

**PART 1 - GENERAL**

- 1.1 RELATED REQUIREMENTS
- .1 Section 01 33 00 - Submittal Procedures.
  - .2 Section 01 35 29.06 - Health and Safety Requirements.
  - .3 Section 01 45 00 - Quality Control.
  - .4 Section 01 61 00 - Common Product Requirements.
  - .5 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- 1.2 REFERENCES
- .1 Canadian Standards Association (CSA International)
    - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
    - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
  - .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 DEFINITIONS
- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- 1.4 DESIGN REQUIREMENTS
- .1 Operating voltages: to CAN3-C235.
  - .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
    - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
  - .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
  - .4 Use one nameplate or label for each language.
- 1.5 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 Product Data: submit WHMIS MSDS.
  - .3 Shop drawings:
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
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- 1.5 ACTION AND INFORMATIONAL SUBMITTALS (Cont'd)
- .3 Shop drawings:(Cont'd)
    - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
    - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
    - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
    - .5 Submit drawings and product data to authority having jurisdiction.
    - .6 If changes are required, notify Departmental Representative of these changes before they are made.
  - .4 Quality Control: in accordance with Section 01 45 00 - Quality Control.
    - .1 Provide CSA certified equipment and material.
    - .2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.
    - .3 Submit test results of installed electrical systems and instrumentation.
    - .4 Permits and fees: in accordance with General Conditions of contract.
    - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
    - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- 1.6 QUALITY ASSURANCE
- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
  - .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
    - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
    - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
  - .3 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
- 1.7 DELIVERY, STORAGE AND HANDLING
- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
  - .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.
- 1.8 SYSTEM STARTUP
- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
  - .2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant will aspects of its care and operation.
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- 1.9 OPERATING INSTRUCTIONS
- .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.

**PART 2 - PRODUCTS**

- 2.1 MATERIALS AND EQUIPMENT
- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
  - .3 Factory assemble control panels and component assemblies.

- 2.2 WIRING TERMINATIONS
- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

- 2.3 EQUIPMENT IDENTIFICATION
- .1 Identify electrical equipment with nameplates and labels as follows:
    - .1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black face, black white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
    - .2 Sizes as follows:

**NAMEPLATE SIZES**

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: electronically printed, self adhesive labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- 2.3 EQUIPMENT IDENTIFICATION (Cont'd)
- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. " as directed by Departmental Representative .
  - .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
  - .8 Terminal cabinets and pull boxes: indicate system and voltage.
  - .9 Transformers: indicate capacity, primary and secondary voltages.

- 2.4 WIRING IDENTIFICATION
- .1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
  - .2 Maintain phase sequence and colour coding throughout.
  - .3 Colour coding: to CSA C22.1.
  - .4 Use colour coded wires in communication cables, matched throughout system.

- 2.5 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 15 m intervals.
  - .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	<u>Prime</u>	<u>Auxiliary</u>
up to 250 V	Yellow	
up to 600 V	Yellow	Green

- 2.6 FINISHES
- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
    - .1 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

**PART 3 - EXECUTION**

- 3.1 INSTALLATION
- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

- 3.2 NAMEPLATES AND LABELS
- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

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- 3.3 LOCATION OF OUTLETS
- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
  - .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
  - .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- 3.4 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 Wall receptacles:
      - .1 General: 450 mm.
      - .2 Above top of continuous baseboard heater: 200 mm.
      - .3 In mechanical rooms: 1220 mm.
    - .2 Panelboards: as required by Code or as indicated.
- 3.5 CO-ORDINATION OF PROTECTIVE DEVICES
- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- 3.6 FIELD QUALITY CONTROL
- .1 Load Balance:
    - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
    - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
    - .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
  - .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
    - .1 Power distribution system including phasing, voltage, grounding and load balancing.
    - .2 Circuits originating from branch distribution panels.
    - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
    - .4 Insulation resistance testing:
      - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
      - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
      - .3 Check resistance to ground before energizing.
  - .3 Carry out tests in presence of Departmental Representative.
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3.6 FIELD QUALITY CONTROL (Cont'd) .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.7 CLEANING .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.  
.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**PART 1 - GENERAL**

