

PROJECT: CCIW-010-Ji119

# L757 VOLATILE CHEMICAL STORAGE FIRE SUPPRESSION

WSP PROJECT: 131-15735-00

ISSUED FOR TENDER

APRIL 15, 2016





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Electrical - Neil Ali, P.Eng. M.Sc.



Mechanical - Vince Janzen, P.Eng.



Fire Protection - William Kuffner, M.A.Sc., P.Eng. PMP



PART 1      GENERAL

1.1      RELATED REQUIREMENTS

- .1      Section 01 11 01 – General Instructions for Minor Works.

1.2      WORK COVERED BY CONTRACT DOCUMENTS

- .1      Work of this Contract comprises general construction of chemical storage rooms L757, L757A and W203 located at 876 Lakeshore Rd, Burlington, ON.

1.3      CONTRACT METHOD

- .1      Construct Work under lump sum contract.

1.4      WORK SEQUENCE

- .1      Construct Work in stages to accommodate tenants continued use of premises during construction.
- .2      Co-ordinate Progress Schedule and co-ordinate with occupancy during construction.
- .3      Maintain fire access/control.

1.5      CONTRACTOR USE OF PREMISES

- .1      Limit use of premises for Work, for storage, and for access, to allow:
  - .1      Owner occupancy.
- .2      Co-ordinate use of premises under direction of Departmental Representative.
- .3      Contractor personnel, including subcontractors, shall sign in at security desk each day prior to start of shift.
- .4      Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .5      Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .6      Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.
- .7      At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.6      OCCUPANCY

- .1      Premises will be occupied during entire construction period for execution of normal operations.

- .2 Co-operate with Departmental Representative in scheduling operations to minimize conflict and to facilitate tenant usage.

1.7 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building operations, occupants and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.
- .2 Use only elevators existing in building for moving workers and material.
  - .1 Protect walls of passenger elevators, to approval of Departmental Representative prior to use.
  - .2 Accept liability for damage, safety of equipment and overloading of existing equipment.

1.8 EXISTING SERVICES

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours' notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from 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.
- .6 Provide temporary services when directed by Departmental Representative to maintain critical building and tenant systems.
- .8 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .10 Record locations of maintained, re-routed and abandoned service lines.

1.9 DOCUMENTS REQUIRED

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

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not used.



PART 1 GENERAL

1.1 MINIMUM STANDARD

- .1 Execute work to meet or exceed:
  - .1 National Building Code of Canada 2010, National Fire Code of Canada 2010, Ontario Building Code 2012 and any other code of provincial or local application, including all amendments up to project date, provided that in any case of conflict or discrepancy, the more stringent requirements shall apply.
  - .2 Rules and regulations of authorities having jurisdiction.
  - .3 Observe and enforce construction safety measures required by National Building Code 2010, Part 8 Safety Measures at Construction and Demolition Sites, Occupational Health and Safety Act and Regulations for Construction Projects, Revised Statutes of Ontario 1990, Chapter O.1 as amended, O. Reg. 213/91 as amended by O. Reg. 631/94, O. Reg. 143/99, O. Reg. 571/99, O. Reg. 145/00, O. Reg. 527/00, R.R.O. 1990, Reg. 834, O. Reg. 278/05 (Asbestos), Workplace Safety and Insurance Board and municipal statutes and authorities.
  - .4 Environmental Protection Act, O. Reg. 102/94 and O. Reg. 103/94.

1.2 SAFETY PLANS FOR WORK ORDERS

- .1 Provide a Fire Safety Plan, specific to the work location, in accordance with NBC 2010, Division B, Part 8, and NFC 2010, Division B, Part 2, subsection 2.8.2 prior to commencement of work. The plan shall be coordinated with, and integrated into, the existing Emergency Procedures and Evacuation Plan in place at the site. Departmental Representative will provide Emergency Procedures and Evacuation Plan. Deliver two copies of the Fire Safety Plan to the Departmental Representative not later than 14 days before commencing work.
- .2 On award of Contract, submit to Departmental Representative, two copies of Contractor's and sub-contractors':
  - .1 Site Specific Safety Plan.
  - .2 Safety Communication Plan.
  - .3 Emergency Procedures Plan.
  - .4 WSIB - Workplace Safety and Insurance Board Experience report.

1.3 TAXES

- .1 Pay applicable Federal, Provincial and Municipal taxes.

1.4 FEES, PERMITS, CERTIFICATES AND LETTERS

- .1 Provide authorities having jurisdiction with information requested.
- .2 Pay fees and obtain certificates, permits and letters required.
- .3 Furnish certificates, permits and letters when requested.

1.5 EXAMINATION

- .1 Examine existing conditions and determine conditions affecting work.

1.6 DOCUMENTS

- .1 Keep one copy of contract documents and shop drawings on the site.

1.7 ELECTRONIC SUBMITTALS

- .1 Submit in electronic format as pdf files. Forward pdf, NMS Edit Professional spp, MS Word, MS Excel, MS Project and AutoCAD dwg files; on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

1.8 CONTRACTOR'S AS-BUILT DRAWINGS AND SPECIFICATIONS

- .1 As work progresses, neatly record significant deviations from the Contract drawings and specifications using fine, red marker on full size white prints and specifications. Make the same changes on the electronic files.
- .2 Neatly print lettering and numbers in size to match original. Lines may be drawn free-hand but shall be neat and accurate. Add at each title block note: "AS BUILT". Also circle on List of Drawings each title and number of drawing marked with "AS-BUILT" information. Circle on Table of Contents each specification section number and title of specification sections marked with "AS-BUILT" information.
- .3 Departmental Representative will provide one electronic set of drawings, schedules and specifications to contractor for as-built drawing and specification purposes.
  - .1 Drawings are in AutoCAD.
  - .2 Specifications are in NMS Edit Professional or Word.
  - .3 Amendments and addenda are in MS Word.
- .4 Record following significant deviations:
  - .1 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.
  - .2 Field changes of dimension.
  - .3 Other significant deviations which are concealed in construction and cannot be identified by visual inspection.
- .5 Turn one set, paper copy and electronic copy, of AS-BUILT drawings and specifications over to Departmental Representative on completion of work. Submit pdf files on USB compatible with PWGSC encryption requirements, through email or alternate electronic file sharing service such as ftp.
- .6 If project is completed without significant deviations from Contract drawings and specifications submit to Departmental Representative one set of drawings and specifications marked "AS-BUILT".

1.9 OPERATIONS AND MAINTENANCE DATA

- .1 On completion of project submit to Departmental Representative 3 copies of Operations and Maintenance Data assembled in three 255 x 295 mm vinyl-covered, 3-ring, loose-leaf binders with title sheet labelled "Operations Data and Maintenance Manual", project title, date and list of contents. Organize content into applicable sections between hard paper dividers with labelled tabs.
- .2 Include in each binder maintenance instructions for finished surfaces, warranties and guarantees in form approved by Departmental Representative and operations and maintenance data for equipment and systems with parts list, suppliers' names and addresses, hardware schedule, schematic diagrams for electrical hardware, complete set of final shop drawings (bound separately), names, addresses and phone numbers of sub-contractors and suppliers, list of materials with names of manufacturer and source of supply. Neatly type lists and rates. Use clear drawings, diagrams or manufacturer's literature.

1.10 SHOP DRAWINGS AND PRODUCT DATA SHEETS

- .1 Prior to submission check and certify as correct, shop drawings and product data sheets. Issue to Departmental Representative each submission at least 14 days before dates reviewed submission will be needed.
- .2 Where technical sections specify that shop drawings bear the stamp of a Registered Professional Engineer, the Engineer must be registered in the Province of Ontario.
- .3 Submit 1 electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .4 Submit 1 electronic copy 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.
- .5 The review of shop drawings by Departmental Representative is for sole purpose of ascertaining conformance with general concept. This review shall not mean that Departmental Representative 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 all requirements of construction and Contract Documents. 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 all sub-trades.
- .6 Submit 1 electronic of product data sheets for standard manufactured items. Indicate VOC's in g/l for adhesives, primers, sealants, paints, curing and sealing compounds, sealers, particleboard, plywood, preserved wood, and any other product that emits more than 25 g/l VOC during application, curing, initial off gassing or end use.
- .7 Responsibility for errors, omissions or deviations from requirements of Contract Documents is not relieved by Departmental Representative's review of submittals.

1.11 CONSTRUCTION PHOTOGRAPHS

- .1 Submit electronic copy of digital photography in jpg format, standard resolution.
- .2 Identification: name and number of project and date of exposure indicated.
- .3 Viewpoints and location of viewpoints determined by Departmental Representative.
- .4 Frequency: with monthly progress draws (if required), before concealment and as directed by Departmental Representative.

1.12 DESIGN DATA, TEST REPORTS, CERTIFICATES, MANUFACTURER'S INSTRUCTIONS AND MANUFACTURER'S FIELD REPORTS

- .1 Prior to submission check and certify as correct each submission. Issue to Departmental Representative each submission at least 14 days before reviewed submission will be needed.
- .2 Submit electronic copies of each item requested.
- .3 Responsibility for errors, omissions or deviations from requirements of Contract Documents is not relieved by Departmental Representative's review of submittals.

1.13 SAMPLES

- .1 Submit duplicate samples.
- .2 Identify manufacturer's name, product and colour.
- .3 Installed work shall match reviewed sample.

1.14 ADDITIONAL DRAWINGS

- .1 Departmental Representative may furnish additional drawings to clarify work.
- .2 Such drawings become part of Contract Documents.

1.15 PROTECTION

- .1 Protect existing work from damage.
- .2 Replace damaged existing work with material and finish to match original.
- .3 Cover furniture and fittings prior to commencing work.
- .4 Remove coverings and clean following completion of work.

1.16 EXISTING SERVICES

- .1 Maintain existing services in occupied areas.
- .2 Use designated existing sanitary facilities.

- .3 Use existing water and electrical services at no cost.
- .4 Use elevator designated, protect walls from damage.

1.17 TEMPORARY FACILITIES AND SERVICES

- .1 Provide and maintain temporary facilities and services required to carry out work.
- .2 Remove temporary facilities and services on completion of work.

1.18 METRIC SIZED MATERIALS

- .1 SI metric units of measurement are used exclusively on the drawings and in the specifications for this project.
- .2 The Contractor is required to provide metric products in the sizes called for in the Contract Documents except where a valid claim can be made that a particular product is not available on the Canadian market.
- .3 Claims for exemptions from use of metric sized products shall be in writing and fully substantiated with supportive documentation. Promptly submit application to Departmental Representative for consideration and ruling. Non-metric sized products may not be used unless Contractor's application has been approved in writing by the Departmental Representative.
- .4 Difficulties caused by the Contractor's lack of planning and effort to obtain modular metric sized products which are available on the Canadian market will not be considered sufficient reasons for claiming that they cannot be provided.
- .5 Claims for additional costs due to provision of specified modular metric sized products will not be considered.

