

Mechanical Consultant: Morrison Hershfield Limited

Issued for Tender

Professional Engineer of Ontario Seal:



Electrical Consultant: Morrison Hershfield Limited

Issued for Tender

Professional Engineer of Ontario Seal:



END OF SECTION

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END OF SECTION

Part 1 General

1.1 TAXES

- .1 Pay taxes properly levied by law (including federal, provincial and municipal).

1.2 FEE, PERMITS, AND CERTIFICATES

- .1 Obtain and pay for building permit, certificates, licenses and other permits as required by municipal, provincial and federal authorities.
- .2 Building Permit:
 - .1 Constructor shall apply for, obtain and pay for building permit on behalf of Departmental Representative, and other permits required for Work and its various parts.
 - .2 Constructor shall display building permit and other permits in a conspicuous location at Place of Work.
- .3 Provide authorities with plans and information for acceptance certificates.
- .4 Provide inspection certificates as evidence that work conforms to requirements of authority having jurisdiction.
- .5 Submit to Departmental Representative, copy of application submission and approval documents received for authority having jurisdiction.

1.3 DOCUMENTATION

- .1 Contractor to provide the following prior to contract award:
 - .1 Integrity check – Complete form and list of company Departmental Representatives.
 - .2 Copy of WSIB & this document must be kept updated.
 - .3 Copy of Liability insurance
- .2 Contractor to provide the following after contract award
 - .1 Copy of trade certificate;
 - .2 Contractor health and safety procedure;
 - .3 Site specific safety plan;
 - .4 Copy of Ministry of Labour Regulations;
 - .5 Names and date of birth of each worker coming to site;
 - .6 Detailed description at each invoice;
 - .7 Statutory declaration required with each invoice;
 - .8 Copy of ESA permit number and ESA final inspection;
 - .9 Lock out and tag out procedure, as required.

1.4 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 by government departments. Arrange with Departmental Representative to facilitate execution of work.

1.5 EXISTING SERVICES

- .1 Where work involves breaking into or connecting to existing services, carry out work at times directed by governing authorities, with minimum disturbance to tenant operations.
- .2 Establish location and extent of service lines in area of work before starting work and notify Departmental Representative of findings.
- .3 Submit Schedule to and obtain approval Departmental 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.
- .4 Where unknown services are encountered, immediately advise departmental representative and confirm findings in writing.
- .5 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .6 Record locations of maintained, re-routed and abandoned service lines.

1.6 ACCESS AND EGRESS

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

1.7 USE OF SITE AND FACILITIES

- .1 Maintain existing services to building and provide for personnel and vehicle access.
- .2 Departmental Representative will assign sanitary facilities for use by Contractor’s personnel. Keep facilities clean; keep facility clean and ensure proper de-sanitation after use.
 - .1 Contractor to utilise washroom 366.
 - .2 Contractor to post signage affixed to the washroom door during hours of use to indicate contractor use only
 - .3 Contractor is responsible for daily cleaning as part of the Departmental Representative’s COVID-19 policies.
- .3 Closures: protect work temporarily until permanent enclosures are completed.

1.8 VEHICLE ACCESS ON SPARK STREET

- .1 For Vehicular access on sparks street contact Spark Street Business Improvement Area or Sparks Street Mall Authority Mall authority
 - .1 Address: 100 Sparks Street, suite 300
 - .2 Telephone: 613-230-0984
 - .3 Mobile: 613-223-7898

1.9 CONTRACTOR'S USE OF EXISTING ELEVATORS

- .1 Departmental Representative shall allow use of one (1) Freight elevator to deliver the material to existing building.
 - .1 151 Sparks Street, Ottawa, Ontario
- .2 Delivery hours shall be coordinated and confirmed with Departmental Representative. Advise 5 business days prior to delivery date.
- .3 Contractor shall provide and ensure that the elevator cab interior and landing jamb protection are in place and secure all times. All damages to the elevator cab interior, doors, controls and landing jambs caused by Contractor shall be repaired and/or replaced to the satisfaction of the Departmental Representative at no extra costs to the Departmental Representative.
- .4 Elevator may be used for moving workers and material.

1.10 SECURITY SCANNING OF CONSTRUCTION MATERIALS AND EQUIPMENT

- .1 All deliveries are required to go to a scanning facility for inspection (location A) prior to being delivered to site (location B). Location B will be final delivery location
 - A) Company: SCI Group Inc.
Location: 2303 Stevenage Drive,
Ottawa, Ontario,
K1G 3W1
Contact: Eric Maurier – eric.maurier@sci.ca, 613-731-7331 ext. 4310.
Hours: 7:00AM to 3:00PM
 - B) Valour Building, 151 Sparks Street, Ottawa, Ontario
- .2 Refer to 01 00 10 General Instructions Appendix A. This form must be completed by the contractor for scanning purposes.
- .3 The Supplier must coordinate all deliveries and installations dates as detailed above with the Departmental Representative.
- .4 The Scanning Facility is open Monday through Friday from 7:00 AM to 3:00 PM
- .5 Groups arriving at the facility for processing are serviced on a first come, first served basis.
- .6 All construction materials and equipment must be scanned prior to delivery to site.
- .7 Items to be scanned are to be removed from the transporting vehicle for processing. Items are then placed back into the contractor vehicle for sealing.
- .8 Seal number is communicated from SCI staff to receiving staff on site at Confederation building.
- .9 A cube van or trailer with lockable door, with the ability to install a transportation seal, must be used at the scanning center.
- .10 No advance notice for small loads received at SCI is necessary, however for larger loads (such as 53 foot trailers) advance notice is required. Details required are as follows:

- .1 The Supplier is required to provide the Departmental Representative with the following information a minimum of five (5) working days prior to on site delivery:
 - .1 Date and time of delivery;
 - .2 Vehicle description;
 - .3 Vehicle licence plate;
 - .4 Names of employees including the driver

1.11 REMOVED MATERIALS

- .1 Unless otherwise specified, materials for removal become contractor's property. Remove Materials Promptly.

1.12 DOCUMENTS REQUIRED

- .1 Maintain at job site or readily available, 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 (maintain on site).
 - .11 Hot work permit (maintain on site).
 - .12 Communiqué (maintain on site).
 - .13 Other documents as specified

1.13 FAMILIARIZATION WITH SITE

- .1 Contractor may visit site prior to submitting tender to examine site conditions and assess risks and requirements for completing work. No allowance is made on account of error or negligence to properly observe and determine existing conditions.
- .2 Obtain prior permission from Departmental representative before carrying out site inspection.

1.14 PROJECT MEETINGS

- .1 Departmental Representative will arrange project meeting and assume responsibility for setting times and recording minutes.
- .2 Assist to project meeting, held bi-weekly, for entire duration of work and as directed by Departmental Representative.

1.15 CONSTRUCTION PROGRESS SCHEDULE

- .1 On award of contract submit construction schedule for work, indicating anticipated progress stages within time of completion. Schedule must be “Gantt Type” chart. When schedule has been reviewed by Departmental Representative, take necessary measures to complete work within scheduled time
- .2 Allow for all power shutdowns required to suit the scope of work. Provide a minimum of 2 weeks notice to Departmental Representative for any shutdowns.
- .3 Schedule and execute work with least possible interference or disturbance to normal use of premises.
- .4 Do not change schedule without notifying Departmental representative.
- .5 All work requiring shutdown of AHU-4, all noisy work and all work who required a hot work permit must be completed “after hours”:
 - .1 “After hours” when the House of Commons is not sitting.
 - .1 6:00PM to 6:00AM on weekday.
 - .2 All day during the weekend or Statutory holiday.
 - .2 “After hours” when the House of Commons is sitting.
 - .1 9:00PM to 6:00AM on weekday.
 - .2 All day during the weekend or Statutory holiday.
 - .3 “After hours” when the House of Commons requires late sitting.
 - .1 The contractor requires to include two (2) work stoppage caused by late sitting.
 - .2 If Departmental Representative provides a 24hr notice in advance to the contractor for a late sitting this is not considered a work stoppage.
 - .3 If Departmental Representative does not provide a 24hr notice, PSPC will pay 4hr for each worker scheduled to be on site and not all workers listed on the ABA.
- .6 Carry out all other work during “regular hours”:
 - .1 “Regular hours” when the House of Commons is not sitting.
 - .1 6:00AM to 6:00PM on weekday.
 - .2 “Regular hours” when the House of Commons is sitting.
 - .1 6:00AM to 9:00PM on weekday.
- .7 Access to the House of Commons Calendar can be found at:
<https://www.ourcommons.ca/en/sitting-calendar>
- .8 The contractor must advise by writing the Departmental Representative at least 4 working days in advance to get the Authorization for Building Access (ABA) approved.

- .9 Submit schedule updates when requested, to Departmental Representative, due to changing project condition. Provide a narrative explanation of necessary changes and schedule revisions at each update.

1.16 FIRE SAFETY REQUIREMENTS

- .1 Comply with the National Building Code of Canada 2015 (NBC) for fire safety in construction and the National Fire Code of Canada 2015 (NFC) for fire prevention, firefighting and life safety in building in use.
 - .1 The National Building Code (NBC): for fire safety and fire protection features that are required to be incorporated in a building during construction.
 - .2 The National Fire Code (NFC)
 - .1 The on-going maintenance and use of the fire safety and fire protection features incorporated in buildings.
 - .2 The conduct of activities that might cause fire hazards in and around buildings.
 - .3 Limitations on hazardous contents in and around buildings.
 - .4 The establishment of fire safety plans.
 - .5 Fire Safety at construction and demolition sites.
- .2 Welding and cutting:
 - .1 At least 4 days prior to commencing cutting, welding or soldering procedure, provide to Departmental Representative.
 - .1 Notice of Intent, indicating devices affected, time and duration of isolation or bypass.
 - .2 Return welding permit to Departmental Representative immediately upon completion of procedures for which permit was issued.
 - .2 A fire alarm bypass is required for all work that could generate dust.
 - .1 Fire alarm bypass is not permitted when the House of Commons is sitting.
 - .1 Access the House of Commons Calendar can be found at:
<https://www.ourcommons.ca/en/sitting-calendar>
 - .2 The contractor has the responsibility to do or sub-contract the fire alarm bypass. The contractor is responsible for this expense.
 - .1 An allowance of \$10,000 is to be included in the bid to cover all charges related to the fire alarm bypass.
 - .2 The contractor must provide an invoice or an estimate to the Departmental Representative as a back-up with the monthly invoice for any allowances.
 - .3 The building fire alarm maintenance contractor is:

- .3 Before welding, soldering, grinding, core drilling, concrete drilling and/or cutting work, obtain a permit from Fire Prevention Unit as directed by Departmental representative.
- .4 Immediately upon completion of work, restore fire protection systems to normal operation and verify that devices are fully operational.
- .5 Inform fire alarm system monitoring agency and local Fire Department immediately prior to isolation and immediately upon restoration of normal operation.
- .6 “Fire Watchers” as described in NFC shall be assigned when welding or cutting operations are carried out in areas where combustible materials within 15m may be ignited.

1.17 SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit for Departmental Representative review, soft copies of each shop drawings.
 - .2 Review is for sole purpose of ascertaining conformance with general design concept and does not mean approval of design details inherent in shop drawings, responsibility for which remains with contractor.
 - .3 Departmental Representative’s review does not relieve Contractor of responsibility for errors or omissions in shop drawings or Contractor’s responsibility for meeting requirements of Contract Documents
 - .4 Do not commence manufacture or order materials before shop drawings are reviewed
- .2 Product Data
 - .1 Submit soft copies of product data
 - .2 Delete information not applicable to project.
 - .3 Cross-Reference product data information by division and section number to applicable portions of Contract Documents.

1.18 SECURITY CLEARANCES

- .1 Contractor to provide Departmental Representative the names of all worker complete with date of birth a minimum 4 days in advance.
- .2 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.

1.19 SECURITY ESCORT

- .1 Personnel employed on this project must be escorted when executing work on the roof areas during normal working hours.
- .2 Submit an escort request to Departmental Representative at least 4 business days before service is needed. For requests submitted within time mentioned above, costs of security escort will be paid for by Departmental Representative. Cost incurred by late request will be Contractor’s responsibility.

1.20 REFERENCES TO REGULATORY REQUIREMENTS

- .1 Perform Work in accordance with the Ontario Building Code of Canada OBC, 2012 including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code
 - .1 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.

1.21 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.

1.22 ASBESTOS DISCOVERY

- .1 Should material resembling spray or trowel-applied asbestos be encountered in course of work, stop and notify Departmental representative immediately. Do not proceed until written instructions have been received from Departmental Representative.

1.23 FIELD QUALITY CONTROL

- .1 Carry out work using qualified licenced workers or apprentices in accordance with provincial act respecting manpower vocational training and qualification.
- .2 Permit employees registered in Provincial Apprenticeship program to perform specific task only if under direct supervision of qualified licenced workers.
- .3 Determine permitted activities and tasks by apprentices, based on level of training attended and demonstration of ability to perform specific duties.

1.24 HAZARDOUS MATERIALS

- .1 Comply with the requirements of 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 Social Development Canada (HRSDC), Labour Program.
- .2 Provide MSDS upon request of Departmental Representative.

1.25 SIGNS

- .1 Provide common use signs related to traffic control, information, instruction, use of equipment, public safety devices, and other signs as directed by Departmental Representative in both official languages or by use of commonly understood graphic symbols to approval of Departmental Representative.
- .2 No advertising is permitted on this project.
- .3 Departmental Representative will provide a sign describing project for information of building users. Erect sign as directed by Departmental representative.

1.26 PUBLIC WAY PROTECTION

- .1 Design, erect and maintain hoarding and covered pedestrian walkways to support loads including wind loads and provide protection, complete with signs and electrical lighting as required by authority having jurisdiction.

1.27 DUST CONTROL

- .1 Provide temporary 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 such work is complete.
- .3 Protect furnishing within work area with 0.102mm thick polyethylene film during construction. Remove film during non-construction hours and leave premises in clean, unencumbered and safe manner for normal daytime function.