- 1.1 CODES AND STANDARDS
- .1 Institute of Electrical and Electronics Engineers (IEEE)
    - .1 IEEE 242-2001, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
    - .2 IEEE 1584a-2004, IEEE Guide for Performing Arc-Flash Hazard Calculations - Amendment 1.
  - .2 National Fire Protection Association (NFPA)
    - .1 NFPA (Fire) 70E, Standard for Electrical Safety in the Workplace, 2012 Edition.
- 1.2 SUBMITTALS
- .1 The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
  - .2 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Two (2) bound copies of the complete final report shall be submitted, along with electronic pdf version.
  - .3 The report shall include the following sections:
    - .1 Executive Summary.
    - .2 Descriptions, purpose, basis and scope of the study.
    - .3 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
    - .4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
    - .5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
    - .6 Details of the incident energy and flash protection boundary calculations.
    - .7 Recommendations for system improvements, where needed.
    - .8 One-line diagram.
- 1.3 QUALIFICATIONS
- .1 The short-circuit/device evaluation, protective device coordination and arc flash hazard analysis studies shall be performed or reviewed and sealed by a licensed Professional Electrical Engineer registered to practice in the Province of Ontario skilled in performing and interpreting the power system studies.
  - .2 The licensed Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.
  - .3 The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
  - .4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.
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- 1.4 GENERAL .1 Include in the tender all costs for preparation of a complete System Coordination/Short Circuit/ Device Evaluation Study in accordance with IEEE 242, 'Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems', and IEEE 1584, 'Guide for Performing Arc-Flash Hazard Calculations'.
- .2 The scope of the studies shall include:
- .1 The Study shall include all relevant distribution and protective devices within the following scope:
- .1 Downstream to the affected branch circuit panels.
- 1.5 COORDINATION STUDY .1 The work of the Coordination Study shall include:
- .1 Liaison with the local Utility for information on relays and other protective devices, and system and substation capacities which affect the coordination of this system for both primary and any standby feeders.
- .2 Liaison with distribution equipment and switchgear manufacturers to obtain actual trip curves of existing and proposed protective devices for new & existing equipment.
- .3 Sending a trained and qualified representative on site to gather data on existing equipment within the scope of the study; such as transformers, cables, and lengths, breakers, fuses, and all adjustable protective device settings. The information gathered will include the method of installation where such installation impacts upon the Study (e.g. method of cable installation reflecting upon the allowable ampacity of the cable).
- .4 Recommendations shall be included, listing all deficiencies within the scope of the study and proposing methods of correction for each deficiency.
- .2 The Coordination Study report shall include the following:
- .1 Each Time-Current graph shall be printed in colour. The selected colours will allow the end-user to easily discriminate between different device curves, especially on complicated graphs where devices overlap.
- .2 The Time-Current curves shall be drawn on special log-log graphs with time coordinate range of 0.01 to 1,000 seconds and current coordinate ranges of 4 orders. Separate graphs are to be provided for phase and ground protection for each portion of the system. The entire distribution system shall be subdivided into portions so that the curve for each device clearly shows its relationship to associated upstream and downstream devices. The coordination study should separate the emergency power from the normal power distributions. Each graph for a portion of the system shall include/show the following:
- .1 The portion of the distribution system represented by the devices on the graph shall be represented by a single line diagram drawn in the corner of the Time-Current coordination graph.
- .2 Each device curve shall end at the 3 phase symmetrical fault level calculated for that bus.
- .3 Cable, Bus, or Conductor damage curves shall be shown where appropriate. All Transformer inrush, damage and overload curves shall be shown.
- .4 Motor starting curves and protective devices shall be shown for all motors larger than 75 HP.
- .5 On the graphs, or on the same page as the graph, all protective device curves within the scope of the graph shall be shown with the following information:
- .1 Relay curves with text indicating; Manufacturer, Type, Current Transformer size, Tap or Pickup setting, Time Dial settings, and curve type.
- .2 Fuse curves with average melting curve for low voltage fuses and minimum melt and total clearing for high voltage fuses with text indicating; Manufacturer, Type, Ampacity, Voltage, and Speed.
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1.5 COORDINATION STUDY (Cont'd)