1.19 MATERIAL AND EQUIPMENT

- .1 Use new products unless otherwise specified.
- .2 Deliver and store material and equipment to manufacturer's instructions with manufacturer's labels and seals intact.
- .3 When material or equipment is specified by standard or performance specifications, upon request of Departmental Representative, obtain from manufacturer an independent testing laboratory report, stating that material or equipment meets or exceeds specified requirements.

1.20 CONCEALMENT

- .1 Conceal pipes, ducts, conduits and wiring in finished areas.

1.21 CUTTING AND REMEDIAL WORK

- .1 Co-ordinate work to keep cutting and remedial work to a minimum.
- .2 Execute cutting and remedial work required. Notify Departmental Representative before cutting, boring or sleeving structural members.
- .3 Prior to cutting or drilling horizontal or vertical surfaces including concrete, concrete block or other structural substrate, determine location of reinforcing, service lines, pipes, conduits or other items by x-ray, ground penetrating radar or other appropriate method. Submit findings to Departmental Representative prior to cutting or drilling.
- .4 Use specialists in affected material to execute cutting and remedial work.
- .5 Match work to adjoining construction and finishes.
- .6 Fit components tight to adjoining surfaces.
- .7 Make good surfaces exposed or disturbed by work with material and finish to match existing adjoining surfaces.
- .8 After patching wall, ceiling or other painted surfaces, paint the entire wall or area up to the next change in plane or direction as directed by Departmental Representative.

1.22 FASTENINGS

- .1 Provide fastenings of type, size and spacing required to assure secure anchorage.
- .2 Obtain Departmental Representative's permission before using explosive actuated fasteners.

1.23 COORDINATION AND COOPERATION

- .1 Building will be occupied during execution of work.
- .2 Execute work with minimum disturbance to occupants and normal use of building.

1.24 ALTERATIONS TO EXISTING BUILDING

- .1 Remove and recycle or dispose of material removed as part of this project unless indicated otherwise by Departmental Representative.
- .2 Provide new openings required in existing construction.
- .3 Block in openings where items removed with material and finish to match existing adjoining construction.

1.25 TEMPORARY SIGNS

- .1 Public Works and Government Services Canada and Contractor's signs of 1200 x 2400 x 20 mm thick, medium density overlaid plywood. Apply to frames with non-ferrous or hot dip galvanized fasteners. Sand and seal plywood edges.
- .2 Paint wood surfaces with 1 coat primer to CGSB 1-GP-55M and 2 coats exterior enamel to

CAN/CGSB-1.59-M89, paints Ecologo certified. Frames black and signs white colour.

- .3 Install overlay in accordance with manufacturer's instructions. Overlay and instructions supplied by Departmental Representative.
- .4 Contractor's sign to match size, style and format of Departmental Representative sign. All information in both official languages. Do not include Federal symbols and logo. Submit drawing of Contractor's sign for Departmental Representative's review prior to erection.
- .5 Maintain signs for duration of project.
- .6 Dismantle and dispose of signs and frames on completion of work.

#### 1.26 INSPECTION AND TESTING

- .1 Were tests reveal work is not in conformance to contract documents, pay for testing/inspection required on corrected work as directed by Departmental Representative.

#### 1.27 TRAINING

- .1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel two (2) weeks prior to date of final inspection and before transfer of operational responsibility.
- .2 Owner will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.
- .3 Manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel.
  - .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.
  - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
  - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
- .4 Provide written report that demonstration and instructions have been completed. Obtain acceptance of satisfactory training from Owner's representative on the report.

#### 1.28 COST BREAKDOWN

- .1 Within 48 hours of notification of acceptance of bid furnish a cost breakdown by Section aggregating contract amount.
- .2 Show separately cost of equipment purchased exempt from Ontario Retail Sales Tax under your Ontario Sales Tax licence number.
- .3 Within 48 hours of acceptance of bid submit a list of subcontractors.

#### 1.29 SCHEDULING

- .1 On award of contract submit bar chart construction schedule for work, indicating anticipated progress stages within time of completion. When schedule has been reviewed by the Departmental Representative take necessary measures to complete work within scheduled time. Do not change schedule without notifying Departmental Representative.

- .2 Carry out work Monday to Friday from 07:30 to 18:30 hours. All work outside of these hours will have to be coordinated with Departmental Representative.
- .3 Carry out noise generating work Monday to Friday from 18:30 to 07:30 hours and on Saturdays, Sundays and statutory holidays.
- .4 Prior to performing any hot work, follow procedures required by Departmental Representative and obtain all required permits and approvals. Hot work shall be permitted between 07:30 and 16:30; work outside of these hours will have to be coordinated with Departmental Representative.

### 1.30 CLEANING

- .1 Maintain project free of accumulated waste and rubbish.
- .2 Final cleaning:
  - .1 Remove temporary protection.
  - .2 Remove dust, dirt and foreign matter from surfaces. HEPA vacuum interior surfaces.
  - .3 Polish new metal surfaces.

### 1.31 CONSTRUCTION & DEMOLITION WASTE

- .1 Carefully deconstruct and source separate materials/equipment and divert from D&C waste destined for landfill to maximum extent possible. Reuse, recycle or sell material off site for reuse except where indicated otherwise. On site sales are not permitted.
- .2 For construction and demolition projects source separate waste and maintain waste audits in accordance with the Environmental Protection Act, Ontario Regulation 102/94 and Ontario Regulation 103/94.
  - .1 Provide facilities for collection, handling and storage of source separated wastes.
  - .2 Source separate the following waste:
    - .1 Brick and portland cement concrete.
    - .2 Corrugated cardboard.
    - .3 Wood, not including painted or treated wood or laminated wood.
    - .4 Gypsum board, unpainted.
    - .5 Steel.
- .3 Submit a waste reduction workplan indicating the materials and quantities of material that will be recycled and diverted from landfill.
  - .1 Indicate how material being removed from the site will be reused or recycled.
- .4 Submit proof that all waste is being disposed of at a licensed land fill site or waste transfer site. A copy of the disposal/waste transfer site's license and a letter verifying that said landfill site will accept the waste must be supplied to Departmental Representative prior to removal of waste from the demolition site.

### 1.32 ASBESTOS DISCOVERY

- .1 If during alteration work existing asbestos material is discovered (e.g. fireproofing, acoustic or thermal insulation, pipe or tank covering) stop work and immediately notify Departmental Representative. Do not remove any existing material containing asbestos fibres.

1.33 DESIGNATED SUBSTANCES (ASBESTOS)

- .1 The project site has been surveyed for the presence of asbestos.
- .2 The list of designated substances present at the project site is to be made available.
- .3 Provide copies of this document to each prospective subcontractor prior to entering into a contract with them.

1.34 HALOCARBONS

- .1 Comply with Federal Halocarbon Regulations 2003 under the Canadian Environmental Protection Act 1999, EPAM and PWGSC Ontario Region Halocarbon Information Sheet dated March 2010.

1.35 SPECIAL PROTECTION AND PRECAUTIONS

- .1 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and the provision of material safety data sheets.

1.36 IAQ – INDOOR AIR QUALITY

- .1 Comply with CSA Z204-94(R1999), Guideline for Managing Indoor Air Quality in Office Buildings.

1.37 POLLUTION CONTROL

- .1 Spills of deleterious substances:
  - .1 Immediately contain, limit spread and clean up in accordance with provincial regulatory requirements.
  - .2 Report immediately to Ontario Spills Action Centre: 1-800-268-6060.
  - .3 Further information on dangerous goods emergency cleanup and precautions including a list of companies performing this work can be obtained from the Transport Canada 24-hour number (613) 996-6666 collect.

1.38 COMMISSIONING

- .1 All equipment shall be properly tested and commissioned prior to training. Refer to applicable codes and standards, manufacturer requirements and applicable specification sections for commissioning requirements of equipment.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not used.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 11 01 – General Instructions for Minor Works.

1.2 REFERENCES

- .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 2005.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions for Minor Works.
- .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 Departmental Representative.
- .4 Submit copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 11 01 – General Instructions for Minor Works.
- .7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.
- .8 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.
- .9 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.

1.4 FILING OF NOTICE

- .1 File Notice of Project with Provincial authorities prior to beginning of Work.
- .2 Contractor shall be responsible and assume the Principal Contractor role for each work zone location and not the entire complex. Contractor shall provide a written acknowledgement of this responsibility with 3 weeks of contract award.
- .3 Work zone locations include:
  - .1 Rooms L757 , L757A and W203.
  - .2 Penthouse above rooms L757 and L757A.
- .4 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.

1.6 MEETINGS

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

1.7 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 and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.8 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 coordinator and follow procedures in accordance with Acts and Regulations of Province having jurisdiction and advise Departmental Representative verbally and in writing.

1.9 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
  - .1 Have site-related working experience specific to activities associated with contract.
  - .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.

1.10 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.

1.11 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.

1.12 POWDER ACTUATED DEVICES

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

1.13 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.

PART 1      GENERAL

1.1      DESCRIPTION

- .1      This section specifies the repair of the blockwork forming the interior walls, including repair of cracks, spalls, and other defects in the exposed block face, and the repair of all defective or deteriorated mortar filled joints.

1.2      STANDARDS AND REFERENCES

- .1      All work of this section is to be carried out in strict accordance with the requirements of all relevant sections of the latest edition of the Ontario Building Code and all relevant standards referenced therein.
- .2      All masonry work shall conform to the requirements detailed in:
  - .1      CAN/CSA-A82.1-M87 (R1992)
  - .2      CAN/CSA-A5-93 - Portland Cements
- .3      CAN/CSA-A8-93 - Masonry Cements

1.3      ENVIRONMENTAL CONDITIONS

- .1      Perform masonry work only when temperature is at or above 4°C.
- .2      During periods when work is interrupted, provide and maintain protection to prevent moisture from entering into the repair area. Protection shall consist of polyethylene sheets or tarpaulins, properly sealed and secured to prevent wind lift.

1.4      WARRANTY

- .1      Provide a written and signed warranty in the name of the Owner.
- .2      The warranty shall cover the installation of the masonry repair and associated work of this section as a result of faulty materials or workmanship for a period of two (2) years from the date of Substantial Performance of the work.

