest level of quality is maintained.
 - .10 Visit the site during the pathway installation to ensure the conduit and wiring is installed as per ULC and manufacturer's requirements.
 - .11 Provide certified test reports from approved independent testing laboratories indicating compliance with specifications for special performance characteristics and physical property; such certificates shall be signed by the manufacturer that materials comply with specified performance characteristics and physical properties.
 - .12 Submit ULC /UL Product Certificates.
- .2 All Products shall be new, of high commercial standard and quality and free from any defects. All equipment shall be installed to present no safety hazards to the public,

operating personnel or other trades. Ensure that all equipment client purchased to be installed is new, does not include refurbished equipment and is of current manufacture. Any missing or damaged products must be replaced by the manufacturer. Ensure that all parts supplied by the Contractor in performing the maintenance, repair or replacement services as per Warranty arrangements are new.

- .3 The Security Contractor shall carry out all work using qualified, factory-certified technicians.
- .4 Smoking is not permitted in the building. Obey smoking restrictions on the property.
- .5 The Security Contractor shall:
 - .1 Provide protection for finished and partially finished building finishes and equipment during performance of the work.
 - .2 Provide necessary screens, covers and hoardings.
 - .3 Be responsible for damage incurred due to lack of or improper protection.
 - .4 Cut existing surfaces as required to accommodate the new work.
 - .5 Remove all items so shown or specified.
 - .6 Patch and make good surfaces cut, damaged or disturbed, to the approval of the DCC Representative.
 - .7 Match existing material, colour, finish and texture.
 - .8 Wash and polish glass, ceramic tile, aluminium, chrome, stainless steel, baked or porcelain enamel, plastic laminate and other surfaces, floors, hardware and fixtures. All cleaning shall be undertaken at least equal to that previously existing and to the approval of the DCC Representative.
- .6 The Security Contractor shall provide on-site support for the day during which the work is expected to be completed after successful acceptance testing and performance verification is completed. Such support shall include sufficient Security Contractor technical and business resources.

3.11 SHOP DRAWINGS

- .1 Within 15 days of receipt of an order to proceed, the Security Contractor shall provide six sets of Shop Drawings. Shop Drawings shall be provided in a three-ringed binder and shall be divided into sections to provide for easy review. As well, a DVD copy of all electronic files shall be provided in native file format and .pdf. Shop Drawings shall include, at a minimum, the following:

- .1 Technical Data Sheets
- .2 Floor plan drawings indicating device installation locations
- .3 Single Line Drawings
- .4 System interconnection diagrams and power requirements
- .5 Device schedules
- .6 Equipment Lists
- .7 Project Plan and Schedule
- .8 Contractor's Project Manager Name and Workforce Loading Schedule
- .9 Commissioning Plan, Schedule and Forms
- .10 Statement of Compliance with Specification
- .11 Training Plan
- .2 Where applicable, the Security Contractor shall also provide wiring, single line and schematic design, drawings and diagrams illustrating interconnections with the work of other Contractors.
- .3 Shop Drawings shall be signed by an authorized representative of the Security Contractor and shall include a transmittal sheet.
- .4 Shop Drawings must be reviewed and signed by the DCC Representative before any work affected by the submittal proceeds.
- .5 Prior to the development of the Shop Drawings, the client will provide the Security Contractor with the following documents as input into the programming and configuration of the system:
 - .1 Alarm Zone Nomenclature
 - .2 User Information
 - .3 Alarm Arming/Disarming Parameters
 - .4 Naming Convention Guide
- .6 Adjustments made on the shop drawings by the DCC Representative are not intended to change the Contract Price. If adjustments affect the value of the work, such adjustment shall be described in writing to the DCC Representative prior to proceeding with the work.

3.12 WORK SITE CONDITIONS

- .1 The Security Contractor shall be responsible for the security and protection of all equipment supplied and installed as part of this work before, during and after installation.

- .2 The Security Contractor shall perform final cleaning of all electrical and security components.
- .3 All areas shall be cleaned with a vacuum cleaner at the end of each working day. All public areas shall be vacuumed and broom swept during working hours to avoid build-up of debris.
- .4 The Security Contractor shall examine work areas prior to commencing work. The Security Contractor shall remedy conditions detrimental to the proper and timely completion of the work where possible and advise the DCC Representative regarding conditions that are the responsibility of others.

3.13 IMPLEMENTATION

- .1 The Security Contractor shall be responsible for the supply and installation of all additional signal and power cabling required for a complete and functional Intrusion Alarm System. Such cable shall conform to manufacturers' specifications and be installed to meet industry best practices.
- .2 Unless otherwise indicated in specifications, the Security Contractor shall:
 - .1 Install or erect products in accordance with manufacturer's instructions
 - .2 Not rely on labels or enclosures provided with the products
 - .3 Obtain written instructions directly from the manufacturer
 - .4 Notify the DCC Representative, in writing, of conflicts between specifications and manufacturer's instructions, so that the DCC Representative may establish a course of action
- .3 Should the Security Contractor improperly install or erect the products due to failure in complying with the manufacturers' instructions, the Security Contractor shall remove and re-install the products at no increase in the Contract Price or Contract Time.
- .4 When breaking into or connecting to existing services or utilities, the Security Contractor shall execute the work at times directed by the DCC Representative, local governing authorities or the client, with minimum disturbance to work and/or building occupants and pedestrian and vehicular traffic.
- .5 The Security Contractor shall submit a written request in advance of any cutting or alteration which affects:

- .1 Structural integrity of any element of the 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
- .5 Work of Project Manager, Security Consultant or separate contractor.
- .6 Such written request shall include:
 - .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 Alternatives to cutting and patching
 - .6 Effect on work of the Client or separate contractor
 - .7 Written permission of affected separate contractor
 - .8 Date and time work will be executed
- .7 In preparation for carrying out the work, the Security Contractor shall:
 - .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching
 - .2 After uncovering, inspect conditions affecting performance of work
 - .3 Provide supports to assure structural integrity of surrounding
 - .4 Provide devices and methods to protect other portions of project from damage
 - .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water
- .8 The Security Contractor shall:
 - .1 Execute cutting, fitting, and patching to complete the work
 - .2 Remove and replace defective and non-conforming work
 - .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 are not allowed on masonry work without prior approval

- .6 Restore work with new products in accordance with requirements of Contract Documents
- .7 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces
- .8 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with fire-stopping material to the full thickness of the construction element
- .9 Refinish surfaces to match adjacent finishes; refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing the entire unit
- .10 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

3.14 MARKINGS AND LABELLING

- .1 The Security Contractor shall label all cable and equipment as per drawings.
- .2 The label standard is to have self-adhesive, elasticized clear labels with black writing on white surface.
- .3 Labels shall be affixed to both ends of the cable.
- .4 The writing shall be machine made.
- .5 The cable number shall follow a schema approved by the DCC Representative.
- .6 The label shall be approximately 4 inches from the termination, with its least significant digit nearest to the connector.
- .7 Labels shall remain accessible at all time and in all conditions.
- .8 Label shall be a Brady type.
- .9 Prior to installation, the contractor shall submit a sample of equipment and cable labels for approval by the DCC Representative

3.15 COMMISSIONING REQUIREMENTS

- .1 This section includes general requirements relating to commissioning of the system and to verifying the components, equipment, sub-systems, systems, and integrated systems.
- .2 Commissioning is a planned program of tests, procedures and checks carried out systematically on the system. Commissioning is performed after the security devices are completely installed, functional and the Security

Contractor's Performance Verification responsibilities have been completed and approved. The objectives of commissioning are:

- .1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
- .2 Ensure appropriate documentation is provided to the client.
- .3 Effectively train client staff.
- .3 Design Criteria: The system shall meet the included functional and operational requirements.
- .4 Should the system, system components, and associated controls be incorrectly installed or malfunction during commissioning, the Security Contractor shall correct deficiencies, re-verify equipment and components within the un-functional system, including related systems as deemed required by the DCC Representative to ensure effective performance.
- .5 Costs for corrective work, additional tests and inspections to determine acceptability and proper performance of such items to be borne by the Security Contractor. These costs are to be in form of progress payment reductions or hold-back assessments.
- .6 Before Commissioning begins the Security Contractor shall ensure that:
 - .1 The installation of related components, equipment, sub-systems, and systems is complete.
 - .2 The Security Contractor fully understands the commissioning requirements and procedures.
 - .3 The commissioning documentation is shelf-ready.
 - .4 The design criteria and intent and special features are fully understood by the Security Contractor.
 - .5 Complete start-up documentation has been submitted to the DCC Representative.
 - .6 Commissioning schedules are up to date.
 - .7 As-built system schematics are available.
- .7 All conflicts shall be reported to the DCC Representative before start-up to obtain clarification. Failure to report a conflict and obtain clarification will result in application of the most stringent of requirements.
- .8 No later than four weeks after contract award, the Security Contractor shall submit the name of the Security Contractor's commissioning agent, draft commissioning documentation and a preliminary commissioning schedule.

Note that the commissioning schedule shall include timelines for commissioning report approval, verification of reported results, repairs/retesting/re-commissioning/ re-verification and training.

- .9 The Security Contractor shall assume the liability and cost associated with inspections. This shall include disassembly and re-assembly after approval, starting, testing and adjusting, including the supply of testing equipment.
- .10 The DCC Representative, Commissioning Manager and Security Consultant shall witness the commissioning.
- .11 The Security Contractor shall:
 - .1 Coordinate the time and location of the testing.
 - .2 Provide testing documentation for approval by the Project Manager and Commissioning Manager.
 - .3 Arrange for the Commissioning Manager to witness the tests.
 - .4 Obtain written approval of the test results and documentation from the Commissioning Manager.
 - .5 Compare completed installation with the manufacturer's published data, record discrepancies and review with the manufacturer.
 - .6 Modify procedures detrimental to equipment performance and review same with the manufacturer before start-up.
 - .7 Use manufacturers trained start-up personnel, if applicable.
 - .8 Verify with the manufacturer that the testing as specified will not void the warranty.
 - .9 Be experienced in the design, installation and operation of the security system and its devices.
 - .10 Be able to interpret test results accurately.
 - .11 Be able to report results in a clear, concise and logical manner.
 - .12 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and commissioning.
 - .13 Conduct start-up and testing in following distinct phases:
- .12 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
- .13 Start-up: follow accepted start-up procedures.

- .14 Operational testing: document equipment performance.
- .15 System PV: include repetition of tests after correcting deficiencies.
- .16 Post-substantial performance verification: to include fine-tuning.
- .17 Correct deficiencies and obtain approval the Commissioning Manager after distinct phases have been completed and before commencing next phase.
- .18 Document required tests on approved PV forms.
- .19 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by the Commissioning Manager. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by the DCC Representative
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by the DCC Representative.
 - .3 If evaluation report concludes that major damage has occurred, the DCC Representative shall reject equipment.
 - .4 Rejected equipment to be removed from site and replaced with new.
 - .5 Subject new equipment/systems to specified start-up procedures.
- .20 Assemble start-up documentation as follows:
 - .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 the Commissioning Manager to repeat start-up at any time.
- .21 Operate and maintain the equipment, after start-up, as directed by the manufacturer.
- .22 Develop a written maintenance program and submit same to the DCC Representative for approval.
- .23 Operate and maintain the system for the length of time required for commissioning to be completed.