1.28 WORK CO-ORDINATION

- .1 Co-ordinate work of sub-trades.
 - .1 Designate one person to be responsible for review of contract documents, shop drawings, and planning and managing co-ordination of work.
- .2 Convene meeting between subcontractors whose work interfaces and ensure awareness of areas and extent of interface required.
 - .1 Provide each subcontractor with complete plans and specifications for contract, to assist them in planning and carrying out their respective work. Ensure subcontractors receive Division 01.
 - .2 Develop co-ordination drawings when required, illustrating potential interference between work of various trades and distribute to affected parties.
 - .1 Pay particularly close attention to overhead work above ceilings and within or near building structural elements.
 - .2 Identify on co-ordination drawings, building elements, services lines rough-in points and indicate location of services entrance to site.
 - .3 Facilitate meeting and review coordination drawings. Ensure subcontractors agree and sign-off on drawings.
 - .4 Publish minutes of each meetings.
 - .5 Plan and co-ordinate work to minimize number of service line offsets.
 - .6 Submit copy of coordination drawings and meeting minutes to Departmental Representative for information purposes.
- .3 Submit Shop drawings and order prefabricated equipment or prebuilt components only after co-ordination meeting for such items has taken place.
- .4 Work co-operation:
 - .1 Ensure co-operation between trades in order to facilitate general progress of work and avoid situations of spatial interference.
 - .2 Ensure that each trade provides other trades reasonable opportunity for completion of work to prevent unnecessary delays, cutting, patching and removal or replacement of completed work.

- .5 Departmental Representative is not responsible for, or accountable for extra costs incurred as a result of Contractor's failure to co-ordinate Work.

- .1 Resolve disputes between subcontractors.

1.29 BILINGUAL NOTATIONS

- .1 Any items supplied and installed under this contract which have operating instructions on them and which can be expected to be used by building tenants, must have operating instructions in English and French.
- .2 Factory embossed or recessed symbols illustrating equipment operation is an acceptable alternative to lettering.
- .3 Items supplied with factory embossed or recessed lettering in one official language with an applied sticker or decal representing second official language is not acceptable without approval from Departmental Representative before items are ordered.
- .4 Internationally recognized colour coding such as red and blue centre pieces for plumbing brass is acceptable
- .5 Contractor is responsible for cost incurred for re-stocking or re-ordering as a result of failure to ensure bilingual designation on items.

1.30 SLEEVES, HANGERS AND INSERTS

- .1 Co-ordinate setting and packing of sleeves and supply and installation of hangers and inserts. Obtain Departmental Representative's approval before cutting into structure.

1.31 SITE STORAGE

- .1 Contractor will equip and maintain storage space assigned by Departmental Representative
- .2 Do not unreasonably encumber site with materials or equipment.
- .3 Move stored products or equipment which interfere with operations of Departmental Representative or other contractors.
- .4 Obtain and pay for use of additional storage or work areas needed for operations.

1.32 PROTECTION

- .1 Protect finished work against damage.
- .2 Protect adjacent work against spread of dust and dirt beyond work areas.
- .3 Protect operatives and other users of site from hazards.

1.33 EXAMINATION

- .1 Examine site and conditions likely to affect work and be familiar and conversant with existing conditions.
- .2 Provide photographs of surrounding properties, objects and structures liable to be damaged or subject of subsequent claims.

1.34 SETTING OUT WORK.

- .1 Departmental Representative will define location, alignment and elevations of work.
- .2 Give Departmental Representative a minimum 5-day notice of requirements for construction layout.
- .3 Departmental Representative will provide only those survey control points as necessary to define general location, alignment and elevations of work. Give Departmental Representative a minimum 48-hour notice of requirements for control points.
- .4 Lay out work in detail from control points established by Departmental Representative.
- .5 Assume full responsibility for, and execute complete layout of work to locations, lines and elevations indicated.
- .6 Provide devices, stakes and survey markers required to lay out and construct work.
- .7 Supply such devices as straight edges and templates required to facilitate Departmental Representative's inspection of work.

1.35 CUT, PATCH AND MAKE GOOD

- .1 Cut existing surfaces as required to accommodate new work.
- .2 Remove items shown or specified.
- .3 Do not cut, bore, or sleeve load-bearing members.
- .4 Make cuts with clean, true, smooth edges. Make patches inconspicuous in final assembly.
- .5 Patch and make good surfaces cut, damaged or disturbed, to Departmental Representative's approval. Match existing material, colour finish and texture.

1.36 CLEAN UP

- .1 Clean up work area as work progresses. At end of each work period, and more often if required by Departmental Representative, remove debris from site, neatly stack material for use, and clean up generally.
- .2 Upon completion remove scaffolding, temporary protection and surplus materials. Make good defects noted at this stage.
- .3 Wash and polish glass, mirrors, ceramic tile, aluminum, chrome, stainless steel, baked or porcelain enamel, plastic laminate and other plastic surfaces, floors, hardware and washroom. Clean manufactured articles in accordance with manufacturer's directions.
- .4 Clean areas under contract to condition at least equal to that previously existing and to approval of Departmental Representative.

1.37 WASTE MANAGEMENT

- .1 Comply with the Environmental Protection Act., Ontario Regulations O. Reg. 102/94 O. reg 103/94 for waste management program on construction and demolition projects.
- .2 Conduct "waste audit" to determine waste generated during demolition or construction operations, prepare written "waste reduction work plan" and implement procedures to reduce, reuse and recycle materials to the extent possible.

- .3 Provide source separation program to disassemble and collect in an orderly fashion material designated for alternative disposal from general waste stream as follows:
 - .1 Brick and Portland cement concrete
 - .2 Cardboard (corrugated)
 - .3 Gypsum board (unfinished)
 - .4 Steel.
 - .5 Wood (not including treated or laminated wood)
- .4 Submit Complete Records of removals from site for both materials designated for alternative disposal and general waste including:
 - .1 Time and date of removal.
 - .2 Description of material and quantities.
 - .3 Proof that materials have been received at an approved waste processing site or certified waste disposal site as required.

1.38 RECORDS

- .1 As work progresses, maintain accurate records to show deviations from contract drawings. Just prior to Departmental Representative's inspection of issuance of final certificate of completion, supply to Departmental Representative one (1) set of white prints with all deviations marked-up in red.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

- .1 Not used.

END OF SECTION

SCI Scanning Form – PSPC Projects

Date of Scanning (dd/mm/yr):	
PSPC Project Number:	
Project Title:	
PSPC Project Manager / Email: Cell:	
Fund Commitment Number	
HoC Client Representative / Email: <small>*for Senate projects no contact info is required</small>	<small>*for Senate projects simply state "Senate" in this field</small>
-Shipment Details-	
Construction Manager/General Contractor Name	
Sub-Contractor Company Name:	
Size and Type of vehicle:	
Type of material and quantity (as well as whether on a skid or not):	
Expected arrival time at the SCI facility:	
Load destination (specific building):	

Please send a copy to:

- SCI : Eric Maurier : eric.maurier@sci.ca
- HoC : Stephanie Charron : stephanie.charron@parl.gc.ca
- HoC: Derick Dubeau : derick.dubeau@parl.gc.ca

Part 1 General

1.1 REFERENCE STANDARDS

- .1 Refer to laws, by laws, ordinances, rules, regulations, and orders of authority having jurisdictions, and other legally enforceable requirements applicable to Work at that area; or become in force during Work performance.
- .2 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.
- .3 Federal Legislation
 - .1 Canada Labour Code, Part II, section 124 and 125.
 - .1 Canada Occupational Health and Safety Regulations
 - .2 Transportation of Dangerous Goods Act, 1992 (TDGA)
 - .3 PSPC Asbestos Management Standard
 - .4 Canada Consumer Product Safety Act
 - .1 Surface Coating Materials Regulations SOR/2016-193
 - .5 Canadian Environmental Protection Act, 1999 (CEPA)
 - .1 PCB Regulations (SOR/2008-273)
 - .2 Federal Halocarbon Regulations (SOR/2003-289)
 - .3 Ozone-depleting Substances and Halocarbon Alternatives Regulations (SOR/2016-137)
 - .4 Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems (2015)
- .4 Provincial Legislation
 - .1 Ontario Occupational Health and Safety Act, R.S.O. 1990
 - .1 Ontario Regulation 490/09, Designated Substances (O.Reg. 490/09).
 - .2 Ontario Regulation 278/05, Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations, (O.Reg. 278/05).
 - .2 Ontario Environmental Protection Act, R.R.O. 1990,
 - .1 Ontario Regulation 347/90, General – Waste Management (O.Reg. 347/90).
 - .2 Ontario Regulation 463/10, Ozone Depleting Substances and Other Halocarbons (O.Reg. 463/10).
 - .3 R.R.O. 1990, Regulation 362, Waste Management - PCB's (R.R.O. 1990, Reg. 362)
- .5 Environmental Abatement Council of Ontario (EACO) Lead Guideline for Construction, Renovation, Maintenance or Repair (2014).
- .6 Environmental Abatement Council of Ontario (EACO) Mould Abatement Guidelines (2015).

- .7 Ontario Ministry of Labour, Training and Skills Development Guideline entitled Lead on Construction Projects
- .8 Ontario Ministry of Labour, Training and Skills Development Guideline entitled Silica on Construction Projects.
- .9 Canadian Standards Association (CSA International). CAN/CSA-Z94.4-18 – Selection, Care and Use of Respirators

1.2 DEFINITIONS

Amended Water: water with non-ionic surfactant wetting agent added to reduce water tension to allow wetting of fibres.

Asbestos-Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

Asbestos Work Area: area where work takes place which will, or may, disturb ACMs.

Authorized Visitors: Visitors provided authorization for site access by the Departmental Representative, and representatives of regulatory agencies.

Competent worker: in relation to specific work, means a worker who:

- Is qualified because of knowledge, training, and experience to perform the work;
- Is familiar with the provincial and federal laws and with the provisions of the regulations that apply to the work; and
- Has knowledge of all potential or actual danger to health or safety in the work.

Friable material: means material that:

- When dry, can be crumbled, pulverized or powdered by hand pressure; or
- is crumbled, pulverized or powdered.

Glove Bag: prefabricated glove bag as follows:

- Minimum thickness 0.25 mm polyvinyl-chloride bag.
- Integral 0.25 mm thick polyvinyl-chloride gloves and elastic ports.
- Equipped with reversible double pull double throw zipper on top and at approximately mid-section of the bag.
- Straps for sealing ends around pipe.

Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities, and hazardous products, including but not limited to: corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.

HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any dimension at 99.97% efficiency.

Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

Occupied Area: any area of building or work site that is outside Asbestos Work Area.

Polychlorinated Biphenyls (PCBs): includes chlorobiphenyls referred to in Column I of item 1 of the List of Toxic Substances in Schedule I of Canadian Environmental Protection Act (CEPA).

Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for scope of work.

Toxic: substance is considered toxic if it is listed on Toxic Substances List found in Schedule 1 of CEPA.

Threshold Limit Value (TLV): an airborne concentration which cannot be exceeded as prescribed by the American Conference of Governmental Industrial Hygienists (ACGIH) as adopted in Part II of the Canada Labour Code – Occupational Health and Safety, the Canada Occupational Health and Safety Regulations (COHSR) Part X – Hazardous Substances.

1.3 RELATED REQUIREMENTS

- .1 Section 02 82 00.01 Asbestos Abatement - Minimum Precautions.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Before start of Work arrange for Site visit with the Departmental Representative to examine existing Site conditions.

1.5 RESPONSIBILITY

- .1 Contractor shall be responsible for reading and evaluating the information provided in DSR, for the Site.
- .2 Contractor shall incorporate any recommendations in the Site DSR as they pertain to the health and safety of workers on Site, and in compliance with authority having jurisdictions for that area.
- .3 Contractor shall ask the Departmental Representative should they have any questions related to the Site specific DSR.
- .4 Contractor shall exercise every reasonable precaution for the protection of each worker on Site.
- .5 Contractor shall furnish the Site specific DSR to all subcontractors who will be performing work on Site.

1.6 REGULATORY REQUIREMENTS

- .1 Do Work in compliance with Federal, Provincial, and local requirements pertaining to the hazardous materials, provided that in case of conflict among these requirements or with these specifications, more stringent requirement applies. Comply with regulations in effect at time Work is performed.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit Site-specific Health and Safety Plan, within 7 days after date of Notice to proceed and before mobilization to Site. List relevant hazardous or contaminated materials or substances required by the authority having jurisdiction which need to be included in the Contractor's Health and Safety Plan.

1.8 DESIGNATED SUBSTANCES

Confirm with the Departmental Representative that no additional designated substances have been brought to the project area prior to beginning work. Additional designated substances and hazardous materials may exist outside the accessible survey areas but are beyond the scope of this project.

Should any additional material, suspected to be a designated substance, be encountered within the project area, any disturbance of such material must be stopped, precautionary measures taken, and the Departmental Representative must be notified immediately. Do not proceed until written instructions have been received.

- 1. ACRYLONITRILE: Not Identified

2. ARSENIC: Not Identified

3. ASBESTOS: **Identified**

Materials sampled and identified as asbestos containing:

- **Sample Set CAU-01A - C – Grey Caulking, on exhaust air vent (2% Chrysotile).**
 - Grey caulking taken from the exhaust air vent on the lower roof assembly (2nd floor) was identified as asbestos-containing.

Materials sampled and identified as non-asbestos containing:

- Sample Set CAU-02A – C; Black Caulking (lower roof assembly - 3rd floor); and
- Sample Set CMOR-01A – C; Cinderblock Mortar (Mechanical Room 353).

The following materials in Mechanical Room 353 on the 3rd floor of the Valour building were noted to be suspect asbestos-containing, but were not or could not be sampled at the time of the assessment:

- **Gasket seals on pipe fittings** (inaccessible); and,
- **Cement parging on wall penetration** near where a unit will be mounted on the wall (not anticipated to be impacted by the project).