- .2 (Cont'd)
- .2 (Cont'd)
- .5 (Cont'd)
- .3 Static-Trip Breaker curves with text indicating; Breaker and Trip Unit Manufacturer and type, Current Transformer and Sensor Type, and all trip unit settings.
- .4 Thermal-Magnetic Breaker curves with text indicating; Breaker type, Trip rating, and instantaneous trip settings.
- .3 Include tables within the Study that clearly list all protective devices within the scope of the study and all associated information. These tables are to be based on settings established and noted in the coordination curves. The tables shall be logically arranged and grouped to effectively present the following information. The tables shall include:
  - .1 Relays; including manufacturer, type, curve, CT, and all protective settings.
  - .2 Transformers; including size, type, manufacturer, configuration, voltage, and impedance.
  - .3 Fuses; including manufacturer, type, ampacity, voltage, speed.
  - .4 Static Trip Units; including manufacturer, type, CT, sensor or plug, all protective settings.
  - .5 Thermal-Magnetic Trip Units; including manufacturer, rating, and instantaneous setting.
  - .6 Motor Protectors (Overloads); include manufacturer, type, rating, all protective settings.
  - .7 All protective devices shall be listed with clear descriptive text to identify their place within the distribution system.
  - .8 All protective devices shall have a reference to the Time-Current graph where they are shown.
- .4 The tables shall list all existing and recommended settings of all protective devices within the scope of the study. This will allow the end-user to identify and plan for required changes to protective device settings, and to determine which settings have been implemented and modified.

1.6 SHORT CIRCUIT/ DEVICE EVALUATION STUDY

- .1 The work of the Short Circuit study shall include:
  - .1 Evaluation and documentation of three phase single phase & ground fault short circuit fault levels at all distribution busses, motor control centres and main panel board locations within the scope listed above.
  - .2 The output of the short circuit study shall be a printed tabulation of asymmetrical and symmetrical RMS short circuit current values for both interrupting duty and momentary duty, including X/R ratios.
  - .3 All significant sources and impedances shall be evaluated, including but not limited to, Utility and Emergency Sources, motors, cables and their lengths, transformers, reactors, and any other devices impacting upon the available short circuit.
- .2 The work of the device evaluation study shall include:
  - .1 All pertinent interrupting devices within the scope of the job shall be listed with its interrupting rating or its series interrupting rating as applicable.
  - .2 A cross reference in table form shall be provided whether the protective devices at each bus are appropriate for the available fault current at each bus.

1.7 ARC FLASH  
HAZARD ANALYSIS

- .1 Arc Flash Hazard Analysis
  - .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.
  - .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
  - .3 The Arc-Flash Hazard Analysis shall include all locations in the systems.
  - .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm<sup>2</sup>.
  - .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
  - .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
  - .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
    - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
    - .2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
  - .8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
  - .9 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
  - .10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
  - .11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific situation.
- .2 The electrical contractor shall ensure that the recommendations of the study are implemented as part of the contract.

**PART 2 - PRODUCTS**

2.1 NOT USED .1 Not used.

**PART 3 - EXECUTION**

3.1 FIELD ADJUSTMENT .1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

.2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

.3 Notify Owner in writing of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS .1 The contractor of the Arc Flash Hazard Analysis shall provide a 89 mm x 127 mm (3.5 in. x 5 in.) thermal transfer type label of high adhesion polyester for each work location analyzed.

.2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

.3 The label shall include the following information, at a minimum:

- .1 Location designation
- .2 Nominal voltage
- .3 Flash protection boundary
- .4 Hazard risk category, PPE
- .5 Incident energy
- .6 Working distance
- .7 Engineering report number, revision number and issue date.
- .8 Labels shall be machine printed, with no field markings.

.4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

- .1 For each 600, and applicable 208 volt panelboard, one arc flash label shall be provided.
- .2 For each motor control center, one arc flash label shall be provided.
- .3 For each low voltage switchboard, one arc flash label shall be provided.
- .4 For each switchgear, one arc flash label shall be provided.
- .5 For medium voltage switches one arc flash label shall be provided