- .24 After completion, operate and maintain the systems until issuance of a certificate of substantial performance.
- .25 Repair, replace or repeat the starting and/or PV procedures if the start-up, testing and or PV produce unacceptable results, until acceptable results are achieved.
- .26 Provide manpower and materials and assume all costs for re-commissioning.
- .27 Notify the DCC Representative at least 21 days prior to the start of commissioning.
- .28 Start commissioning after elements of the building affecting start-up and performance verification of the systems have been completed.
- .29 Submit to the DCC Representative a complete list of all instruments proposed to be used, including serial number, current calibration certificate, calibration date, expiry date and accuracy of all test equipment.
- .30 Come prepared with all tools/facilities required for such commissioning (e.g., ladders, 2-way radios, etc.)
- .31 The DCC Representative, Security Consultant and Commissioning Manager shall witness the commissioning.
- .32 Where specified start-up, testing or commissioning procedures duplicate verification requirements of an authority having jurisdiction, the Security Contractor shall arrange for the authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility. The Security Contractor shall obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction and shall provide copies to the DCC Representative within five days of test and with the commissioning report.
- .33 The Security Contractor shall assume costs incurred by the client for third and subsequent verifications where the verification of reported results fail to receive the Commissioning Managers' approval and where repetition of second verification again fails to receive approval and where the Commissioning Manager deems that the Security Contractor's request for second verification was premature.
- .34 The Security Contractor shall correct deficiencies found during start-up and commissioning to the satisfaction of the DCC Representative and report problems, faults or defects affecting commissioning to the DCC Representative in writing. All commissioning activities shall cease until problems are rectified. The Security Contractor shall only proceed with written approval from the DCC Representative.

- .35 Upon completion of the commissioning, the Security Contractor shall leave the systems in normal operating mode. Except for warranty and seasonal verification activities specified in the commissioning specifications, complete commissioning prior to issuance of Certificate of Completion. Commissioning is to be considered complete when contract commissioning deliverables have been submitted and accepted by the DCC Representative.

3.16 COMMISSIONING PLAN

- .1 The DCC Representative shall monitor the Security Contractor's performance against the commissioning schedule.
- .2 Upon completion of the commissioning to the satisfaction of the Commissioning Manager and the DCC Representative, the Security Contractor shall lock the systems into their final positions, indelibly mark settings and include such in the commissioning reports.

3.17 COMMISSIONING FORMS

- .1 Three copies of the Commissioning Forms shall be provided by the Security Contractor and completed for all equipment, systems and integration elements of this project.
- .1 The Security Contractor shall develop Commissioning Forms including the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 The Security Contractor shall use checklists for the installation of the security devices. A document describing the checks that have been made and verifying same shall be delivered to the DCC Representative and Commissioning Manager before operational commissioning is undertaken.
- .3 The Security Contractor shall .provide Product Information (PI) forms which compile gathered data on items of equipment produced by the security device manufacturer, including nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that are necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation

- shall be submitted to the DCC Representative at the completion of work. And prior to Performance Verification
- .4 The Security Contractor shall perform performance verification using Performance Verification (PV) reports which are used for checks, running dynamic tests making adjustments to the devices to ensure correct, efficient and independent operation.
- .5 To facilitate the commissioning of the new security devices, the Security Contractor shall develop PV forms which will be noted in the test and sign-off documents as acceptable or not acceptable (deficiency).
- .6 Commissioning Forms are used to verify the installation and to record performance when starting the systems and equipment. The strategy for the use of the commissioning forms is reflected in the Security Contactor's responsibilities which are to:
- .1 Provide project-specific Commissioning forms with Specification data included.
 - .2 Provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .3 Confirm operation as per design criteria and intent.
 - .4 Identify variances between design and operation and reasons for variances.
 - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
 - .6 Record analytical and substantiating data.
 - .7 Verify reported results.
 - .8 Bear signatures of recording technician and the Project Manager and Commissioning Manager.
 - .9 Submit immediately after tests are performed.
 - .10 Provide the DCC Representative and Commissioning Manager with originals of completed forms.
 - .11 Maintain copy on site during start-up, testing and commissioning period.
 - .12 Provide in both hard copy and electronic format with typed written results.
- .7 Physical Unit Installation
- .1 Level
 - .2 Plumb
 - .3 All Dimensions Match
 - .4 Appearance
 - .5 Cleanliness

- .6 Finish as per Specification
- .7 Floor/Wall Patch/Repair/Clean Complete
- .8 Operational System Checks
 - .1 Operational System Checks/Commissioning tests shall be developed by the Security Contractor and approved by the DCC Representative and shall address, at a minimum:
 - .1 Operator Log-on and Log-off procedure and archiving of activity
 - .2 System Parameters and Configurations
 - .3 Zone Arming/Disarming
 - .4 Keypad Operation
 - .5 Alarm Activation and Reporting
 - .6 Tamper Alarm Activation and Reporting
 - .7 Communication Loss Activation and Reporting
 - .8 Scheduled Arming/Disarming Function and Reporting
 - .9 Event Logging
 - .10 24 Hour Battery Test

3.18 AS-BUILT DOCUMENTATION

- .1 The Security Contractor shall submit three copies of as-built documentation (and one CD containing all electronic files) annotated with the changes made during installation of the Work such that a complete set of "as installed" plans, wiring diagrams and documents can be prepared by others.
- .2 The format of such as-built documentation shall:
 - .1 Be organized in the form of an instruction manual
 - .2 Use vinyl, hard-covered 3 "d" ringed binders, loose leaf, 219mm x 279 mm with spine and face pockets
 - .3 Correlate data into related consistent groupings, identifying contents on each spine, when multiple binders are used
 - .4 Include a cover identifying each binder contents
 - .5 Be arranged by systems
 - .6 Be tabbed for each section
 - .7 Include all drawings as noted in this section below
- .3 Final acceptance of the Project will be predicated on receipt and approval of As-Built Documentation.
- .4 The Security Contractor shall record, as work progresses, all equipment, cabling and conduit locations, including wiring schedules (however limited).

- .5 As-Built Documentation shall provide confirmed installation locations, quantities and from-to schedules for all equipment and devices included in the Works. At a minimum, As-Built Documentation shall include:
 - .1 Technical Data Sheets
 - .2 Floor plan drawings indicating device installation locations
 - .3 Single Line Drawings
 - .4 System interconnection diagrams and power requirements
 - .5 Device Schedules
 - .6 Equipment Lists
 - .7 System Interconnection Diagrams, Wiring Schematics and Power Distribution
 - .8 Commissioning Results
 - .9 Programming and Configuration Data
 - .10 Naming Convention Guide
 - .11 Training Manuals
 - .12 Special tools: provide special tools to the client in quantities as required for timely and professional maintenance and troubleshooting of the projects
 - .13 Internal wiring schematics for security devices
 - .14 Manufacturer Operation and Maintenance Manuals
 - .15 Materials and Finishes Schedule, including:
 - .16 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations
 - .17 Information for re-ordering custom manufactured products
 - .18 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance
- .6 System configuration data (for all software programming, configuration and settings performed during the works, even if performed by others).
- .7 Upon final acceptance of the As-Built Drawings, the Security Contractor shall return all site specific data related to the project and delete such data from any of its own storage devices.

3.19 WARRANTY

- .1 This Section describes the Security Contractor's responsibilities in relation to the provision of warranty services for the works included in this Section.

- .2 The Security Contractor shall furnish a one year written warranty in form stipulated by the DCC Representative, signed by the Security Contractor agreeing to repair or replace any of the work which has failed as a result of defects in materials or workmanship during the term of the warranty.
- .3 The Security Contractor shall provide warranty services in accordance with the requirements listed in this Section. The warranty services are to be provided to keep the equipment in, or restore the equipment to, good working order. Two primary services shall be provided during the warranty period: Remedial Services.
 - .1 Remedial Services: The Security Contractor shall respond warranty service requests and deliver repair and replacement products and services in a timely manner. Such remedial services shall be carried out in accordance with the Security Contractors' responsibilities as described in this Section.
- .4 All warranty services shall be performed in a workmanlike manner in accordance with manufacturer standard practices and shall be completed in accordance with a mutually agreed upon schedule.
- .5 The Security Contractor shall be available to provide warranty services in a timely manner.
- .6 Items NOT covered include: damage caused by misuse, abuse, accident, disaster, fire, flood, water, wind, lightning, and Acts of God; items designed to fail in order to protect the equipment, such as power and/or lightning suppressors; damage caused to conduit, cable & wiring resulting in cuts, shorts or un-traceable loss of voltage or communications; and all security panel Gel-cell batteries.
- .7 The Security Contractor shall provide a detailed Error Log and written analysis of the cause of each error including all steps taken to resolve the error. This Error Log shall be created by the Security Contractor and maintained and monitored on-line. The Error Log shall also be available to DND at any time, as requested and determined by DND.
- .8 Within the warranty period, the Security Contractor shall install any and all software and firmware updates, bug fixes and maintenance releases provided by the relevant system manufacturers during the term of the contract. While the installations shall be performed by the Security Contractor, the purchase of these updates is not the responsibility of the Security Contractor.
- .9 The Security Contractor shall not use any subcontractors to provide the services described in this Section without the express written approval of the DND.

- .10 The Security Contractor shall perform a site visit six months after substantial completion to confirm operation of the security equipment and devices at the performance level at the time of installation in accordance with manufacturer's specifications. In addition, the Security Contractor shall perform all oiling, lubricating and mechanical maintenance checks, as per manufacturer's specifications.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for fire alarm systems.
 - .2 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
 - .3 Trouble signal devices.
 - .4 Power supply facilities.
 - .5 Manual alarm stations.
 - .6 Automatic alarm initiating devices.
 - .7 Audible signal devices.
 - .8 Visual alarm signal devices.
 - .9 Ancillary devices.

1.2 REFERENCE STANDARDS

- .1 Government of Canada
 - .1 TB OSH Chapter 3-03, 1997-01-28, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-03, Standard for Fire protection Electronic Data Processing Equipment.
 - .2 TB OSH Chapter 3-04, 1994-12-22, Treasury Board of Canada, Occupational Safety and Health, Chapter 3-04, Standard for Fire Alarm Systems.
- .2 Canadian Forces Fire Marshall Directive - FMD 4003.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Safety Data Sheets (SDS).
- .4 National Fire Protection Agency
 - .1 NFPA 72-2019, National Fire Alarm Code.
 - .2 NFPA 90A-2018, Installation of Air Conditioning and Ventilating Systems.
- .5 National Research Council Canada (NRC)
 - .1 National Building Code of Canada 2015 (NBC).
- .6 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524-2014, Standard for the Installation of Fire Alarm Systems.

- .2 CAN/ULC-S525-2016, Audible Signal Device for Fire Alarm Systems.
- .3 CAN/ULC-S526-2016, Visual Signal Devices for Fire Alarm Systems.
- .4 CAN/ULC-S527-2019, Control Units.
- .5 CAN/ULC-S528-2014, Manual Pull Stations for Fire Alarm Systems.
- .6 CAN/ULC-S529-2016, Smoke Detectors for Fire Alarm Systems.
- .7 CAN/ULC-S530-M91(R2018), Heat Actuated Fire Detectors for Fire Alarm Systems.
- .8 CAN/ULC-S536-13(R2018), Standard for Inspection and Testing of Fire Alarm Systems.
- .9 CAN/ULC-S537-13(R2018), Standard for Verification of Fire Alarm Systems.