4. BENZENE: Not Identified

5. COKE OVEN EMISSIONS: Not identified

6. ETHYLENE OXIDE: Not Identified

7. ISOCYANATES: Not Identified

8. LEAD: **Identified**

One of the five sampled paints is considered “lead-based” (lead content > 5,000 ppm) according to the EACO Lead Guideline for Construction, Renovation, Maintenance or Repair dated October 2014. The remaining paints are considered “low-level lead” (lead content <1,000 ppm). Below summarizes the identified lead-based paint:

- **Red on Metal Valves (Sample ID: P-04), 88,300 ppm**
 - The red paint was collected from a shut-off valve on piping adjacent to AHU-04 in Mechanical Room 353. Three valves will be removed as part of the renovation project.

The following paints were sampled and determined to contain less than 1,000 ppm of lead:

- Sample P-01; Black – Exhaust air vent, lower roof assembly (2nd floor);
- Sample P-02; White – Cinderblock walls, Mechanical Room 353;
- Sample P-03; Grey – Cinderblock walls, Mechanical Room 353;

- Sample P-05; Black – Drain Pan in AHU-04, Mechanical Room 353.

9. **MERCURY: Identified**

Fluorescent light tubes were observed within the project areas of Mechanical Room 353, however, they are not anticipated to be disturbed during the work.

Mercury may be present in the internal parts of the AHU. Some internal areas of the AHU were inaccessible to BluMetric at the time of the assessment and therefore, the presence of mercury cannot be confirmed.

10. **SILICA: Identified**

Silica is known to be present in cementitious building materials. At the time of the assessment, the following silica-containing building materials were observed within the buildings:

- Concrete;
- Cinderblock and mortar; and,
- Textured concrete with stone finish (exterior wall adjacent to roof).

11. **VINYL CHLORIDE MONOMER: Not Identified**

12. **POLYCHLORINATED BIPHENYLS (PCBs): Not Identified**

Light ballasts were present in Mechanical Room 353, however, are not expected to be impacted by the Upgrading of Air Handling Unit (AH-04) and Refurbishing Core Components project.

13. **HALOCARBONS: Identified**

The upcoming work involves the upgrading of air handling unit (AH-04) and the refurbishing of core components associated with the AHU. The AHU may be charged or supplied with a refrigerant.

14. **MOULD: Not Identified**

15. **OTHER HAZARDOUS MATERIALS: Not Identified**

1.9 **RECOMMENDATIONS**

.1 **ASBESTOS**

Regulatory Requirements: comply with Federal, Provincial, and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications, more stringent requirement applies. Comply with regulations in effect at time Work is performed.

The hazardous abatement procedures to be followed during the project are based on the scope of impacted area, type of building material, friability, type of work to be undertaken, equipment to be used, wet/dry work procedures, and fibre-release control measures (e.g., power tools equipped with HEPA filters). The classification of asbestos-related work is based on Section 6.2.1. of the Public Services and Procurement Canada Asbestos Management Standard which was developed to supplement the legislative requirements outlined in the Canada Occupational Health and Safety Regulations (COHSR) Part X – Hazardous Substances. Abatement work must comply the legislative requirements as indicated in O.Reg. 278/05 (Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations), and O. Reg. 490/09 (Designated Substances) under the Ontario Occupational Health and Safety Act, R.S.O. 1990, c. O.1.

Refer to the following specification sections for the project requirements for submittals, abatement work classification, personnel training, work procedures / precautions, materials, inspection and air monitoring (if applicable), waste management, disposal, and quality assurance:

- .1 Section 02 82 00.01 Asbestos Abatement - Minimum Precautions.

Low risk work includes:

- non-destructive (i.e. without breaking, cutting, drilling, abrading) removal of non-friable asbestos-containing material;
- destructive work (i.e. breaking, cutting, drilling, abrading) on wetted non-friable asbestos-containing material with non-powered hand-held tools;
- removal of one square meter or less of drywall in which joint compounds contain asbestos-containing materials;
- removal or replacement of 7.5 square metres or less of non-friable asbestos-containing compressed-mineral-fibre-type ceiling tiles; and
- collecting samples of materials suspected of containing friable asbestos.

Moderate risk work includes:

- entry into ceiling spaces, crawlspace, pipe tunnels, etc., where friable asbestos debris is or may be present;
- removal or replacement of greater than 7.5 square metres of non-friable asbestos-containing compressed-mineral-fibre-type ceiling tiles;
- removing more than 2 square meters of friable asbestos-containing suspended ceiling tiles that are removed without being broken, cut, drilled, abraded, ground, sanded, or vibrated;
- removal of more than one square metre of drywall where asbestos-containing joint compound materials has been used;
- destructive work (i.e. breaking, cutting, drilling, abrading) on non-wetted, non-friable asbestos-containing material with non-powered hand held tools;

- destructive work (i.e. breaking, cutting, drilling, abrading) on non-friable asbestos-containing material if the work is done by means of power tools that are attached to dust collecting devices equipped with a high efficiency particulate air (HEPA) filters;
- minor removal or disturbance of friable asbestos-containing material. Minor is defined as follows:
 - in British Columbia: up to 0.1 m² surface area, or 3 linear metres of pipe insulation
 - in Quebec: up to 0.03 m³ of debris
 - all others: up to 1 m² of surface area
- enclosing friable asbestos-containing material;
- applying tape or cover to asbestos-containing insulation;
- glove bag removal of asbestos-containing material from a pipe, duct or similar structure;
- removing filters in an air handling unit in a building that has sprayed-on asbestos-containing fireproofing; and
- work not otherwise classified as either low or high risk.

High risk work includes:

- major removal or disturbance of friable asbestos-containing material (greater than quantities defined under moderate work);
- destructive work (i.e. breaking, cutting, drilling, abrading) of non-friable asbestos-containing material using power tools not attached to dust-collecting devices equipped with HEPA filters;
- encapsulating friable asbestos-containing material by spray application of an encapsulant or sealant;
- cleaning or removal of ductwork and air handling equipment serving or passing through areas of buildings with sprayed, friable asbestos-containing material; and
- repair, alteration or demolition of a boiler, furnace, kiln, or similar equipment made of asbestos-containing refractory materials.

If new or suspect asbestos-containing materials are encountered during the upcoming Project, work in the immediate area should cease, and the material should be sampled and analyzed for asbestos content.

.2 LEAD

- Follow recommendations provided in the Ontario Ministry of Labour (MOL) Guideline titled *Guideline: Lead on Construction Projects*. This guideline classifies all lead disturbances as Type 1, Type 2a, Type 2b, Type 3a or Type 3b work, and assigns different levels of respiratory protection and work procedures for each classification.
- Safe work procedures and personal protective equipment must be used to ensure that workers are not exposed to airborne lead levels that exceed the time weighed average of 0.05 milligram per cubic metre (mg/m³) prescribed by COHS Reg Part X and O.Reg. 490/09, and outlined in the EACO Lead Guideline for Construction, Renovation, Maintenance or Repair.

- Paints containing less than 1,000 ppm are considered low-level lead coatings. Regardless of the lead content, aggressive disturbance of paint coatings (e.g. welding, abrasive blasting) may generate lead exposure. Work must be completed in accordance with the procedures listed in Section 7 and in Section 8 of the EACO *Lead Guideline for Construction, Renovation, Maintenance or Repair*.
- Disposal of construction waste containing lead must be done in accordance with O.Reg. 347/90 – General Waste Management. The classification of the waste as hazardous or non-hazardous is dependent upon the results of the Toxicity Characteristic Leaching Procedure (TCLP analysis).

.3 MERCURY

- All work involving disturbance of mercury-containing equipment must be done in accordance with O.Reg. 490/09, Designated Substances.
- If removal of fluorescent light tubes is required, the tubes should be removed intact from the fixtures. Other sources of elemental mercury should be removed intact to prevent worker exposure.
- Disposal of waste containing mercury must be done in accordance with O.Reg. 347/90, General – Waste Management.

.4 SILICA

- Comply with O.Reg. 490/09 when performing work that may disturb silica-containing materials. The regulation outlines Control Program requirements and the exposure limits, TWA, for airborne silica.
- Silica dust can be generated through such processes as blasting, grinding, crushing, and sandblasting silica-containing material. Since silica is present in select materials within the project area, appropriate respiratory protection must be donned during the demolition and modifications of these structures.
- Follow recommendations provided in the Ontario Ministry of Labour, Training and Skills Development Guideline entitled *Silica on Construction Projects*. This guideline outlines the hazards associated with silica in construction and the measures and procedures that should be taken to control those hazards.

.5 HALOCARBONS

- The handling, transport and disposal of halocarbons is governed by the following:
 - Federal Halocarbon Regulations (FHR), SOR 2003/289,
 - Ozone-depleting Substances and Halocarbon Alternatives Regulations (SOR 2016-137),
 - Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems (2015);

- O.Reg. 463/10, Ozone Depleting Substances and Other Halocarbons, and
 - Federal Transport of Dangerous Goods Act
- Halocarbon-containing equipment is unlikely to be disturbed in the Project Area. Should any equipment suspected of containing a refrigerant be uncovered and be disturbed, a certified service technician must recycle, reclaim or dispose of the halocarbon. The service technician must provide written acknowledgement of the requirements of SOR/2003-289. Appropriate records of the service technician certification and records of equipment decommissioning must be provided and maintained in accordance with requirements of SOR/2003-289.

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 01 00 10 – General Instruction
- .2 Section 01 35 29.06 – Health and Safety Requirements
- .3 Section 01 78 00 – Closeout Submittals
- .4 Section 01 79 00 – Demonstration and Training

1.2 ADMINISTRATIVE

- .1 Submit to Departmental 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 Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Departmental 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 co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental 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 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment,

indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

- .4 Allow seven (7) working days review for each submission
- .5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.
- .6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.
- .7 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .8 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.
- .9 After Departmental Representative's review, distribute copies.

- .10 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .11 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .13 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .14 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Departmental Representative.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .15 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .17 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .18 Delete information not applicable to project.
- .19 Supplement standard information to provide details applicable to project.
- .20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .21 The review of shop drawings by Public Services and Procurement Canada (PSPC) is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that PSPC approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or

omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.

- .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.4 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of colour digital photography, fine resolution as directed by Departmental Representative.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Frequency of photographic documentation: as directed by Departmental Representative.

1.5 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.

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 01 00 10- General Instruction
- .2 Section 01 33 00 – Submittal Procedures

1.2 REFERENCE STANDARDS

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Province of Ontario
 - .1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990, c.0.1, as amended and O. Reg. 213/91 as amended - Updated march 2018.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit electronic copies of Contractor's authorized representative's work site health and safety inspection reports to authority having jurisdiction, and weekly report Departmental Representative
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within (5) business days after receipt of plan.
- .7 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .8 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.
- .9 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.4 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.

- .2 Work zone locations include:
 - .1 Wellington Building (180 Wellington St., Ottawa)
 - .2 Dover-Brouse-Slater Building (177-187 Sparks St., Ottawa)
 - .3 Sir John A. MacDonald Building (144 Wellington St., Ottawa)
- .3 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout life of project.

1.5 SAFETY ASSESSMENT

- .1 Perform site specific safety hazard assessment related to project and submit to Departmental Representative

1.6 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.7 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.8 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Contractor will be responsible and assume the role Constructor as described in the Ontario Occupational Health and Safety Act and Regulations for Construction Projects.
- .3 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.9 COMPLIANCE REQUIREMENTS

- .1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990, c. 0.1 and Ontario Regulations for Construction Projects, O. Reg. 213/91.
- .2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.10 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

- .2 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, advise Health and Safety co-ordinator and follow procedures in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.11 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have site-related working experience specific to activities associated with roof barrier, davit arms and working at heights
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of Work

1.12 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.

1.13 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.14 POWDER ACTUATED DEVICES

- .1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

1.15 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 NOT USED

.1 Not used.

END OF SECTION

Approved: 2006-03-31

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 00 10 – General Instruction

1.2 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
 - .2 CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2 CSA Group (CSA)
 - .1 CSA-O121-08(R2013), Douglas Fir Plywood.
- .3 Public Works Government Services Canada (PWGSC) Standard Acquisition Clauses and Conditions (SACC)-ID: R0202D, Title: General Conditions 'C', In Effect as of: May 14, 2004.

1.3 INSTALLATION AND REMOVAL

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

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,

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;
- .3 Design enclosures to withstand wind pressure.

1.6 DUST TIGHT SCREENS

- .1 Provide dust tight screens 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 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.8 PUBLIC TRAFFIC FLOW

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

1.9 FIRE ROUTES

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.10 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.

1.11 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 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
- .4 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 REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures
- .2 Section 01 00 10 - General Instruction
- .3 Section 01 79 00 – Demonstration and Training

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting one week prior to contract completion with Departmental Representative, to:
 - .1 Verify Project requirements.
 - .2 Review warranty requirements and manufacturer's installation instructions.
 - .2 Departmental 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 Departmental Representative, four final hardcopy and (1) electronic copy of operating and maintenance manuals in English and French.
- .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 as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 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, 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.
 - .1 Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dwg format.

1.5 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Departmental Representative 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 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.
- .6 Training: refer to Section 01 79 00- Demonstration and Training.

1.6 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, at site for Departmental 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.

- .1 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.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Departmental Representative.

1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Field changes of dimension and detail.
 - .2 Changes made by change orders.
 - .3 Details not on original Contract Drawings.
 - .4 Referenced Standards to related shop drawings and modifications.
- .5 Specifications: 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 inspection certifications, manufacturer's certifications, field test records, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.8 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.

- .2 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .3 Include manufacturer's printed operation and maintenance instructions.
- .4 Additional requirements: as specified in individual specification sections.

1.10 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
 - .1 Provide information for re-ordering custom manufactured products.
- .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.

1.11 GUARANTEES AND WARRANTIES

- .1 Before completion of work collect manufacturer's, guarantees and warranties and include all documents in O&M manuals. Guarantees and warranties to be one year from date of substantial completion.
- .2 Contractor shall provide to the Departmental Representative a letter of guarantee.

1.12 NOT USED

- .1 Not Used.

Part 2 Execution

2.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 01 00 10 – General Instruction
- .2 Section 01 33 00 – Submittal Procedures
- .3 Section 01 78 00 – Closeout Procedure

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental Representative personnel two weeks prior to date of final inspection.
- .2 Departmental Representative: provide list of personnel to receive instructions, and co-ordinate 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 in accordance with Manufacturer's shop drawings
 - .4 Ensure testing, adjusting, and balancing has been performed as per Manufacturer's shop drawings and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, two times, at the agreed upon scheduled 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:

1.3 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 Departmental 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.