PART 2      PRODUCTS

2.1      MATERIAL

- .1      Materials shall be as specified or approved equivalent.
- .2      Aggregate: Clean, sharp and conforming to CSA A179-94.
- .3      Mixing Water: From municipal supply, clear and free from deleterious substances.
- .4      Portland Cement: Conforming to CAN/CSA A5-93, "Portland Cements".
- .5      Hydrated Lime: Conforming to CSA A179-94.
- .6      Masonry Cement: Conforming to CAN/CSA A8-93, "Masonry Cement".

- .7 Colouring Pigments: Pigments constituted of ground coloured natural aggregates, colour to match existing as approved by the Owner. Ratio of colouring agent/density of Portland cement shall not exceed 10%.
- .8 Mortar Mixes: To comply with the requirements of "Type N Mortar" with a compressive strength of 5.0 +/- 1.0 Mpa.
- .9 Sealant: "Dymeric" by Tremco or approved equivalent, colour to approval of Owner and generally similar to predominant material to which sealant is applied.

### PART 3 EXECUTION

#### 3.1 PREPARATORY WORK

- .1 Verify on the work all grades, lines, levels and dimensions shown, and report all discrepancies in levels or dimensions to the departmental representative before commencing work.

#### 3.2 MORTAR JOINT

- .1 Cut out defective mortar joints to their full width and to a minimum depth of either, a depth equal to the width of the joint or to 19 mm, whichever is greater, or additionally, as necessary to remove loose or deteriorated mortar. Joints in which the mortar is missing, cracked, crumbling, containing cracks between the mortar and the adjacent brick surface, or which are surface sealed with caulking material shall be deemed to be defective.
- .2 Rout out joints with one of the following:
  - .1 With a cold chisel, either manually or fixed to a compressed air hammer.
  - .2 With a circular saw, diamond blade of 100 mm diameter, for horizontal joints only. Rake only 1/3 of joint with saw and remaining with a chisel.
- .3 Add colouring agents to the mortar mix to match the colour of the existing mortar.
- .4 Mix with a clean mechanical mixer, devoid of dried mortar and other contaminants.
- .5 Mix at a rate of 3.3 litres of water to each 25 kg bag of mortar mix, or as otherwise specified by the manufacturer.
- .6 Let the mortar rest for 45 minutes. Add approximately 0.5 litres of water to the prehydrated mortar in order to give it the desired plasticity (consistency slightly higher than a laying mortar). Do not alter mortar in any way other than by adding mixing water.
- .7 Mixing time shall not be less than 3 minutes and shall not exceed 5 minutes. For mortar which is coloured on site, mixing shall last from 8 to 10 minutes.
- .8 Mortar shall be used within 2-1/2 hours after mixing when the surrounding temperature is below 25°C, and within 1-1/2 hours after mixing when the surrounding temperature is at or above 25°C.
- .9 Clean dust and residues from exposed joints with a water jet and maintain some humidity in the existing joints in order to prevent older mortar and masonry from absorbing water too quickly.
- .10 Using a joint filler tool lay a first layer of mortar in the joints so as to obtain a uniform depth of

+/-25 mm. After this layer has hardened, apply successive layers at 6 mm each until mortar reaches the surface of the masonry. Compact each layer to prevent the formation of air pockets and let each layer harden slightly before applying the next.

- .11 Tool mortar joints when "thumb-print" hard to match the profile of existing joints.



PART 1      GENERAL

1.1      REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .2 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S101-07, Standard Methods of for Fire Endurance Tests of Building Construction and Materials.
  - .2 CAN/ULC-S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
  - .3 CAN/ULC-S115-11, Standard Method of Fire Tests of Firestop Systems.

1.2      DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Continuity of Fire Separations: NBC 2010, Division B, Parts 3.1.8 and 3.1.9.1, 9.10.9):
  - .1 Wall, partition or floor assemblies required to be a fire separation shall be: constructed as a continuous element; have a fire resistance rating; have openings protected by a closure; and have penetrations sealed by a firestop.

1.3      SUBMITTALS

- .1 Provide submittals in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets.
- .3 Shop Drawings:
  - .1 Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation.
  - .2 Construction details should accurately reflect actual job conditions.
- .4 Quality assurance submittals: submit following in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

.2 Manufacturer's Field Reports: submit to manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
  - .3 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC markings.
- .2 Storage and Protection:
  - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Replace defective or damaged materials with new.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

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

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
  - .1 Ensure that substrates and surfaces are clean, dry and frost free.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.3 INSTALLATION

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

3.4 SEQUENCES OF OPERATION

- .1 Proceed with installation only when submittals have been reviewed by Departmental Representative.
- .2 Install floor fire stopping before interior partition erections.
- .3 Metal deck bonding: fire stopping to precede spray applied fireproofing to ensure required bonding.
- .4 Mechanical pipe insulation: certified fire stop system component.
  - .1 Ensure pipe insulation installation precedes fire stopping.

3.5                    FIELD QUALITY CONTROL

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

3.6                    CLEANING

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

3.7                    SCHEDULE

- .1            Fire stop and smoke seal at:
  - .1            Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
  - .2            Edge of floor slabs at curtain wall and precast concrete panels.
  - .3            Top of fire-resistance rated masonry and gypsum board partitions.
  - .4            Intersection of fire-resistance rated masonry and gypsum board partitions.
  - .5            Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
  - .6            Penetrations through fire-resistance rated floor slabs, ceilings and roofs.
  - .7            Openings and sleeves installed for future use through fire separations.
  - .8            Around mechanical and electrical assemblies penetrating fire separations.
  - .9            Rigid ducts: greater than 129 cm<sup>2</sup>: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

PART 1      GENERAL

1.1      REFERENCES

- .1 Architectural Painting Specifications Manual, Master Painters Institute (MPI), 2010.
- .2 Systems and Specifications Manual, SSPC Painting Manual, Volume Two, Society for Protective Coatings (SSPC).
- .3 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings) of the Environmental Protection Agency (EPA).
- .4 National Fire Code of Canada 2010 (NFC).

1.2      QUALITY ASSURANCE

- .1 Contractor shall have a minimum of five years proven satisfactory experience. When requested, provide a list of last three comparable jobs including, job name and location, specifying authority, and project manager.
- .2 Qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.
- .3 Conform to latest MPI requirements for interior painting work including preparation and priming.
- .4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) shall be in accordance with MPI Painting Specification Manual "Approved Product" listing and shall be from a single manufacturer for each system used.
- .5 Other paint materials such as linseed oil, shellac, turpentine, etc. shall be the highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and shall be compatible with other coating materials as required.
- .6 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Departmental Representative.
- .7 Standard of Acceptance:
  - .1 Walls: No defects visible from a distance of 1000 mm at 90° to surface.
  - .2 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.3      ENVIRONMENTAL PERFORMANCE REQUIREMENTS

- .1 Provide paint products meeting MPI "Environmentally Friendly" E2 ratings based on VOC (EPA Method 24) content levels.
- .2 Where indoor air quality (odour) is a problem, use only MPI listed materials having a minimum E2 rating.

#### 1.4 INSPECTION REQUIREMENTS

- .1 Interior painting and decorating work shall be inspected by a Paint Inspection Agency (inspector) acceptable to the specifying authority and local Painting Contractor's Association. Painting contractor shall notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Finish Schedule.
- .2 Interior surfaces requiring painting shall be inspected by Paint Inspection Agency who shall notify Departmental Representative and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.
- .3 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Departmental Representative.

#### 1.5 SCHEDULING OF WORK

- .1 Submit work schedule for various stages of painting to Departmental Representative for approval. Submit schedule minimum of 48 hours in advance of proposed operations.
- .2 Obtain written authorization from Departmental Representative for any changes in work schedule.
- .3 Schedule painting operations to prevent disruption of occupants in and about the building.

#### 1.6 SUBMITTALS

- .1 Submit product data and manufacturer's installation/application instructions for each paint and coating product to be used in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Submit WHMIS MSDS.- Material Safety Data Sheets in accordance with Section 01 11 01 – General Instructions Minor Works.
- .3 Upon completion, submit records of products used. List products in relation to finish system and include the following:
  - .1 Product name, type and use.
  - .2 Manufacturer's product number.
  - .3 Colour numbers.
  - .4 MPI Environmentally Friendly classification system rating.
  - .5 Manufacturer's Material Safety Data Sheets (MSDS).

#### 1.7 SAMPLES

- .1 Submit full range colour sample chips in accordance with Section 01 11 01 – General Instructions Minor Works. Indicate where colour availability is restricted.
- .2 Submit duplicate 200 x 300 mm sample panels of each paint and special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on the following substrate materials:

- .1 3 mm plate steel for finishes over metal surfaces.
  - .2 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
  - .3 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
- .3 When approved, sample panels shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

#### 1.8 QUALITY CONTROL

- .1 When requested by Departmental Representative, prepare and paint designated surface, area, room or item (in each colour scheme) to requirements specified herein, with specified paint or coating showing selected colours, gloss/sheen, textures and workmanship to MPI Painting Specification Manual standards for review and approval. When approved, surface, area, room and/or items shall become acceptable standard of finish quality and workmanship for similar on-site work.