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.
 - .1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Shop drawings: stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Include:
 - .1 Layout of equipment.
 - .2 Zoning.
 - .3 Complete wiring diagram, including schematics of modules.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

- .4 Closeout Submittals:
 - .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals in accordance with ANSI/NFPA 20.
 - .2 Authority of Jurisdiction will delegate authority for review and approval of submittals required by this Section.
 - .3 Submit to Authority of Jurisdiction two (2) sets of approved submittals and drawings immediately after approval but no later than 15 working days to prior to final inspection.
 - .4 Submit following:
 - .1 Manufacturer's Data for:
 - .2 System wiring diagrams:
 - .3 Instructions for operation:
 - .4 Schedules:
 - .5 Test Reports:

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in fire alarm system installations with documented experience.
- .2 Provide services of representative or technician from manufacturer of system, experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system and to provide instruction to project personnel.
- .3 System:
 - .1 To TB OSH Chapter 3-04.
 - .2 Subject to Fire Commissioner of Canada (FC) approval.
 - .3 Subject to FC inspection for final acceptance.
 - .4 To Canadian Forces Fire Marshal approval.
- .4 Maintenance Service:
 - .1 Provide one year's warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to DCC Representative.

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.

Part 2 Products

2.1 MATERIALS

- .1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .2 Power supply: to CAN/ULC-S524.
- .3 Audible signal devices: to CAN/ULC-S525.
- .4 Visual signal devices: to CAN/ULC-S526.
- .5 Control unit: to CAN/ULC-S527.
- .6 Manual pull stations: to CAN/ULC-S528.
- .7 Thermal detectors: to CAN/ULC-S530.
- .8 Smoke detectors: to CAN/ULC-S529.

2.2 SYSTEM OPERATION

- .1 Provide new devices to function as per the existing facility system operation.

2.3 CONTROL PANEL

- .1 Existing Fire Alarm Control Panel to remain. Main control panel located in the fire pump room on the ground floor of the building.
- .2 Existing Fire Alarm Control Panel is SIEMENS Brand - FireFinder - XLS System.
- .3 Existing system is Class A circuiting.

2.4 POWER SUPPLY

- .1 Existing to remain.

2.5 GRAPHIC DISPLAY

- .1 The building is provided with graphic displays at each building entrance on the ground floor next to the annunciator panels.

2.6 MANUAL ALARM STATIONS

- .1 Provide to be compatible with existing.

- .2 Stations: surface or semi-flush mounted and interior type as indicated.
 - .1 For surface mounting provide station manufacturer's approved back box.
 - .2 Back box finish to match station finish.
- .3 Equip each station with terminal strip with contacts of proper number and type to perform functions required.
- .4 Stations: type not subject to operation by jarring or vibration.
 - .1 Break-glass-front stations are not permitted; pull-lever break-rod type is acceptable provided presence of rod is not required to reset station.
- .5 Station colour: red.
- .6 Provide station with visible indication of operation.
- .7 Restoration to require use of key.
 - .1 Keys: identical throughout system for stations and control panel(s).
- .8 Mount stations with operating lever not more than 1.2 m above finished floor.
 - .1 Finish housings with red enamel paint and provide permanently affixed bilingual signage indicating "FIRE ALARM/FEU" with white letters of 19 mm high.

2.7 AUTOMATIC ALARM INITIATING DEVICES

- .1 Heat detectors: compatible with existing as required.
- .2 Open-Area Smoke Detectors: match existing as required.
- .3 Locate detectors in accordance with their listing by ULC and the requirements of NFPA 72, except provide at least two (2) detectors in rooms of 54 square meters or larger in area.
- .4 Mount detectors at underside of ceiling or deck above unless otherwise indicated.
 - .1 For mounting heights greater than 3 m above floor level, reduce actual detector linear spacing from listed spacing as required by NFPA 72.
 - .2 For heights greater than 9 m space detectors no farther apart than 34% of their listed spacing.
- .5 Temperature rating of detectors: in accordance with NFPA 72.
- .6 Locate detectors minimum 300 mm to lighting fixtures and not closer than 600 mm to air supply or return diffuser.

- .7 Ensure detectors, located in areas subject to moisture or exterior atmospheric conditions or hazardous locations as defined by NFPA 70, are approved for such locations.
- .8 Provide detectors with terminal screw type connections.
- .9 Removal of detector head from its base to cause activation of system trouble signals if detectors are provided with separable heads and bases.

2.8 ALARM INITIATING DEVICE SPACING AND LOCATION

- .1 Detector spacing and location: in accordance with manufacturer's recommendations and requirements of NFPA 72.
- .2 Provide at least two (2) detectors in rooms of 54 square meters or larger.
- .3 Spacing: not to exceed 9 m by 9 m per detector, and 9 linear m per detector along corridors.
- .4 Locate detectors minimum 0.6 m from air discharge or return grille, and not closer than 300 mm to lighting fixtures.
- .5 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.

2.9 DUCT SMOKE DETECTORS

- .1 Provide detectors installed in ducts of photoelectric type and listed by ULC duct installation.
- .2 Provide integral control and power modules required for operation with main control panel.
- .3 Ensure detectors and associated modules are compatible with main control panel and suitable for use in supervised circuit.
- .4 Detector circuits: 4-wire type where detector operating power is transmitted over conductors separate from initiating circuit. Malfunction of electrical circuits to detector or its control or power modules to cause operation of system trouble signals.
- .5 Provide a separate, fused power circuit for each smoke detection initiating circuit.
- .6 Failure of power circuit: indicated as a trouble condition on corresponding initiating circuit.
- .7 Provide duct detectors in accordance with NFPA 90A.
- .8 Provide duct detectors with approved duct housing, mounted exterior to duct, with perforated sampling tubes extending across width of duct.

- .9 Activation of duct detectors to close fire-smoke dampers and cause shutdown of associated air handling unit annunciation at control panel and tripping of master box and sounding of building evacuation alarms.
- .10 Provide detectors with visible indicator lamp that flashes when detector is in normal standby mode and glows continuously when detector is activated.
- .11 Provide remote indicator lamp for each detector.
- .12 Permanently label remote indicator with description of associated air handling unit(s).
- .13 Provide each detector with remote test switch. Mount switch not more than 1.8 m above finished floor.
- .14 Permanently label test switch with description of associated air handling unit(s).

2.10 AUDIBLE SIGNAL DEVICES

- .1 Audible device(s):
 - .1 Horns: 100 db, flush-mounted, 24 V dc.
- .2 Do not exceed 80 percent of listed rating in amperes of notification appliance circuit. Provide additional circuits above those shown if required to meet this requirement.
- .3 Provide appliances specifically listed for outdoor use in locations exposed to weather.
- .4 Finish appliances in red enamel.
- .5 For surface mounting provide appliance manufacturer's approved back box. Back box finish to match appliance finish.

2.11 VISUAL ALARM SIGNAL DEVICES

- .1 Flush-mounted assembly of stroboscopic type suitable for use in electrically supervised circuit and powered from notification appliance circuits.
- .2 Appliances: minimum of 30 candela measured as approved by ULC, but not less than effective intensity required by National Building Code of Canada for appliance spacing and location.
- .3 Protect lamps with thermoplastic lens and labelled "FIRE/FEU" in letters at least 12 mm high.
- .4 Provide visible appliances within 300 mm of each audible appliance as indicated.
- .5 Visible appliances may be part of audio-visual assembly, where more than two appliances are located in the same room or corridor.

2.12 CONDUIT

- .1 Electrical Metallic Tubing (EMT).

2.13 WIRING

- .1 Wire for 120 V circuits: No. 12 AWG minimum solid copper conductor.
- .2 Wire for low voltage DC circuits: No. 14 AWG minimum solid copper conductor
- .3 Wire to remote annunciators: No. 16 AWG minimum solid copper conductor.
- .4 Insulation 75 degrees C minimum with nylon jacket.
- .5 Colour code wiring.

2.14 AS-BUILT RISER DIAGRAM

- .1 Fire alarm system riser diagram: in glazed frame, minimum size 600 x 600 mm.

2.15 ANCILLARY DEVICES

- .1 Remote relay unit to initiate fan shutdown.
- .2 Remote relay unit for the fire-smoke dampers.

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 systems in accordance with CAN/ULC-S524 and FMD 4003.
- .2 Install power boosters as required.
- .3 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .5 Connect new alarm circuits to main control panel.

- .6 Locate and install horns and visual signal devices and connect to signalling circuits.
- .7 Connect signalling circuits to main control panel.
- .8 Locate and install remote relay units to control fire-smoke dampers and fan shut down.
- .9 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .10 Connect fire suppression systems to control panel.

3.3 GRAPHIC DISPLAY PANELS

- .1 Contractor to provide updated graphic display panels to suit the project changes. Coordinate this with the building fire alarm maintenance contractor.

3.4 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.
 - .2 Fire alarm system:
 - .1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors, sprinkler system transmit alarm to control panel and actuate general alarm and ancillary devices.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
 - .4 Class A circuits.
- .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.
 - .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 TRAINING

- .1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

3.6 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

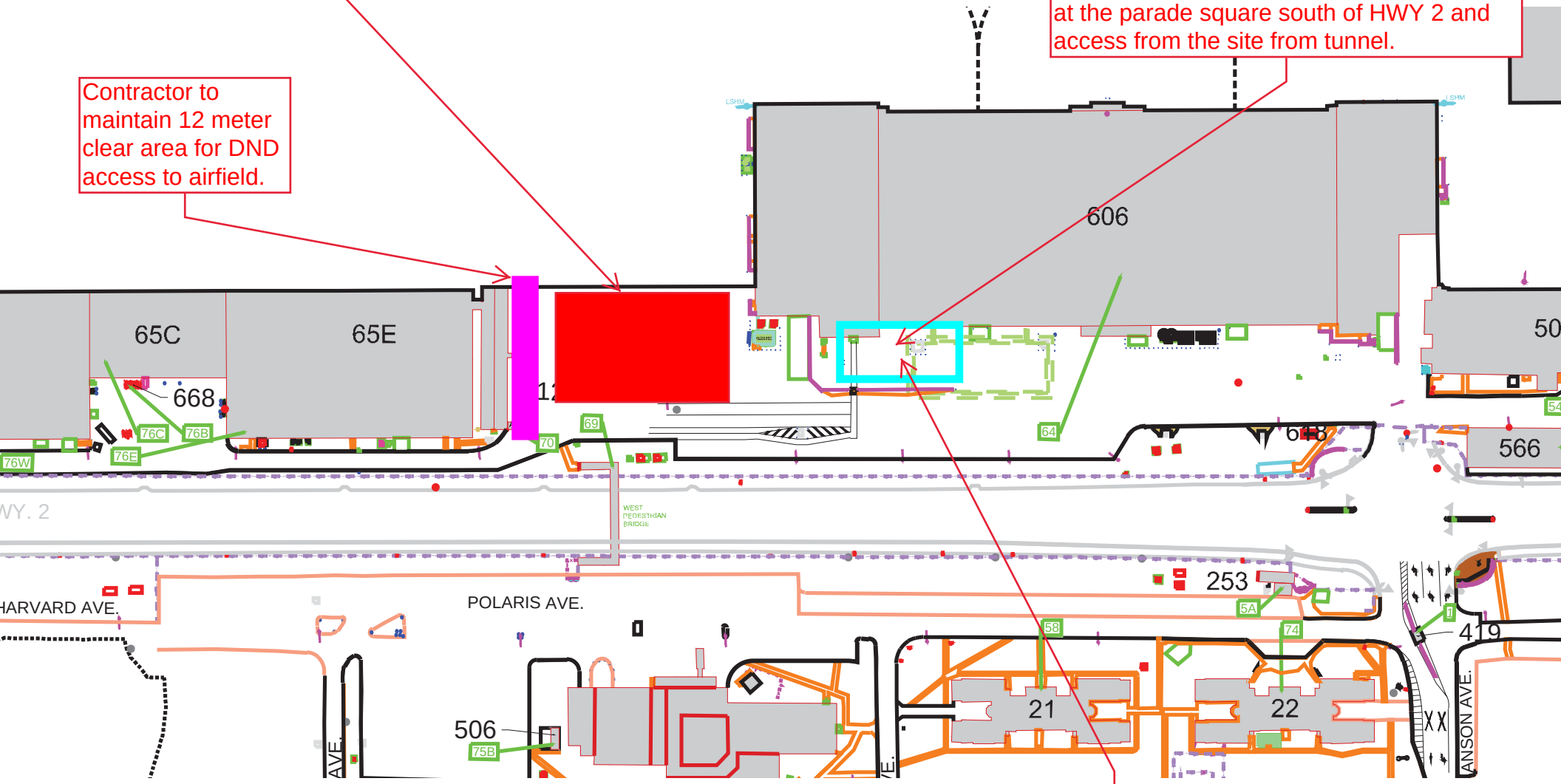
APPENDIX A

Hangar 6 Fit-Up Project Parking Laydown CNSLT

Primary lay down area for equipment, material and parking for contractor. Contractor to fence the laydown area, to define area as well as help with Foreign Object Damage (FOD). No utilities or telecom available.