1.4 QUALITY ASSURANCE

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:
 - .1 Instruct Departmental Representative'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

Approved: 2017-07-21

Part 1 General

1.1 TRAINEES

- .1 Trainees: personnel selected for operating and maintaining this facility. Includes Facility Manager, Departmental Representative, 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.

1.2 INSTRUCTORS

- .1 Departmental 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, shutdown 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 shutdown of equipment they have certified installation, started up and carried out PV tests.

1.3 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 troubleshooting.
 - .4 Ability to update documentation.
 - .5 Ability to operate equipment and systems under emergency conditions until appropriate qualified assistance arrives.

1.4 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 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.

1.5 SCHEDULING

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

1.6 RESPONSIBILITIES

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

1.7 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.

1.8 VIDEO-BASED TRAINING

- .1 Manufacturer's videotapes to be used as training tool with Departmental Representative's review and written approval 3 weeks 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 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

Approved: 2005-09-30

Part 1 General

1.1 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.

1.2 RELATED REQUIREMENTS

- .1 01 79 00.13 Demonstration and Training for Building Commissioning
- .2 01 91 13.13 Commissioning Plan
- .3 01 91 13.16 Commissioning Forms

1.3 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.

1.4 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 Departmental Representative's requirements or determined by designer. To meet Project functional and operational requirements.
- .4 AFD managed projects the term Departmental Representative in Cx specifications to be interpreted as AFD Service Provider.

1.5 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 Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.6 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 Departmental 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.

1.7 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review Contract Documents, confirm by writing to Departmental 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 Departmental 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 Departmental Representative for review and approval.
 - .10 Ensure "As-Built" system schematics are available.
- .4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.8 CONFLICTS

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

1.9 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.10 COMMISSIONING DOCUMENTATION

- .1 Refer to Section 01 91 13.16 - Commissioning (Cx) Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Departmental Representative to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Departmental Representative.

1.11 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule.
- .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.

1.12 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings 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 Departmental 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 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.

1.13 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.

1.14 WITNESSING OF STARTING AND TESTING

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

1.15 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing: manufacturer to:

- .1 Coordinate time and location of testing.
- .2 Provide testing documentation for approval by Departmental Representative.
- .3 Arrange for Departmental Representative to witness tests.
- .4 Obtain written approval of test results and documentation from Departmental 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 Departmental 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.

1.16 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 Departmental 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 Departmental 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 Departmental Representative.
- .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
- .3 If evaluation report concludes that major damage has occurred, Departmental 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.

1.17 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Departmental 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 Departmental Representative to repeat start-up at any time.

1.18 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 Departmental 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.

1.19 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.

1.20 START OF COMMISSIONING

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

1.21 INSTRUMENTS / EQUIPMENT

- .1 Submit to Departmental 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.

1.22 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under accepted simulated operating 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.

1.23 WITNESSING COMMISSIONING

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

1.24 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 Departmental Representative within 5 days of test and with Cx report.

1.25 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.

1.26 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 Departmental Representative in accordance with

equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.27 EXTENT OF VERIFICATION

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

1.28 REPEAT VERIFICATIONS

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

1.29 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.

1.30 DEFICIENCIES, FAULTS, DEFECTS

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

1.31 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 Departmental Representative.

1.32 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.

1.33 TRAINING

- .1 In accordance with Section 01 79 00.13 Demonstration and Training for Building Commissioning.

1.34 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.35 OCCUPANCY

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

1.36 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 Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.37 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.

1.38 DEPARTMENTAL REPRESENTATIVE'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by Departmental 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

Approved: 2017-07-21

Part 1 General

1.1 SECTION INCLUDES:

- .1 Description of overall structure of Plan and roles and responsibilities of commissioning team.

1.2 RELATED REQUIREMENTS

- .1 01 79 00.13 Demonstration and Training for Building Commissioning
- .2 01 91 13 General Commissioning (Cx) Requirements
- .3 01 91 13.16 Commissioning Forms

1.3 REFERENCE STANDARDS

- .1 Public Works and Government Services Canada (PSPC)
 - .1 PSPC - Commissioning Guidelines CP.4 -3rd edition-03.
- .2 Underwriters' Laboratories of Canada (ULC)

1.4 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 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 Cx - Commissioning.
 - .2 BMM - Building Management Manual.
 - .3 EMCS - Energy Monitoring and Control Systems.
 - .4 MSDS - Material Safety Data Sheets.
 - .5 PI - Product Information.
 - .6 PV - Performance Verification.
 - .7 TAB - Testing, Adjusting and Balancing.
 - .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.

1.5 DEVELOPMENT OF 100% CX PLAN

- .1 Cx Plan to be 95% completed before added into Project Specifications.
- .2 Cx Plan to be 100% completed within 8 weeks of award of contract to take into account:
 - .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, suppliers' requirements.
 - .6 Project construction team's and Cx team's requirements.
- .3 Submit completed Cx Plan to Departmental Representative and obtain written approval.

1.6 REFINEMENT OF CX PLAN

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

1.7 COMPOSITION, ROLES AND RESPONSIBILITIES OF CX TEAM

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

- .1 PSPC Design Quality Review Team: during construction, will conduct periodic site reviews to observe general progress.
- .2 PSPC Quality Assurance Commissioning Manager: ensures Cx activities are carried out to ensure delivery of a fully operational project including:
 - .1 Review of Cx documentation from operational perspective.
 - .2 Review for performance, reliability, durability of operation, accessibility, maintainability, operational efficiency under conditions of operation.
 - .3 Protection of health, safety and comfort of occupants and O&M personnel.
 - .4 Monitoring of Cx activities, training, development of Cx documentation.
 - .5 Work closely with members of Cx Team.
- .3 Departmental 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 Performing verification of performance of installed systems and equipment.
 - .8 Implementation of Training Plan.
- .4 Construction Team: contractor, subcontractors, suppliers and support disciplines, is 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 person as point of contact with Departmental Representative and PSPC Cx Manager for administrative and coordination purposes.
- .5 Contractor's Cx agent implements specified Cx activities including:
 - .1 Demonstrations.
 - .2 Training.
 - .3 Testing.
 - .4 Preparation, submission of test reports.
- .6 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.

1.8 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.
 - .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 Departmental Representative's program but are outside scope or expertise of Cx specialists on this project.
 - .5 Departmental Representative: 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 Departmental Representative and details of instruments and procedures to be followed for Cx 3 months prior to starting date of Cx for review and approval.

1.9 EXTENT OF CX

- .1 Commission mechanical systems and associated equipment:
 - .1 HVAC and exhaust systems:
 - .1 AHU-4 Supply Fan and Return Fan control
 - .2 AHU-4 Economizer control
 - .3 AHU-4 Humidifier control
 - .4 AHU-4 airflow stations
 - .5 AHU-4 damper control
 - .6 AHU-4 CO2 sensor calibration
 - .2 EMCS:

- .1 Control of AHU-4, all associated components, and downstream equipment as it pertains to feedback required for reset strategies.

1.10 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 or CMMS) identification system used.
 - .5 WHMIS information.
 - .6 MSDS data sheets.
 - .7 Electrical Panel inventory containing detailed inventory of electrical circuitry for each panel board. Duplicate of inventory inside each panel.

1.11 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.
 - .2 Startup, pre-Cx activities and documentation for systems, and equipment.
 - .3 Completed installation checklists (ICL).
 - .4 Completed product information (PI) report forms.
 - .5 Completed performance verification (PV) report forms.
 - .6 Results of Performance Verification Tests and Inspections.
 - .7 Description of Cx activities and documentation.
 - .8 Description of Cx of integrated systems and documentation.
 - .9 Tests witnessed by PSPC Design Quality Review Team:
 - .10 Tests performed by Departmental Representative.
 - .11 Training Plans.
 - .12 Cx Reports.

- .13 Prescribed activities during warranty period.
- .4 Departmental Representative to witness and certify tests and reports of results provided to Departmental Representative.
- .5 Departmental Representative to participate.

1.12 PRE-CX ACTIVITIES AND RELATED DOCUMENTATION

- .1 Items listed in this Cx Plan include the following:
 - .1 Pre-Start-Up inspections: by Departmental Representative prior to permission to start up and rectification of deficiencies to Departmental Representative's satisfaction.
 - .2 Departmental Representative to use approved check lists.
 - .3 Departmental Representative will monitor some of these 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 Departmental Representative and does not form part of Cx specifications.
 - .6 Departmental Representative will monitor some of these inspections and tests.
 - .7 Include completed documentation in Cx report.
- .2 Pre-Cx activities - MECHANICAL:
 - .1 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 Departmental Representative.
 - .2 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 Departmental 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".

1.13 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, systems:
 - .1 Humidifiers
- .3 Departmental Representative to monitor some of these start-up activities.
 - .1 Rectify start-up deficiencies to satisfaction of Departmental Representative.
- .4 Performance Verification (PV):
 - .1 Approved Cx Agent to perform.
 - .1 Repeat when necessary until results are acceptable to Departmental Representative.
 - .2 Use procedures modified generic procedures to suit project requirements.
 - .3 Departmental Representative to witness and certify reported results using approved PI and PV forms.
 - .4 Departmental Representative to approve completed PV reports and provide to Departmental Representative.
 - .5 Departmental Representative reserves right to verify up to 30% of reported results at random.
 - .6 Failure of randomly selected item shall result in rejection of PV report or report of system startup and testing.

1.14 CX ACTIVITIES AND RELATED DOCUMENTATION

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

1.15 CX OF INTEGRATED SYSTEMS AND RELATED DOCUMENTATION

- .1 Not required.

1.16 INSTALLATION CHECK LISTS (ICL)

- .1 Refer to Section 01 91 13.16- Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.17 PRODUCT INFORMATION (PI) REPORT FORMS

- .1 Refer to Section 01 91 13.16- Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.18 PERFORMANCE VERIFICATION (PV) REPORT

- .1 Refer to Section 01 91 13.16- Commissioning Forms: Installation Check Lists and Product Information (PI) / Performance Verification (PV) Forms.

1.19 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.

1.20 CX SCHEDULES

- .1 Prepare detailed Cx Schedule and submit to Departmental 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: 28 days after contract award.
 - .4 Cx procedures: 28 days after contract award.
 - .5 Cx Report format: 28 days after contract award.
 - .6 Discussion of heating/cooling loads for Cx: 28 days after contract award.
 - .7 Submission of list of instrumentation with relevant certificates: 28 days after contract award.
 - .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.
 - .2 Detailed training schedule to demonstrate no conflicts with testing, completion of project and hand-over to Departmental Representative.
 - .3 6 months in Cx schedule for verification of performance in all seasons and wear conditions.
- .2 After approval, incorporate Cx Schedule into Construction Schedule.
- .3 Contractor, Contractor's Cx agent, and Departmental Representative will monitor progress of Cx against this schedule.

1.21 CX REPORTS

- .1 Submit reports of tests, witnessed and certified by Departmental 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 Departmental Representative.

1.22 PRELIMINARY AND FINAL CX

- .1 Not required

1.23 ACTIVITIES DURING WARRANTY PERIOD

- .1 Cx activities must be completed before issuance of Interim Certificate, 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.

1.24 TESTS TO BE PERFORMED BY DEPARTMENTAL REPRESENTATIVE

- .1 None is anticipated on this project.

1.25 TRAINING PLANS

- .1 Refer to Section 01 79 00.13- Demonstration and Training for Building Commissioning.

1.26 FINAL SETTINGS

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

1.27 PAYMENTS FOR CX

- .1 Cx to be a line item of Contractor's cost breakdown.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Approved: 2017-07-21

Part 1 General

1.1 SECTION INCLUDES:

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

1.2 RELATED REQUIREMENTS

- .1 01 79 00.13 Demonstration and Training for Building Commissioning
- .2 01 91 13 General Commissioning (Cx) Requirements
- .3 01 91 13.13 Commissioning Plan

1.3 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 Departmental 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 Departmental 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.

1.4 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 Departmental Representative's approval.

1.5 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 Departmental Representative's approval.

1.6 SAMPLES OF COMMISSIONING FORMS

- .1 Departmental 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.

1.7 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

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

1.8 COMMISSIONING FORMS

- .1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 Departmental 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 Departmental Representative.
 - .9 Submit immediately after tests are performed.
 - .10 Reported results in true measured SI unit values.
 - .11 Provide Departmental 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.

1.9 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 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.2-2003, Bored and Preamsembled Locks and Latches.
 - .2 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.

1.2 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 door hardware and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .4 Manufacturer's Instructions: submit manufacturer's installation instructions.

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 door hardware for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Certificates: 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 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 door hardware from nicks, scratches, and blemishes.
- .3 Protect prefinished surfaces with wrapping.
- .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 DOOR HARDWARE

- .1 Locks and latches:
 - .1 Bored and preassembled locks and latches: to ANSI/BHMA A156.2, series 2000 preassembled lock, grade 1, designed for passage function.
 - .2 Lever handles: plain design.
 - .3 Roses: round.
 - .4 Normal strikes: box type, lip projection not beyond jamb.
 - .5 Finished to 626.

2.2 FASTENINGS

- .1 Use only fasteners provided by 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 finish of hardware.
- .4 Use fasteners compatible with material through which they pass.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove existing lever and latch system. Clean door surfaces under existing hardware as required and prepare the surface for new hardware installation.
- .2 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .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).