**PART 1 - GENERAL**

<u>1.1 RELATED SECTIONS</u>	.1	Section 26 05 00 - Electrical General Requirements.
<u>1.2 DEFINITIONS</u>	.1	SRS: acronym for Seismic Restraint System.
<u>1.3 GENERAL DESCRIPTION</u>	.1	This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project by Division 26. This includes, but is not limited to, electrical light fixtures, transformers, MCC's, UPS, diesel generators, fire protection, conduit, communications, electrical equipment and systems, both vibration isolated and statically supported.
	.2	Cable restraint systems, rod stiffener clamps and seismic isolator capacities to be verified by an independent test laboratory. Connection materials and site specific designs to be by the Seismic Engineer. The Seismic Engineer may specify material and anchors provided by the contractor where this is appropriate. It is the contractors' responsibility to ensure that the Seismic Engineers' requirements and specification have been met.
<u>1.4 REFERENCES</u>	.1	Canadian Standards Association (CSA) .1 CSA S832-06(R2011), Seismic Risk Reduction of Operational and Functional Components (OFCs) of Buildings.
	.2	National Research Council Canada .1 NRCC NBCC-2010, National Building Code of Canada 2010.
<u>1.5 SUBMITTALS</u>	.1	Submit shop drawings and product data in accordance with Section 26 05 00 - Electrical General Requirements.
	.2	Submit seismic restraint shop drawings, c/w seal of Professional Engineer registered in Province of Ontario, clearly identifying equipment/systems reviewed and the equipment/systems requiring restraint. Shop drawings must clearly show all forces transferred to structure.
	.3	Seismic Design Engineer shall provide a spreadsheet identifying all equipment and systems requiring or not requiring seismic restraints and include all circulations.
	.4	Submit additional copy of shop drawings and product data to project Structural Engineer for review of connection points to building structure.
<u>1.6 MAINTENANCE DATA</u>	.1	Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 26 05 00 - Electrical General Requirements.

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- 1.7 SEISMIC FORCE .1 The Importance Factor for this project is:  
.1 I = 1.0 - All other buildings i.e.: Office & General Buildings.

Note: As per NBCC.

**PART 2 - PRODUCTS**

- 2.1 SRS MANUFACTURER .1 SRS to be from one manufacturer regularly engaged in production of same, 5 years experience.  
.2 Acceptable materials: Korfund-Sampson, Mason Industries, Tecoustics, Vibra-Sonic Control, Vibron.

- 2.2 GENERAL .1 Design to be by Professional Engineer specializing in design of SRS and registered in Province of Ontario. Division 26 to include all costs associated with this work as it relates to Division 26 installations.  
.2 SRS to be fully integrated into, compatible with:  
.1 Noise and vibration controls specified elsewhere in this project specification, telecommunications.  
.2 Structural, mechanical, electrical design of project.  
.3 During seismic event, SRS to prevent systems and equipment from causing personal injury, interfering with other systems, and from moving from normal position.  
.4 Design and installation in accordance with NBCC, CSA S832.  
.5 SRS to provide gentle and steady cushioning action and avoid high impact loads  
.6 SRS to restrain seismic forces in all directions.  
.7 Fasteners and attachment points to resist same load as seismic restraints.  
.8 SRS of conduit systems to be compatible with:  
.1 Expansion, anchoring and guiding requirements.  
.2 Equipment vibration isolation and equipment SRS.  
.9 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.  
.10 Attachments to RC structure:  
.1 Use high strength mechanical expansion anchors.  
.2 Drilled or power driven anchors not permitted.  
.11 Seismic control measures not to interfere with integrity of firestopping.

- 2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS .1 Floor-mounted equipment, systems:  
.1 Anchor equipment to equipment supports.  
.2 Anchor equipment supports to structure.  
.3 Use size of bolts scheduled in approved shop drawings.
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2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS (Cont'd)

- .2 Suspended equipment, systems:
- .1 Use one or combination of following methods:
    - .1 Install tight to structure.
    - .2 Cross-brace in all directions.
    - .3 Brace back to structure.
    - .4 Slack cable restraint system.
  - .2 SRS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
  - .3 Hanger rods to withstand compressive loading and buckling.

2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT

- .1 Floor mounted equipment, systems:
- .1 Use one or combination of following methods:
    - .1 Vibration isolators with built-in snubbers.
    - .2 Vibration isolators and separate snubbers.
    - .3 Built-up snubber system approved by Engineer, consisting of structural elements and elastomeric layer.
  - .2 SRS to resist complete isolator unloading.
  - .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
  - .4 Cushioning action to be gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.
- .2 Suspended equipment, systems:
- .1 Use one or combination of following methods:
    - .1 Slack cable restraint system.
    - .2 Brace back to structure via vibration isolators and snubbers.

**PART 3 - EXECUTION**

3.1 INSTALLATION

- .1 Install Seismic Restraint Systems in accordance with Seismic Engineer's and manufacturer's recommendations.
- .2 Install SRS at least 25 mm from all other equipment, systems, services.
- .3 Co-ordinate connections with all disciplines.