Contractor to maintain 12 meter clear area for DND access to airfield.

These doors will be primary access point to building for the contractor. Contractor to park MAX 4 vehicles in this area. This will allow them access to tools and safe unloading. Only contractor vehicles in this area and the primary laydown area shown in RED BOX. All personal vehicles are to park at the parade square south of HWY 2 and access from the site from tunnel.



Contractor not to block access to any Fire hydrants, Emergency Exits, or Fire Department Connections

Contractor to coordinate large material deliveries with DCC representative. Deliveries will be required to be lifted to a second level overhead door within the hangar.

APPENDIX B

CAT6 Networks Design & Installation Tips

CAT6 NETWORKS DESIGN & INSTALLATION TIPS

1.0 Aim

- 1.1 The aim of this Technical Installation Practice (TIP) is to provide specific information regarding the design and installation of category 6 (CAT6) networks.

2.0 General

- 2.1 In general, the installation of CAT6 cabling is done in the same fashion as a CAT5E networks. Cabling is installed using raceways and conduits and is terminated on rack mounted terminals and Telecom Outlets. The outlets and Patch Panels shall be equipped with Keystone format ports.
- 2.2 However, due to the construction of the cable and its inherent technical properties, some specific installation restrictions exist. In addition, to provide optimum management flexibility, voice circuits will migrate to rack patch panels. As a result, both the designers and installers have to implement new design and installation procedures.

3.0 Design and Installation Procedures

- 3.1 CAT6 Installation: The installation of CAT6 cabling and associated terminating hardware is only to be done as part of new construction and major retrofit of existing buildings. Under no circumstances shall CAT6 cabling be used in conjunction with CAT5 or 5E networks.
- 3.2 Cable pulling and placement: CAT6 cables shall be pulled in the same manner as CAT5E cables. However, in order to maintain the cable electrical and technical properties and especially to be within the prescribed attenuation parameters, the following installation procedure shall be adhered to:
- a. to maintain the cable pair twists within the cable sheath, use of cable ties is strictly forbidden . Velcro straps are to be used to loosely secure cables to raceways and or racks; and
 - b. to maintain the twist of cable pairs and to avoid the cables to be crushed by sharp bends and over stacking of cable is to be avoided. Pre-manufactured soft bends (ca tray water fall and conduit 45 degree couplers) are to be used at transition points such as but not limited to the following locations:
 1. At the end of zone conduits (over a cable tray);
 2. On cable tray directly over a cable rack; and
 3. In any other locations where the cables could be affected by sharp bends or pressure.

4.0 Cable Termination

- 4.1** Great care is to be taken not to untwist the cable pairs at termination points. The use of any other types of material other than CAT6 rated terminals, ports, MMOs and patch cords is strictly forbidden in a CAT6 network environment.

5.0 Cable Testing

- 5.1** Prior to testing, installing agents are to ensure that the test set is verified for the following:
- a. set is equipped with the latest software upgrade version;
 - b. set is equipped with the proper personality module; and
 - c. set parameters are properly selected.

6.0 Fault Locating

- 6.1** The following table details common testing failures, their causes and possible solutions.

Failure	Possible Causes	Solutions
Next / Fext	Untwisted pair at termination's ends Crushed or pinched cables	Verify pair twist at both ends Survey cable routing and fix sharp bends and crushed cables
Attenuation	Untwisted pair at termination's ends Crushed or pinched cables Stretched cable	Verify pair twist at both ends Survey cable routing and fix sharp bends and crushed cables Replace cable run
Polarity	Termination sequence code Test equipment setting	Ensure that the cable has been terminated IAW ISDN or 568A standard Ensure test set parameters were set to meet ISDN or 568A standard.

7.0 Rack Disposition and Labeling

- 7.1** To ensure that users can easily manage their network and in accordance with TIA / EIA 606, patch panel disposition and labeling scheme all racks, patch panels and ports will be labeled using an alphanumeric code as follows: (See Figure 1, at end of document)
- a. Racks will be sequentially numbered (1, 2, 3...);
 - b. Patch panels will be sequentially tagged by “U” designation starting at the bottom of the Rack being 01 (01, 02, 03....) the “U” is where the top of Patch Panel starts; and
 - c. Ports will be sequentially numbered from the first to the last port within a single patch panel. (1-48). Note: cumulative numbering between patch panels is not permitted. Refer to the following figure for additional information.

8.0 Telecom Outlet Labeling

- 8.1** All MMO ports shall be identified by an alphanumeric code that will coincide with the associated Telecom Room (TR), racks, patch panel and port as follows:
- a. All face plates are to be equipped with a Telecom Room identifier label (MER, TR1-1, TR2-1, TR3-1);
 - b. All Telecom outlet ports are to be identified using a numeric code that coincides with the applicable patch panel port. As such, a port labeled as 1-24-23 indicates that the other end of the cable is terminated to Rack 1, Patch Panel 24, and Port 23. Refer to the following figure for additional information; and
 - c. Refer to Figure 1 for further details.

9.0 Migration of Voice Circuits to Racks

- 9.1** As stated above, to enable greater network flexibility, voice circuits will be installed on racks on RJ45 ports via a normal riser cable (CAT3) originating from the MER wall distribution (BIX). In most cases, one pair will be allocated per single RJ45 port. This will provide connectivity to single pair circuits. On some occasions, a two pair circuit is required for special circuitry such as but not limited to SL1 circuits. To accommodate these special circuits and since a normal riser cable is manufactured in 25 pair increments, port 24 will be equipped with pairs 24 and 25 of the voice riser cable. Refer to Figure 2 for further details.

10.0 Voice Patch Panel Labeling Procedure

- 10.1** To eliminate confusion while cross connecting and activating circuits at the BIX Field location, the CAT3 riser cables will be installed on 1U 24 port patch panel dedicated for voice circuit distribution and will be labeled as per Figure3.

11.0 Yellow Field Patch Panel on Racks

- 11.1** In rare circumstances, special requirements may arise where more than 2 pairs might be required to be activated on a single port. When this is the case, a special requirement patch panel (12 to 24 ports) “Yellow Field” shall be installed and wired for that special application. This practice is not repeat not to be considered as the norm but is rather to be considered as the exception to the rule.

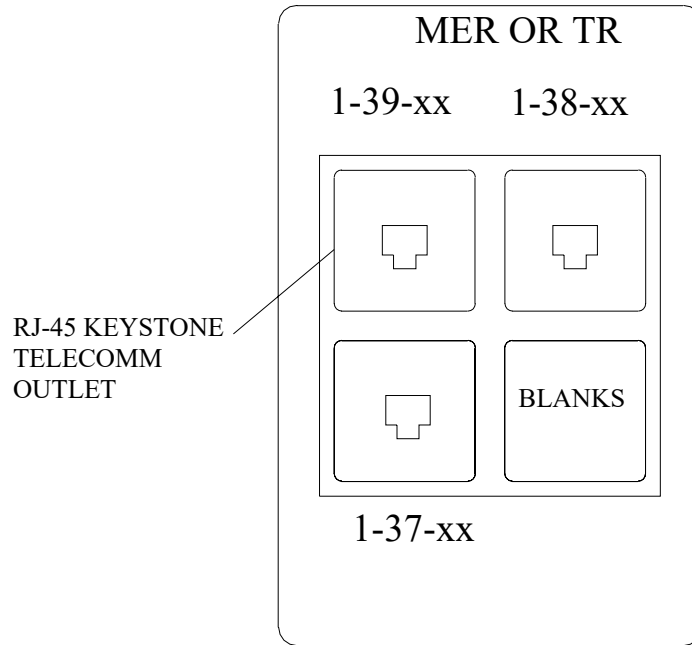
12.0 Applicability

- 12.1** This Technical Installation Procedure is applicable to all CAT6 installation in all Government of Canada (GoC) buildings including leased buildings occupied by GoC Departments. To ensure that a national standard will be maintained across Canada and foremost to guarantee future interconnectivity, interoperability and network upgradeability, regional or local installation procedures are prohibited and will not be supported by SSC / TCNDE.

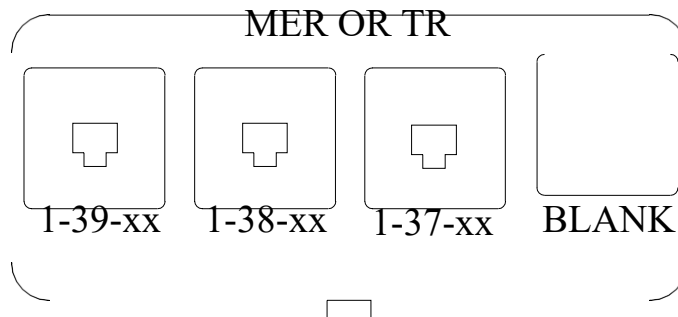
13.0 OPI

- 13.1** The OPI for this Technical Installation Procedure is the Shared Services Canada Telecommunication Cable Network Design and Engineering (TCNDE) Manager.

