

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 All division 26 sections.
- .2 Section 41 22 23 - Hoists.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CSA C22.2 No. 18 1-2013, Metallic Outlet Boxes.
 - .3 CSA C22.2 No. 5-2013, Moulded Case Circuit Breakers.
 - .4 CSA C22.2 No. 14-2013, Industrial Control Equipment.
 - .5 CSA C22.3 No. 1-2010, Overhead Systems.
 - .6 CSA C22.3 No. 7-2010, Underground Systems.
- .2 Illumination Engineering Society (IES)
 - .1 IES Handbook.
- .3 National Building Code of Canada (NBCC).
- .4 National Fire Code of Canada (NFCC)
 - .1 NFPA 101, Life Safety Code.
- .5 Occupational Health and Safety Act (OHSA)
 - .1 Regulations for Construction Projects.
- .6 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 Voltage: 120/240 V, single-phase, 3-wire, 60 Hz.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

- .3 Language Operating Requirements: provide identification nameplates for control items in English and French.
- .4 Use one nameplate for each language.

1.5 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Single-line electrical diagrams under plexiglass or glazed frame and locate in main electrical room.
- .3 Shop Drawings:
 - .1 Stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
 - .5 Required number of copies of 600 x 600-mm minimum size drawings to authority having jurisdiction.
- .4 Quality Control:
 - .1 Permits and fees: in accordance with General Conditions of contract.
 - .2 Load balance report.
 - .3 Certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .5 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.
- .6 Site Meetings:
 - .1 In accordance with Section 01 32 16.06 - Construction Progress Schedule - Critical Path Method (CPM).
 - .2 Site Meetings: as part of Manufacturer's Field Services, schedule site visits to review work upon completion of work.

1.6 SYSTEM STARTUP

- .1 Instruct Departmental Representative operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.7 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:
 - .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.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Test results of installed electrical systems and instrumentation.
- .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 to Departmental Representative.
- .3 Factory assemble control panels and component assemblies.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and coordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and Departmental Representative.

- .2 Decal Signs: minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

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

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
- .1 Nameplates: lamicoid 3-mm thick black face, 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 Wordings on nameplates to be approved by Departmental Representative prior to manufacture.
- .3 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .4 Identify equipment with Size 3 labels engraved as directed by Departmental Representative.
- .5 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .6 Terminal cabinets and pull boxes: indicate system and voltage.
- .7 Transformers: indicate capacity, primary and secondary voltages.

2.6 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.

2.7 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.
- .3 Colours: 25-mm wide prime colour and 20-mm wide auxiliary colour.

Conduit/Cable Type	Prime	Auxiliary
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Up to 5 kV	Yellow	Blue
Up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.8 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 outdoor electrical equipment light gray finish to EEMAC 2Y-1.
 - .2 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.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.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.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: Schedule 40 polyvinyl chloride (PVC) 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.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with the drawings and Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .3 Locate light switches on latch side of doors.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centerline 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: 1200 mm.
 - .2 Wall receptacles:
 - .1 General: 400 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Panelboards: as required by Code or as indicated.

3.6 COORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 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 line and neutral currents on panelboards, 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 and submit results to Departmental Representative:
 - .1 Power generation and distribution systems including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: intrusion alarm, fire alarm and communications.
 - .6 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.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work.

END OF SECTION

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. 18-2013, Outlet Boxes, Conduit Boxes and Fittings.
 - .2 CAN/CSA-C22.2 No. 65-2013, Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
 - .3 EEMAC 1Y-2, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 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 Operation and maintenance data for wire and box connectors for incorporation into manual.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No. 65, with current-carrying parts of copper, copper alloy, aluminum and aluminum alloy sized to fit copper, aluminum conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No. 65, with current-carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for TECK cable, mineral-insulated cable, flexible conduit, nonmetallic sheathed 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 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 or cables and:
 - .1 Apply coat of zinc joint compound on incoming overhead aluminum duplex conductors prior to installation of connectors.
 - .2 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.
 - .3 Install fixture type connectors and tighten to CAN/CSA-C22.2 No. 65. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

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 Standard C22.2 No. 129-2010, Neutral supported cables.
 - .2 CSA Standard C22.2 No. 38-2010, Thermoset-insulated wires and cables.
 - .3 CSA Standard C22.2 No. 131-2007 (R2012), Type Teck 90 cable.

1.3 SUBMITTALS

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

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 12 AWG and larger. Minimum size: Power 12 AWG, Control 14 AWG.
- .2 Copper Conductors: size as indicated, with 600-V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketted.
- .3 Neutral Supported Cable: single-phase insulated conductors of aluminum and one neutral conductor of aluminum steel reinforced, size as indicated. Type: NS90 Insulation: Type NSF-2 flame retardant rated 600 V.

2.2 TECK 90 POWER, CONTROL CABLE AND INSTRUMENTATION CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene (XLPE).
 - .2 Rating: 600 V.
- .4 Inner Jacket: polyvinyl chloride (PVC) material.
- .5 Armour: interlocking aluminum.
- .6 Overall Covering: thermoplastic PVC, compliant to applicable Building Code classification for this project.

- .7 Fastenings:
 - .1 One-hole malleable iron straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1000-mm centers.
 - .3 Threaded rods: 6-mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

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 insulation and continuity 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 Install cable in trenches and in ducts as indicated.
- .2 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors (0-1000 V).
- .4 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .5 Conductor length for parallel feeders to be identical.
- .6 Lace or clip groups of feeder cables at distribution centers, pull boxes, and termination points.
- .7 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.
- .8 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.

- .2 Install cable exposed, securely supported by straps.

3.5 INSTALLATION OF INSTRUMENTATION CONTROL CABLES

- .1 Install control cables by cabletroughs.
- .2 Ground control cable shield.

END OF SECTION

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 C22.2 No. 41-07 (R2009), Grounding and Bonding Equipment.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data.
- .3 Certificates: obtain inspection certificate of compliance coning from inspection authority and include it with maintenance manuals.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 Copper short barrel compression connectors to CSA C22.2 as required sized for conductors.
- .2 Contact aid for incoming overhead duplex aluminum cables where applicable.

Part 3 Execution

3.1 INSTALLATION

- .1 Bond and ground as required to CSA C22.2 No. 41.

END OF SECTION

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 837-2002, Qualifying Permanent Connections Used in Substation Grounding.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures and testing.