3.2 ADJUSTING

- .1 Adjust door hardware 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 PROTECTION

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

3.4 SCHEDULE

- .1 Single Door to Mechanical Room:
 - .1 1 Passage Set Latchbolt

END OF SECTION

Approved: 2013-06-30

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 220500 COMMON WORK RESULTS FOR PLUMBING
- .2 Section 221317 DRAINAGE WASTE AND VENT PIPING - CAST IRON AND COPPER
- .3 Section 230500 COMMON WORK RESULTS FOR HVAC
- .4 Section 230505 SELECTIVE DEMOLITION FOR HEATING, VENTILATION AND AIR CONDITIONING (HVAC)
- .5 Section 230548 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
- .6 Section 230553.01 MECHANICAL IDENTIFICATION
- .7 Section 230593 TESTING, ADJUSTING AND BALANCING FOR HVAC
- .8 Section 230715 THERMAL INSULATION FOR PIPING
- .9 Section 238413 HUMIDIFIERS
- .10 Section 250111 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .11 Section 250112 EMCS: TRAINING
- .12 Section 250501 EMCS: GENERAL REQUIREMENTS
- .13 Section 250502 EMCS: SUBMITTAL AND REVIEW PROCESS
- .14 Section 250503 EMCS: PROJECT RECORD DOCUMENTS
- .15 Section 250554 EMCS: IDENTIFICATION
- .16 Section 250560 EMCS: FIELD INSTALLATION
- .17 Section 250820 EMCS: WARRANTY AND MAINTENANCE
- .18 Section 253002 EMCS: FIELD CONTROL DEVICES
- .19 Section 259001 EMCS: SITE REQUIREMENTS APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

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 new equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .2 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .3 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 new equipment and EMCS for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.

- .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information at end of project to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 10 – General 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 all furnished equipment and materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .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 for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 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 Refer to section 017900 - DEMONSTRATION AND TRAINING

3.6 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.

3.7 PROTECTION

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

END OF SECTION

Approved: 2013-06-30

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 210501 COMMON WORK RESULTS FOR MECHANICAL
- .2 Section 221317 DRAINAGE WASTE AND VENT PIPING - CAST IRON AND COPPER
- .3 Section 230500 COMMON WORK RESULTS FOR HVAC
- .4 Section 230505 SELECTIVE DEMOLITION FOR HEATING, VENTILATION AND AIR CONDITIONING (HVAC)
- .5 Section 230548 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
- .6 Section 230553.01 MECHANICAL IDENTIFICATION
- .7 Section 230593 TESTING, ADJUSTING AND BALANCING FOR HVAC
- .8 Section 230715 THERMAL INSULATION FOR PIPING
- .9 Section 238413 HUMIDIFIERS
- .10 Section 250111 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .11 Section 250112 EMCS: TRAINING
- .12 Section 250501 EMCS: GENERAL REQUIREMENTS
- .13 Section 250502 EMCS: SUBMITTAL AND REVIEW PROCESS
- .14 Section 250503 EMCS: PROJECT RECORD DOCUMENTS
- .15 Section 250554 EMCS: IDENTIFICATION
- .16 Section 250560 EMCS: FIELD INSTALLATION
- .17 Section 250820 EMCS: WARRANTY AND MAINTENANCE
- .18 Section 253002 EMCS: FIELD CONTROL DEVICES
- .19 Section 259001 EMCS: SITE REQUIREMENTS APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

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 all new equipment and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in 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 new equipment and EMCS for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information at end of project to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 10 – General 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 all furnished equipment and materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 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 Refer to section 017900 - DEMONSTRATION AND TRAINING

3.6 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.7 PROTECTION

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

END OF SECTION

Approved: 2016-10-26

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 220500 COMMON WORK RESULTS FOR PLUMBING.

1.2 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .5 ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .6 ASME B31.9, Building Services Piping.
 - .7 ASME B36.19M, Stainless Steel Pipe.
- .2 ASTM International
 - .1 ASTM A182/A 182M, Standard Specification for Forged or Rolled Alloy and Stainless-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - .2 ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
 - .3 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A312/A312M, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless-Steel Pipes.
 - .5 ASTM A351/A351M, Castings, Austenitic, for Pressure Containing Parts.
 - .6 ASTM A403/A403M, Wrought Austenitic Stainless Steel Piping Fittings.
 - .7 ASTM A536, Standard Specification for Ductile Iron Castings.
 - .8 ASTM B32, Standard Specification for Solder Metal.
 - .9 ASTM B42, Seamless Copper Tube, Standard Sizes.
 - .10 ASTM B88M, Standard Specification for Seamless Copper Water Tube (Metric).
 - .11 ASTM F876, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

- .12 ASTM F877, Standard Specification for Crosslinked Polyethylene (PEX) Hot and Cold-Water Distribution System.
- .3 American National Standards Institute/American Water Works Association (ANSI)/(AWWA)
 - .1 ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .2 ANSI/AWWA C151/A21.51, Ductile Iron Pipe, Centrifugally Cast, for Water.
 - .3 AWWA C904-06, Crosslinked Polyethylene (PEX) Pressure Pipe, ½ In. (12 mm) through 3 In. (76mm), for Water Service.
- .4 CSA Group
 - .1 CSA B137.5-13, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
 - .2 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S101, Fire Endurance Tests of Buildings Construction and Materials.
 - .2 CAN/ULC S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
 - .3 CAN/ULC S115, Standard Method of Fire Tests of Firestop.
- .6 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67, Butterfly Valves.
 - .2 MSS-SP-70, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
- .9 National Research Council (NRC)
 - .1 National Plumbing Code of Canada (NPC).
- .10 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

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 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.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Place materials defined as hazardous or toxic in designated containers.
.2 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
.1 Above ground:
.1 Copper tube, hard drawn, type L: to ASTM B88M.
.2 PEX Piping to CSA B137.5.

2.2 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 1 ½ and smaller:
.1 Wrought copper to ANSI/ASME B16.22, cast copper to ANSI/ASME B16.1; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.
.2 PEX fittings to CSA B137.5.

2.3 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm 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 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

- .6 NPS 1 ½ and smaller: PEX fittings to CSA B137.5.

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.
 - .2

2.5 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Forged Brass body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle.

2.6 BACK FLOW PREVENTERS

- .1 Preventers: to CSA-B64 Series, application double check valve assembly.

2.7 WATER HAMMER ARRESTORS

- .1 Copper construction, piston type: to PDI-WH201.

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 NPC.
- .2 Assemble piping using fittings manufactured to ANSI and Standard Council of Canada (SCC) standards.
- .3 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.
- .4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .5 Provide water hammer arrestors on all equipment with fast acting actuated valves including humidifier.
- .6 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.

.7 **WATER HAMMER ARRESTORS**

- .1 Install on branch supplies to fixtures or group of fixtures where indicated.

.8 **BACK FLOW PREVENTERS**

- .1 Install in accordance with CSA-B64 Series, where indicated and elsewhere as required by code.
- .1 Water Make-up Assembly.
- .2 Pipe discharge to terminate over nearest drain.

3.3 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.

3.4 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 to Federal potable water guideline. Let system flush for additional 2 hours, then draw off another sample for testing.

3.5 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.

3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction.
- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

3.7 START-UP

- .1 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.

- .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
- .3 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.8 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
 - .2 Verify compliance with safety and health requirements.
 - .3 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut off water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
 - .4 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.
- .2 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.

3.9 OPERATION REQUIREMENTS

- .1 Co-ordinate operation and maintenance requirements including cleaning and maintenance of specified materials and products.

END OF SECTION

Approved: 2008-12-31

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 210501 COMMON WORK RESULTS FOR MECHANICAL
- .2 Section 220500 COMMON WORK RESULTS FOR PLUMBING

1.2 REFERENCE STANDARDS

- .1 ASTM International Inc.
 - .1 ASTM B32, Standard Specification for Solder Metal.
 - .2 ASTM B306, Standard Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67, Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125.3, Plumbing Fittings.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36, Commercial Adhesives.
- .4 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada (NPC).
- .5 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.

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 adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 10 – General Instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

Part 2 Products

2.1 SUSTAINABLE MATERIAL

- .1 Adhesives and Sealants:
 - .1 Maximum VOC limit 70 g/L to SCAQMD Rule 1168 GSES GS-36.

2.2 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary and 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.

2.3 CAST IRON PIPING AND FITTINGS

- .1 Above ground sanitary and vent: to CAN/CSA-B70.
 - .1 Joints:
 - .1 Hub and spigot:
 - .1 Caulking lead: to CSA B67.
 - .2 Mechanical joints:
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install in accordance with 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 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .4 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 220500 COMMON WORK RESULTS FOR PLUMBING.

END OF SECTION

Approved: 2013-06-30

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 230505 SELECTIVE DEMOLITION FOR HEATING, VENTILATION AND AIR CONDITIONING (HVAC)
- .2 Section 230548 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
- .3 Section 230553.01 MECHANICAL IDENTIFICATION
- .4 Section 230593 TESTING, ADJUSTING AND BALANCING FOR HVAC
- .5 Section 230715 THERMAL INSULATION FOR PIPING
- .6 Section 238413 HUMIDIFIERS
- .7 Section 250111 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .8 Section 250112 EMCS: TRAINING
- .9 Section 250501 EMCS: GENERAL REQUIREMENTS
- .10 Section 250502 EMCS: SUBMITTAL AND REVIEW PROCESS
- .11 Section 250503 EMCS: PROJECT RECORD DOCUMENTS
- .12 Section 250554 EMCS: IDENTIFICATION
- .13 Section 250560 EMCS: FIELD INSTALLATION
- .14 Section 250820 EMCS: WARRANTY AND MAINTENANCE
- .15 Section 253002 EMCS: FIELD CONTROL DEVICES
- .16 Section 259001 EMCS: SITE REQUIREMENTS APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

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 new equipment and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 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 new equipment and EMCS for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:
 - .1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
 - .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.

- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information at end of project to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right-hand corner in letters at least 12 mm high as follows: "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 00 10 – General 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 all furnished equipment and materials from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 MATERIALS

- .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 for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 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 Refer to section 017900 - DEMONSTRATION AND TRAINING

3.6 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.

3.7 PROTECTION

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

END OF SECTION

Approved: 2017-04-25

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 210501 COMMON WORK RESULTS FOR MECHANICAL
- .2 Section 230500 COMMON WORK RESULTS FOR HVAC

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .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 Departmental 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 the Federal Hazardous Products Act (RSC 1985) including latest amendments.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide the following in accordance with Section 01 33 00 – Submittal Procedures before starting work of this Section:
 - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials prepared in accordance with Section 01 74 19 – Construction Waste Management and Disposal.
 - .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.
- .2 Scheduling: Account for Representative's continued occupancy requirements during selective demolition and schedule staged occupancy and worksite activities.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with the following
 - .1 Federal Workers' Compensation Service
 - .2 Government of Canada, Labour Program: Workplace Safety

1.7 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
- .2 Existing Hazardous Substances: Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
 - .1 Hazardous substances are as defined in the Hazardous Products Act
 - .2 Hazardous substances will be removed by the Contractor as a part of the Contract before starting Work in accordance with work results described in Related Requirements listed above.
- .3 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify Representative if materials suspected of containing hazardous substances are encountered and perform the following activities:
 - .1 Hazardous substances will be as defined in the Hazardous Products Act.
 - .2 Stop work in the area of the suspected hazardous substances.
 - .3 Take preventative measures to limit users' and workers' exposure, provide barriers and other safety devices and do not disturb.
 - .4 Hazardous substances will be removed by Departmental Representative under a separate contract or as a change to the Work.
 - .5 Proceed only after written instructions have been received from Representative.

Part 2 Products

- .1 HVAC Repair Materials: Use only new materials required for completion or repair matching materials damaged during performance of work of this Section; new materials are required to meet assembly or system characteristics as existing systems indicated to remain and carry CSA approval labels required by the Authority Having Jurisdiction.
- .2 Firestopping Repair Materials: Use firestopping materials compatible with existing firestopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

2.2 SALVAGE AND DEBRIS MATERIALS

- .1 Material Ownership: Demolished materials become Contractor's property and will be removed from Project site.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect the work of this Section before tendering the Bid; Representative will not consider claims for extras for work or materials necessary for proper execution and completion of the contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:
 - .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
 - .2 Notify Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
 - .3 Prevent debris from blocking drainage inlets.
 - .4 Protect mechanical systems that must remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with the use of the building by the Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering the safe access to and egress from occupied buildings.
 - .2 Notify 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: Coordinate requirements of this Section as follows:
 - .1 Do not disrupt active or energized utilities without approval of the Representative.
 - .2 Erect and maintain dust proof and weather tight partitions to prevent the spread of dust and fumes to occupied building areas; remove partitions when complete.
 - .3 Demolish parts of existing building to accommodate new construction and remedial work as indicated.
 - .4 At end of each day's work, leave worksite in safe condition.
 - .5 Perform demolition work in a neat and workmanlike manner:

- .1 Remove any tools or equipment after completion of work and leave site clean and ready for subsequent renovation work.
- .2 Repair and restore damages caused as a result of work of this Section to match existing materials and finishes.

3.4 CLOSEOUT ACTIVITIES

- .1 Demolition Waste Disposal: Arrange for legal disposal and remove demolished materials to accredited provincial landfill site or alternative disposal site (recycle centre).
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances in accordance with municipal requirements.

END OF SECTION

Approved: 2005-09-30

Part 1 General

1.1 SECTION INCLUDES:

- .1 Vibration isolation materials and components, seismic control measures and their installation.

1.2 RELATED REQUIREMENTS

- .1 Section 230500 COMMON WORK RESULTS FOR HVAC

1.3 REFERENCE STANDARDS

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Research Council Canada (NRC)
 - .1 National Building Code of Canada (NBC).

1.4 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 Departmental Representative will make available 1 copy of systems supplier's installation instructions.
 - .3 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store and handle in accordance with Section 010010 GENERAL INSTRUCTIONS.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation as indicated.

2.2 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 9 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed; 9 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 9 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 9 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 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 Cadmium plate for outdoor 100% relative humidity installations.
- .4 Colour code springs.

2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.
- .6 Performance: as indicated.

2.6 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.
- .6 Performance: as indicated.

2.7 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.

2.8 STRUCTURAL BASES

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm on smallest dimension, split for field welding on sizes over 2400 mm on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.

- .3 Bases to clear housekeeping pads by 25 mm minimum.

2.9 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 Departmental 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 Departmental 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 system after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .2 Take vibration measurements for equipment as indicated.
 - .3 Provide Departmental Representative with notice 24 hours in advance of commencement of tests.
 - .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
 - .5 Submit complete report of test results including sound curves.