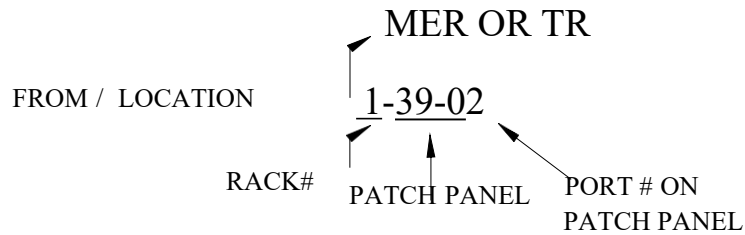
4 PORT OUTLET WALL



DESK



TELECOMMUNICATION OUTLET LAYOUT AND NUMBERING STANDARD



SHARED SERVICES
PARTAGE SHARED

TCNDE / ICRCT

DRAWING
TITLE

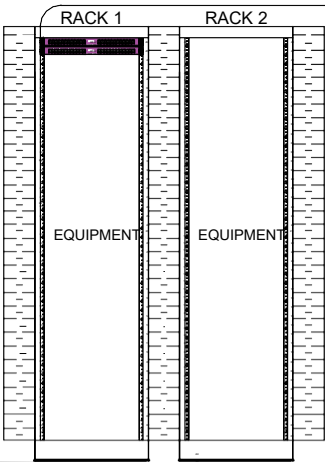
TYPICAL FACEPLATE LABELING

FIGURE
NUMBER

1

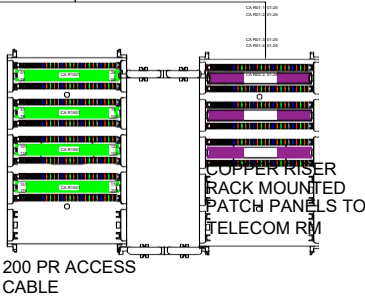
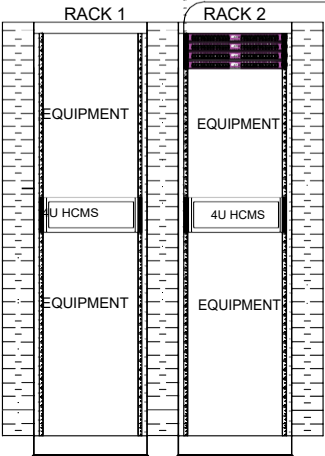
TR 2-1

CA R02-1, 01-25 fr MER
CA R02-2, 01-25 fr MER



MER

CA R02-1, 01-25 to TR2-1
CA R02-2, 01-25 to TR2-1
CA R01-1, 01-25 MER
CA R01-2, 01-25 MER
CA R01-3, 01-25 MER
CA R01-4, 01-25 MER



SHARED SERVICES
PARTAGE SHARED

TCNDE / ICRCT

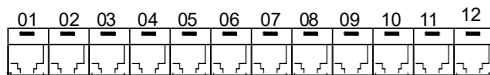
DRAWING
TITLE

TYPICAL BIX TO RACK RISER
INSTALLATION

FIGURE
NUMBER

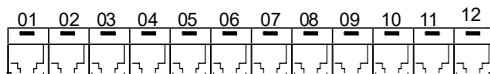
2





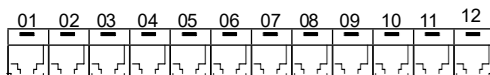
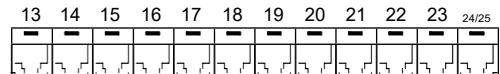
41U

CA R01-1, 01-25



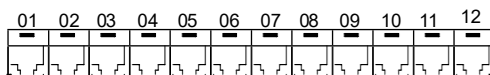
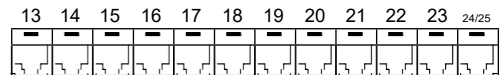
40U

CA R01-2, 01-25



39U

CA R01-3, 01-25



38U

CA R01-4, 01-25



SHARED SERVICES
PARTAGE SHARED

TCNDE / ICRCT

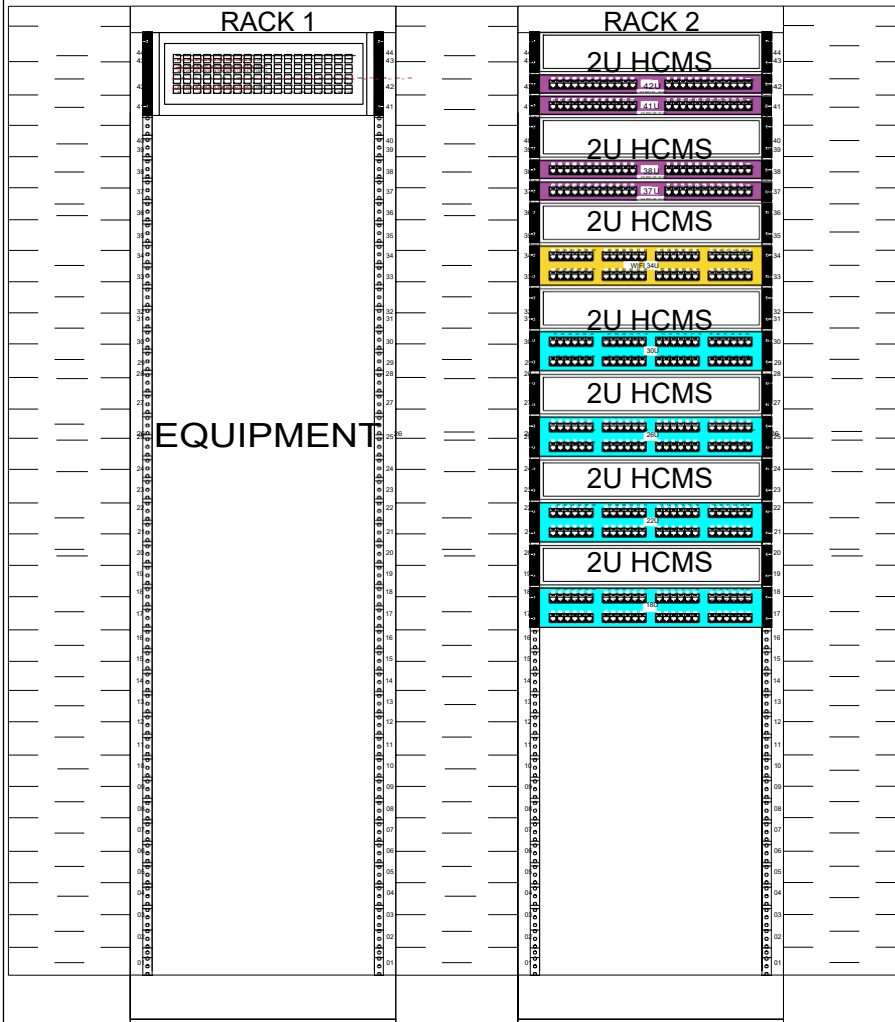
DRAWING
TITLE

VOICE PATCH PANEL
LABELING PROCEDURE

FIGURE
NUMBER

3

TYPICAL 2 RACK DISTRIBUTION 1U RISER AND 2U HORIZONTAL PATCH PANELS



RACK 1

44U -- 144 FDU LC DUPLEX KEYSTONE
ENTRANCE & RISER FIBRE DISTRIBUTION

RACK 2

42U -- 24 PORT TIE OR RISER PATCH PANEL

41U -- 24 PORT TIE OR RISER PATCH PANEL

38U -- 24 PORT TIE OR RISER PATCH PANEL

37U -- 24 PORT TIE OR RISER PATCH PANEL

34U -- 48 PORT WIFI

HORIZONTAL DISTRIBUTION

30U -- 48 PORT CAT 5E/6
HORIZONTAL DISTRIBUTION

26U -- 48 PORT CAT 5E/6
HORIZONTAL DISTRIBUTION

22U -- 48 PORT CAT 5E/6

HORIZONTAL DISTRIBUTION

18U -- 48 PORT CAT 5E/6

HORIZONTAL DISTRIBUTION



SHARED SERVICES
PARTAGE SHARED

TCNDE / ICRCT

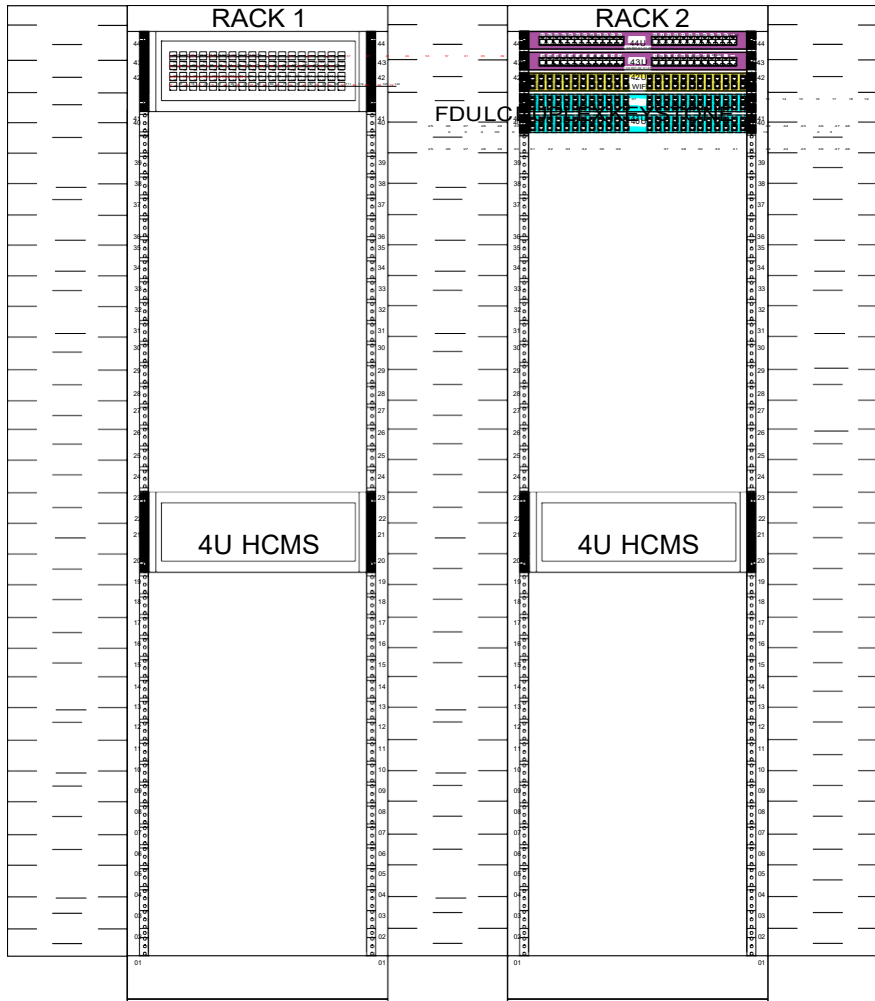
DRAWING
TITLE

TYPICAL 2 RACK DISTRIBUTION
1U RISER & 2U HORIZONTAL PP

FIGURE
NUMBER

4

TYPICAL 2 RACK DISTRIBUTION 1U ANGLED PATCHPANELS



RACK 1
44U-- 144
ENTRANCE & RISER FIBRE DISTRIBUTION

RACK 2
44U -- 24 PORT TIE OR RISER PATCH PANEL
43U -- 24 PORT TIE OR RISER PATCH PANEL
42U -- 48 PORT WIFI
HORIZONTAL DISTRIBUTION
41U -- 48 PORT CAT 5E/6
HORIZONTAL DISTRIBUTION
40U -- 48 PORT CAT 5E/6
HORIZONTAL DISTRIBUTION



SHARED SERVICES
PARTAGE SHARED

TCNDE / ICRCT

DRAWING
TITLE

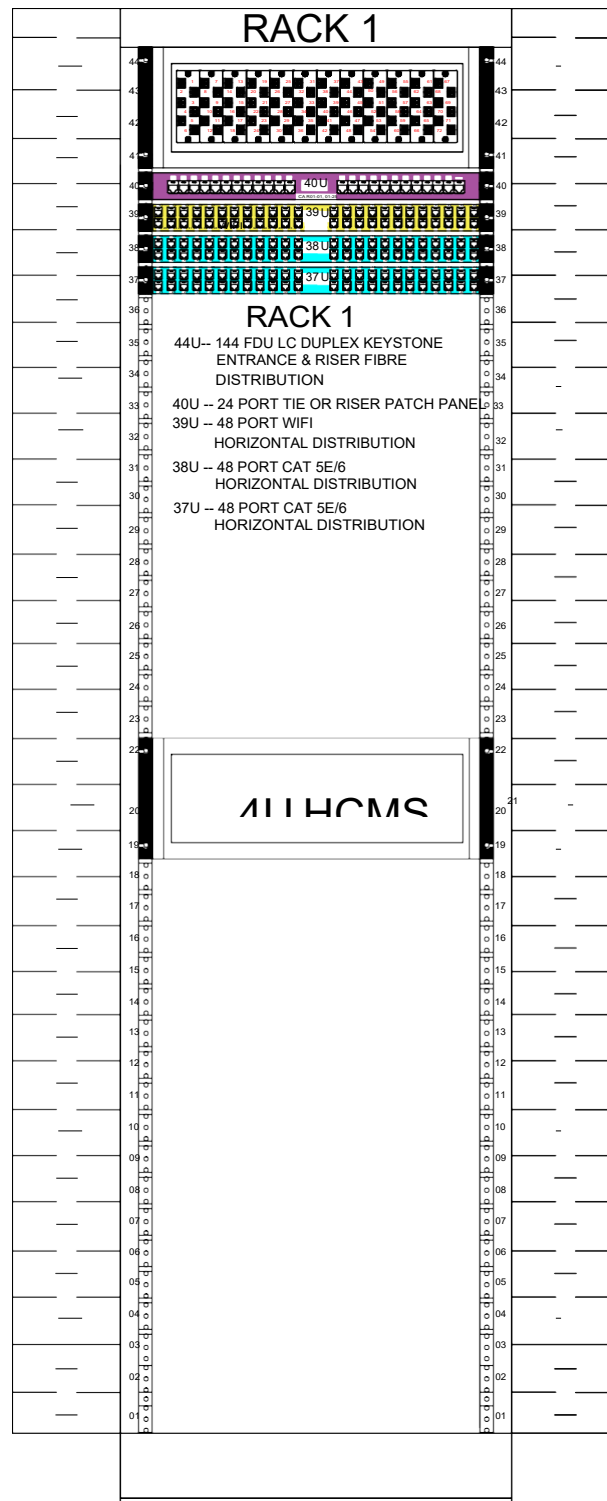
TYPICAL 2 RACK DISTRIBUTION
1U ANGLED PATCH PANEL