Part 2 Products

2.1 MATERIALS

- .1 Rod Electrodes: copper-clad steel, 19-mm diameter by 3 m long.
- .2 Plate Electrode: galvanized steel or copper surface area 0.2 m², 1.6 mm thick.
- .3 Thermite welded type ground connections for all buried and embedded ground connections.
- .4 Conductors: bare, stranded, soft annealed copper wire, size No. 2/0 AWG for ground bus, electrode interconnections, metal structures and size No. 2 AWG for electrical equipment, motors, panels and ground connections.
- .5 Conductors: polyvinyl chloride (PVC) insulated, coloured green, stranded soft annealed copper wire, size No. 4 AWG for grounding cable sheaths, raceways, pipe work, screen guards, switchboards, potential transformers.
- .6 Conductors: PVC insulated, coloured green, stranded soft annealed copper wire No. 10 AWG for grounding meter and relay cases.
- .7 Accessories: noncorroding, necessary for complete grounding system, type, size material as indicated, including:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermite welded type conductor connectors.

- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.
- .8 Wire connectors and terminations: as indicated.
- .9 Cable sheath isolating sleeves.

Part 3 Execution

3.1 INSTALLATION

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
- .2 Install connectors and exothermic copper welding in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors during and after construction.
- .4 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermite process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Use No. 2/0 AWG bare copper cable for main ground bus and No. 2 AWG MHD bare copper cable for taps on risers from main ground bus to equipment.
- .7 Use tinned copper conductors for aluminum structures.

3.2 ELECTRODE INSTALLATION

- .1 Install ground rod and/or plate electrodes. Make grounding connections to station equipment.
- .2 Install ground rod electrodes at dam structures and control building locations.
- .3 Make special provision for installing electrodes that will give acceptable resistance to ground value, where rock or sand terrain prevails.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical station equipment including: neutral. Noncurrent-carrying parts of: motors, panelboards and control cabinets. Cable sheaths, raceways, light standards and switchboards. Meter and relay cases.

3.4 NEUTRAL GROUNDING

- .1 Connect transformer neutral and distribution neutral together using 1000-V insulated conductor to one side of ground test link; the other side of the test link being connected directly to main station ground. Ensure distribution neutral are bonded directly to transformer neutral and not to main station ground.
- .2 Interconnect electrodes and neutrals at each grounding installation.
- .3 Connect neutral of station service transformer to main neutral bus with tap of same size as secondary neutral.

3.5 CABLE SHEATH GROUNDING

- .1 Bond single conductor, metallic-sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables.
- .2 Use No. 6 AWG flexible copper wire to cable sheath.
- .3 Connect bonded cables to ground with No. 2 AWG copper conductor.

3.6 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Engage an independent testing agent to inspect grounding and perform ground resistance test before backfill.
- .3 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction.
- .4 Perform test before energizing electrical system.

END OF SECTION

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 837-2002, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 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 Operation and maintenance data for grounding equipment for incorporation into manual.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required.
- .2 Copper Conductor: minimum 3 m long for each concrete-encased electrode, bare, stranded, soft annealed, size as required.
- .3 Rod Electrodes: copper-clad steel 19 mm diameter by minimum 3 m long.
- .4 Plate Electrodes: galvanized steel or copper, surface area 0.2 m², minimum 1.6 mm thick.
- .5 Grounding Conductors: bare stranded copper, soft annealed, size as indicated.
- .6 Insulated Grounding Conductors: green, copper conductors, size as indicated.
- .7 Ground Bus: copper, size as required, complete with insulated supports, fastenings, connectors.
- .8 Noncorroding 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 Thermite 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 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 electrical metallic tubing (EMT) is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes, using copper welding by thermite process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate ground conductor to outdoor lighting standards.
- .9 Connect building structural steel and metal siding to ground.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .11 Bond single conductor, metallic-armoured cables to cabinet at supply end, and provide nonmetallic entry plate at load end.
- .12 Ground secondary service pedestals.

3.3 ELECTRODES

- .1 Install rod and/or plate electrodes and make grounding connections.
- .2 Bond separate, multiple electrodes together.
- .3 Use size 2/0 AWG copper conductors for connections to electrodes.

- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails.

3.4 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral system.

3.5 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, frames of motors, starters, control panels, building steel work, generators, hoists, distribution panels, outdoor lighting and cable trays.

3.6 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical room.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size 6 AWG.

3.7 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, security systems, communication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Security system, communication systems as required.

3.8 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.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

Part 2 Products

2.1 SUPPORT CHANNELS

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

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to hollow or solid masonry, surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls with toggle bolts.
- .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 malleable iron 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 two or more cables or conduits on channels supported by 6-mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits, use channels at 1 m on center spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 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.

- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION

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 C22.1-2012, Canadian Electrical Code, Part 1, 22nd Edition.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's printed product literature, specifications and datasheet and include physical size and finish.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Construction: indoor welded steel enclosure, outdoor stainless steel.
- .2 Covers Flush Mounted: 25-mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on flat or turned edge covers.

2.2 CABINETS

- .1 Construction: welded sheet steel, hinged door, handle, lock 2 keys and catch.

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 1.8 m above finished floor except where indicated otherwise.
- .3 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.

END OF SECTION

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 C22.1-2012, Canadian Electrical Code, Part 1, 22nd Edition.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES - GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 Use 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 Use 120-V outlet boxes for 120-V switching devices.

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. Use 102-mm square outlet boxes when more than one conduit enters one side.
- .3 Utility boxes for outlets connected to surface-mounted electrical metallic tubing (EMT) conduit, minimum size 102 x 54 x 48 mm.
- .4 Use 102-mm square or octagonal outlet boxes for lighting fixture outlets.

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

2.6 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 and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 18.3-2012, Conduit, Tubing and Cable Fittings.
 - .2 CSA C22.2 No. 18.4-2004 (R2009), Hardware for the Support of Conduit, Tubing and Cable.
 - .3 CSA C22.2 No. 45.1-2007 (R2012), Electrical Rigid Metal Conduit - Steel.
 - .4 CSA C22.2 No. 56-2004 (R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .5 CSA C22.2 No. 83-M1985 (R2008), Electrical Metallic Tubing.
 - .6 CSA C22.2 No. 211.2-2006 (R2011), Rigid PVC (Unplasticized) Conduit.
 - .7 CSA C22.2 No. 227.3-2005 (R2010), Nonmetallic Mechanical Protection Tubing (NMPT).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit cable manufacturer's printed product literature, specifications and datasheets.

Part 2 Products

2.1 CABLES AND REELS

- .1 Provide cables on reels or coils.
 - .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.
- .2 Each coil or reel of cable to contain only one continuous cable without splices.
- .3 Identify cables for exclusively dc applications.