#### 1.9 DELIVERY, HANDLING AND STORAGE

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Labels shall clearly indicate:
  - .1 Manufacturer's name and address.
  - .2 Type of paint or coating.
  - .3 Compliance with applicable standard.
  - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Provide and maintain dry, temperature controlled, secure storage.
- .5 Observe manufacturer's recommendations for storage and handling.
- .6 Store materials and supplies away from heat generating devices.
- .7 Store materials and equipment in a well ventilated area with temperature range 7°C to 30°C.
- .8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Departmental Representative. After completion of operations, return areas to clean condition to approval of Departmental Representative.
- .10 Remove paint materials from storage only in quantities required for same day use.
- .11 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
- .12 Fire Safety Requirements:
  - .1 Provide one Type ABC fire extinguisher adjacent to storage area.
  - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

#### 1.10 SITE REQUIREMENTS

- .1 Heating, Ventilation and Lighting:
  - .1 Ventilate enclosed spaces.
  - .2 Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10°C for 24 hours before, during and after paint application until paint has cured sufficiently.
  - .3 Where required, provide continuous ventilation for seven days after completion of application of paint.
  - .4 Coordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
  - .5 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
  - .6 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by General Contractor.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
  - .1 Unless specifically pre-approved by the specifying body, Paint Inspection Agency and the applied product manufacturer, perform no painting work when:
    - .1 Ambient air and substrate temperatures are below 10°C.
    - .2 Substrate temperature is over 32°C unless paint is specifically formulated for application at high temperatures.
    - .3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.
    - .4 The relative humidity is above 85% or when the dew point is less than 3°C variance between the air/surface temperature.
    - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
  - .2 Perform no painting work when the maximum moisture content of the substrate exceeds:
    - .1 12% for concrete and masonry (clay and concrete brick/block).
    - .2 12% for plaster and gypsum board.
  - .3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".
  - .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
  - .1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
  - .2 Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.
  - .3 Apply paint only when previous coat of paint is dry or adequately cured.
- .4 Additional Interior Application Requirements:
  - .1 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
  - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

PART 2      PRODUCTS

2.1      MATERIALS

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Paint materials for paint systems shall be products of a single manufacturer.
- .3 Only qualified products with E2 or E3 "Environmentally Friendly" rating are acceptable for use on this project.
- .4 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, shall:
  - .1 be water-based.
  - .2 be non-flammable.
  - .3 be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
  - .4 be manufactured without compounds which contribute to smog in the lower atmosphere.
  - .5 do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.
- .5 Water-borne surface coatings must be manufactured and transported in a manner that steps of process, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).
- .6 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .7 Water-borne surface coatings and recycled water-borne surface coatings must have a flash point of 61.0°C or greater.
- .8 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
  - .1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 1] mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
  - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
- .9 Water-borne paints and stains, recycled water-borne surface coatings and water borne varnishes must meet a minimum "Environmentally Friendly" E2 rating.
- .10 The following must be performed on each batch of consolidated post-consumer material before surface coating is reformulated and canned. These tests must be performed at a laboratory or facility which has been accredited by the Standards Council of Canada.
  - .1 Lead, cadmium and chromium are to be determined using ICP-AES (Inductively Coupled Plasma - Atomic Emission Spectroscopy) technique no. 6010 as defined in EPA SW-846.
  - .2 Mercury is to be determined by Cold Vapour Atomic Absorption Spectroscopy using Technique no. 7471 as defined in EPA SW-846.
  - .3 Organochlorines and PCBs are to be determined by Gas Chromatography using Technique no. 8081 as defined in EPA SW-846.

2.2 COLOURS

- .1 Submit proposed Colour Schedule to Departmental Representative for approval.
- .2 Colour schedule will be based upon the selection of five base colours and three accent colours. No more than eight colours will be selected for the entire project and no more than three colours will be selected in each area.
- .3 Selection of colours will be from manufacturers full range of colours.
- .4 Where specific products are available in a restricted range of colours, selection will be based on the limited range.
- .5 Second coat in a three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Departmental Representative's written permission.
- .2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.
- .3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- .4 Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Departmental Representative.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Level Category	Units @ 60°	Units @ 85°
G1 – matte finish	0 to 5	Max. 10
G2 – velvet finish	0 to 10	10 to 35
G3 – eggshell finish	10 to 25	10 to 35
G4 – satin finish	20 to 35	Min. 35
G5 – semi-gloss finish	35 to 70	
G6 – gloss finish	70 to 85	
G7 – high finish	> 85	

- .2 Gloss level ratings of painted surfaces shall be as specified herein.

2.5            INTERIOR PAINTING SYSTEMS

- .1     Concrete Vertical Surfaces:
  - .1        INT 3.1A Latex G5 finish (over sealer).
  
- .2     Concrete Masonry Units: smooth and split face block and brick
  - .1        INT 4.2A Latex G5 finish.
  
- .3     Galvanized Metal: doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etc.
  - .1        INT 5.3A Latex G5 finish.
  
- .4     Plaster and Gypsum Board: gypsum wallboard, drywall, "sheet rock type material", etc., and textured finishes
  - .1        INT 9.2A Latex G5 finish (over latex sealer).

PART 3        EXECUTION

3.1            GENERAL

- .1     Perform preparation and operations for interior painting in accordance with MPI Painting Specifications Manual except where specified otherwise.
  
- .2     Apply paint materials in accordance with paint manufacturer's written application instructions.

3.2            EXISTING CONDITIONS

- .1     Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
  
- .2     Conduct moisture testing of surfaces to be painted using a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to Departmental Representative. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
  
- .3     Maximum moisture content as follows:
  - .1        Stucco, Plaster and Gypsum Board: 12%.
  - .2        Concrete: 12%.
  - .3        Clay and Concrete Block/Brick: 12%.

3.3            PROTECTION

- .1     Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Departmental Representative.
  
- .2     Protect items that are permanently attached such as Fire Labels on doors and frames.
  
- .3     Protect factory finished products and equipment.
  
- .4     Protect building occupants in and about the building.
  
- .5     Removal of electrical cover plates, light fixtures, surface hardware on doors, bath accessories

and other surface mounted equipment, fittings and fastenings shall be done prior to undertaking any painting operations by General Contractor. Items shall be securely stored and re-installed after painting is completed by General Contractor.

- .6 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
- .7 As painting operations progress, place "WET PAINT" signs in occupied areas to approval of Departmental Representative.

### 3.4 CLEANING AND PREPARATION

- .1 Clean and prepare surfaces in accordance with MPI Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
  - .1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
  - .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
  - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
  - .4 Allow surfaces to drain completely and allow to dry thoroughly.
  - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
  - .6 Use trigger operated spray nozzles for water hoses.
  - .7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean up water-based paints.
- .2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .3 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .4 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, blowing with clean dry compressed air, or vacuum cleaning.
- .5 Touch up of shop primers with primer as specified in applicable section. Major touch-up including cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas, shall be by supplier of fabricated material.
- .6 Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

### 3.5 APPLICATION

- .1 Apply paint by brush or roller. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
  - .1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.

- .2 Work paint into cracks, crevices and corners.
- .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
- .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple unless approved by Departmental Representative.
- .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Departmental Representative.
- .4 Apply coats of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .5 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .6 Sand and dust between coats to remove visible defects.
- .7 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.
- .8 Finish inside of cupboards and cabinets as specified for outside surfaces.
- .9 Finish closets and alcoves as specified for adjoining rooms.
- .10 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

### 3.6 MECHANICAL/ ELECTRICAL EQUIPMENT

- .1 Unless otherwise specified, paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.
- .2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.
- .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .8 Paint fire protection piping red.
- .9 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .10 Paint natural gas piping yellow.

- .11 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .12 Do not paint interior transformers and substation equipment.

### 3.7 FIELD QUALITY CONTROL

- .1 Field inspection of painting operations to be carried out by independent inspection firm as designated by Departmental Representative.
- .2 Advise Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .3 Co-operate with inspection firm and provide access to areas of work.

### 3.8 RESTORATION

- .1 Clean and re-install all hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

PART 1      GENERAL

1.1      SUBMITTALS

- .1      Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2      Product Data:
  - .1      Submit manufacturer's instructions, printed product literature and data sheets for plastic shelving and include product characteristics, performance criteria, physical size, finish and limitations.
- .3      Shop Drawings:
  - .1      Indicate shelving layouts, number of bays, number of shelves, number and size of drawers, bins, number of dividers, system of bracing and anchoring devices.
- .4      Samples:
  - .1      Submit representative sample bay of specified shelving showing finish colour and including accessories.

PART 2      PRODUCTS

2.1      DESIGN REQUIREMENTS

- .1      Design and construct plastic storage shelving to support uniform load of 544 kg per 1220 mm of span.
- .2      Design shelving to accommodate vertical adjustment of shelves in 50 mm increments and to permit easy assembly, expansion, dismantling and re-use of shelving component parts.
- .3      Each shelving unit to include a solid bottom shelf.
- .4      All shelving to have an edge lip to contain spill of chemicals.
- .5      Each shelving unit to have six (6) shelves.

2.2      MATERIALS

- .1      Longitudinal Beams & Posts:
  - .1      Pultrusions - continuous glass fibers and termoset resin composite with built in antimicrobial product protection.
- .2      End Beams, adjustable foot and Socket:
  - .1      Injection molded polyester thermoplastic resin with glass reinforcement.
- .3      Shelf Wedge Connector:
  - .1      Reinforced nylon
- .4      Mats, solid:
  - .1      Mineral reinforced polypropylene
- .5      Post Cap and Center Beam Cap:

- .1 High density polyethylene
- .6 "S" Hook Tab Hole Plug: Vinyl
- .7 Collor and "S" Hook: Type 304 Stainless steel
- .8 Shelving:
  - .1 Storage shelving:
    - .1 Provide 6 shelves per unit

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Do storage shelving work except where specified otherwise.
- .2 Install storage shelving in accordance with reviewed layout.
- .3 Brace, secure and anchor shelving units in place.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 01 – General Instructions Minor Works.

PART 1 GENERAL

1.1 REFERENCES

- .1 National Fire Prevention Association (NFPA)
  - .1 NFPA 13, 2013 Standard for the Installation of Sprinkler Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 11 01 – General Instructions for Minor Works.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Manufacturer's Catalog Data, including specific model, type, and size for:
  - .1 Pipe and fittings.
  - .2 Alarm valves.
  - .3 Valves, including gate, check, and globe.
  - .4 Water motor alarms.
  - .5 Sprinkler heads.
  - .6 Pipe hangers and supports.
  - .7 Pressure or flow switch.
  - .8 Fire department connections.
  - .9 Excess pressure pump.
  - .10 Mechanical couplings.
- .4 Manufacturers' Instructions:
  - .1 Provide manufacturer's installation instructions.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 11 01 – General Instructions for Minor Works in accordance with NFPA 13.
- .2 Manufacturer's Catalog Data, including specific model, type, and size for:
  - .1 Sprinklers.
- .3 Field Test Reports:
  - .1 Preliminary tests on piping system.
- .4 Records:
  - .1 As-built drawings of each system.
    - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
- .5 Operation and Maintenance Manuals:
  - .1 Provide Contractors Material and Test Certificate for aboveground piping and other documentation for incorporation into manual in accordance with NFPA 13.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Installer: company or person specializing in wet sprinkler systems.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Provide spare sprinklers and tools in accordance with NFPA 13.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
  - .1 Store materials indoors in dry location.
  - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 Replace existing sprinklers with new in room W203 as shown on drawings.
- .2 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.

2.2 SPRINKLER

- .1 General: to NFPA 13 and ULC listed for fire services.
- .2 Sprinkler Type:
  - .1 Type A: pendant chrome glass bulb type.
- .3 Provide nominal 1.2 cm orifice sprinkler.
  - .1 Release element of each head to be of ordinary temperature rating or higher as suitable for specific application.
  - .2 Provide corrosion-resistant sprinklers.

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PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with NFPA 13.

3.3 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
  - .1 Perform test to determine compliance with specified requirements in presence of Departmental Representative
  - .2 Test, inspect, and approve piping before covering or concealing.
  - .3 Tests:
    - .1 Hydrostatically test each system at normal system working pressure for a 2 hour period with no leakage or reduction in pressure.