FIGURE
NUMBER

5

TYPICAL SINGLE RACK DISTRIBUTION

1U ANGLED PATCH PANELS



SHARED SERVICES
PARTAGE SHARED

TCNDE / ICRCT

DRAWING
TITLE

TYPICAL SINGLE RACK DISTRIBUTION
1U ANGLED PATCH PANEL

FIGURE
NUMBER

6

April 2019

TECHNICAL INSTALLATION PRACTICE

FOR

IDENTIFYING CABLE PLANT CABLE

USING

SSC CABLE IDENTIFICATION TAGS

10 GENERAL

- 11 The intent of this Technical Installation Practice (TIP) is to standardize the installation and inscription of SSC Cable Identification Tags installed on Government of Canada (GoC) owned cable plants.

20 INSTALLATION PRACTICE DETAILS

21 Purpose of Cable Identification Tag

- 2.2.1 Cable Identification Tags must be installed on SSC cables to provide maintaining agencies with pertinent cable network information such as but not limited to the following:
- a. Cable Identification Number ie: CA 01, FOM 01 or FOS 01;
 - b. Pair or Fibre Count ie: 01-1800 for copper cable or 1-12 for fibre cables; and
 - c. Cable type, size, gauge, direction (from – to) and, if applicable, CC or DD status ie: XKMB 1800-24 From MH 01 (1701-1800 DD)

22 Location of Cable Identification Tags

- 2.2.1 Cable identification tags are to be installed at the following location:
- a. in buildings on entrance cable and in close proximity to the building entrance protector terminal;
 - b. in building on each end of a riser cable and in close proximity to the distribution terminals or patch panels;
 - c. in manholes on straight runs of cables passing through the manholes (install qty 2 tags to show direction information “FROM and TO”);
 - d. in manholes on both sides of a splice closure regardless if the cable pair count has changed or not changed in the splice;
 - e. in utility tunnels at change of direction and in regular interval of no more than 200 meters;
 - f. in MDF and IDF at location of cable entrance and on MPS protector tails directly above the splice enclosure and on the distribution frame;
 - g. on cables within a direct buried splice enclosures (Pedestals); and
 - h. at any other locations as detailed in the Bell System Practices.

23 Cable Plant Direction Identification Procedure

2.3.1 For the purpose of tagging cables, the cables will be tagged using the analogy that the cable is installed from the MDF or IDF to the building or to access point. As such, the following examples are provided:

a. In MDF Bldg:

- .1 all cables leaving the MDF in the direction of the next access point (manhole, hand hole, building, pedestal, pole or utility tunnel splice) shall bare the inscription TO identifying the direction leading away from the MDF or switch ie: TO MH 1, TO Bldg 45, TO Splice 1A (utility tunnel only) or TO Pole 123;

b. In Manhole:

- .1 all incoming cables entering a manhole from an access point (manhole, hand hole, building, pedestal, pole or utility tunnel splice) located in the direction coming from the MDF, switch or IDF shall bare the inscription FR identifying the direction coming from the MDF, switch or IDF ie: FR MDF, FR Pole 0 or FR MH 1.
- .2 all outgoing cables from an access point to another access point (manhole, hand hole, building, pedestal, pole or utility tunnel splice) and leading away from the MDF, switch or from the IDF shall bare the inscription TO identifying the direction leading away from the MDF or switch ie: TO MH 2, TO PED 5, TO Bldg 123.

c. In buildings:

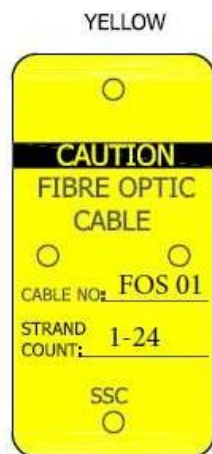
- .1 all building entrance cables originating from an access point (manhole, hand hole, building, pedestal, pole or utility tunnel splice) and in the direction of the MDF or switch shall bare the inscription FR identifying the direction coming from the MDF or switch ie: FR MH 27-1, FR PED 123 or FR Pole 34.

d. In IDF Building:

- .1 all incoming cables originating from the MDF of switch shall bare the inscription FR identifying the direction coming from the MDF or switch ie: MH 27-1 or Pole 34. FR
- 2 all outgoing distribution cables leaving the IDF Bldg shall bare the inscription TO identifying the direction leading away from the I DF and to the building ie: TO MH 27-1, TO PED 123 or TO Pole 34.