2.2 CONDUITS

- .1 Rigid Metal Conduit: to CSA C22.2 No. 45, hot-dipped galvanized steel threaded.
- .2 Electrical Metallic Tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid Polyvinyl Chloride (PVC) Conduit: to CSA C22.2 No. 211.2.
- .4 Flexible Metal Conduit: to CSA C22.2 No. 56, liquid-tight, flexible, metal aluminum.

2.3 CONDUIT FASTENINGS

- .1 One-hole malleable iron 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 m on center.
- .4 Threaded rods, 6-mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory “ells” where 90° bends for 25-mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100-mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19-mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

- .1 Polypropylene.

Part 3 Execution

3.1 MANUFACTURER’S INSTRUCTIONS

- .1 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 Surface mount conduits.
- .3 Use rigid hot-dipped galvanized steel threaded conduit for all outdoor and embedded applications.
- .4 Use EMT in indoor applications only.
- .5 Use rigid PVC conduit underground.
- .6 Use flexible metal conduit for connection to motors in dry areas work in movable metal partitions.

- .7 Use liquid-tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet locations.
- .8 Minimum conduit size for lighting and power circuits: 19 mm.
- .9 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .10 Mechanically bend steel conduit over 19-mm diameter.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on surface channels.
- .4 Do not pass conduits through structural members.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in center one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25-mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 25 mm and larger below slab and encase in 75-mm concrete envelope.

- .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END OF SECTION

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 No. 126.1-2009, Metal Cable Tray Systems.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA VE-1-2009, Metal Cable Tray Systems.
 - .2 NEMA VE-2-2009, Cable Tray Installation Guidelines.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit manufacturer's product data sheets for cable tray indicating dimensions, materials, and finishes, including classifications and certifications.
- .3 Shop Drawings: submit shop drawings showing materials, finish, dimensions, accessories, layout, and installation details.
- .4 Identify types of cabletroughs used.
- .5 Show actual cabletrough installation details and suspension system.

Part 2 Products

2.1 CABLETROUGH

- .1 Cabletroughs and Fittings: to NEMA VE-1 and CAN/CSA C22.1 No. 126.1.
- .2 Ladder type, Class D1 to CAN/CSA C22.2 No. 126.1.
- .3 Trays: galvanized steel; 450, 600 mm wide with depth of 100 mm.
- .4 Fittings: horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required, manufactured accessories for cabletrough supplied.
 - .1 Radii on fittings: 450 mm minimum.
- .5 Solid covers for complete cabletrough system including fittings.
- .6 Barriers where different voltage systems are in same cabletrough.
- .7 Ground cable trays with #2 AWG bare copper conductor attached to each tray section in accordance with CEC requirements.

2.2 SUPPORTS

- .1 Provide splices, supports for a continuously grounded system.

Part 3 Execution

3.1 INSTALLATION

- .1 Install complete cabletrough system in accordance with NEMA VE-2.
- .2 Support cabletrough on both sides or with wall-mounted brackets.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

3.2 CABLES IN CABLETROUGH

- .1 Install cables individually.
- .2 Lay cables into cabletrough. Use rollers when necessary to pull cables.
- .3 Secure cables in cabletrough at 1.5-m centers, with nylon ties.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 Insulated Cable Engineers Association, Inc. (ICEA).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit manufacturer's instructions, printed product literature and data sheets for cables.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for cable 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 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA-approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour-coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends cables with moisture seal tape.

- .7 After installation of cables, seal duct ends with duct sealing compound.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
 - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Preacceptance Tests:
 - .1 After installing cable but before terminating, perform insulation resistance test with 600-V megger on each phase conductor.
 - .2 Check insulation resistance after each termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.4 PROTECTION

- .1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

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 C39.1-1981 (R1992), Requirements, Electrical Analog Indicating Instruments.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN3-C17-M84 (R2008), Alternating - Current Electricity Metering.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's instructions, printed product literature and data sheets for metering and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 METER

- .1 Single-phase kilowatt-hour energy meter: to CAN3-C17.
- .2 Outdoor, weatherproof.
- .3 Ratings: 120/240 V, 200 A.

2.2 METER SOCKET

- .1 Weatherproof meter socket to suit meter with automatic current transformer shorting devices when meter removed.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for metering and switchboard instruments 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 METERING INSTALLATION

- .1 Install meter in location free from vibration and shock.
- .2 Make connections in accordance with diagrams.

3.3 FIELD QUALITY CONTROL

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with manufacturer's recommendations.
- .2 Verify correctness of connections, polarities of meters, potential and current transformers, transducers, signal sources and electrical supplies.
- .3 Perform tests to obtain correct calibration.
- .4 Do not dismantle meters and instruments.

3.4 PROTECTION

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

END OF SECTION

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 C22.1-2012, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's instructions, printed product literature and data sheets for photoelectric devices and include product characteristics, performance criteria, physical size, finish and limitations.

Part 2 Products

2.1 PHOTOELECTRIC LIGHTING CONTROL

- .1 Photoelectric Lighting Controls: to CSA C22.1.
 - .1 Wall mounting.
 - .2 Capable of switching 1000 W of lighting at 120 V.
 - .3 Voltage variation: $\pm 10\%$.
 - .4 Temperature range: -40°C to $+40^{\circ}\text{C}$.
 - .5 Switching on lights at dusk.
 - .6 Switching off lights at daybreak.
 - .7 Rated for 5000 operations minimum.
 - .8 Options:
 - .1 Fail-safe circuit completed when relay de-energized.
 - .2 Twist-lock type receptacle.
 - .3 Sensitivity adjustment.
 - .9 Switching time delay of 30 seconds.
 - .10 Wall-mounting bracket.
 - .11 Colour-coded leads: size 10 AWG, 460 mm long.

2.2 CONTACTOR

- .1 Contactor: to CSA C22.1.
 - .1 Cabinet mounting.
 - .2 Capable of switching multiple lamp circuits with total lighting load of 3000 W.

- .3 NEMA 12 enclosure.
- .4 Manual override.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections are acceptable for lighting control device 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 photoelectric controls in accordance with manufacturer's written instructions and to CSA C22.1.

3.3 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

Part 2 Products

2.1 EQUIPMENT

- .1 Fused Disconnect Switch: in accordance with Section 26 28 23 - Disconnect Switches - Fused and Non-Fused, rating as indicated.
- .2 Enclosed Circuit Breaker: in accordance with Section 26 28 16.02 - Moulded Case Circuit Breakers, rating as indicated.
- .3 Panelboard Breaker Type: in accordance with Section 26 24 16.01 - Panelboards Breaker Type, rating as indicated.