3.2 INSPECTION AND CERTIFICATION

- .1 SRS to be inspected and certified by Manufacturer upon completion of installation.
- .2 Seismic Design Engineer shall provide written report to Engineer certifying that SRS has been installed in accordance with the SRS drawings. The report shall bear the seal and signature of the SRS Design Engineer.

3.3 COMMISSIONING DOCUMENTATION

- .1 Upon completion and acceptance of certification, hand over to Engineer complete set of construction documents, revised to show "as-built" conditions.

**PART 1 - GENERAL**

- 1.1 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 National Electrical Manufacturers Association (NEMA)

**PART 2 - PRODUCTS**

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

**PART 3 - EXECUTION**

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of 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 NEMA.

**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 34 - Conduits, Conduit Fastenings and Conduit Fittings.

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

**PART 3 - EXECUTION**

- 3.1 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.
- 3.2 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.

**PART 1 - GENERAL**

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

**PART 2 - PRODUCTS**

- 2.1 EQUIPMENT .1 Grounding conductors: bare stranded copper, tinned, soft annealed, size as required.
- .2 Insulated grounding conductors: green, copper conductors, size as required.
- .3 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, 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.
-

3.2 INSTALLATION  
GENERAL  
(Cont'd)

- .8 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.3 EQUIPMENT  
GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, frames of motors, motor control centres, starters, control panels, distribution panels, cable trays.

3.4 FIELD QUALITY  
CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

**PART 1 - GENERAL**

1.1 NOT USED .1 Not used.

**PART 2 - PRODUCTS**

2.1 SUPPORT CHANNELS .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

**PART 3 - EXECUTION**

- 3.1 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 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 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.
- .5 Suspended support systems.
- .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .6 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .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.

**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 C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.

**PART 2 - PRODUCTS**

2.1 SPLITTERS .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.  
.2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.  
.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 JUNCTION AND PULL BOXES .1 Construction:welded steel enclosure.  
.2 Covers Flush Mounted: 25 mm minimum extension all around.  
.3 Covers Surface Mounted: screw-on flat covers.

**PART 3 - EXECUTION**

3.1 SPLITTER INSTALLATION .1 Mount plumb, true and square to building lines.  
.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES 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.

3.3 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 REFERENCES .1 Canadian Standards Association (CSA International)  
.1 CSA C22.1-12, Canadian Electrical Code, Part 1, 22nd Edition.

**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 Extension and plaster rings for flush mounting devices in finished walls.
- 2.3 CONDUIT BOXES .1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of devices.
- 2.4 FITTINGS - GENERAL .1 Bushing and connectors with nylon insulated throats.  
.2 Knock-out fillers to prevent entry of debris.  
.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.  
.4 Double locknuts and insulated bushings on sheet metal boxes.
-

**PART 3 - EXECUTION**

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

**PART 1 - GENERAL**

- 1.1 REFERENCES .1 Canadian Standards Association (CSA International)
- .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-04(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

**PART 2 - PRODUCTS**

- 2.1 CONDUITS .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
  - .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

- 2.2 CONDUIT  
FASTENINGS .1 One hole steel straps to secure surface conduits 50 mm and smaller.
- .1 Two hole steel straps for conduits larger than 50 mm.
  - .2 Beam clamps to secure conduits to exposed steel work.
  - .3 Channel type supports for two or more conduits at 1.5 m on centre.
  - .4 Threaded rods, 6 mm diameter, to support suspended channels.

- 2.3 CONDUIT  
FITTINGS .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
- Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.
  - .3 Watertight connectors and couplings for EMT.
    - .1 Set-screws are not acceptable.

- 2.4 FISH CORD .1 Polypropylene.
-

**PART 3 - EXECUTION**

- 3.1 MANUFACTURER'S INSTRUCTIONS .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- 3.2 INSTALLATION .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in unfinished areas.
- .3 Use rigid galvanized steel threaded conduit outdoors.
- .4 Use electrical metallic tubing (EMT).
- .5 Use flexible metal conduit for connection to motors in dry areas.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .7 Minimum conduit size for lighting and power circuits: 21 mm.
- .8 Bend conduit cold:  
.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 21 mm diameter.
- .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .11 Install fish cord in empty conduits.
- .12 Run 2-27 mm spare conduits up to ceiling space and 2-27 mm spare conduits down to ceiling space from each flush panel.  
.1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in surface type box.
- .13 Remove and replace blocked conduit sections.  
.1 Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.
- 3.3 SURFACE CONDUITS .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on channels.
- .5 Do not pass conduits through structural members except as indicated.
-

3.3 SURFACE  
CONDUITS  
(Cont'd) .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with  
minimum of 25 mm at crossovers.