3.4 CLEANING

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

END OF SECTION

Approved: 2005-09-30

Part 1 General

1.1 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 RELATED REQUIREMENTS

- .1 Section 210501 COMMON WORK RESULTS FOR MECHANICAL
- .2 Section 220500 COMMON WORK RESULTS FOR PLUMBING
- .3 Section 230500 COMMON WORK RESULTS FOR HVAC.

1.3 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3, Identification of Piping Systems.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include paint colour chips, other products specified in this section.
- .3 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.5 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store and handle in accordance with Section 010010 GENERAL INSTRUCTIONS.
 - .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.
- .2 Dispose of unused material at official hazardous material collections site.
- .3 Do not dispose of unused material into sewer system, into streams, lakes, onto ground or in locations where it will pose health or environmental hazard.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic, 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 Departmental Representative.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend, direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: 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 vinyl 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 Departmental 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		
Make-up water	Yellow	MAKE-UP WTR
Steam	Yellow	STEAM
Domestic cold-water supply	Green	DOM. CWS
Sanitary	Green	SAN

2.5 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.

2.6 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.

2.7 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.

2.8 LANGUAGE

- .1 Identification in both official languages.
- .2 Use one nameplate and label for each language.

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 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 Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively.

3.7 CLEANING

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

END OF SECTION

Approved: 2005-12-31

Part 1 General

1.1 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Departmental Representative within 28 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
 - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1.
 - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-2019.
 - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .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.

1.2 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.

1.3 EXCEPTIONS

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

1.4 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.

1.5 PRE-TAB REVIEW

- .1 Review Contract Documents before project construction is started confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report Departmental 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.

1.6 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.

1.7 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.8 START OF TAB

- .1 Notify Departmental Representative 7 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.

1.9 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5%, minus 5%.

1.10 ACCURACY TOLERANCES

- .1 Measured values accurate to within plus or minus 2% of actual values.

1.11 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental 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 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.12 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.13 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.

- .3 Calculations procedures.
- .4 Summaries.

1.14 TAB REPORT

- .1 Format in accordance with referenced standards.
- .2 TAB report to show results in SI units and to include:
 - .1 Project record drawings.
 - .2 System schematics.
- .3 Submit digital copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.15 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide personnel and instrumentation to verify up to 30% of reported results.
- .3 Number and location of verified results as directed by Departmental Representative.
- .4 Pay costs to repeat TAB as required to satisfaction of Departmental Representative.

1.16 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Do not eradicate or cover markings.

1.17 COMPLETION OF TAB

- .1 TAB considered complete when final TAB Report received and approved by Departmental Representative.

1.18 AIR SYSTEMS

- .1 Standard: TAB to most stringent of TAB standards of ASHRAE, NEBB, AABC, or SMACNA.
- .2 Do TAB of following systems, equipment, components, controls:
 - .1 AHU-4 Preliminary airflow measurements before undertaking any work.
 - .2 AHU-4 final airflow measurements after work complete
 - .3 As required to support recalibration of supply and return air flow stations
 - .4 As required to support EMCS contractor in setting minimum damper position to provide required outdoor air (1,080 L/S).
 - .5 As required to support commissioning.
- .3 Qualifications: personnel performing TAB qualified to standards of NEBB, or AABC.

- .4 Quality assurance: perform TAB under direction of supervisor qualified to standards of NEBB or AABC.
- .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).

1.19 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 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

Approved: 2005-12-31

Part 1 General

1.1 SECTION INCLUDES:

- .1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 RELATED REQUIREMENTS

- .1 Section 220500 COMMON WORK RESULTS FOR PLUMBING.
- .2 Section 221116 DOMESTIC WATER PIPING.

1.3 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1, 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, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C335, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C449/C449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C533, Calcium Silicate Block and Pipe Thermal Insulation.
 - .6 ASTM C547, Mineral Fiber Pipe Insulation.
 - .7 ASTM C795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (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, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.4 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.5 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 1 33 00 - Submittal Procedures].
 - .1 Shop drawings: Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .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 Departmental Representative will make available 1 copy of systems supplier's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section and have at least 3 years successful experience in this size and type of project, qualified to standard] of TIAC.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 010010 GENERAL INSTRUCTIONS.
 - .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 recycling.
 - .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.

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 ASTM C547, CAN/ULC-S702.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702, ASTM C547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702, ASTM C547.
- .5 TIAC Code C-2: mineral fibre blanket faced with, without factory applied vapour retarder jacket (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to CAN/ULC-S702, ASTM C547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to ASTM C547, CAN/ULC-S702.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Air drying 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 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type to CAN/CGSB-51.53 with pre-formed shapes as required.

- .2 Colours: to match adjacent finish paint.
- .3 Minimum service temperatures: -20 degrees C.
- .4 Maximum service temperature: 65 degrees C.
- .5 Moisture vapour transmission: 0.02 perm.
- .6 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 with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint.
 - .3 Minimum service temperatures: -40 degrees C.
 - .4 Maximum service temperature: 82 degrees C.
 - .5 Moisture vapour transmission: 0.012 perm.
 - .6 Thickness: .75] mm.
 - .7 Fastenings:
 - .1 Solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Locations:
 - .1 For outdoor use ONLY.
- .3 Canvas:
 - .1 220 and 120 gm/m²cotton, plain weave, treated with dilute fire-retardant lagging adhesive to ASTM C921.
 - .2 Lagging adhesive: compatible with insulation.
- .4 Aluminum:
 - .1 To ASTM B209.
 - .2 Thickness: 0.50 mm sheet.
 - .3 Finish: stucco embossed.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

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, PREFABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at valves, flanges and unions at equipment 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: Tape at 300 mm on centre.

- .2 Seals: lap seal adhesive, lagging adhesive.
- .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
- .1 Securements: Tape at 300 mm on centre.
- .2 Seals: VR lap seal adhesive, VR lagging adhesive.
- .3 Installation: TIAC Code: 1501-C.
- .4 TIAC
- .5 TIAC Code: C-2
- .1 Insulation securements: Tape at 300 mm on centre.
- .2 Seals: lap seal adhesive, lagging adhesive.
- .3 Installation: TIAC Code: 1501-C.
- .6 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)					
Steam	up to 175	A-1	38	50	65	75	90	90
Domestic CWS		A-3	25	25	25	25	25	25
Cooling Coil cond. drain		C-2	25	25	25	25	25	25

- .7 Finishes:
 - .1 Exposed indoors: PVC jacket.
 - .2 Exposed in mechanical rooms: PVC jacket.
 - .3 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 **CLEANING**

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

END OF SECTION

Approved: 2013-12-31

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 210501 COMMON WORK RESULTS FOR MECHANICAL
- .2 Section 220500 COMMON WORK RESULTS FOR PLUMBING
- .3 Section 230500 COMMON WORK RESULTS FOR HVAC

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 humidifiers 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 to indicate project layout, dimensions, and extent of humidification system.
 - .1 Indicate following: Steam Capacity.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .6 Manufacturer's Field Reports:
 - .1 Submit manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

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

1.4 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: Two replacement cylinders for each humidifier. Four total.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 010010 GENERAL INSTRUCTIONS 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 humidifiers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

Part 2 Products

2.1 PACKAGED ELECTRODE STEAM GENERATING TYPE

- .1 CSA certified and ULC listed.
- .2 Components housed in factory fabricated cabinet with factory enameled finish and electrically interlocked door.
- .3 Factory sealed disposable steam cylinder complete with factory installed electrodes to suit water condition.
- .4 Controls:
 - .1 Solid state panel.
 - .2 Solenoid valve on water and drain lines.
 - .3 Duct humidistat.
 - .4 Airflow proving switch.
 - .5 Adjustable flush cycle timer.
 - .6 Amp meter.
 - .7 Cylinder replacement indicator light.
 - .8 Humidifiers to be interconnected (lead/lag) and operate together as a single humidifier without the requirements for additional controllers.
- .5 Duct distribution header complete with condensate drain and supply hose.
 - .1 Absorption distance: Within 30 cm.

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 Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Humidifier and evaporator media to be new and clean when project is accepted.
- .3 Install humidistat in accessible location.
- .4 Water service overflow drain: to manufacturers' recommendation.
- .5 Install access doors or panels in adjacent ducting.
- .6 When installing in ducting, provide waterproof duct up and downstream.
- .7 Install capped drain connection at low point in duct.

3.3 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 3 days of review, and submit immediately Departmental Representative.
- .2 Performance Verification (PV):

- .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx)
Requirements: General Requirements, supplemented as specified.
- .2 Application tolerances: +/- 10%.
- .3 Timing:
 - .1 After TAB of ducted air systems.
 - .2 At same time as PV of related air handling units.
- .4 PV procedures:
 - .1 Packaged Electrode Steam Generating Type: Verify the RAH setpoint is maintained.
 - .2 Verify all safeties and interlocks work as required.
- .3 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.
- .4 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 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Approved: 2004-06-30

Part 1 General

1.1 SECTION INCLUDES.

- .1 Methods and procedures for start-up, verification, and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
 - .1 Start-up testing and verification of systems.
 - .2 Check out demonstration or proper operation of components.
 - .3 On-site operational tests.

1.2 RELATED REQUIREMENTS

- .1 Section 00 01 10 TABLE OF CONTENTS
- .2 Section 25 01 12 EMCS: TRAINING
- .3 Section 25 05 01 EMCS: GENERAL REQUIREMENTS
- .4 Section 25 05 02 EMCS: SUBMITTALS AND REVIEW PROCESS
- .5 Section 25 05 03 EMCS: PROJECT RECORD DOCUMENTS
- .6 Section 25 05 60 EMCS: FIELD INSTALLATION
- .7 Section 25 08 20 EMCS: WARRANTY AND MAINTENANCE
- .8 Section 25 90 01 EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

1.3 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.

1.4 DESIGN REQUIREMENTS

- .1 Confirm with Departmental 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.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Final Report: submit report to Departmental 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 Departmental Representative before commissioning is started.
 - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions, or energy consumption.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O& M Manuals, and training of O& M personnel for review of Departmental Representative before interim acceptance.

1.7 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 General Commissioning Requirements.
- .2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative.
- .3 Inform, and obtain approval from Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of Departmental 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.

1.8 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

1.9 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

Part 2 Products

2.1 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

Part 3 Execution

3.1 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed in Section 01 91 13 General Commissioning Requirements.
- .3 Debug system software.
- .4 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

3.2 FIELD QUALITY CONTROL

- .1 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.
- .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 Departmental Representative. This document will be used in final start-up testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system and provide:
 - .1 Technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Commissioning to commence during final start-up testing.
 - .3 O& M personnel may choose to assist in commissioning procedures as part of training.
 - .4 Operate systems as long as necessary to commission entire project.
 - .5 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
 - .1 Prior to beginning of 30-day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
 - .2 Test to last at least 30 consecutive 24 hour days.
 - .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
 - .4 System will be accepted when:

- .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
- .2 Requirements of Contract have been met.
- .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
- .6 Correct defects when they occur and before resuming tests.
- .5 Departmental Representative to verify reported results.

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

- .1 Demonstrate to Departmental Representative operation of modified systems.

END OF SECTION

Approved: 2004-06-30

Part 1 General

1.1 SECTION INCLUDES.

- .1 Requirements and procedures for training program, instructors, and training materials, for building Energy Monitoring and Control System (EMCS) Work.

1.2 RELATED REQUIREMENTS

- .1 Section 00 01 10 TABLE OF CONTENTS
- .2 Section 25 01 11 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .3 Section 25 05 01 EMCS: GENERAL REQUIREMENTS
- .4 Section 25 05 02 EMCS: SUBMITTALS AND REVIEW PROCESS
- .5 Section 25 05 03 EMCS: PROJECT RECORD DOCUMENTS
- .6 Section 25 05 60 EMCS: FIELD INSTALLATION
- .7 Section 25 08 20 EMCS: WARRANTY AND MAINTENANCE
- .8 Section 25 90 01 EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

1.3 DEFINITIONS

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit training proposal including brief overview of content to Departmental Representative 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.
- .2 Submit reports within one week after completion of training program indicating that training has been satisfactorily completed.

1.5 QUALITY ASSURANCE

- .1 Provide competent instructors thoroughly familiar with aspects of EMCS installed in facility.
- .2 Departmental Representative reserves right to approve instructors.

1.6 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance, and pertinent safety requirements of EMCS installed.

- .2 Training to be project specific.

1.7 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).

1.8 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).

1.9 TRAINING PROGRAM

- .1 1/2 (half) day program.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - .3 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Approved: 2005-03-31

Part 1 General

1.1 SECTION INCLUDES:

- .1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.

1.2 RELATED REQUIREMENTS

- .1 Section 00 01 10 TABLE OF CONTENTS
- .2 Section 25 01 11 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .3 Section 25 01 12 EMCS: TRAINING
- .4 Section 25 05 02 EMCS: SUBMITTALS AND REVIEW PROCESS
- .5 Section 25 05 03 EMCS: PROJECT RECORD DOCUMENTS
- .6 Section 25 05 60 EMCS: FIELD INSTALLATION
- .7 Section 25 08 20 EMCS: WARRANTY AND MAINTENANCE
- .8 Section 25 90 01 EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

1.3 REFERENCE STANDARDS

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE STD 135, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .3 Consumer Electronics Association (CEA).
 - .1 CEA-709.1, Control Network Protocol Specification.

1.4 ABBREVIATIONS AND ACRONYMS

- .1 Acronyms used in EMCS:
 - .1 AEL - Average Effectiveness Level
 - .2 AI - Analog Input
 - .3 AIT - Agreement on International Trade
 - .4 AO - Analog Output
 - .5 BACnet - Building Automation and Control Network.
 - .6 BC(s) - Building Controller(s).
 - .7 BECC - Building Environmental Control Centre.
 - .8 CAD - Computer Aided Design.
 - .9 CDL - Control Description Logic.