Part 3 Execution

3.1 INSTALLATION

- .1 Install service equipment.
- .2 Connect to incoming service.
- .3 Connect to outgoing load circuits.
- .4 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.
- .5 Make provision for power supply authority's metering.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 Canadian Standard Association (CSA International)
 - .1 CSA C22.2 No. 29-11, Panelboards and Enclosed Panelboards.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's instructions, printed product literature and data sheets for panelboards and include physical size and finish.

1.4 CLOSEOUT SUBMITTALS

- .1 Operation and maintenance data for panelboards.

Part 2 Products

2.1 PANELBOARDS (SERVICE ENTRANCE)

- .1 Panelboard: 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-V Panelboards: bus and breakers rated for 10-kA (symmetrical) interrupting capacity or as indicated.
- .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 two flush locks for each panelboard.
- .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: as per colour schedule.
- .11 Include grounding busbar with three of terminals for bonding conductor equal to breaker capacity of the panelboard.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main Service Entrance Breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for breakers installed as required.

2.3 EQUIPMENT IDENTIFICATION

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

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections 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 Install surface-mounted panelboards on galvanizes steel strut.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.

- .2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 94.1-07 (R2012), Enclosures for Electrical Equipment, Non-Environment Considerations.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit manufacturer's instructions, printed product literature and data sheets for electrical cabinets and enclosures and include physical size and finish.
- .3 Shop drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .1 Indicate on drawings:
 - .1 Equipment and components.
 - .2 Schematic diagrams.
 - .3 Panel equipment arrangement.

1.4 CLOSEOUT SUBMITTALS

- .1 Operation maintenance data for electrical cabinets.

Part 2 Products

2.1 MATERIALS

- .1 Indoor enclosures constructed with 2.7-mm thick minimum steel to NEMA 250, CAN/CSA C22.2, size as required.
- .2 Outdoor enclosures constructed with 2.7-mm thick stainless steel to NEMA 250, CAN/CSA C22.2, size as required.
- .3 Removable enclosure panels with formed edges, galvanized steel external fasteners for indoor enclosures, stainless steel external fasteners for outdoor enclosures, removable only from inside enclosure.
- .4 Cover: tamperproof, bolt-on, domed to shed water.
- .5 Door: 3-point latching, with padlocking means.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for electrical cabinet and enclosure 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 Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with galvanized steel channels, supports and fastenings.
- .2 Mount equipment in enclosure if shipped separately.
- .3 Label electrical cabinets and enclosure to Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 42-2010, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No. 42.1-2000 (R2009), Cover Plates for Flush-Mounted Wiring Devices.
 - .3 CSA C22.2 No. 55-M1986 (R2012), Special Use Switches.
 - .4 CSA C22.2 No. 111-2010, General-Use Snap Switches.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's instructions, printed product literature and data sheets for wiring devices.

1.4 CLOSEOUT SUBMITTALS

- .1 Operation and maintenance data for wiring devices.

Part 2 Products

2.1 SWITCHES

- .1 20-A, 120-V, single-pole switches to: CSA C22.2 No. 55, 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 Brown toggle.
- .3 Toggle operated fully rated for tungsten filament and 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 5-20 R, 125 V, 20 A, U-ground, to: CSA C22.2 No. 42 with following features:
 - .1 Brown 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 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 Sheet metal cover plates for wiring devices mounted in surface-mounted FD type conduit boxes.
- .4 Weatherproof, double-lift, spring-loaded PVC cover plates, complete with gaskets for duplex ground-fault circuit interrupter (GFCI) receptacles as indicated.

2.4 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections 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.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

- .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .4 Install GFCI type receptacles for all outdoor applications.
- .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 PROTECTION

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

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 5-13, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics and performance criteria.

Part 2 Products

2.1 BREAKERS - GENERAL

- .1 Moulded case circuit breakers, 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°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.
- .5 Circuit breakers to have minimum 10-kA symmetrical RMS interrupting capacity rating.

2.2 THERMAL MAGNETIC BREAKERS (DESIGN A)

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time-current tripping and instantaneous tripping for short-circuit protection.

2.3 OPTIONAL FEATURES

- .1 Include:
 - .1 On-off locking device.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections 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.

END OF SECTION

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 C22.2 No. 144-M1991 (R2011), Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2-1999 (R2009), Application Guide for Ground Fault Protection Devices for Equipment.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's instructions, printed product literature and data sheets for ground-fault circuit interrupters (GFCIs) and include product characteristics and performance criteria.

1.4 CLOSEOUT SUBMITTALS

- .1 Operation and maintenance data for GFCIs.

Part 2 Products

2.1 MATERIALS

- .1 Equipment and Components for GFCIs: to CSA C22.2 No. 144 and NEMA PG 2.2.
- .2 Components comprising ground-fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND-FAULT INTERRUPTER

- .1 Single-pole GFCI for 20-A, 120-V, single-phase circuit complete with test and reset facilities.

2.3 GROUND-FAULT PROTECTOR UNIT

- .1 Self-contained with 15-A, 120-V circuit interrupter and duplex receptacle complete with:
 - .1 Solid-state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 Waterproof enclosure, surface mounted with waterproof faceplate.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for GFCI 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 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and coordinate with Section 01 45 00 - Quality Control.
- .2 Demonstrate simulated ground-fault tests.

END OF SECTION

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 C22.2 No. 4-04 (R2009), Enclosed Switches.
 - .2 CSA C22.2 No. 39-M1987 (R2007), Fuseholder Assemblies.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible, nonfusible, horsepower-rated disconnect switch in CSA Enclosure 4X and 12/3R, to CAN/CSA C22.2 No. 4.
- .2 Provision for padlocking in "ON-OFF" switch position.
- .3 Mechanically interlocked door to prevent opening when handle in "ON" position.
- .4 Fuseholders: to CSA C22.2 No. 39 suitable without adaptors, for type and size of fuse required.
- .5 Quick-make, quick-break action.
- .6 "ON-OFF" switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

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

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

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 C22.2 No. 14-2013, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-2000, Controllers, Contactors and Overload Relays Rated 600 V.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's instructions, printed product literature and data sheets for contactors.

1.4 CLOSEOUT SUBMITTALS

- .1 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.

Part 2 Products

2.1 CONTACTORS

- .1 Contactors: to CSA C22.2 No. 14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled.
- .3 Complete with normally open and normally closed auxiliary contacts as indicated.
- .4 Mount in NEMA enclosure unless otherwise indicated.
- .5 Include following options in cover as required:
 - .1 Indicating lamp.
 - .2 Hand-Off-Auto selector switch.
- .6 Control Transformer: not applicable.