3.4 CONCEALED  
CONDUITS .1 Run parallel or perpendicular to building lines.

**PART 1 - GENERAL**

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

1.2 REFERENCES .1 CSA International.  
.2 National Electrical Manufacturers Association (NEMA)

**PART 2 - PRODUCTS**

2.1 DESIGN DESCRIPTION .1 Type: ANN.  
.2 3 phase, 600 V input, 120/208 V output, 60 Hz.  
.3 Voltage taps: 4-2½% taps, 2FCAN, 2FCBN.  
.4 Insulation: Class H, 150 degrees C temperature rise.  
.5 Basic Impulse Level (BIL): standard  
.6 Hipot: standard.  
.7 Average sound level: less than 45 dB.  
.8 Impedance at 170 degrees C: less than 6.5%.  
.9 Enclosure: NEMA & CSA, removable metal front panel, sprinklerproof.  
.10 Mounting: floor or wall as indicated.  
.11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.  
.12 Copper windings.  
.13 Primary delta 3 wire, secondary wye ground 4 wire.  
.14 Voltage Regulation to be 4% or better.

2.2 EQUIPMENT IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.  
.2 Label size: 7.

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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 dry type transformers 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 Mount dry type transformers as indicated.
- .2 Ensure adequate clearance around transformer for ventilation.
  - .3 Install transformers in level upright position.
  - .4 Remove shipping supports only after transformer is installed and just before putting into service.
  - .5 Loosen isolation pad bolts until no compression is visible.
  - .6 Make primary and secondary connections in accordance with wiring diagram.
  - .7 Energize transformers after installation is complete.
  - .8 Make conduit entry into bottom 1/3 of transformer enclosure.
- 3.3 PROTECTION .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

**PART 1 - GENERAL**

- 1.1 RELATED REQUIREMENTS .1 Section 26 05 00 - Common Work Results for Electrical.  
.2 Section 26 28 16.02 - Moulded Case Circuit Breakers.

- 1.2 REFERENCES .1 CSA International  
.1 CSA C22.2 No. 29-11, Panelboards and Enclosed Panelboards.

**PART 2 - PRODUCTS**

- 2.1 PANELBOARDS .1 Panelboards: to CSA C22.2 No. 29 and product of one manufacturer.  
.1 Install circuit breakers in panelboards before shipment.  
.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.  
.2 250 and 600 V panelboards: bus and breakers rated for interrupting capacity as indicated in the short circuit study.  
.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.  
.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.  
.5 Minimum of 2 flush locks for each panel board.  
.6 Two keys for each panelboard and key panelboards alike.  
.7 Copper bus with neutral of same ampere rating of mains.  
.8 Mains: suitable for bolt-on breakers.  
.9 Trim with concealed front bolts and hinges.  
.10 Trim and door finish: baked enamel.
- 2.2 BREAKERS .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.  
.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
-

- 2.3 EQUIPMENT IDENTIFICATION
- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .2 Nameplate for each panelboard size 4 engraved.
  - .3 Nameplate for each circuit in distribution panelboards size 2 engraved.
  - .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

**PART 3 - EXECUTION**

- 3.1 EXAMINATION
- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
    - .1 Visually inspect substrate in presence of 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 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
  - .2 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
  - .3 Connect loads to circuits.

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

**PART 1 - GENERAL**

1.1 RELATED REQUIREMENTS .1 Section 26 28 23 - Disconnect Switches - Fused and Non-fused

1.2 REFERENCES .1 CSA International  
.1 CSA C22.2 No. 27-09, Busways. (Tri-national standard, with UL 857-, -  
NMX-J-148-ANCE).

**PART 2 - PRODUCTS**

2.1 PLUG-IN TYPE BUSWAYS .1 Plug-in units to consist of disconnect switches in accordance with Section 26 28 23 -  
Disconnect Switches - Fused and Non-fused.

- .2 Plug-in units: to CSA C22.2 No. 27, with grounding spring to ground unit to busway  
housing before plug-in jaws make contact with bus bars.  
.1 Include interlock so that unit can be inserted or withdrawn only in de-energized  
position.