3.4 CLEANING

- .1 Clean in accordance with Section 01 11 01 – General Instructions for Minor Works.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 11 01 – General Instructions for Minor Works.



PART 1      GENERAL

1.1      RELATED REQUIREMENTS

- .1      Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2      ACTION AND INFORMATIONAL SUBMITTALS

- .1      Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2      Product Data:
  - .1      Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3      Shop Drawings:
  - .1      Submit drawings stamped and signed by professional engineer registered or licensed in Province of 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 11 01 – General Instructions Minor Works.
- .2      Operation and Maintenance Data: submit operation and maintenance data for 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 weekly to reproducibles, revising reproducibles to show work as actually installed.
    - .3 Use different colour waterproof ink for each service.
    - .4 Make available for reference purposes and inspection.
  - .8 As-built drawings:
    - .1 Prior to start of Testing, Adjusting and Balancing for HVAC; finalize production of as-built drawings.
    - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
    - .3 Submit to 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 11 01 – General Instructions Minor Works.
- .2 Furnish spare parts as follows:
  - .1 One set of packing for each pump.
  - .2 One casing joint gasket for each size pump.
  - .3 One head gasket set for each heat exchanger.
  - .4 One glass for each gauge glass.
  - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 HVAC and R Equipment:

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.4            FIELD QUALITY CONTROL

- .1        Site Tests: conduct following tests in accordance with Section 01 11 01 – General Instructions Minor Works and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  
- .2        Manufacturer's Field Services:
  - .1        Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2        Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.5            CLEANING

- .1        Progress Cleaning: clean in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1        Leave Work area clean at end of each day.
  
- .2        Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 01 – General Instructions Minor Works.

3.6            PROTECTION

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

PART 1 GENERAL

1.1 SUMMARY

- .1 TAB is used throughout this Section to describe the process, methods and requirements of testing, adjusting and balancing for HVAC.
- .2 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.2 QUALIFICATIONS OF TAB PERSONNEL

- .1 Submit names of personnel to perform TAB to Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 TAB: performed in accordance with the requirements of standard under which TAB Firm's qualifications are approved:
  - .1 Associated Air Balance Council, (AABC) National Standards for Total System Balance, MN-1-2002.
  - .2 National Environmental Balancing Bureau (NEBB) TABES, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems-1998.
  - .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), HVAC TAB HVAC Systems - Testing, Adjusting and Balancing-2002.
- .4 Recommendations and suggested practices contained in the TAB Standard: mandatory.
- .5 Use TAB Standard provisions, including checklists, and report forms to satisfy Contract requirements.
- .6 Use TAB Standard for TAB, including qualifications for TAB Firm and Specialist and calibration of TAB instruments.
- .7 Where instrument manufacturer calibration recommendations are more stringent than those listed in TAB Standard, use manufacturer's recommendations.
- .8 TAB Standard quality assurance provisions such as performance guarantees form part of this contract.
  - .1 For systems or system components not covered in TAB Standard, use TAB procedures developed by TAB Specialist.
  - .2 Where new procedures, and requirements, are applicable to Contract requirements have been published or adopted by body responsible for TAB Standard used (AABC, NEBB, or TABB), requirements and recommendations contained in these procedures and requirements are mandatory.

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

- .2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

#### 1.4 EXCEPTIONS

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

#### 1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

#### 1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started.
- .2 Review specified standards and report to 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.

#### 1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Division 23.

#### 1.8 OPERATION OF SYSTEMS DURING TAB

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

#### 1.9 START OF TAB

- .1 Start TAB when building is essentially completed, including:
- .2 Installation of ceilings, doors, windows, other construction affecting TAB.
- .3 Application of weatherstripping, sealing, and caulking.
- .4 Pressure, leakage, other tests specified elsewhere Division 23.

- .5 Provisions for TAB installed and operational.
- .6 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
  - .1 Proper thermal overload protection in place for electrical equipment.
  - .2 Air systems:
    - .1 Filters in place, clean.
    - .2 Duct systems clean.
    - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
    - .4 Correct fan rotation.
    - .5 Fire, smoke, volume control dampers installed and open.
    - .6 Coil fins combed, clean.
    - .7 Access doors, installed, closed.
    - .8 Outlets installed, volume control dampers open.
  - .3 Liquid systems:
    - .1 Flushed, filled, vented.
    - .2 Correct pump rotation.
    - .3 Strainers in place, baskets clean.
    - .4 Isolating and balancing valves installed, open.
    - .5 Calibrated balancing valves installed, at factory settings.
    - .6 Chemical treatment systems complete, operational.

#### 1.10 APPLICATION TOLERANCES

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

#### 1.11 ACCURACY TOLERANCES

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

#### 1.12 INSTRUMENTS

- .1 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .2 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

#### 1.13 ACTION AND INFORMATIONAL SUBMITTALS

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

#### 1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of 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.

#### 1.15 TAB REPORT

- .1 Format in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:
  - .1 Project record drawings.
  - .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

#### 1.16 VERIFICATION

- .1 Reported results subject to verification by 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.

#### 1.17 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.

#### 1.18 COMPLETION OF TAB

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

#### 1.19 AIR SYSTEMS

- .1 Standard: TAB to most stringent of this section or TAB standards of AABC NEBB SMACNA ASHRAE.
- .2 Qualifications: personnel performing TAB current member in good standing of AABC or NEBB qualified to standards of AABC or NEBB.
- .3 Quality assurance: perform TAB under direction of supervisor qualified by to standards of AABC or NEBB.
- .4 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.

- .5 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.
  
- .6 Locations of systems measurements to include as appropriate: main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.20 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
  - .1 Qualifications of TAB personnel: as for air systems specified this section.
  - .2 Quality assurance: as for air systems specified this section.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not used.



PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 Definitions:
  - .1 For purposes of this section:
    - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
    - .2 "EXPOSED" - means "not concealed" as previously defined.
    - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
  - .2 TIAC Codes:
    - .1 CRD: Code Round Ductwork,
    - .2 CRF: Code Rectangular Finish.
- .2 Reference Standards:
  - .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
    - .1 ANSI/ASHRAE/IESNA 90.1-04, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - .2 ASTM International Inc.
    - .1 ASTM B 209M-07, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
    - .2 ASTM C 335-05ae1, Standard Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
    - .3 ASTM C 411-05, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - .4 ASTM C 449/C 449M-00, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
    - .5 ASTM C 547-07e1, Standard Specification for Mineral Fiber Pipe Insulation.
    - .6 ASTM C 553-02e1, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - .7 ASTM C 612-04e1, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - .8 ASTM C 795-03, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
    - .9 ASTM C 921-03a, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
  - .3 Canadian General Standards Board (CGSB)
    - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .4 Green Seal Environmental Standards (GSES)
    - .1 Standard GS-36-00, Commercial Adhesives.
  - .5 South Coast Air Quality Management District (SCAQMD), California State
    - .1 SCAQMD Rule 1168-A2005, Adhesive and Sealant Applications.
  - .6 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (2005).
  - .7 Underwriters Laboratories of Canada (ULC)
    - .1 CAN/ULC-S102-03, Method of Test for Surface Burning Characteristics of

Building Materials and Assemblies.

.2 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and datasheets for duct insulation, and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Description of equipment giving manufacturer's name, type, model, year and capacity.
    - .2 Details of operation, servicing and maintenance.
    - .3 Recommended spare parts list.
- .3 Samples:
  - .1 Submit for approval: complete assembly of each type of insulation system, insulation, coating, and adhesive proposed.
  - .2 Mount sample on 12 mm plywood board.
  - .3 Affix typewritten label beneath sample indicating service.
- .4 Manufacturers' Instructions:
  - .1 Provide manufacture's written duct insulation jointing recommendations. and special handling criteria, installation sequence, cleaning procedures.

### 1.4 QUALITY ASSURANCE

- .1 Qualifications:
  - .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards.

### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address and ULC markings.

## PART 2 PRODUCTS

### 2.1 FIRE AND SMOKE RATING

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

### 2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.

- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with without factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with factory applied vapour retarder jacket to CGSB 51-GP-52Ma (as scheduled in PART 3 of this section).
  - .1 Mineral fibre: to ASTM C 553.
  - .2 Jacket: to CGSB 51-GP-52Ma.
  - .3 Maximum "k" factor: to ASTM C 553.

### 2.3 JACKETS

- .1 Canvas:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: compatible with insulation.

### 2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
  - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
- .4 ULC Listed Canvas Jacket:
  - .1 220 gm/m<sup>2</sup> cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921 untreated.
- .5 Outdoor Vapour Retarder Mastic:
  - .1 Vinyl emulsion type acrylic, compatible with insulation.
  - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m<sup>2</sup>.
- .6 Tape: self-adhesive, aluminum, plain reinforced, 50 75 mm wide minimum.
- .7 Contact adhesive: quick-setting.
- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 12 mm wide, 0.5 mm thick stainless steel.
- .11 Facing: 25 mm galvanized steel hexagonal wire mesh stitched on one face both faces of insulation one face of insulation with expanded metal lath on other face.
- .12 Fasteners: 4 mm diameter pins with 35 mm diameter square clips, length to suit thickness of insulation.

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PART 3 EXECUTION

3.1 APPLICATION

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

3.2 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork systems complete, witness and certify.
- .2 Ensure surfaces are clean, dry, and free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturer's instructions and as indicated.
- .3 Use 2 layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
  - .1 Ensure hangers, and supports are outside vapour retarder jacket.
- .5 Hangers and supports in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
  - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: install at 300 mm on centre in horizontal and vertical directions, minimum 2 rows each side.

3.4 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses: conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	Yes	50
Round cold and dual temperature supply air ducts	C-2	Yes	50
Rectangular warm air ducts	C-1	No	25
Round warm air ducts	C-1	No	25
Supply, return and exhaust ducts exposed in space being served			None
Outside air ducts to mixing plenum	C-1	Yes	25
Mixing plenums	C-1	No	25
Exhaust duct between dampers and louvres	C-1	No	25
Rectangular ducts outside	C-1	Special	50
Round ducts outside	C-1	Special	50
Acoustically line ducts	None		

.2 Exposed round ducts 600 mm and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.1 Finishes: conform to following table:

	TIAC Code	
	Rectangular	Round
Indoor, Concealed	None	None
Indoor, exposed within mechanical room	CRF/1	CRD/2
Indoor, exposed elsewhere	CRF/2	CRD/3
Outdoor, exposed to precipitation	CRF/3	CRD/4
Outdoor, elsewhere	CRF/4	CRD/5

3.5 CLEANING

.1 Clean in accordance with Section 01 11 01 – General Instructions Minor Works.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.