ample 1

ENGLISH SIDE OF TAGS



FRENCH SIDE OF TAGS



Sample 2

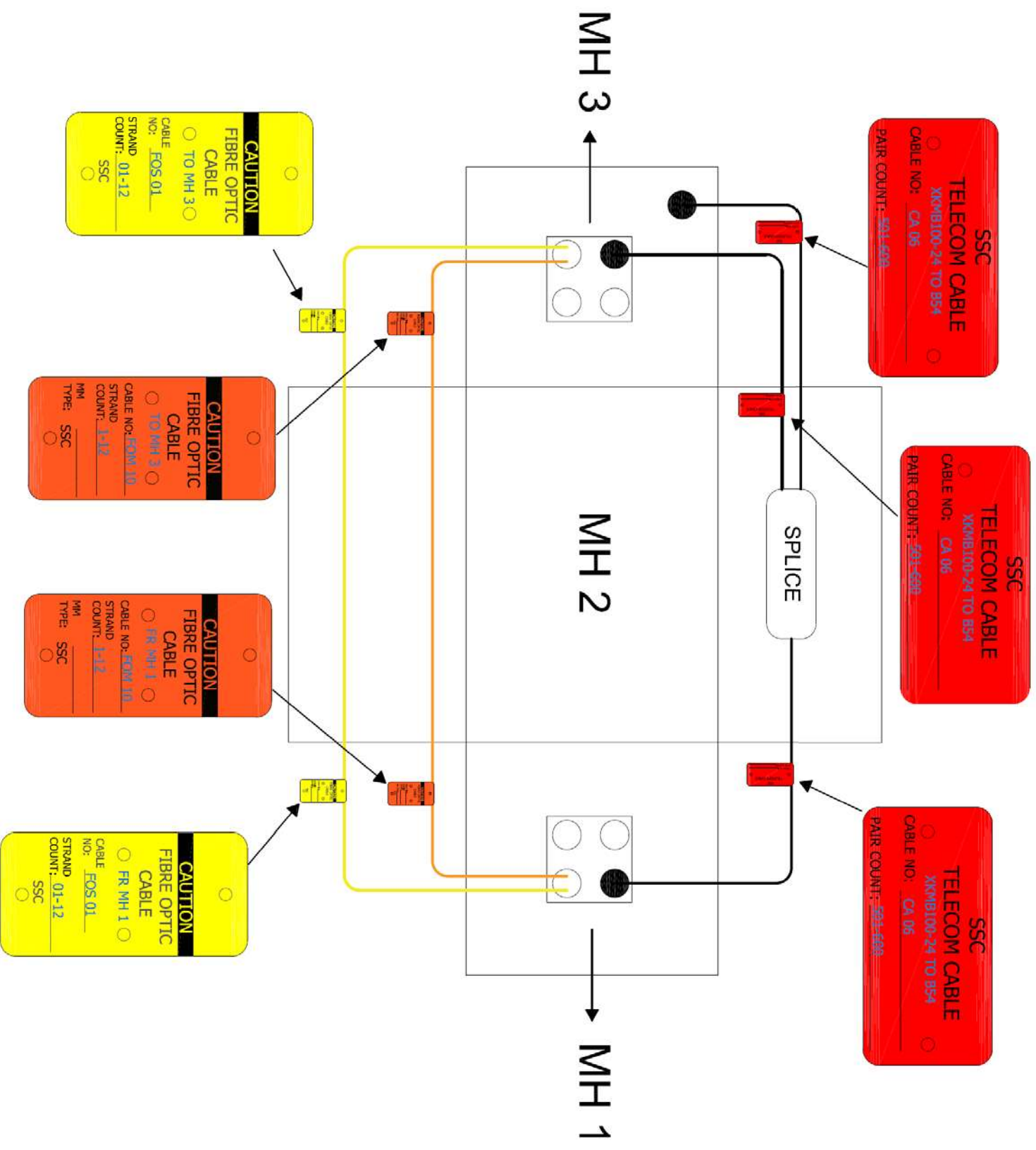
RED COPPER CABLE TAG

ENGLISH SIDE OF TAG

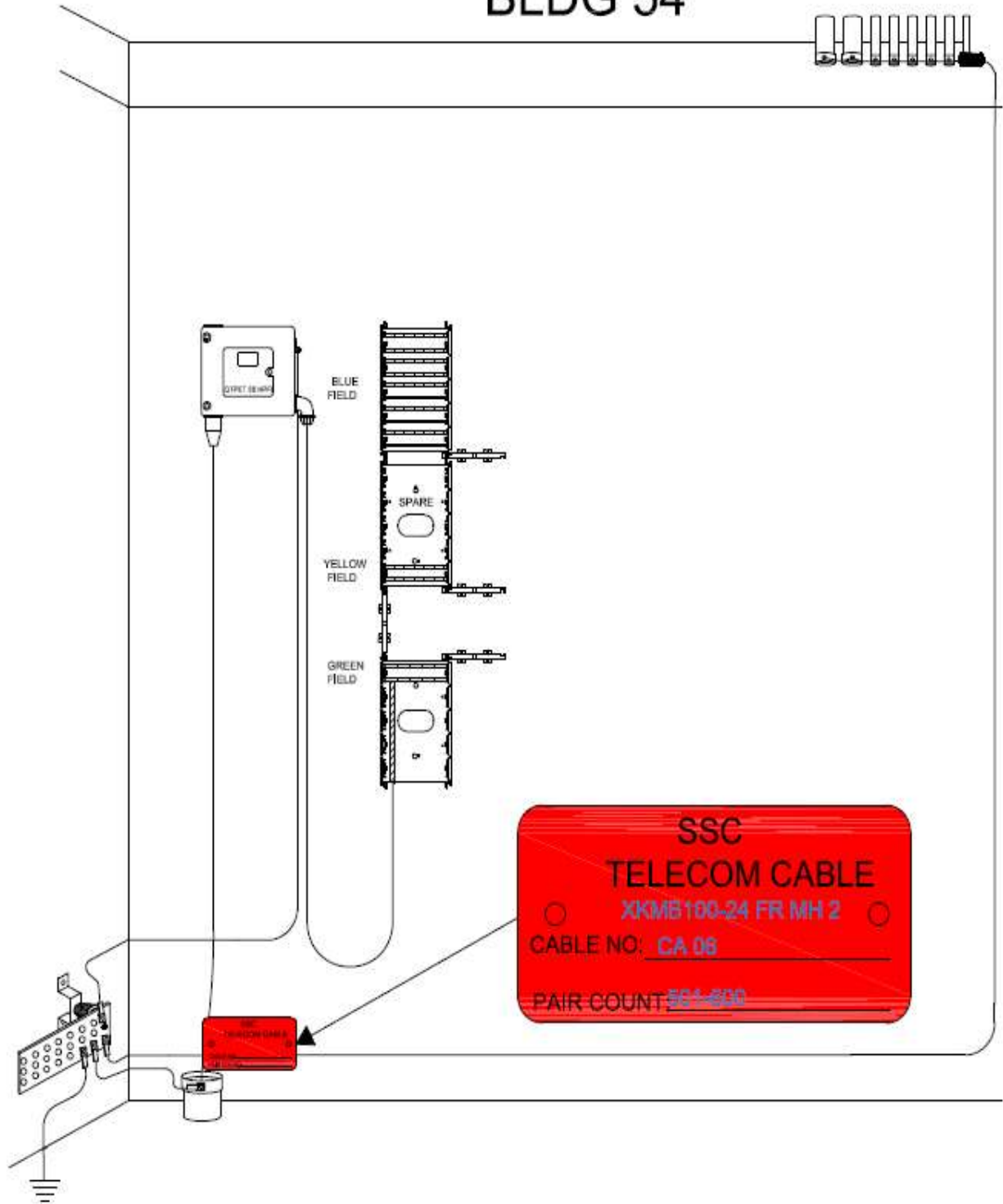


FRENCH SIDE OF TAG

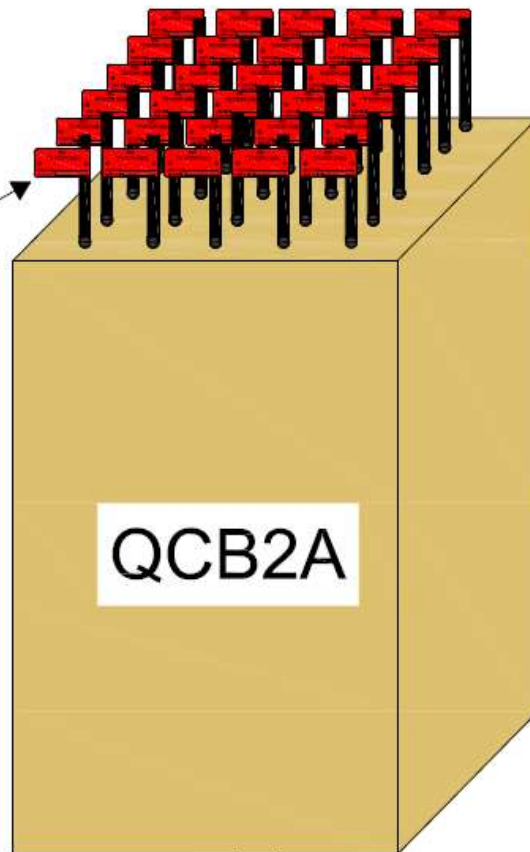




BLDG 54



FR FRAME



TO MH 1

APPENDIX C

Canadian Forces Fire Marshal Directive FMD 4005



CANADIAN FORCES FIRE MARSHAL

DIRECTIVE

FMD 4005

Authority Having Jurisdiction: CFFM

Subject:

Partial Occupancy

Date of

Original publication:
June 2008

Section:

Fire Protection Engineering

Latest revision:

September 2009

OPI:

CFFM 4

Reference:

RAMM Chapter 10
National Fire Code of Canada
NFPA 13 Installation of Sprinkler Systems
CAN/ULC-S524 Installation of Fire Alarm
Systems
CAN/ULC-S537 Verification of Fire Alarm
Systems

PURPOSE

To provide direction on fire protection requirements in order to occupy a building during construction or renovation, or to partially occupy a building under construction or renovation.



TABLE OF CONTENTS

PURPOSE	1
TABLE OF CONTENTS	2
RECORD OF AMENDMENTS	3
INTRODUCTION	4
Background.....	4
Application	4
POLICY & GOVERNANCE	5
RAMM - Chapter 10.....	5
National Fire Code of Canada	5
Approval Authority.....	6
Approval to Occupy.....	6
REQUIREMENTS	7
Fire Safety Plan	7
Water Supply for Fire Protection.....	8
Automatic Sprinkler System.....	8
Standpipe and Hose Systems	9
Fire Alarm and Detection System	9
Fire Separation.....	10
Emergency and Exit Lighting.....	11
Egress / Exits	13
Fire Extinguishers.....	13
Fire Protection System Impairment.....	14
Building Fire Risk Status Form	14
APPENDIX A: BUILDING FIRE RISK STATUS FORM	A-1

RECORD OF AMENDMENTS

Amendment No.	Additions/Revisions	New Version No.	Date
1	Document creation	1.1	Aug 2008
2	Addition of DND risk mgmt framework in para 11 Change to para 13	1.2	Jan 2009
3	Revisions to paras 2, 3, 4, 11, 14, 19, 20, 24, 26, 27, 31, 32, 34, 39, 40, 48, 56, 65-68, Appendix A	1.3	July 2009
4	Title change from FMOG to FMD	1.3	1 Sep 09

INTRODUCTION

BACKGROUND

1. Buildings constructed by the Department of National Defence are intended to respond to the needs of the Canadian Forces. Occasionally, a unit or group must maintain operations in a building during renovations, or needs to occupy the building prior to its substantial completion. In order to assure the safety of the personnel occupying a portion or portions of a building under construction or renovation, compliance with this Directive is required.

APPLICATION

2. This directive applies to construction and renovation projects, where continued occupancy is required in the following cases:
 - a. Phased new construction: where a construction project is phased over a period of time, or completion is in stages and areas of the building could potentially be occupied while adjacent areas are still under construction.
 - b. Early or partial occupancy of new construction: where units must move into building ahead of completion of the construction project.
 - c. New construction being added onto an existing building;
 - d. Renovation or recapitalization of portions of an existing building: where construction operations increase the risk to the occupants outside the construction area of the building. Examples of risk activities are hot works, temporary heating equipment, presence of considerable quantities of flammable and combustible liquids or explosives, etc; and
 - e. Phased renovation or recapitalization of existing buildings.
3. This directive is not intended to be applied to routine maintenance projects. Routine maintenance projects are those where the risk to personnel in the construction or renovation side of the building is no greater than the every day operations on the occupied side. The approval authority shall determine which measures of this directive can be reasonably applied without being detrimental to the overall project timeline and cost. Some examples of projects that are considered routine maintenance include: carpet replacement, toilet change out, interior space re-organization, etc.

4. This directive and the requirements contained herein are intended as direction for both the occupying unit and the contractor. It must be clear that in occupied portions of the building, DND/CF retains responsibility for fire safety of its occupants and infrastructure. Interactions between the occupying unit, the contract authority and the contractor are expected where new or existing fire protection systems are affected by construction or renovation projects.
5. The approval authority must ensure the occupying unit and the contractor each meet their respective responsibilities as set out in this directive to ensure the safety of personnel in the construction or renovation sides and the occupied sides of the building.
6. Occupied areas in all cases listed in paragraph 2 shall be kept separate from areas under construction or renovation by a minimum 1-hour fire separation and be provided with all active fire and life safety systems as required by this directive.

POLICY & GOVERNANCE

RAMM - CHAPTER 10

7. Chapter 10 of the Realty Asset Management Manual (RAMM) identifies the minimum standard of compliance as the provisions of the National Fire Code of Canada (NFCC) and the documents referenced therein.

NATIONAL FIRE CODE OF CANADA

8. Section 5.6 of the NFCC addresses fire and life safety requirements for construction and demolition sites, including renovations. Section 5.6 applies to buildings, parts of buildings and associated areas undergoing construction or demolition operations, including renovations.
9. Section 6.1 of the NFCC addresses maintenance of fire protection and life safety systems installed in a building. Section 6.1 includes requirements for the inspection, testing, maintenance and operation of portable fire extinguishers, water-based fire protection systems, special extinguishing systems, fire alarm systems, emergency electrical power supply systems, and emergency lighting.

APPROVAL AUTHORITY

10. For locally managed construction or renovation projects, all requests for partial occupancy shall be submitted to the Base Fire Chief / Chief Fire Inspector for review and approval prior to implementation.
11. For nationally managed construction or renovation projects, all requests for partial occupancy shall be submitted to CFFM 4: Fire Protection Engineering for review and approval prior to implementation.
12. All documentation, as required in the remainder of this directive, shall be forwarded to the approval authority before commencement of construction or renovation operations.
13. The approval authority shall perform an inspection of the building prior to partial occupancy, to ensure the requirements of this directive have been met.
14. The approval authority shall assess all hazards present as well as the adequacy of the risk mitigation measures required in this directive to determine whether a building is fit to be occupied. Approval for occupancy is at the sole discretion of the approval authority.
15. In cases where the approval authority must exercise judgement in assessing the relative risk to occupants, and where the actual risk to occupants is difficult to define, the approval authority shall refer to the DND/CF Integrated Risk Management Policy ([Link](#)) and Guidelines ([Link](#)).
16. In any case where deviation from the requirements in this directive may be necessary, specific approval in writing shall be obtained from the relevant approval authority, and this specific approval shall apply only to the particular case for which it is given.

APPROVAL TO OCCUPY

17. Occupancy shall not be permitted unless all requirements of the approval authority are met. A building or structure in part or total shall not be occupied until written permission has been obtained from the approval authority.

REQUIREMENTS

FIRE SAFETY PLAN

18. Section 5.6.1.2 (1) of the NFCC requires that “Prior to the commencement of construction or demolition operations, a fire safety plan conforming to Section 2.8 (of the NFCC) shall be prepared for this site.”
19. For any construction or renovation project where there will be partial occupancy during the project, the contractor shall prepare a project fire safety plan, to be submitted to the contract authority and approved by the approval authority.
20. The fire safety plan shall be limited to the construction or renovation area only. DND/CF shall retain responsibility for fire safety of its occupants and infrastructure, including any amendments required to the building’s existing fire safety plan outside the project boundaries.
21. The fire safety plan for the construction or renovation area shall have consideration for any building system that will be impaired and identify the extent to which the system(s) in question will be affected on the occupied side of the building.
22. The contract authority shall forward, for review and approval, a fire safety plan for the construction or renovation areas of the building, which shall contain, as a minimum, the following information:
 - a. The designation and organization of site personnel to carry out fire safety duties, including fire watch service if applicable;
 - b. The emergency procedures to be followed by construction personnel in the event of a fire, including:
 - i. Sounding the fire alarm;
 - ii. Notifying the fire department;
 - iii. Instructing site personnel on the procedures to be followed when the alarm sounds; and
 - iv. Attacking the fire with portable fire fighting equipment if safely able to do so.
 - c. Measures for controlling fire hazards in and around the building; and

- d. A maintenance procedure for fire fighting equipment.
23. The approval authority shall determine what other measures found in section 2.8 of the NFCC, if any, shall be required as part of the site fire safety plan.