**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 enclosed bus assemblies 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 busways fittings, supports and accessories in accordance with manufacturer's  
recommendations.

## **PARTIE 1 - GÉNÉRALITÉS**

- 1.1 EXIGENCES CONNEXES .1 Section 26 28 23 - Interrupteurs à fusibles et sans fusibles
- 1.2 RÉFÉRENCES .1 CSA International  
.1 CSA C22.2 numéro 27-09, Barres blindées. (Norme trinationale avec UL 857-, -  
NMX-J-148-ANCE).

## **PARTIE 2 - PRODUITS**

- 2.1 BARRES BLINDÉES EMBROCHABLES .1 Éléments embrochables : sectionneurs conformes à la section 26 28 23 - Interrupteurs à fusibles et sans fusibles.
- .2 Éléments embrochables : conformes à la norme CSA C22.2 numéro 27, avec ressorts de mise à la terre, afin que ces éléments soient mis à la terre à l'enveloppe des barres blindées avant que les pinces des éléments embrochables n'établissent le contact avec les barres.  
.1 Inclure un enclenchement pour que les éléments embrochables puissent être insérés ou retirés seulement en l'absence de courant dans le circuit.

## **PARTIE 3 - EXÉCUTION**

- 3.1 EXAMEN .1 Vérification des conditions : avant de procéder à l'installation des barres blindées, s'assurer que l'état des surfaces/supports préalablement mis en oeuvre aux termes d'autres sections ou contrats est acceptable et permet de réaliser les travaux conformément aux instructions écrites du fabricant.  
.1 Faire une inspection visuelle des surfaces/supports en présence du Représentant du Ministère.  
.2 Informer immédiatement le Représentant du Ministère de toute condition inacceptable décelée.  
.3 Commencer les travaux d'installation seulement après avoir corrigé les conditions inacceptables et reçu l'approbation écrite du Représentant du Ministère.
- 3.2 INSTALLATION .1 Poser les raccords, les supports et les accessoires appropriés conformément aux recommandations du fabricant.

**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).

**PART 2 - PRODUCTS**

- 2.1 RECEPTACLES .1 Duplex receptacles, CSA type 5-15 R, 5-20RA, 125 V, 15 or 20A, U ground, to: CSA C22.2 No. 42 with following features:
- .1 White urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Other receptacles with ampacity and voltage as indicated.
- .3 Receptacles of one manufacturer throughout project.
- 2.2 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, vertically brushed, 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 type conduit boxes.
  - .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for receptacles as indicated.
- 2.3 SOURCE QUALITY CONTROL .1 Cover plates from one manufacturer throughout project.
-

**PART 3 - EXECUTION**

- 3.1 EXAMINATION .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of 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 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 Install GFI type receptacles as indicated.
- .2 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 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 REFERENCES .1 CSA International  
.1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

**PART 2 - PRODUCTS**

- 2.1 BREAKERS GENERAL .1 Moulded-case circuit breakers, circuit breakers, and ground-fault circuit-interrupters,: to CSA C22.2 No. 5.  
.2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.  
.3 Common-trip breakers: with single handle for multi-pole applications.  
.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.  
.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- 2.2 THERMAL MAGNETIC BREAKERS .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous

**PART 3 - EXECUTION**

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

**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 CAN/CSA C22.2 No. 4-04 (2009), Enclosed Switches.  
.2 CSA C22.2 No. 39-1987 (R2007), Fuseholder Assemblies.

**PART 2 - PRODUCTS**

2.1 DISCONNECT SWITCHES .1 Fusible or non-fusible disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No. 4 size as indicated.  
.2 Provision for padlocking in off switch position by three locks.  
.3 Mechanically interlocked door to prevent opening when handle in ON position.  
.4 Fuseholders: to CSA C22.2 No. 39 relocatable and suitable without adaptors, for type and size of fuse indicated.  
.5 Quick-make, quick-break action.  
.6 ON-OFF switch position indication on switch enclosure cover.  
.7 NEMA 4 enclosure in outdoor locations, sprinklerproof in indoor locations.

2.2 EQUIPMENT IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.  
.2 Indicate name of load controlled on size 4 nameplate.

**PART 3 - EXECUTION**

3.1 INSTALLATION .1 Install disconnect switches complete with fuses if applicable.