## PART 1 GENERAL

### 1.1 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
  - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for air duct accessories and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate:
    - .1 Flexible connections.
    - .2 Duct access doors.
    - .3 Turning vanes.
    - .4 Instrument test ports.

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect air duct accessories from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## PART 2 PRODUCTS

### 2.1 GENERAL

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

### 2.2 ACCESS DOORS IN DUCTS

- .1 Non-Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated Ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.

- .3 Gaskets: neoprene.
- .4 Hardware:
  - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
  - .2 301 to 450 mm: four sash locks complete with safety chain.
  - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
  - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
  - .5 Hold open devices.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION

- .1 Access Doors and Viewing Panels:
  - .1 Size for servicing entry.
  - .2 Locations:
    - .1 Fire and smoke dampers.
    - .2 Control dampers.
    - .3 Devices requiring maintenance.
    - .4 Required by code.
    - .5 Reheat coils.
    - .6 Elsewhere as indicated.

#### 3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 01 – General Instructions Minor Works.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCES

- .1 National Fire Protection Association (NFPA)
  - .1 NFPA 90A-12, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .2 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S112-10, Standard Test Method of Fire Test of Fire Damper Assemblies.
  - .2 CAN/ULC-S112.2-07, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.
  - .3 ULC-S505-1974, Standard for Fusible Links for Fire Protection Service.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for fire and smoke dampers and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate the following:
    - .1 Fire dampers.
    - .2 Smoke dampers.
    - .3 Fire stop flaps.
    - .4 Operators.
    - .5 Fusible links.
    - .6 Design details of break-away joints.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire and smoke dampers for incorporation into manual.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
  - .1 Submit maintenance materials in accordance with Section 01 11 01 – General Instructions Minor Works.

- .2 Provide:
  - .1 6 fusible links of each type.

## 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect fire and smoke dampers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## PART 2 PRODUCTS

### 2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B, listed, and bear label of ULC, meet requirements of authorities having jurisdiction. Fire damper assemblies' fire tested in accordance with CAN/ULC-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
  - .1 Fire dampers: 1-1/2 hour fire rated unless otherwise indicated.
  - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; roll door type; guillotine type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.
- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.

- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION

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

#### 3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 01 – General Instructions Minor Works.



PART 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for diffusers, registers and grilles and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Indicate following:
    - .1 Capacity.
    - .2 Throw and terminal velocity.
    - .3 Noise criteria.
    - .4 Pressure drop.
    - .5 Neck velocity.

1.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect diffuser, registers and grilles from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Performance Requirements:
  - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

2.2 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
  - .1 Full perimeter gaskets.
  - .2 Plaster frames where set into plaster or gypsum board and as specified.
  - .3 Concealed fasteners.

- .3 Concealed manual volume control damper operators.

### 2.3 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type, products of one manufacturer.

### 2.4 DIFFUSERS

- .1 Steel, square cone type, fixed pattern, surface mounted finish: White.

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with flat head screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place, in gymnasium and similar game rooms.

### 3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 01 – General Instructions Minor Works.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements

1.2 SUMMARY

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

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 Submittals in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 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 in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .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 in accordance with Section 01 11 01 – General Instructions Minor Works.

1.7 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 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.
- .3 Correct deficiencies, re-test until satisfactory performance is obtained.
- .4 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .5 Load system with project software.
- .6 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 2months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

PART 3 EXECUTION

3.1 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commissioning to be done by manufacturer representative.
- .3 Debug system software.
- .4 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- .5 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
  - .1 General: consists of field tests of equipment just prior to installation.
  - .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
  - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
  - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
  - .5 Additional instruments to include:
    - .1 DP transmitters.
    - .2 VAV supply duct SP transmitters.
    - .3 DP switches used for dirty filter indication and fan status.
  - .6 Transmitters above 0.5% error will be rejected.
  - .7 DP switches to open and close within 2% of setpoint.

- .2 Completion Testing.
  - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
  - .2 Include following activities:
    - .1 Test and calibrate field hardware including stand-alone capability of each controller.
    - .2 Verify each A-to-D convertor.
    - .3 Test and calibrate each AI using calibrated digital instruments.
    - .4 Test each DI to ensure proper settings and switching contacts.
    - .5 Test each DO to ensure proper operation and lag time.
    - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
    - .7 Test operating software.
    - .8 Test application software and provide samples of logs and commands.
    - .9 Verify each CDL including energy optimization programs.
    - .10 Debug software.
    - .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
    - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on commissioning technician and Departmental Representative. This document will be used in final startup testing.
  - .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative and provide:
    - .1 2 technical personnel capable of re-calibrating field hardware and modifying software.
    - .2 Detailed daily schedule showing items to be tested and personnel available.
    - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
    - .4 Commissioning to commence during final startup testing.
    - .5 O&M personnel to assist in commissioning procedures as part of training.
    - .6 Commissioning to be supervised by qualified supervisory personnel.
    - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
    - .8 Operate systems as long as necessary to commission entire project.
    - .9 Monitor progress and keep detailed records of activities and results.
  - .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.
    - .1 Prior to beginning of 30day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
      - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
    - .2 Test to last at least 30consecutive 24 hour days.
    - .3 Tests to include:
      - .1 Demonstration of correct operation of monitored and controlled points.
      - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
    - .4 System will be accepted when:
      - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
      - .2 Requirements of Contract have been met.
    - .5 In event of failure to attain specified AEL during test period, extend test period

- on day-to-day basis until specified AEL is attained for test period.
- .6 Correct defects when they occur and before resuming tests.
- .5 Departmental Representative to verify reported results.

### 3.3 ADJUSTING

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

### 3.4 DEMONSTRATION

- .1 Demonstrate to Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs in accordance with Section 01 11 01 – General Instructions Minor Works.



PART 1      GENERAL

1.1      RELATED REQUIREMENTS

- .1      Section 09 91 23- Interior Painting.
- .2      Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .3      Section 25 05 54 - EMCS: Identification.

1.2      SUMMARY

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

1.3      REFERENCES

- .1      American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
  - .1      ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2      American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
  - .1      ANSI/IEEE 260.1-1993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3      American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
  - .1      ASHRAE STD 135-R2001, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4      Canadian Standards Association (CSA International).
  - .1      CAN/CSA-Z234.1-89(R1995), Canadian Metric Practice Guide.
- .5      Consumer Electronics Association (CEA).
  - .1      CEA-709.1-B-2002, Control Network Protocol Specification.
- .6      Department of Justice Canada (Jus).
  - .1      Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
  - .2      Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .7      Electrical and Electronic Manufacturers Association (EEMAC).
  - .1      EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .8      Health Canada/Workplace Hazardous Materials Information System (WHMIS).
  - .1      Material Safety Data Sheets (MSDS).
- .9      Transport Canada (TC).
  - .1      Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

#### 1.4 ACRONYMS AND ABBREVIATIONS

- .1 Acronyms used in EMCS:
  - .1 AEL - Average Effectiveness Level.
  - .2 AI - Analog Input.
  - .3 AIT - Agreement on International Trade.
  - .4 AO - Analog Output.
  - .5 BACnet - Building Automation and Control Network.
  - .6 BC(s) - Building Controller(s).
  - .7 BECC - Building Environmental Control Center.
  - .8 CAD - Computer Aided Design.
  - .9 CDL - Control Description Logic.
  - .10 CDS - Control Design Schematic.
  - .11 COSV - Change of State or Value.
  - .12 CPU - Central Processing Unit.
  - .13 DI - Digital Input.
  - .14 DO - Digital Output.
  - .15 DP - Differential Pressure.
  - .16 ECU - Equipment Control Unit.
  - .17 EMCS - Energy Monitoring and Control System.
  - .18 HVAC - Heating, Ventilation, Air Conditioning.
  - .19 IDE - Interface Device Equipment.
  - .20 I/O - Input/Output.
  - .21 ISA - Industry Standard Architecture.
  - .22 LAN - Local Area Network.
  - .23 LCU - Local Control Unit.
  - .24 MCU - Master Control Unit.
  - .25 NAFTA - North American Free Trade Agreement.
  - .26 NC - Normally Closed.
  - .27 NO - Normally Open.
  - .28 OS - Operating System.
  - .29 O&M - Operation and Maintenance.
  - .30 OWS - Operator Work Station.
  - .31 PC - Personal Computer.
  - .32 PCI - Peripheral Control Interface.
  - .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
  - .34 PID - Proportional, Integral and Derivative.
  - .35 RAM - Random Access Memory.
  - .36 SP - Static Pressure.
  - .37 ROM - Read Only Memory.
  - .38 TCU - Terminal Control Unit.
  - .39 USB - Universal Serial Bus.
  - .40 UPS - Uninterruptible Power Supply.
  - .41 VAV - Variable Air Volume.

#### 1.5 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 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 01 11 01 – General Instructions Minor Works and 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Co-ordinate submittal requirements and provide submittals required by Section 01 11 01 – General Instructions Minor Works.
- .3 Submit for review:
  - .1 Equipment list and systems manufacturers at time of tender within 48 h within 10 days after award of contract.
  - .2 List existing field control devices to be re-used included in tender, along with unit price.
- .4 Quality Control:
  - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
  - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
  - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.
  - .4 In lieu of such evidence, submit certificate from testing organization, approved by 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.
  - .8 Existing devices intended for re-use: submit test report.

#### 1.7 QUALITY ASSURANCE

- .1 Have local office within 50 km of project staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems,
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .5 Health and Safety:
  - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- .6 Sustainable Requirements:
  - .1 Construction requirements: in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .2 Verification: contractor's verification in accordance with Section 01 11 01 – General Instructions Minor Works.

#### 1.8 EXISTING- CONTROL COMPONENTS

- .1 Utilize existing control wiring and piping as indicated.
- .2 Re-use field control devices that are usable in their original configuration provided that they conform to applicable codes, standards specifications.
  - .1 Do not modify original design of existing devices without written permission from Departmental Representative.
  - .2 Provide for new, properly designed device where re-usability of components is uncertain.
- .3 Inspect and test existing devices intended for re-use within 30 days of award of contract, and prior to installation of new devices.
  - .1 Furnish test report within 40 days of award of contract listing each component to be re-used and indicating whether it is in good order or requires repair by Departmental Representative.
  - .2 Failure to produce test report will constitute acceptance of existing devices by contractor.
- .4 Non-functioning items:
  - .1 Provide with report specification sheets or written functional requirements to support findings.
  - .2 Departmental Representative will repair or replace existing items judged defective yet deemed necessary for EMCS.