2.2 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Size 4 nameplate indicating name of load controlled.

Part 3 Execution

3.1 INSTALLATION

- .1 Install contactors and connect power wires and auxiliary control devices.
- .2 Identify contactors with nameplates or labels indicating panel and circuit number.
- .3 Test contactors in accordance with Section 26 05 00 - Common Work Results for Electrical.

3.2 PROTECTION

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

END OF SECTION

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 C22.2 No. 14-2013, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000 (R2008), Industrial Control and Systems: General Requirements.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's instructions, printed product literature and data sheets for control devices and include physical size and finish.

1.4 QUALITY ASSURANCE

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

- .1 Operation maintenance data for control device.

Part 2 Products

2.1 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No. 14 and NEMA ICS 1.
- .2 Convertible Contact Type: contacts field convertible from normally open (NO) to normally closed (NC), electrically held. Coil rating: 120 V, 120 VA. Contact rating: 600 V, 10 A.
- .3 Sealed Contact Type: electrically held with minimum four poles and front-mounted contact block to provide four additional poles. Coil rating: 120 V, 120 VA. Contact rating: 600 V, 10 A.
- .4 Universal Pole Type: electrically held with minimum four poles, convertible from NO to NC by changing wiring connections. Coil rating: 120 V, 120 VA. Contact rating: 600 V, 10 A.

2.2 RELAY ACCESSORIES

- .1 Standard Contact Cartridges: normally open - convertible to normally closed in field.

2.3 OILTIGHT LIMIT SWITCHES

- .1 Snap Action Type: actuator as required, CSA type 4x enclosure. Contact rating NEMA ICS 1, 120 V, 10 A AC.
- .2 Surface mounted.
- .3 Standard contact block.
- .4 Push Type Switches: spring return or maintained contact, single or double pole, double throw as required. Contact rating: NEMA ICS 1, 120 V, 10 A AC.

2.4 SOLID-STATE TIMING RELAYS

- .1 Construction: AC-operated electronic timing relay with solid-state timing circuit to operate output contact.
- .2 Operation: on-delay or off-delay as required.
- .3 Potentiometer: self-contained to provide time interval adjustment.
- .4 Supply Voltage: 120 V, AC, 60 Hz.
- .5 Temperature Range: -20°C to +60°C.
- .6 Output Contact Rating: maximum voltage 300 V AC or DC. Current: NEMA ICS 1 10 A.
- .7 Timing Ranges: as noted.

2.5 OPERATOR CONTROL STATIONS

- .1 Enclosure: CSA Type 12 indoor, 4X stainless steel outdoor, surface mounting.

2.6 PUSHBUTTONS

- .1 NEMA style 30.5 mm, standard, heavy duty, oiltight. Operator extend and mushroom type, as indicated. Black, with minimum 1-NO and 1-NC maintained contacts rated at 120 V, 10 A, AC, labels as indicated. Stop pushbuttons coloured red, provision for padlocking in depressed position labelled "emergency stop".

2.7 SELECTOR SWITCHES

- .1 NEMA style 30.5 mm, maintained labelled as indicated, operators standard, heavy duty, oiltight, contact arrangement as indicated, rated standard 120 V, 10 A, AC.

2.8 INDICATING LIGHTS

- .1 NEMA style 30.5 mm, standard, heavy duty, oiltight, full-voltage LED type, push-to-test, lens colour: indicated, supply voltage: 120 V AC, lamp voltage: 120 V AC, labels as indicated.

2.9 CONTROL AND RELAY PANELS

- .1 CSA Type 12 sheet steel indoor and 4X stainless steel outdoor enclosures with hinged padlockable access door, accommodating relays timers, labels, as indicated, factory installed and wired to identified terminals.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for control 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 Install pushbutton stations, control and relay panels, control devices and interconnect as required.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 American Petroleum Institute (API)
 - .1 API Std. 650, Welded Steel Tanks for Oil Storage 12th Edition.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-3.6-2000, Regular Sulphur Diesel Fuel.
- .3 Canadian Environmental Protection Act (CEPA)
 - .1 CCME PN 1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems for Petroleum Products and Allied Petroleum Products.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA-B139ON-2006, Installation Code for Oil Burning Equipment.
- .5 International Organization for Standardization (ISO)
 - .1 ISO 3046-1-2002, Reciprocating Internal Combustion Engines - Performance - Part 1: Declarations of Power, Fuel and Lubricating Oil Consumptions, and Test Methods - Additional requirements for engines for general use.
- .6 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA MG 1-2011, Motors and Generators.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S601-2007, Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids.
- .8 Technical Standards and Safety Act 2000
 - .1 TSSA LFHC-2007, TSSA Liquid Fuels Handling Code 2007.

1.3 SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and data sheets for power generators 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, and include:

- .1 Engine: make and model, with performance curves.
- .2 Alternator: make and model.
- .3 Voltage regulator: make, model and type.
- .4 Battery: make, type and capacity.
- .5 Battery charger: make, type and model.
- .6 Alternator control panel: make and type of meters and controls.
- .7 Mechanical governor type and model.
- .8 Automatic engine room ventilation system.
- .9 Cooling air requirements in m³/s.
- .10 British standard or DIN rating of engine.
- .11 Flow diagrams for:
 - .1 Diesel fuel.
 - .2 Cooling air.
- .12 Dimensioned drawing showing complete generating set mounted on steel base, including vibration isolators, exhaust system, drip trays, and total weight.
- .13 Continuous full load output of set at 0.8 PF lagging.
- .14 Description of set operation including:
 - .1 Manual starting.
 - .2 Automatic shutdown and alarm on:
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temperature.
 - .4 Low lube oil pressure.
 - .5 Short circuit.
 - .6 Alternator overvoltage.
 - .7 Lube oil high temperature.
 - .8 Overtemperature on alternator.
 - .3 Manual remote emergency stop.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for diesel generator for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier and:
 - .1 Operation and maintenance instructions for engine, alternator, control panel, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.
 - .2 Technical data:
 - .1 Illustrated parts lists with parts catalogue numbers.
 - .2 Schematic diagram of electrical controls.