- .10 CDS - Control Design Schematic.
- .11 COSV - Change of State or Value.
- .12 CPU - Central Processing Unit.
- .13 DI - Digital Input.
- .14 DO - Digital Output.
- .15 DP - Differential Pressure.
- .16 ECU - Equipment Control Unit.
- .17 EMCS - Energy Monitoring and Control System.
- .18 HVAC - Heating, Ventilation, Air Conditioning.
- .19 IDE - Interface Device Equipment.
- .20 I/O - Input/Output.
- .21 ISA - Industry Standard Architecture.
- .22 LAN - Local Area Network.
- .23 LCU - Local Control Unit.
- .24 MCU - Master Control Unit.
- .25 NAFTA - North American Free Trade Agreement.
- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Workstation.
- .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.

1.5 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties or providing status conditions of

- contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be short forms or acronyms. Database must provide 25 character field for each point identifier.
 - .2 Point expansion: comprised of three fields, one for each descriptor. Expanded form of short form or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
 - .3 Bilingual systems to include additional point identifier expansion fields of equal capacity for each point name for second language.
 - .1 System to support use of numbers and readable characters including blanks, periods or underscores to enhance user readability for each of the above strings.
- .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to ANSI/IEEE 260.1.
 - .2 Refer also to Section 25 05 54 - EMCS: Identification.

1.6 SYSTEM DESCRIPTION

- .1 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers (as required).
 - .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.
- .2 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of types to meet project requirements.
 - .3 Provide utility power to new EMCS components as required.
 - .4 Metric references: in accordance with CAN/CSA Z234.1.
- .3 Language Operating Requirements:
 - .1 Match existing

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Submit for review:
 - .1 Equipment list within 10 days after award of contract.
- .3 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested in accordance with their test methods and that item conforms to their standard/code.
 - .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
 - .6 Permits and fees: in accordance with general conditions of contract.
 - .7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.

1.8 QUALITY ASSURANCE

- .1 Have access to local supplies of essential parts.

- .2 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Ontario Ministry of Labour.

1.9 EXISTING- CONTROL COMPONENTS

- .1 Utilize existing control wiring to the extent possible.
- .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 Departmental Representative.
 - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .4 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
 - .1 Be responsible for repair costs due to negligence or abuse of equipment.
- .5 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

Part 2 Products

2.1 EQUIPMENT

- .1 Match existing building standard.

Part 3 Execution

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

END OF SECTION

Approved: 2004-06-30

Part 1 General

1.1 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 RELATED REQUIREMENTS:

- .1 Section 00 01 10 TABLE OF CONTENTS
- .2 Section 25 01 11 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .3 Section 25 01 12 EMCS: TRAINING
- .4 Section 25 05 01 EMCS: GENERAL REQUIREMENTS
- .5 Section 25 05 03 EMCS: PROJECT RECORD DOCUMENTS
- .6 Section 25 05 60 EMCS: FIELD INSTALLATION
- .7 Section 25 08 20 EMCS: WARRANTY AND MAINTENANCE
- .8 Section 25 90 01 EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

1.3 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Shop Drawings to consist of 1 soft copy of design documents, shop drawings, product data and software.
- .2 Soft copy to be structured using menu format for easy loading and retrieval on OWS.

1.5 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
 - .1 Proof of demonstrated ability of system to integrate with existing building EMCS
 - .2 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.
 - .3 Detailed system architecture showing all points associated with each controller including.
 - .4 Spare point capacity of each new controller by number and type.
 - .5 New controller locations.
 - .6 New control cabinet locations.

- .7 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
- .8 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).
- .9 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
- .10 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.
- .11 Graphic system schematic displays of water and air systems with point identifiers and textual description of system, and typical floor plans as specified.
- .12 Listing and example of specified reports.
- .13 Listing of time-of-day schedules.
- .14 Mark up to-scale construction drawing to detail control room showing location of new equipment.
- .15 Type and size of memory with statement of spare memory capacity.
- .16 Full description of software programs provided.
- .17 Sample of "Operating Instructions Manual" to be used for training purposes.
- .18 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.6 QUALITY ASSURANCE

- .1 Preliminary Design Review Meeting: Convene meeting within 30 working days of award of contract to:
 - .1 Resolve conflicts between Contract Document requirements and actual items (e.g.: points list inconsistencies).
 - .2 Review interface requirements of materials supplied by others or existing.
 - .3 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Approved: 2004-06-30

Part 1 General

1.1 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 RELATED REQUIREMENTS

- .1 Section 00 01 10 TABLE OF CONTENTS
- .2 Section 25 01 11 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .3 Section 25 01 12 EMCS: TRAINING
- .4 Section 25 05 01 EMCS: GENERAL REQUIREMENTS
- .5 Section 25 05 02 EMCS: SUBMITTALS AND REVIEW PROCESS
- .6 Section 25 05 60 EMCS: FIELD INSTALLATION
- .7 Section 25 08 20 EMCS: WARRANTY AND MAINTENANCE
- .8 Section 25 90 01 EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

1.3 DEFINITIONS

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Workstation.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit As-built drawings and Operation and Maintenance Manual to Departmental Representative.
- .2 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.

1.5 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
 - .1 Changes to Contract Documents as well as addenda and contract extras.

- .2 Changes to interface wiring.
- .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
- .4 Locations of obscure devices to be indicated on drawings.
- .5 Listing of alarm messages.
- .6 Panel/circuit breaker number for sources of normal/emergency power.
- .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
- .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
- .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.6 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics, or in-depth control theory.
- .4 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
 - .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces, and requirements for components in functions and operating modes.
 - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
 - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm, and failure recovery.

- .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including keystrokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
 - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
 - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, and 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, and 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

Approved: 2004-06-30

Part 1 General

1.1 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 RELATED REQUIREMENTS

- .1 Section 250501 EMCS GENERAL REQUIREMENTS.

1.3 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.4 DEFINITIONS

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.5 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in English and French.

1.6 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 Departmental 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, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by plastic tie.
- .2 Sizes: 50 x 100 mm minimum.

- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by Departmental Representative.
- .3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

- .1 Equipment including motors, starters under remote automatic control: supply and install orange-coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative's.

2.5 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets, and outlet boxes.
- .2 Colour coding: to CSA C22.1. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 PNEUMATIC TUBING

- .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.7 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

Part 3 Execution

3.1 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

- .1 Correct existing nameplates and legends to reflect changes made during Work.

END OF SECTION

Approved: 2014-12-31

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 00 01 10 TABLE OF CONTENTS
- .2 Section 25 01 11 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .3 Section 25 01 12 EMCS: TRAINING
- .4 Section 25 05 01 EMCS: GENERAL REQUIREMENTS
- .5 Section 25 05 02 EMCS: SUBMITTALS AND REVIEW PROCESS
- .6 Section 25 05 03 EMCS: PROJECT RECORD DOCUMENTS
- .7 Section 25 08 20 EMCS: WARRANTY AND MAINTENANCE
- .8 Section 25 90 01 EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

1.2 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.

1.3 SYSTEM DESCRIPTION

- .1 Electrical:
 - .1 Provide power wiring 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.
- .2 Mechanical:
 - .1 Pipe Taps Required for EMCS equipment will be supplied and installed by Mechanical Contractor. Coordinate with mechanical contractor.

- .2 Wells and Control Valves Shall Be Supplied by EMCS Contractor and Installed by Mechanical Contractor. Coordinate with mechanical contractor.

1.4 PERSONNEL QUALIFICATIONS

- .1 Qualified supervisory personnel to:
 - .1 Continuously direct and monitor all work.
 - .2 Attend site meetings (as required).

1.5 EXISTING CONDITIONS

- .1 Repair all surfaces damaged during execution of work.
- .2 Turn over to Departmental Representative existing materials removed from work not identified for re-use.

Part 2 Products

2.1 WIRING

- .1 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run-in conduit. All other cases use FT4 wiring.
- .3 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.
 - .4 Analog input and output: shielded #18 minimum solid copper. Wiring must be continuous without joints.
 - .5 More than 4 conductors: #22 minimum solid copper.
- .4 Terminations:
 - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

2.2 CONDUIT

- .1 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.
- .2 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.
- .3 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.

- .4 Outlet boxes: 100 mm minimum, square.
- .5 Conduit boxes, fittings:
 - .1 Bushings and connectors: with nylon insulated throats.
 - .2 With push pennies to prevent entry of foreign materials.
- .6 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.
- .7 Fittings for thin wall conduit:
 - .1 Connectors and couplings: steel, set screw type.

2.3 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.

2.4 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 SUPPORTS

- .1 Install special supports as required and as indicated.

3.3 ELECTRICAL GENERAL

- .1 Do complete installation in accordance with requirements of:
 - .1 CSA 22.1 Canadian Electrical Code.
 - .2 ANSI/NFPA 70.
 - .3 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 Conform to manufacturer's recommendations for storage, handling, and installation.
- .4 Check factory connections and joints. Tighten where necessary to ensure continuity.
- .5 Install electrical equipment between 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .6 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .7 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.

3.4 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 Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .4 Locate conduits at least 150 mm from parallel 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 Departmental Representative.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove, and replace blocked sections.
- .12 Conduits may be run in flanged portion of structural steel.
- .13 Group conduits wherever possible on suspended or surface channels.
- .14 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.
- .15 Install bonding conductor for 120 volt and above in conduit.

3.5 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 Departmental Representative with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

3.6 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.

3.7 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.

3.8 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.

3.9 IDENTIFICATION

- .1 Match building standard equipment identification, EMCS point naming, and asset management naming systems.

END OF SECTION

Approved: 2004-06-30

Part 1 General

1.1 SECTION INCLUDES.

- .1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).

1.2 RELATED REQUIREMENTS

- .1 Section 00 01 10 TABLE OF CONTENTS
- .2 Section 25 01 11 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .3 Section 25 01 12 EMCS: TRAINING
- .4 Section 25 05 01 EMCS: GENERAL REQUIREMENTS
- .5 Section 25 05 02 EMCS: SUBMITTALS AND REVIEW PROCESS
- .6 Section 25 05 03 EMCS: PROJECT RECORD DOCUMENTS
- .7 Section 25 05 60 EMCS: FIELD INSTALLATION
- .8 Section 25 90 01 EMCS: SITE REQUIREMENTS, APPLICATIONS AND SYSTEMS SEQUENCES OF OPERATION.

1.3 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Workstation.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .2 Submit detailed inspection reports to Departmental Representative.
- .3 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.

- .4 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .5 Records and logs:
 - .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 Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .6 Revise and submit to Departmental Representative "As-built drawings" documentation and commissioning reports to reflect changes, adjustments, and modifications to EMCS made during warranty period.

1.5 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 Departmental Representative with telephone number where service personnel may be reached at any time.
 - .4 Service personnel to be on site ready to service EMCS within 2 hours after receiving request for service.
 - .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date, and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental 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 inspections per year. Provide detailed written report to Departmental Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 0800 to 1630 h, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
 - .2 Check each field input/output device.
 - .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 Departmental Representative to discuss suggested or required changes.
- .5 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .6 Continue system debugging and optimization.

END OF SECTION

Approved: 2005-03-31

Part 1 General

1.1 SECTION INCLUDES:

- .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transducers, valve actuators, damper operators, dampers, meters, transmitters, switches, controls, sensors, valves, low voltage current transformers.
- .2 Related Sections:
 - .1 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
 - .2 Section 25 05 01 - EMCS: General Requirements.
 - .3 Section 25 05 02 - EMCS: Submittal and Review Process.
 - .4 Section 25 05 54 - EMCS: Identification.
 - .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7, Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B148, Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by Departmental 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 as specified herein.
- .2 Repair surfaces damaged during execution of Work.
- .3 Turn over to Departmental Representative existing materials removed from Work not identified for re-use.

Part 2 Products

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .3 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .4 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .5 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .6 Devices installed in user occupied space does not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .7 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 HUMIDITY SENSORS

- .1 Room and Duct Requirements:
 - .1 Range: 5 - 90 % RH minimum.
 - .2 Operating temperature range: 0 - 60 degrees C.
 - .3 Absolute accuracy:
 - .1 Duct sensors: plus or minus 3 %.
 - .2 Room sensors: plus or minus 2 %.
 - .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
 - .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
 - .6 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 - 50 degrees C.
- .3 Absolute accuracy: plus or minus 2 %.
- .4 Temperature coefficient: plus or minus 0.03%RH/degrees C over 0 to 50 degrees C.
- .5 Must be unaffected by condensation or 100% saturation.
- .6 No routine maintenance or calibration is required.

2.3 HUMIDITY TRANSMITTERS

- .1 Requirements:
 - .1 Input signal: from RH sensor.
 - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
 - .3 Input and output short circuit and open circuit protection.
 - .4 Output variations: not to exceed 0.2 % of full-scale output for supply voltage variations of plus or minus 10 %.
 - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
 - .6 Integral zero and span adjustment.
 - .7 Temperature effect: plus or minus 1.0 % full scale/6 months.
 - .8 Long term output drift: not to exceed 0.25 % of full-scale output/6 months.

2.4 ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
 - .1 Direct mount proportional type as indicated.
 - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
 - .3 Operator: size to control dampers against maximum pressure and dynamic closing/opening pressure, whichever is greater.
 - .4 Power requirements: 5 VA maximum at 24 V AC.
 - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
 - .6 For VAV box applications floating control type actuators may be used.
 - .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.5 PANELS

- .1 Wall mounted enamelled steel cabinets with hinged and key-locked front door.
- .2 Multiple panels as required to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.6 WIRING

- .1 In accordance with Section 25 05 60 EMCS Field Installation
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run-in conduit. Other cases use FT4 wiring.
- .3 Wiring must be continuous without joints.
- .4 Sizes:
 - .1 Field wiring to digital device: #18AWG.
 - .2 Analog input and output: shielded #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: 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 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 Departmental 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. Departmental Representative to review before starting Work. Wiring in mechanical rooms, wiring in service rooms and exposed wiring must be in conduit.
- .7 Mechanical: supply and install in accordance with 250560 EMCS FIELD INSTALLATION.
 - .1 Pipe Taps.
 - .2 Wells and Control Valves.
 - .3 Air flow stations, dampers, and other devices.