- .5 Submit written request for permission to disconnect controls and to obtain equipment downtime before proceeding with Work.
- .6 Assume responsibility for controls to be incorporated into EMCS after written receipt of approval from Departmental Representative.
  - .1 Be responsible for items repaired or replaced by Departmental Representative.
  - .2 Be responsible for repair costs due to negligence or abuse of equipment.
  - .3 Responsibility for existing devices terminates upon final acceptance of EMCS applicable portions of EMCS as approved by Departmental Representative.
- .7 Remove existing controls not re-used or not required. Place in approved storage for disposition as directed.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT

- .1 Control Network Protocol and Data Communication Protocol: to CEA 709.1 ASHRAE STD 135.
- .2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials, and submit for approval.

### 2.2 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

## PART 3 EXECUTION

### 3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

### 3.2 PAINTING

- .1 Painting: in accordance with Section 09 91 23- Interior Painting, supplemented as follows:
  - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.
  - .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
  - .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
  - .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

3.3                    FIELD QUALITY CONTROL

- .1        Verification requirements in accordance with Section 01 11 01 – General Instructions Minor Works, include:
  - .1        Materials and resources.
  - .2        Storage and collection of recyclables.
  - .3        Construction waste management.
  - .4        Resource reuse.
  - .5        Recycled content.
  - .6        Local/regional materials.
  - .7        Certified Wood.
  - .8        Low-emitting materials.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 SUMMARY

- .1 Section Includes.
  - .1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).

1.3 DEFINITIONS

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

1.4 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
  - .1 Location of [local office.
  - .2 Description and location of installing and servicing technical staff.
  - .3 Location and qualifications of programming design and programming support staff.
  - .4 Names of sub-contractors and site-specific key personnel.
  - .5 Sketch of site-specific system architecture.
  - .6 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
  - .7 Descriptive brochures.
  - .8 Sample CDL and graphics (systems schematics).
  - .9 Response time for each type of command and report.
  - .10 Item-by-item statement of compliance.
  - .11 Proof of demonstrated ability of system to communicate utilizing Proprietary Communications Protocol.

1.5 DETAILED SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within [60] working days after award of contract and before start of installation and include following:
  - .1 Corrected and updated versions (hard copy only) of submissions made during preliminary review.
  - .2 Wiring diagrams.
  - .3 Interface wiring diagrams showing termination connections and signal levels [for equipment to be supplied by others].
  - .4 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
    - .1 Sensing element type and location.
    - .2 Transmitter type and range.
    - .3 Associated field wiring schematics, schedules and terminations.
    - .4 [Pneumatic schematics and schedules] .
    - .5 Complete Point Name Lists.

- .6 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
- .7 Software and programming details associated with each point.
- .8 Manufacturer's recommended installation instructions and procedures.
- .9 Input and output signal levels or pressures where new system ties into existing control equipment.
- .5 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section [25 01 11 - EMCS: Start-up, Verification and Commissioning].

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements.

1.2 SUMMARY

- .1 Section Includes.
  - .1 Requirements and procedures for identification of devices, sensors, wiring tubing, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
  - .1 CSA C22.1-15, The Canadian Electrical Code, Part I, 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.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 11 01 – General Instructions Minor Works supplemented and modified by requirements of this Section.

PART 2 PRODUCTS

2.1 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain.
- .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.

2.2            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.

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.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 25 05 01 - EMCS: General Requirements.

1.2 SUMMARY

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

1.3 REFERENCES

- .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
- .2 Canadian Standards Association (CSA International).
  - .1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.4 DEFINITIONS

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

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .3 Submit detailed inspection reports to Departmental Representative.
- .4 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.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.

- .6 Records and logs: in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .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.
  
- .7 Revise and submit to Departmental Representative in accordance with Section 01 11 01 – General Instructions Minor Works "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

#### 1.6 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 NOT USED

.1 Not Used.



PART 1      GENERAL

1.1      RELATED REQUIREMENTS

- .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: Shop Drawings, Product Data and Review Process.
- .4 Section 25 05 54 - EMCS: Identification.
- .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
- .6 Section 26 05 00 - Common Work Results for Electrical.
- .7 Section 26 27 26 - Wiring Devices.

1.2      SUMMARY

- .1 Section Includes:
  - .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, valve actuators, and low voltage current transformers.

1.3      REFERENCES

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C12.7-1993(R1999), Requirements for Watthour Meter Sockets.
  - .2 ANSI/IEEE C57.13-1993, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).
  - .1 ASTM B 148-97(03), Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
  - .1 NEMA 250-03, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
  - .1 AMCA Standard 500-D-98, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
  - .1 CSA-C22.1-15, Canadian Electrical Code, Part 1 (19th Edition), Safety Standard for Electrical Installations.

1.4      DEFINITIONS

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

1.5 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.

1.6 EXISTING CONDITIONS

- .1 Cutting and Patching: in accordance with Section 01 11 01 – General Instructions Minor Works supplemented 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 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

## 2.2 VOLATILE GAS SENSORS

- .1 Requirements:
  - .1 Explosion proof sensor/transmitter for solvents.
  - .2 Catalytic combustion type sensor.
  - .3 Operates from 24V.
  - .4 4-20 mA output plus dry 3 contacts.
  - .5 c/w transmitter, sensor and junction box
  - .6 Connect sensor back to BAS.
  - .7 Provide OC power supply.
  - .8 Commissioning by manufacturer's representative. See section 25 01 11.

## 2.3 WIRING

- .1 In accordance with Section 26 27 26 - Wiring Devices.
- .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 20AWG stranded twisted pair.
  - .2 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.
- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.
- .6 Electrical:
  - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .2 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .3 Refer to electrical control schematics included as part of control design schematics in Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation on drawings. 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.

### 3.2 IDENTIFICATION

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

### 3.3 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.

PART 1      GENERAL

1.1      SUMMARY

- .1 Section Includes:
  - .1 At minimum detailed narrative description of Sequence of Operation of each system including ramping periods and reset schedules.
  - .1 Control Description Logic (CDL) for each system.
  - .2 Input/output Point Summary Tables for each system.
  - .3 System Diagrams consisting of the following; EMCS System architectural diagram, Control Design Schematic for each system (as viewed on OWS), System flow diagram for each system with electrical ladder diagram for MCC starter interface.

1.2      REFERENCES

- .1 Public Works and Government Services Canada (PWGSC) / Real Property Branch / Architectural and Engineering Services.
  - .1 MD13800-[September 2000], Energy Management and Control Systems (EMCS) Design Manual. English: <ftp://ftp.pwgsc.gc.ca/rps/doccentre/mechanical/me214-e.pdf>

1.3      SEQUENCING

- .1 Present sequencing of operations for system[s], in accordance with MD13800 - Energy Management and Control Systems (EMCS) Design Manual.
- .2 Sequencing of operations for system[s] as follows:
  - .1 Use existing sequence of operation for Volatile Gas Sensor.

PART 2      PRODUCTS

2.1      NOT USED

- .1 Not Used.

PART 3      EXECUTION

3.1      NOT USED

- .1 Not Used.



PART 1      GENERAL

1.1      RELATED REQUIREMENTS

- .1      Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings

1.2      REFERENCES

- .1      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.
- .2      CSA Group
  - .1      CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2      CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .3      Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1      IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3      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 and include product characteristics, performance criteria, physical size, finish and limitations.
- .3      Submit for review single line electrical diagrams under plexiglass and locate.
  - .1      Electrical distribution system in main electrical room.
- .4      Shop drawings:
  - .1      Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2      Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
  - .3      Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4      Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .5      Submit 6 copies product data to Departmental Representative.
  - .6      If changes are required, notify Departmental Representative of these changes before they are made.
- .5      Certificates:
  - .1      Provide CSA certified equipment and material.
  - .2      Where CSA certified equipment and material is not available, submit such equipment and material to the Electrical Safety Authority for approval before delivery to site.
  - .3      Submit test results of installed electrical systems and instrumentation.

- .4 Permits and fees: in accordance with General Conditions of contract.
- .5 Submit certificate of acceptance from the Electrical Safety Authority upon completion of Work to Departmental Representative.
- .6 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

#### 1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
  - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
  - .2 Operating instructions to include following:
    - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
    - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
    - .3 Safety precautions.
    - .4 Procedures to be followed in event of equipment failure.
    - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
  - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
  - .4 Post instructions where directed.
  - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
  - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect materials and equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 11 01 – General Instructions Minor Works.

#### PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Factory assemble control panels and component assemblies.

2.3 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper conductors.

2.4 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered, 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.

2.5 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 1.5 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

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

#### 3.2 INSTALLATION

- .1 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.
- .4 Locate light switches on latch side of doors.
  - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

### 3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to 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 Data outlets: 300 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 in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Systems: communications.
  - .5 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Check resistance to ground before energizing.
- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 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            CLEANING

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

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 CSA International
  - .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
  - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 11 01 – General Instructions Minor Works.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and

packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 11 01 – General Instructions Minor Works.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper alloy sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper alloy sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for stranded copper conductors.
  - .2 Clamp for stranded copper conductors.
  - .4 Stud clamp bolts.
  - .5 Bolts for copper conductors.
  - .6 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable, as required to: CAN/CSA-C22.2 No.18.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connector's 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 Remove insulation carefully from ends of conductors and cables and:
  - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
  - .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
  - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2 NEMA.

### 3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 01 – General Instructions Minor Works.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.



PART 1      GENERAL

1.1      RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .3 Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- .4 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2      PRODUCT DATA

- .1 Provide product data in accordance with Section 01 11 01 – General Instructions Minor Works.

1.3      DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 11 01 – General Instructions Minor Works.

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 thermoplastic insulation type TWU, TWH, T90 Nylon rated at 600 V.

2.2      ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: anti short connectors.

2.3      CONTROL CABLES

- .1 Type: LVT: soft annealed copper conductors, quantity and sized as indicated:
  - .1 Insulation: thermoplastic.
  - .2 Sheath: thermoplastic jacket.

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 megger 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.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
  - .5 In surface and lighting fixture raceways in accordance with Section 26 05 33 - Raceway and Boxes for Electrical Systems.

3.4                    INSTALLATION OF ARMOURED CABLES

- .1            Group cables wherever possible on channels.

3.5                    INSTALLATION OF CONTROL CABLES

- .1            Install control cables in conduit.
- .2            Ground control cable shield.



PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE )
  - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .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.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 11 01 – General Instructions Minor Works.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as indicated to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated and as required.
- .3 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.
- .4 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.
- .5 Insulated grounding conductors: green, copper conductors, size as indicated.
- .6 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .7 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        Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .8        Install grounding resistance bank where required and as indicated.
- .9        Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10      Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .11      Ground secondary service pedestals.

3.3                    SYSTEM AND CIRCUIT GROUNDING

- .1        Install system and circuit grounding connections of secondary 208 V system.

3.4                    COMMUNICATION SYSTEMS

- .1        Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
  - .1        Telephones: make telephone grounding system in accordance with telephone company's requirements.

3.5                    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.

3.6            CLEANING

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

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 11 01 – General Instructions Minor Works.
- .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 01 11 01 – General Instructions Minor Works and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect hangers and supports from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 11 01 – General Instructions Minor Works.

PART 2 PRODUCTS

2.1 SUPPORT CHANNELS

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

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of 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 masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 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.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 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.
- .6 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .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 01 11 01 – General Instructions Minor Works.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 11 01 – General Instructions Minor Works.

- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.



PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 20th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1 Provide drawings stamped and signed by professional engineer registered or licensed in Province s of Ontario Canada.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 01 – General Instructions Minor Works.

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 flat covers.

PART 3 EXECUTION

3.1 JUNCTION, PULL BOXES AND CABINETS 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 system name, voltage and phase or as indicated.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 20th Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 11 01 – General Instructions Minor Works.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 11 11 01 – General Instructions Minor Works.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 11 01 – General Instructions Minor Works.

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 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 Extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

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

2.6 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.

2.7 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

2.8 SERVICE FITTINGS

- .1 'High tension' receptacle fitting made of 2 piece die-cast aluminum with brushed aluminum housing finish for 1 duplex receptacles. Bottom plate with two knockouts for centered or offset installation.
- .2 Pedestal type 'low tension' fitting made of 2 piece die cast aluminum with brushed aluminum housing finish to accommodate two Amphenol jack connectors.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.



PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 CSA International
  - .1 CSA C22.2 No.40-M1989 (R2009), Cutout, Junction and Pull Boxes.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for raceway and boxes and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2 Operation and Maintenance Data: submit operation and maintenance data for raceway and boxes for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect raceway and boxes from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 11 01 – General Instructions Minor Works.

PART 2 PRODUCTS

2.1 JUNCTION BOXES DISTRIBUTION LEVEL

- .1 Welded steel rectangular boxes 6 mm thick minimum painted with chromate primer and gray enamel with removable plate on front side, designed for through run of main cable and porcelain enclosed disconnecting branches of 3 single conductor cables, using pothead plug and socket disconnectors enclosed in porcelain tubes and caps, standard designed for no voltage disconnecting, branch cables rated 100 A, 5 kV, filled with medium hard asphalt base compound.

2.2 JUNCTION BOXES POWER LEVEL

- .1 Cast iron octagonal box painted with chromate primer and gray enamel with joints ground smooth and fitted with gasket, contacts mounted on porcelain supports to which conductors are fastened by soldered-on lugs, medium hard asphalt compound filled, suitable for 3 phase, 15 kV cable, 250 MCM maximum cable size, with stuffing box entrance.
- .2 Welded steel rectangular boxes, oil resistant gasketed steel plate lids fastened with silicon-bronze bolts, shot blasted and painted with chromate primer and gray enamel, cable heads medium hard asphalt compound filled cap nut sealed potheads with stuffing box entrances, disconnecting links insulated switch stick operated at no voltage rated 250 A at 15,000 V, 3 way for wall mounting.

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 raceway and boxes 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 distribution level steel boxes on walls of maintenance holes. Splice main cable in box and connect branch feeder. Fasten cover and fill with compound.
  - .1 Ground steel boxes as required.
- .2 Install power level boxes as follows:
  - .1 Cast iron type: on trench floor, connect cable terminals to box contacts, fasten lid and fill with compound before trench is backfilled.
  - .2 Steel type: mount on wall of maintenance holes; connect cables to box terminals; install disconnect links, fasten lid securely, check for air leaks.
  - .3 Ground power level boxes as required.

3.3            CLEANING

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



PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 CSA International
  - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA C22.2 No.55-M1986(R2008), Special Use Switches.
  - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works..
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario Canada.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 11 01 – General Instructions Minor Works..
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works. and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 11 01 – General Instructions Minor Works.

PART 2            PRODUCTS

2.1                SWITCHES

- .1        15 A, 120 V, single pole, switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2        Manually-operated general purpose AC switches with following features:
  - .1        Terminal holes approved for No. 10 AWG wire.
  - .2        Silver alloy contacts.
  - .3        Urea or melamine moulding for parts subject to carbon tracking.
  - .4        Suitable for back and side wiring.
  - .5        Ivory toggle, to match existing.
- .3        Toggle operated fully rated for fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4        Switches of one manufacturer throughout project.

2.2                RECEPTACLES

- .1        Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
  - .1        Ivory urea moulded housing, to match existing.
  - .2        Suitable for No. 10 AWG for back and side wiring.
  - .3        Break-off links for use as split receptacles.
  - .4        Eight back wired entrances, four side wiring screws.
  - .5        Triple wipe contacts and rivetted grounding contacts.
- .2        Other receptacles with ampacity and voltage as indicated.
- .3        Receptacles of one manufacturer throughout project.

2.3                COVER PLATES

- .1        Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2        Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3        Stainless steel, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .4        Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5        Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .6        Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

2.4                SOURCE QUALITY CONTROL

- .1        Cover plates from one manufacturer throughout project.

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PART 3      EXECUTION

3.1      EXAMINATION

- .1      Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
  - .1      Visually inspect substrate in presence of 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      Switches:
  - .1      Install single throw switches with handle in "UP" position when switch closed.
  - .2      Install switches in gang type outlet box when more than one switch is required in one location.
  - .3      Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.
- .2      Receptacles:
  - .1      Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2      Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.
- .3      Cover plates:
  - .1      Install suitable common cover plates where wiring devices are grouped.
  - .2      Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3      CLEANING

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

3.4      PROTECTION

- .1      Protect installed products and components from damage during construction.
- .2      Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3      Repair damage to adjacent materials caused by wiring device installation.



PART 1            GENERAL

1.1                RELATED REQUIREMENTS

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

1.2                REFERENCES

- .1            American National Standards Institute (ANSI)
  - .1            ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
  - .2            ANSI C82.4-02(R2007), Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.
- .2            American National Standards Institute/Institute of Electrical and Electronics Engineers ( ANSI/IEEE )
  - .1            ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3            ASTM International Inc.
  - .1            ASTM F 1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4            Canadian Standards Association (CSA International)
- .5            ICES-005-07, Radio Frequency Lighting Devices.
- .6            Underwriters' Laboratories of Canada (ULC)

1.3                ACTION AND INFORMATIONAL SUBMITTALS

- .1            Provide submittals in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2            Product Data:
  - .1            Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2            Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval by Departmental Representative.
  - .3            Photometric data to include: VCP Table where applicable.
- .3            Quality assurance submittals: provide following in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1            Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4                QUALITY ASSURANCE

- .1            Provide mock-ups in accordance with Section 01 11 01 – General Instructions Minor Works.

1.5                DELIVERY, STORAGE AND HANDLING

- .1            Deliver, store and handle materials in accordance with Section 01 11 01 – General Instructions Minor Works.
- .2            Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3            Packaging Waste Management: remove for reuse and return of pallets, crates, padding and packaging materials in accordance with Section 01 11 01 – General Instructions Minor Works.

- .4 Divert unused metal materials from landfill to metal recycling facility.
- .5 Disposal and recycling of fluorescent lamps as per local regulations.
- .6 Disposal of old PCB filled ballasts.

PART 2 PRODUCTS

2.1 LAMPS

- .1 Fluorescent lamps to be - T8, 32 Watt, medium bi-pin, rapid-start, 4100 K, 30,000 hour lamp life, 2950 initial lumens, CRI 80; or as indicated.

LIGHT FIXTURE SCHEDULE		
Fixture Type	Description	Watts
A	Surface ceiling mount 1219 mm fluorescent luminaire with post, painted baked white enamel finish, 3.175 mm thick, acrylic, wrap lens, 120 volt electronic ballast and one 54 watt, t5 lamp.	54
AX	Surface ceiling mount 1219 mm fluorescent luminaire with post painted baked white enamel finish, 3.175 mm thick, acrylic, wrap lens, 120 volt t5 fluorescent emergency lighting ballast and one 54 watt, t5 lamp. Emergency lighting ballast to provide 700 lumens for 90 minutes.	54
B	Surface ceiling mount heavy duty hazardous location (Class 1, div 1 &2) LED fixture, aluminum alloy housing, explosion proof impact glass tubes, 4000k temperature, 5000 nominal lumens, replaceable Class 2 120v driver with surge protection, emergency battery backup, fixture ceiling mounting kit and two 610 mm LED tubes nominal 3000 lumens.	26.6
C	Surface ceiling mount heavy duty hazardous location (class 1, div 1 &2) LED fixture, aluminum alloy housing, explosion proof impact glass tubes, 4000k temperature, 5000 nominal lumens, replaceable class 2 120v led driver with surge protection, emergency battery backup, fixture ceiling mounting kit, and three 610 mm led tubes nominal 4000 lumens.	36.75

2.2 BALLASTS

- .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic.
  - .1 Rating: 120 V, 60 Hz for use with 1-54W lamps.
  - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
  - .3 Power factor: minimum 95 % with 95% of rated lamp lumens.
  - .4 Current crest factor: 1.7 maximum.
  - .5 Harmonics: 10 % maximum THD.
  - .6 Operating frequency of electronic ballast: 20 kHz minimum.
  - .7 Total circuit power: 54 Watts.
  - .8 Ballast factor: greater than 0.90.
  - .9 Sound rated: Class A.
  - .10 Mounting: integral with luminaire.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended

installation.

2.4            OPTICAL CONTROL DEVICES

- .1        As indicated in luminaire schedule.

2.5            LUMINAIRES

- .1        As indicated in luminaire schedule.

PART 3        EXECUTION

3.1            INSTALLATION

- .1        Locate and install luminaires as indicated.
- .2        Provide adequate support to suit ceiling system.

3.2            WIRING

- .1        Connect luminaires to lighting circuits:
  - .1        Install flexible or rigid conduit for luminaires as indicated.

3.3            LUMINAIRE SUPPORTS

- .1        For suspended ceiling installations support luminaires independently of ceiling.

3.4            LUMINAIRE ALIGNMENT

- .1        Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2        Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5            CLEANING

- .1        Clean in accordance with Section 01 11 01 – General Instructions Minor Works.
  - .1        Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2        Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 11 01 – General Instructions Minor Works.