- .3 Flow diagrams for:
 - .1 Fuel system.
 - .2 Lubricating oil.
 - .3 Cooling system.
- .4 Certified copy of factory test results.
- .5 Maintenance and overhaul instructions and schedules.
- .6 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 Two fuel filter replacement elements.
 - .2 Two lube oil filter replacement elements.
 - .3 Two air cleaner filter elements.
 - .4 Two sets of fuses for control panel.
 - .5 Special tools for unit servicing.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Generating system consists of:
 - .1 Diesel engine.
 - .2 Alternator.
 - .3 Alternator control panel.
 - .4 Battery charger and battery.
 - .5 Automatic engine room ventilation system.
 - .6 Fuel supply system.
 - .7 Exhaust system.
 - .8 Steel mounting base.
 - .9 Synchronizing panel.

- .2 System designed to operate as emergency standby.

2.2 DIESEL ENGINE

- .1 Diesel Engine: to ISO 3046-1.
- .2 Naturally aspirated or turbo charged, synchronous speed 1800 rpm.
- .3 Capacity:
 - .1 Rated continuous power in kilowatts (kW) at rated speed, after adjustment for system losses in auxiliary equipment necessary for engine operation; to be calculated as follows: Rated continuous output = Generator kW divided by Generator efficiency at full load at existing project site conditions.
 - .2 Engine overload capability 110% of continuous output for 1 hour within 12-hour period of continuous operation.
- .4 Cooling System:
 - .1 Liquid cooled: heavy-duty industrial radiator mounted on generating set base with engine-driven pusher type fan to direct air through radiator from engine side, with ethylene glycol antifreeze nonsludging above -46°C.
 - .2 Air cooled: air cooling duct enveloping cylinder walls with pressure cooling by engine-driven blower.
 - .3 To maintain manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 40°C.
- .5 Fuel: to CAN/CGSB-3.6, Type A, Arctic grade.
- .6 Fuel System: solid injection, mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
- .7 Governor: mechanical hydraulic with:
 - .1 Steady-state speed band of $\pm 0.5\%$.
 - .2 Speed regulation no load to full load 5% maximum.
- .8 Lubrication System:
 - .1 Pressure lubricated by engine-driven pump.
 - .2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.
 - .3 Lube oil cooler.
 - .4 Engine sump drain valve.
 - .5 Oil level dipstick.
- .9 Starting System:
 - .1 Positive shift, gear engaging starter 12 V dc.
 - .2 Cranking limiter to provide three cranking periods of 10-second duration, each separated by 5-second rest.
 - .3 Lead acid, 12 V storage battery with sufficient capacity to crank engine for 1 minute at 0°C without using more than 25% of ampere hour capacity.

- .4 Battery charger: constant voltage, solid-state, two-stage from trickle charge at standby to boost charge after use.
 - .1 Regulation: $\pm 1\%$ output for $\pm 10\%$ input variation.
 - .2 Automatic boost for 6 hours every 30 days.
 - .3 Equipped with dc voltmeter, dc ammeter and on-off switch.
 - .4 Minimum charger capacity: 7 A.
- .10 Vibration isolated engine instrument panel with:
 - .1 Lube oil pressure gauge.
 - .2 Lube oil temperature gauge.
 - .3 Lube oil level gauge.
 - .4 Coolant temperature gauge.
 - .5 Coolant level gauge.
 - .6 Running time meter: nontamper type.
- .11 Guards to protect personnel from hot and moving parts.
 - .1 Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
- .12 Drip tray.

2.3 ALTERNATOR

- .1 Alternator: to NEMA MG1.
- .2 Rating: single-phase, 120/240 V, 3-wire, 50 kW, 60 Hz, at 0.8 PF.
- .3 Output at 40°C ambient:
 - .1 100% full load continuously.
 - .2 110% full load for 1 hour.
 - .3 150% full load for 1 minute.
- .4 Revolving field, brushless, single bearing.
- .5 Drip proof.
- .6 Amortisseur windings.
- .7 Synchronous type.
- .8 Dynamically balanced rotor permanently aligned to engine by flexible disc coupling.
- .9 Exciter: rotating brushless.
- .10 EEMAC or NEMA Class H insulation on windings.
- .11 Thermistors or platinum resistance temperature transducers embedded in stator winding and connected to alternator control circuitry.
- .12 Voltage regulator: thyristor-controlled rectifier.
- .13 Alternator: capable of sustaining 300% rated current for period not less than 10 seconds permitting selective tripping of down line protective devices when short circuit occurs.

2.4 CONTROL PANEL

- .1 Totally enclosed integrally mounted.
- .2 Instruments:
 - .1 Analogue or digital indicating type 2 % accuracy, rectangular face, flush panel mounting:
 - .1 Voltmeter: ac, scale 0 to 300 V.
 - .2 Ammeter: ac, scale 0 to 300 A.
 - .3 Wattmeter: scale 0 to 60 kW.
 - .4 Frequency meter: scale 55 to 65 Hz.
 - .2 Voltmeter selector switch, rotary, panel mounting, round notched handle, three positions, labelled "Off - Line 1 - Line 2".
 - .3 Ammeter selector switch, rotary, maintained contacts, panel mounting, designed to prevent opening of current circuits, round notched handle, three positions labelled "OFF - Line 1 - Line 1".
 - .4 Instrument transformers as required.

2.5 CONTROLS

- .1 Engine start button.
- .2 Selector switch: Off- Manual - Test full load test no load.
- .3 Engine emergency stop button and provision for remote emergency stop button.
 - .1 Alternator output breaker:
 - .1 Circuit breaker: bolt-on, moulded case, temperature compensated for 40°C ambient, dual thermal-magnetic trip.
 - .2 Circuit breaker, solid-state sensing with:
 - .1 Frame containing breaker contacts, arc quenchers, manual mechanism, quick-make, quick-break, spring-loaded overcenter switching mechanism, mechanically trip free from handle, fixed type.
 - .2 Static sensor: current monitors detect overload, short-circuit and ground-fault currents, and send these signals through solid-state circuits to static sensor which acts to trip breaker. Adjustable for current values and time of tripping.
 - .3 Flux-transfer shunt trip-magnetic tripping device actuated by signal from static sensor to open breaker contacts. Requires no external source of power.
 - .2 Voltage control rheostat: mounted on inside of control panel.
 - .3 Operating lights, panel mounted:
 - .1 Green pilot lights for breaker on and red pilot lights for breaker off.
 - .4 Solid-state indicator lights for alarm with one set manually reset normally open (NO)/normally closed (NC) contacts wired to terminal block for remote annunciation on:
 - .1 Low fuel level.

- .2 Low battery voltage.
- .3 Ventilation failure.
- .4 Low coolant temperature.
- .5 Solid-state controller for automatic shutdown and alarms with one set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
 - .1 Engine overcrank.
 - .2 Engine overspeed.
 - .3 Engine high temperature.
 - .4 Engine low lube oil pressure.
 - .5 Short circuit.
 - .6 AC over voltage.
- .6 Lamp test button.
- .7 Synchronization and load sharing.
- .8 Provision for remote monitoring.