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 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.5 AIR FLOW MEASURING STATIONS

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.6 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

END OF SECTION

Approved: 2005-03-31

Part 1 General

1.1 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 RELATED REQUIREMENTS

- .1 Section 00 01 10 TABLE OF CONTENTS
- .2 Section 25 01 11 EMCS: START-UP, VERIFICATION AND COMMISSIONING
- .3 Section 25 01 12 EMCS: TRAINING
- .4 Section 25 05 01 EMCS: GENERAL REQUIREMENTS
- .5 Section 25 05 02 EMCS: SUBMITTALS AND REVIEW PROCESS
- .6 Section 25 05 03 EMCS: PROJECT RECORD DOCUMENTS
- .7 Section 25 05 60 EMCS: FIELD INSTALLATION
- .8 Section 25 08 20 EMCS: WARRANTY AND MAINTENANCE

1.3 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/docentre/mechanical/me214-e.pdf>

1.4 SEQUENCING – AHU-4 Humidification

- .1 Connect the new humidifiers to the building EMCS system.
- .2 Humidifiers to operate in a lead/lag configuration (under onboard control).
- .3 Modulate the humidifier(s) to maintain 40 % (adjustable) return air humidity (RAH).
- .4 Shut down humidifier(s) if SAH rises above 90% RH (interlocked). Alarm at EMCS.
- .5 Shut down humidifier(s) if there is no airflow (interlocked). Alarm at EMCS.
- .6 Monitor humidifiers for alarms. Display at EMCS.
- .7 Display humidification command, feedback, and status.

- .8 Provide trend logs to Departmental Representative for review after 3 months of operation.

1.5 SEQUENCING – AHU-4 SAT Reset

- .1 Reduce the supply air temperature (SAT) to allow for the cooling of interior zones.
- .2 Reset supply air temperature based on the outdoor air temperature (OAT) according to the following schedule:
 - .1 When $OAT \Rightarrow 20C$, $SAT = 13C$
 - .2 When $OAT \Rightarrow 5C$, $SAT = 18C$
 - .3 Interpolate linearly between the two points above.
- .3 Program the following trend logs for each air system:
 - .1 AHU supply air temperature setpoint
 - .2 AHU supply air temperature
 - .3 Outdoor air temperature
 - .4 AHU Fan speed setpoint
 - .5 AHU fan speed
 - .6 Space temperature setpoint (choose 3 interior spaces, and 3 perimeter spaces at random for each system)
 - .7 Space temperature (for spaces identified above)
- .4 Provide trend logs to Departmental Representative for review after 3 months of operation.

1.6 SEQUENCING – AHU-4 Static Pressure Reset

- .1 Implement a static pressure setpoint reset strategy where the static pressure setpoint is reset until one VAV box is nearly wide open (per ASHRAE 90.1 Section 6.5.2.3).
- .2 Poll all VAV boxes served by each AHU.
- .3 If the max VAV position is $< 95\%$ then decrease the static pressure setpoint.
- .4 If the max VAV position is $> 95\%$ then increase the static pressure setpoint.
- .5 Do not exceed the maximum static pressure setpoint.
 - .1 Maximum static pressure setpoint: Current setpoint value
- .6 Program the following trend logs for each system:
 - .1 AHU supply fan speed
 - .2 AHU supply fan speed setpoint
 - .3 AHU return fan speed
 - .4 AHU return fan speed setpoint
 - .5 Supply air static pressure
 - .6 Supply air static pressure setpoint
 - .7 Maximum VAV box position

- .8 Space temperature setpoint (choose 3 interior spaces, and 3 perimeter spaces at random for each system)
- .9 Space temperature (for spaces identified above)
- .7 Provide trend logs to Departmental Representative for review after 3 months of operation.

1.7 SEQUENCING – AHU-4 Economizer Setpoints

- .1 Revise programming of the air side economizer (Outdoor air damper, mixed air damper, and exhaust air damper).
- .2 Set the lockout temperature to 21C.
 - .1 Economizer mode shall be enabled when OAT is below 21C.
 - .2 Economizer shall be disabled when OAT is at or above 21C.
- .3 Allow for simultaneous operation of free cooling and mechanical cooling.
 - .1 Free cooling is first stage of cooling. Modulate the outdoor air dampers to maintain the supply air temperature.
 - .2 If OAT is below 21C, outdoor air dampers are 100% open, and the system is unable to maintain the supply air temperature setpoint, enable the cooling coil. Modulate the cooling control valve (CCV) to maintain the supply air temperature setpoint.
 - .3 Stage down in the reverse order.
- .4 Program the following trend logs for each system:
 - .1 AHU outdoor air damper position
 - .2 AHU supply air temperature
 - .3 AHU return air temperature
 - .4 Cooling control valve position
- .5 Provide trend logs to Departmental Representative for review after 3 months of operation.

1.8 SEQUENCING – AHU-4 CO2 Sensor Recalibration

- .1 Confirm calibration of CO2 sensor. Recalibrate or replace as necessary.
- .2 Provide trend logs to Departmental Representative for review after 3 months of operation.

1.9 SEQUENCING – AHU-4 SF and RF VFD FEEDBACK

- .1 Confirm VFD feedback matches actual drive speed.
- .2 Provide trend logs to Departmental Representative for review after 3 months of operation.

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 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No. 0-10 (R2015).

1.3 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.

1.4 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 electrical equipment and materials (including conductors, junction boxes and conduit) 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 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 co-ordinated 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 on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Submit electronic copies of drawings and product data to authority having jurisdiction for review.
 - .6 If changes are required, notify Departmental Representative of these changes before they are made.
- .4 Certificates:
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such material/equipment to authority having jurisdiction for special approval before delivery to site.

- .3 Submit test results of installed electrical systems.
- .4 Permits and fees: in accordance with General Conditions of contract.
- .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

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 breakers 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.

1.6 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, 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 equipment and materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to waster created by the electrician of this project.
- .5 Packaging Waste Management: remove for reuse of packaging materials, pallets, crates, as specified in Construction Waste Management Plan.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 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.
- .2 Language operating requirements: provide identification nameplates for control items in English and French.
- .3 Use one nameplate label for both languages.

2.2 MATERIALS AND EQUIPMENT

- .1 Material and equipment to be CSA certified. Where CSA certified material/equipment is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 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 Control wiring and conduit: for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections.

2.4 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of Departmental Representative and authority having jurisdiction.
- .2 Porcelain enamel 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: lamacoid 3 mm thick plastic engraving sheet, black face, white 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 to be approved by Departmental 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 Departmental 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: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	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 equipment/material installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 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: schedule 40 steel pipe, 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.

3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline 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.

3.7 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 Conduct following tests for all new equipment.
 - .1 Circuits originating from branch distribution panels.
 - .2 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable.
 - .3 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.
- .2 Carry out tests in presence of Departmental Representative or
- .3 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .4 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.

3.9 SYSTEM STARTUP

- .1 Instruct operating personnel and Departmental Representative 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:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.
- .3 Waste Management: separate waste materials for reuse/recycling in accordance with 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 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (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 Departmental 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 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Action Submittals: Provide in accordance with Section 01 33 00– Submittal Procedures before starting work of this Section:
 - .1 Construction Waste Management Plan (CWM Plan): Submit plan addressing opportunities for reduction, reuse, or recycling of materials.
 - .2 Landfill Records: Indicate receipt and acceptance of selective demolition waste and hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate work of this Section to avoid interference with work by other Sections.

- .2 Scheduling: Account for Department Representative's continued occupancy requirements during selective demolition and schedule staged occupancy and worksite activities as a defined Activity item in Construction Progress Schedule.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements: Perform work of this Section in accordance with:
 - .1 Federal Workers' Compensation Service
 - .2 Government of Canada, Labour Program: Workplace Safety

1.7 SITE CONDITIONS

- .1 Existing Conditions: Condition of materials identified as being salvaged or demolished are based on their observed condition at time of site examination before tendering.
- .2 Existing Hazardous Substances: Departmental Representative has performed a hazardous substances assessment and identified materials requiring abatement as follows:
 - .1 Hazardous substances are as defined in Hazardous Products Act.

Part 2 Products

2.1 NOT USED REPAIR 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 Firestopping Repair Materials: Use firestopping materials compatible with existing firestopping systems where removal or demolition work affects rated assemblies, restore to match existing fire rated performance.

2.2 SALVAGE AND DEBRIS MATERIALS

- .1 Material Ownership: Demolished materials become Contractor's property and will be removed from Project site; except for items indicated as being reused, salvaged, reinstalled, or otherwise indicated to remain Departmental Representative's property.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Existing Conditions: Visit site, thoroughly examine and become familiar with conditions that may affect work of this Section before tendering Bid; Departmental Representative will not consider claims for extras for work or materials necessary for proper execution and completion of contract that could have been determined by a site visit.

3.2 PREPARATION

- .1 Protection of Existing Systems to Remain: Protect systems and components indicated to remain in place during selective demolition operations and as follows:

- .1 Prevent movement and install bracing to prevent settlement or damage of adjacent services and parts of existing buildings scheduled to remain.
- .2 Notify Departmental Representative and cease operations where safety of buildings being demolished, adjacent structures or services appears to be endangered and await additional instructions before resuming demolition work specified in this Section.
- .3 Prevent debris from blocking drainage inlets.
- .4 Protect mechanical systems that will remain in operation.
- .2 Protection of Building Occupants: Sequence demolition work so that interference with use of the building by Departmental Representative and users is minimized and as follows:
 - .1 Prevent debris from endangering safe access to and egress from occupied buildings.
 - .2 Notify Departmental Representative and cease operations where safety of occupants appears to be endangered and await additional instructions before resuming demolition work specified in this Section.

3.3 EXECUTION

- .1 Demolition: Coordinate 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 electrical devices and equipment including associated conduits, boxes, wiring, and similar items unless specifically noted otherwise.
 - .3 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.
 - .4 Disconnect panel feeders back to main distribution panel and re label respective circuit breaker as "SPARE".
 - .5 Remove existing conduits, boxes, cabling, and wiring associated with removed electrical devices and equipment.
 - .6 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.
 - .7 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.
- .2 Hazardous Substances Disposal: Arrange for disposal of hazardous substances.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 22 – Connectors and Terminations.
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 PRODUCT DATA

- .1 Provide product data 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 26 05 00 - Common Work Results for Electrical.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Manage waste in accordance with Section 26 05 00 – Common Work Results for Electrical.

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 1000V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE,

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 before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 22 - Connectors and Terminations.
- .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 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 CLEANING

- .1 Cleaning: clean in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Waste Management: in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
 - .3 CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

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 connectors and terminations and include product characteristics, performance criteria, physical size, finish, and limitations.

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 connectors and terminations for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Manage waste in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.

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 connectors and terminations installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed Departmental Representative.

3.2 INSTALLATION

- .1 Install terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2No.41.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Waste Management: in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 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 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 with manufacturer's written instructions and 26 05 00 - Common Work Results for Electrical.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Manage waste in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 EQUIPMENT

- .1 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .2 Insulated grounding conductors: green jacketed, copper conductors, size as indicated.
- .3 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.

- .6 Pressure wire connectors.

Part 3 Execution

3.1 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 Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION GENERAL

- .1 Install 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 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Make grounding connections in radial configuration only, with connections terminating at. Avoid loop connections.
- .8 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. Transformers, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, cable trays.

3.4 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 Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

- .4 Disconnect ground fault indicator during tests.

3.5 CLEANING

- .1 Cleaning: clean in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Waste Management: in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 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 hangers and supports 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 with manufacturer's written instructions and 26 05 00 - Common Work Results for Electrical.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Manage waste in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted.

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 Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Secure equipment to solid masonry, tile, and plaster surfaces with nylon shields.

- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables to building construction or support system using straps.
 - .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 Provide metal brackets, frames, hangers, clamps, and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .11 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 26 05 00 – Common Work Results for Electrical.
- .2 Waste Management: in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, 24th Edition.

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, specifications and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions and 26 05 00 - Common Work Results for Electrical.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Manage waste in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 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 turned edge covers.

Part 3 Execution

3.1 JUNCTION AND 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.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating supply circuit or as indicated.

3.3 CLEANING

- .1 Cleaning: clean in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Waste Management: in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, 24th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions and 26 05 00 - Common Work Results for Electrical.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Manage waste in accordance with Section 26 05 00 – Common Work Results for Electrical.

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 CONDUIT BOXES

- .1 Cast FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.3 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.

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.

3.2 CLEANING

- .1 Cleaning: clean in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Waste Management: in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18.2-2006 (R2016), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
 - .2 CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 83-M1985 (R2017), Electrical Metallic Tubing.
 - .4 CSA C22.2 No. 211.2-06 (R2011), Rigid PVC (Unplasticized) Conduit.
 - .5 CAN/CSA C22.2 No. 227.3-15, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions and 26 05 00 - Common Work Results for Electrical.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Manage waste in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, steel.

2.2 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller.
- .2 Two-hole steel straps for conduits larger than 50 mm.
- .3 Beam clamps to secure conduits to exposed steel work.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 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.

2.4 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 and in mechanical and electrical service rooms.
- .3 Surface mount conduits except where indicated on drawings.
- .4 Use electrical metallic tubing (EMT) except in cast concrete.
- .5 Use rigid PVC conduit in wet or humid environments.
- .6 Use flexible metal conduit for connection to motors in dry areas.
- .7 Install conduit sealing fittings in hazardous areas.
 - .1 Fill with compound.
- .8 Minimum conduit size for power circuits: 19 mm, NPS 3/4.
- .9 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 19 mm diameter.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .14 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 CLEANING

- .1 Cleaning: clean in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Waste Management: in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Manage waste in accordance with Section 26 05 00 – Common Work Results for Electrical.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5
- .2 Moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 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.
- .5 Circuit breakers with interchangeable trips as indicated.
- .6 Circuit breakers to be 100% rated for amperage shown on drawings or increased in size to suit if 80% rated. Trip setting to match setting shown on drawings.
- .7 Circuit breakers to have minimum 18kA symmetrical rms interrupting capacity rating and to match rating of equipment installed in.

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 On-off locking device.
 - .2 Handle mechanism.

2.4 ENCLOSURE

- .1 Suitable for installation in existing Eaton/Cutler-Hammer MCC-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 installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

3.3 CLEANING

- .1 Cleaning: clean in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Waste Management: in accordance with Section 26 05 00 – Common Work Results for Electrical.

END OF SECTION