WATER SUPPLY FOR FIRE PROTECTION

24. Section 6.1.1.2 (1) of the NFCC requires that “Fire protection installations shall be maintained in operating condition.”
25. Where underground water mains supply existing fire hydrants, automatic sprinkler systems or standpipe and hose systems, the water supply system shall be maintained in operable condition. For new construction, the water supply shall be installed, completed and ready for use by fire department as soon as is possible and prior to the new building being occupied.

AUTOMATIC SPRINKLER SYSTEM

26. Section 6.1.1.2 (1) of the NFCC requires that “Fire protection installations shall be maintained in operating condition.”
27. For existing automatic sprinkler systems, only portions necessary to complete the scope of work shall be impaired. Sprinklers must remain fully operational in all occupied areas of the building.
28. For new or phased construction. The automatic sprinkler system shall be installed, tested and commissioned in accordance with NFPA 13, for all areas to be occupied in the building. The automatic sprinkler system shall be deemed to include all components through to the underground water supply entrance, in accordance with NFPA 13.
29. For new or phased construction, the contract authority shall forward, for review and approval of the automatic sprinkler system for occupied areas, the following information:
- a. Underground test certificate in accordance with NFPA 13, section 10.10;
 - b. Design information as required by NFPA 13, Chapter 22, Plans and Calculations; and

- c. Installation and commissioning information as required by NFPA 13, Chapter 24, Systems Acceptance.
30. The approval authority may request to repeat some of the acceptance testing requirements as found in NFPA 13, during the final approval inspection. It is advisable to have the installation contractor onsite to assist with any requests from the approval authority during the approval inspection.

STANDPIPE AND HOSE SYSTEMS

- 31. Section 6.1.1.2 (1) of the NFCC requires that “Fire protection installations shall be maintained in operating condition.”
- 32. For existing standpipe and hose systems, only portions necessary to complete the scope of work shall be impaired. Standpipes must remain fully operational in all occupied areas of the building.
- 33. In new or phased construction where a standpipe and hose system is provided, they shall be installed as construction progresses, complete with hoses and valves, in such a manner that they are always available for fire department use to the topmost floor that has been erected. Design information as defined in NFPA 14 Standard for the Installation of Standpipe and Hose Systems, shall be provided to the approval authority prior to putting the system in service.

FIRE ALARM AND DETECTION SYSTEM

- 34. Section 6.1.1.2 (1) of the NFCC requires that “Fire protection installations shall be maintained in operating condition.”
- 35. For existing fire alarm systems, only portions necessary to complete the scope of work shall be impaired. The fire alarm and its devices must remain fully operational in all occupied areas of the building.
- 36. For new or phased construction, the fire alarm and detection system, where installed, shall be tested and verified in accordance with CAN/ULC-S537, Verification of Fire Alarm Systems, for all areas to be occupied in the building. The fire alarm system shall be deemed to include all necessary components through the fire alarm control panel, including protection of conductors, in accordance with CAN/ULC-S524, Installation of Fire Alarm Systems.

37. For new or phased construction, the contract authority shall forward, for review and approval of the fire alarm and detection system, the following information:
 - a. All design information as required by CAN/ULC-S524, section 3.5 Plans and Specifications; and
 - b. A verification test report in compliance with CAN/ULC-S537, section 3.2 Documentation.
38. The approval authority may request to repeat some of the acceptance testing requirements as found in CAN/ULC-S537, during the final approval inspection. It is advisable to have the installation contractor onsite to assist with any requests from the approval authority during the approval inspection.

FIRE SEPARATION

39. Section 5.6.1.14 (1) of the NFCC requires that, “Where part of a building continues to be occupied, the occupied part shall be separated from the part being demolished or constructed by a fire separation having a fire resistance rating of not less than one hour.”
40. For projects in which a design professional is retained to provide design documents, the designer of record shall be tasked to specify the design, construction and location of the fire separation. Location shall be determined in cooperation with the approval authority. The location plan and details of the construction must be included as part of the tendered drawings and specifications.
41. For projects for which there is no designer of record, the Construction Engineering Officer or his delegated authority shall review the tender floor plans and identify the locations of the fire separations. This information must be provided to the contract authority prior to tender to ensure bidders are aware of partial occupancy requirements. This review and identification should include a field review of the construction area to properly assess existing conditions. Consideration should be given to existing fire separations. Where deemed appropriate, the construction area could be increased to utilize existing fire separations as a means of meeting the fire separation requirement of this directive without having to construct a new assembly (repair of deficiencies is required for existing separations to be used).

42. The required fire separation shall consist of:
- a. A ULC listed construction assembly intended for use as a vertical or horizontal fire separation or an assembly in compliance with Appendix A (where permitted) or Appendix D of the National Building Code of Canada (NBCC);
 - b. A ULC listed fire stop system at all service penetrations and construction joints to ensure the continuity of the fire separation separating the completed and uncompleted portions of the building; and
 - c. Closures for all penetrations through the fire separation, as required by the NBCC. All closures shall be listed for their intended use and shall be listed at not less than 45 minutes fire resistance rating.
43. The contract authority shall forward, for review and approval of the fire separation, the following information:
- a. Basis for design for the proposed fire separation assembly; and
 - b. The fire stop system's product information and installation sheets from the manufacturer, detailing the ULC listed system number and the installation requirements of the fire stop system.
 - c. Any closure's product information and installation sheets from the manufacturer.

EMERGENCY AND EXIT LIGHTING

44. Section 6.1.1.2 (1) of the NFCC requires that "Fire protection installations shall be maintained in operating condition."
45. Emergency lighting and exit signage shall be provided in areas to be occupied, in accordance with the NBCC.
- a. Emergency lighting, in accordance with the NBCC 3.2.3.7, shall be provided to an average illumination not less than 10 lx at floor or tread level
 - i. In exits;
 - ii. In principal routes providing access to exit in open floor areas and in service rooms;

- iii. In corridors used by the public;
 - iv. Corridors serving patients sleeping rooms;
 - v. Corridors serving classrooms;
 - vi. Underground walkways;
 - vii. Public corridors;
 - viii. Floor areas or parts thereof where the public may congregate
 - 1. In Group A Division 1 occupancies;
 - 2. In Group A division 2 and 3 occupancies having an occupant load of 60 or more;
 - ix. Floor areas or parts thereof of daycare centres where persons are cared for, and
 - x. Food preparation areas in commercial kitchens.
- b. Exit signage shall be provided where required by the NBCC in section 3.4.5, and shall:
- i. Be visible from the exit approach;
 - ii. Have the words EXIT and SORTIE displayed in plain, legible letters or green pictogram exit signs are acceptable; and
 - iii. Be illuminated continuously while the building is occupied.
46. The contract authority shall forward, for review and approval of the emergency and exit lighting, the following information:
- a. The emergency lighting unit's product information and installation sheets from the manufacturer.
 - b. The exit signage's product information and installation sheets from the manufacturer.
47. The approval authority may request acceptance testing for emergency lighting levels and exit signage, during the final approval inspection. It is advisable to have the installation contractor onsite to assist with any requests from the approval authority during the approval inspection.

EGRESS / EXITS

48. Section 6.1.1.2 (1) of the NFCC requires that “Fire protection installations shall be maintained in operating condition.”
49. Means of egress shall be maintained in all occupied areas of the building. Where the scope of the construction or renovation project impairs an existing exit or egress path, alternate measures shall be planned for in the fire safety plan and signage posted in the occupied areas of the building directing occupants to the closest available exit.
50. Means of egress to the outside or other safe location approved by the approval authority by means of stairways, passageways, runways or scaffolds shall be provided at all times from all levels of the building or structure under construction or renovation.
51. At least one stairway shall be maintained in useable condition at all times.
52. Handrails shall be provided for all stairways, passageways, runways or scaffolds forming the means of egress.
53. All means of egress shall be maintained clear of all obstructions.

FIRE EXTINGUISHERS

54. Section 6.1.1.2 (1) of the NFCC requires that “Fire protection installations shall be maintained in operating condition.”
55. Fire extinguishers in occupied areas shall be provided as per the building’s design. The design shall meet the minimum requirements of NFPA 10, Standards for Portable Fire Extinguishers.
56. Fire extinguishers shall be provided in areas under construction or renovation, at the discretion of the approval authority. Distribution of the fire extinguishers shall meet NFPA 10 as in para 54 above.
57. Fire extinguishers shall be class ABC, multi purpose dry chemical. Minimum size shall be 2A-10BC. Maximum travel distance between extinguishers shall be not more than 75ft direct travel distance.



FIRE PROTECTION SYSTEM IMPAIRMENT

58. Fire protection systems active in occupied areas as required by this directive must meet FMD 4006 when impaired due to construction or renovation operations. The approval authority must ensure occupying units are duly notified of any fire protection system impairment as per FMD 4006.

BUILDING FIRE RISK STATUS FORM

59. In all instances where partial occupancy occurs, the Approval Authority shall evaluate fire risk elements in the building prior to building handover to the contractor and prior to building handover from the contractor to DND/CF. The form is intended to be collaborative and should be completed by the approval authority in consultation with the general contractor and the contract authority.
60. The contractor, upon receipt of the form, shall utilize the information appended to formulate the fire safety plan for the construction or renovation area.
61. A building fire risk status form is included at Appendix A to provide general headings which the approval authority must consider prior to handover. This is not intended as a comprehensive list, and should not be limited to the headings contained in the form. The approval authority must evaluate all risks in and around the site to ensure the fire safety of the assets and occupants.
62. The building fire risk status form is intended to capture information which the contractor or the occupying unit should be aware to ensure fire safety measures are amended appropriately for the life of the project. This includes, but is not limited to:
 - a. Fire protection systems status: where fire protection systems are impaired and cannot be relied upon to operate as intended during construction or renovation projects. For example, closing sprinkler valves during renovations; the consideration is the sprinkler system will not provide alarm detection and notification. Alternate means of providing detection and notification must be planned for. Where fire alarm is installed in phased construction, fire alarm devices in all areas of the building to be occupied must be installed and verified prior to occupancy. The consideration is that the personnel on the

occupied side of the project must be notified of any fire emergency in their areas.

- b. Egress and exiting status: the approval authority must review the construction plan and determine the occupants' ability to exit from the building, both in the occupied and project areas. Should an exit or particular path of egress be inaccessible due to construction or renovation work, additional consideration must be given to alternate means of egress and exiting.
- c. Fire department access and water supply status: fire department access must be maintained into the construction or renovation site and adjacent to the building. The approval authority must evaluate the ability of the fire department to respond efficiently and effectively based on the restrictions inherent in the project (i.e. road replacement would affect access to a building). Should the nature of construction operations restrict the fire response to the site, alternate measures should be planned to ensure responding authorities are aware of the restriction in accessing the site and available water supply.
- d. Special hazards status: this is to identify any special hazards present in the occupied portion of the building, or any special hazards intended on the construction or renovation side of the building. For example, if large quantities of flammable liquids are stored adjacent to an exit from an occupied area, it may be advisable to re-route occupants to an alternate exit even if the exit itself is still functional and accessible. Special hazards could include presence of HAZMAT, missing guard rails, confined space requirements, operations in occupied areas affecting construction or renovation operations, etc.



APPENDIX A: BUILDING FIRE RISK STATUS FORM

1 - FIRE PROTECTION SYSTEM STATUS:

1A - AUTOMATIC SPRINKLER SYSTEMS

1B - STANDPIPE AND HOSE SYSTEMS

1C - FIRE PUMPS

1D - FIRE DETECTION AND ALARM SYSTEMS

2 - EGRESS AND EXITING STATUS

3 - FIRE DEPARTMENT ACCESS AND WATER SUPPLY STATUS

4 - SPECIAL HAZARDS STATUS