2.6 STEEL MOUNTING BASE

- .1 Complete generating set mounted on steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.
- .2 Assembly fitted with vibration isolators and control console resiliently mounted.
 - .1 Spring type isolators with adjustable side snubbers and adjustable for levelling.
- .3 Sound insulation pads for installation between isolators and concrete base.

2.7 EXHAUST SYSTEM

- .1 Heavy-duty industrial horizontally mounted exhaust silencer with condensate drain, plug and flanged couplings.
- .2 Heavy-duty flexible exhaust pipe with flanged couplings as required.
- .3 Fittings and accessories as required.
- .4 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion.
- .5 Aluminum insulated cladding for exhaust pipe and muffler.
- .6 Exhaust outlet cut to 45° complete with screen.

2.8 FUEL SYSTEM

- .1 Fuel Storage Tanks: to API Standard 650, ULC labelled, CEPA requirement.
 - .1 Dual wall sub-base in-skid fuel tank: to ULC-S601.
- .2 Fuel Tank; size to operate full load for 12 hours, minimum 265 litres.
 - .1 Built-in electrically operated fuel transfer pump with float switch.
- .3 Fuel level gauge and vent alarm.

- .4 Drain and end plug.
- .5 Black iron feed and return lines, with flexible terminations at engine.
- .6 Shutoff cock.
- .7 Renewable cartridge filter.
- .8 Fire valve.
- .9 Isolating valves on lines serving auxiliaries.
- .10 Low fuel level alarm for remote indication.

2.9 COOLING AIR SYSTEM

- .1 Engine Ventilating System:
 - .1 Recirculating damper assembly with modulating motor.
 - .2 Cold air inlet damper assembly with modulating motor.
 - .3 Air discharge and intake gooseneck weatherhoods.
 - .4 Modulating thermostat.
 - .5 Replaceable air intake filters.

2.10 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Control Panel:
 - .1 Nameplates for controls including alternator breakers and program selector switch.
 - .2 Nameplates for meters, alarms, indicating lights and minor controls.

2.11 FABRICATION

- .1 Shop assemble generating unit including:
 - .1 Base.
 - .2 Engine and radiator.
 - .3 Alternator.
 - .4 Control panel.
 - .5 Battery and charger.
 - .6 Dual wall in-base in-skid fuel tank.

2.12 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Alternator Control Cubicle: paint inside, exterior to match engine and alternator.
- .3 Exhaust and inlet air hoods international orange.
- .4 Other ducts and racks grey.

- .5 Supply 0.25 litres of grey touch-up enamel.

2.13 SOURCE QUALITY CONTROL

- .1 Site test generator set including engine, alternator, control panels and accessories in presence of Departmental Representative.
- .2 Notify Departmental Representative days in advance of date of site test.
- .3 Test Procedure:
 - .1 Prepare blank forms and check sheet with spaces to record data and at top of first sheet record:
 - .1 Date.
 - .2 Generator set serial number.
 - .3 Engine, make, model, serial number.
 - .4 Alternator, make, model, serial number.
 - .5 Voltage regulator, make and model.
 - .6 Rating of generator set, kW, kVA, V, A, r/min, Hz.
 - .2 Mark check sheet and record data on forms in duplicate as test proceeds.
 - .3 Departmental Representative's signature on completed forms to indicate concurrence in results of test.
- .4 Tests:
 - .1 With 100% rated load, operate set for 8 hours, taking readings at 30-minute intervals, and record following:
 - .1 Time of reading.
 - .2 Running time.
 - .3 Ambient temperature in degrees Celsius.
 - .4 Lube oil pressure in kPa.
 - .5 Lube oil temperature in degrees Celsius.
 - .6 Engine coolant temperature in degrees Celsius.
 - .7 Exhaust stack temperature in degrees Celsius.
 - .8 Alternator voltage: phase 1, 2.
 - .9 Alternator current: phase 1, 2.
 - .10 Power in kW.
 - .11 Frequency in Hz.
 - .12 Power factor.
 - .13 Battery charger current in A.
 - .14 Battery voltage.
 - .15 Alternator cooling air outlet temperature.
 - .2 At end of 8 hours run increase load to 110% rated value, and take readings every 15 minutes for 1 hour.
 - .3 After completion of 9 hours run, demonstrate following shutdown devices and alarms:
 - .1 Overcranking.

- .2 Overspeed.
- .3 High engine temperature.
- .4 Low lube oil pressure.
- .5 Short circuit.
- .6 Alternator overvoltage.
- .7 Low battery voltage, or no battery charge.
- .8 Manual remote emergency stop.
- .9 High alternator temperature.
- .4 Next install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady-state conditions exist. Switching increments to include:
 - .1 No load to full load to no load.
 - .2 No load to 70% load to no load.
 - .3 No load to 20% load to no load.
 - .4 20% load to 40% load to no load.
 - .5 40% load to 60% load to no load.
 - .6 60% load to 80% load to no load.
- .5 Simulate/Demonstrate:
 - .1 Manual starting of set on failure of normal power.
 - .2 Operation of manual bypass switch.
 - .3 That battery charger reverts to high rate charge after cranking.
 - .4 Simulate conditions to demonstrate.
- .6 Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate generating unit and install as indicated.
- .2 Install fuel supply system as indicated in CSA-B139.
- .3 Install ventilating air duct system.
- .4 Pipe muffler drains to outside.
- .5 Complete wiring and interconnections as indicated.
- .6 Start generating set and test to ensure correct performance of components.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Notify Departmental Representative 10 working days in advance of test date.

- .3 Provide fuel for testing and leave full tanks on acceptance.
- .4 Demonstrate:
 - .1 Unit start and shutdown on “Manual” control
 - .2 Unit start and transfer on “Test” control.
 - .3 Unit start on “Engine start” control.
 - .4 Operation of automatic alarms and shutdown devices.
- .5 Run unit on load for minimum period of 9 hours to show load-carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling.
- .6 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Divert unused batteries from landfill to battery recycling facility approved by Departmental Representative.
- .3 Divert unused lubricating oil materials from landfill to oil recycling facility approved by Departmental Representative.
- .4 Divert unused antifreeze from landfill to antifreeze recycling facility approved by Departmental Representative.
- .5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.4 MAINTENANCE - CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and CSA-B139.

END OF SECTION

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 C82.1-2004, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
 - .2 ANSI C82.4-2002, 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, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 American Society for Testing and Materials (ASTM International Inc.)
 - .1 ASTM F1137-2000, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-2012, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's printed product literature, specifications and datasheet.
- .3 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.

Part 2 Products

2.1 LAMPS

- .1 Fluorescent Lamps: to be T8, 32 Watts, medium bi-pin, rapid-start, 4100 K, 30,000 hour lamp life, 2950 initial lumens, CRI 80.
- .2 Metal-Halide Lamps: to be clear, 100 Watts, mogul base, horizontal burn, 4100 K, 15,000 hour lamp life, 36,000 initial lumens, CRI65, enclosed type to suit the luminaire.

2.2 BALLASTS

- .1 Fluorescent Ballast: CBM and CSA certified, energy efficient type, IC electronic.
 - .1 Rating: 120 V, 60 Hz, for use with two 32-W, rapid-start lamps.
 - .2 Totally encased and designed for 40°C 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: 62 Watts.
- .8 Ballast factor: greater than 0.90.
- .9 Sound rated: Class A.
- .10 Mounting: integral with luminaire.
- .2 Metal-Halide Ballast:
 - .1 Rating: 120 V, 60 Hz, for use with one 100-W metal-halide lamp.
 - .2 Totally encased and designed for 40°C ambient temperature.
 - .3 Power factor: minimum 95% with 95% of rated lamp lumens.
 - .4 Type: constant wattage autotransformer.
 - .5 Input voltage range: $\pm 10\%$ of nominal.
 - .6 Minimum starting temperature: -30°C at 90% line voltage.
 - .7 Mounting: outdoor integral with luminaire.
 - .8 Current crest factor: 1.7 maximum current.

2.3 FINISHES

- .1 Light fixture finish and construction to meet ULC listing and CSA certification related to intended installation.

2.4 LUMINAIRES

- .1 Indoor, low profile, enclosed and gasketed - luminaire.
- .2 Outdoor, wall-mounted, enclosed, area lighting type luminaire.

Part 3 Execution

3.1 INSTALLATION

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

3.2 WIRING

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

3.3 LUMINAIRE SUPPORTS

- .1 Support luminaires independent of other electrical/mechanical equipment in accordance with local inspection requirements.

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.

END OF SECTION

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 C22.2 No. 141-02, Unit Equipment for Emergency Lighting.
 - .2 CSA C860-11, Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 101, Life Safety Code.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Manufacturer's printed product literature, specifications and datasheet.

Part 2 Products

2.1 SELF-POWERED UNITS

- .1 Exit Lights: to CSA C22.2 No. 141 and CSA C860.
- .2 Housing: cold-rolled steel minimum 1.0 mm thick.
- .3 Faceplate: die formed cold-rolled steel.
- .4 Lamps: light emitting diode (LED) - 12 W, 120 V.
- .5 Operation: designed for over 100,000 hours of continuous operation without relamping.
- .6 Letters: 150 mm high x 19 mm wide, with 13-mm thick stroke, red on white glass, reading "EXIT".
- .7 Downlight: translucent acrylic in bottom of unit.
- .8 Faceplate to remain captive for relamping.
- .9 Supply Voltage: 120 V ac.
- .10 Output Voltage: 12 V dc.
- .11 Operating Time: 4 hours minimum.
- .12 Recharge Time: 12 hours.
- .13 Battery: 10- year sealed, maintenance free.
- .14 Charger: solid-state, voltage/current regulated, inverse temperature compensated, short-circuit protected, with regulated output of ± 0.01 V for $\pm 10\%$ input variation.
- .15 Solid-state transfer circuit.

- .16 Signal Lights: solid-state, for “AC Power ON” and “High Charge” condition.
- .17 Lamp Heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment.
 - .1 Lamp type: quartz, 8 W.
- .18 Remote Heads:
 - .1 Lamp type: quartz, 8 W.
- .19 Mounting: suitable for universal mounting directly on junction box and complete with knockouts for conduit.
 - .1 Removable or hinged front panel for easy access to batteries.
- .20 Cabinet: finish: white.
- .21 Auxiliary Equipment:
 - .1 Lamp disconnect switch.
 - .2 Test switch.
 - .3 AC/DC output terminal blocks inside cabinet.

Part 3 Execution

3.1 MANUFACTURER’S INSTRUCTIONS

- .1 Comply with manufacturer’s written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install exit lights to manufacturer’s recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Ensure that exit light circuit breaker is locked in “ON” position.

END OF SECTION

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 C22.2 No. 206-M1987 (R2008), Lighting Poles.
 - .2 CSA C22.2-2012 STD 250 Luminaries.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI C136:31-2001, Roadway Lighting.
- .3 American Association of State Highway and Transportation Officials (AASHTO)
 - .1 Roadside Design Guide, 2006.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data.

Part 2 Products

2.1 ALUMINUM POLES

- .1 Aluminum poles: to CSA C22.2 No. 206 designed for underground wiring and:
 - .1 Mounting on concrete anchor base, 197-mm bolt circle.
 - .2 Style: Round tapered aluminum, 3.6 mm high, 102-mm x76-mm nominal shaft, 3-mm wall thickness, AASHTO rating of 6.9 max EPA at 90 mph.
 - .3 Straight for one luminaire mounting bracket.
 - .4 Access handhole 450 mm above pole base for wiring connections, with welded-on reinforcing frames bolted-on cover.
 - .5 Anchor bolts: 19-mm x 500-mm steel with shims, nuts, washers and covers.
 - .6 Finish: semi-lustrous satin by rotary sand process.
 - .7 Grounding lug.

2.2 LUMINAIRE MOUNTING BRACKETS

- .1 Mounting brackets steel or aluminum for specified luminaires:
 - .1 Single bracket, tenon mount.

2.3 LUMINAIRES

- .1 Luminaire with cast-aluminum weatherproof housing and:

- .1 Lamp Type: LED, 120 LED lamps.
- .2 Ballast: 120 V, auto-sensing, one lamp, in accordance with Section 26 50 00 - Lighting.
- .3 Light Distribution:
 - .1 IES distribution type 2 medium asymmetrical.
- .4 Self-locking latch of stainless steel and aluminum.
- .5 Factory wired including integral ballast terminated at terminal block.

Part 3 Execution

3.1 INSTALLATION

- .1 Install poles true and plumb, complete with brackets (if required) in accordance with manufacturer's instructions.
- .2 Install luminaires on pole and install lamps.
- .3 Check luminaire orientation, level and tilt.
- .4 Connect luminaire to lighting circuit.
- .5 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

END OF SECTION