

**1. GENERAL****1.1 Reference Standards**

- .1 Reference Standards:
- .2 CSA Group
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
  - .3 CSA B651-17, Accessible design for the built environment.
- .3 Institute of Electrical and Electronics Engineers (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .4 National Building Code of Canada – 2015 (NBC).

**1.2 Definitions:**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.3 Action and Informational Submittals**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for all distribution components, luminaires, fire alarm, telecommunication and security components, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit for review single line electrical diagrams of the electrical distribution system under plexiglass and located in the electrical room.
- .4 Shop drawings:
  - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .3 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .4 Submit drawings and product data to Departmental Representative.
  - .5 If changes are required, notify Departmental Representative of these changes before they are made.

- .5 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Where CSA certified equipment and material is not available, submit such equipment and material to Departmental Representative for approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
  - .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .6 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

#### 1.4 Closeout Submittals

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for all products requiring maintenance for incorporation into manual.
  - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
  - .2 Operating instructions to include following:
    - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
    - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
    - .3 Safety precautions.
    - .4 Procedures to be followed in event of equipment failure.
    - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
  - .3 Post instructions where directed.
  - .4 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
  - .5 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

#### 1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect material and products from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 2. PRODUCTS

### 2.1 Design Requirements

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

### 2.2 Materials and Equipment

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

### 2.3 Electric Motors, Equipment and Controls

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 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.

### 2.4 Warning Signs

- .1 Warning Signs: in accordance with requirements of Departmental Representative.
- .2 Decal signs, minimum size 175 x 250 mm.

### 2.5 Wiring Terminations

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

### 2.6 Equipment Identification

- .1 Identify electrical equipment with nameplates as follows:
  - .1 Nameplates: lamicaid 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 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .3 Allow for minimum of twenty-five (25) letters per nameplate.
- .4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .5 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. XX" as directed by Departmental Representative.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

## 2.7 Wiring Identification

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

## 2.8 Conduit and Cable Identification

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

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

Prime	Auxiliary	
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

## 2.9 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 "equipment green" finish to EEMAC 2Y-1.
- .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

## 3. EXECUTION

### 3.1 Examination

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

### 3.2 Installation

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

### 3.3 Nameplates and Labels

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

### 3.4 Conduit and Cable Installation

- .1 Install conduit and sleeves prior to pouring of concrete.
- .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

### 3.5 Location of Outlets

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 460 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
  - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

### 3.6 Mounting Heights

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1200 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm above finished floor.
    - .2 Above top of continuous baseboard heater: 200 mm.
    - .3 Above top of counters or counter splash backs: 175 mm.
    - .4 Other receptacles indicated to be installed higher than 400mm, must be installed at 100mm above finished floor.
    - .5 In mechanical rooms: 1400 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Telephone and interphone outlets: 400 mm.
  - .5 Wall mounted telephone and interphone outlets: 1200 mm.
  - .6 Smoke alarm: 2100 mm.
  - .7 Pushbuttons and card-readers: 1200 mm.
- .4 All operating controls that must be accessible to a person using a wheelchair must be installed per CSA B651 Standard.

### 3.7 Co-Ordination of Protective Devices

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

### 3.8 Field Quality Control

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Provide upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, and motor controls, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: smoke 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 as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### 3.9 System Startup

- .1 Instruct 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.

**3.10 Commissioning Requirements**

- .1 For general commissioning requirements, refer to sections 01 91 13, 01 91 31, 01 91 33, 01 91 41 and 01 91 51.
- .2 Contractor must provide a Commissioning schedule to include verification of component(s) and system(s) specific to static and dynamic functional performance. Include also period for tests of integrated system(s).
- .3 In addition, for start-up and operational verifications, refer to technical sections and manufacturers' specifications.
- .4 In addition, provide a supplementary 5 days support during testing of integrated systems.
- .5 Coordinate with Contractor Commissioning Agent to determine schedule for test of integrated systems according with other disciplines.

**3.11 Cleaning**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**End of Section**



**1. GENERAL****1.1 Reference Standards**

- .1 CAN/CSA-C22.2 No.18-98(R2003), Outlet Boxes, Conduit Boxes and Fittings.
- .2 CAN/CSA-C22.2 No. 65-13 Wire Connectors.
- .3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .4 National Electrical Manufacturers Association (NEMA)

**1.2 Action and Informational Submittals**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 Closeout Submittals**

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

**1.4 Quality Assurance**

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

**1.5 Delivery, Storage and Handling**

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

## 2. PRODUCTS

### 2.1 Materials

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable and TECK cable as required to: CAN/CSA-C22.2 No.18.

## 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.

### 3.2 Installation

- .1 Remove insulation carefully from ends of conductors and:
  - .1 Apply coat of zinc joint compound on aluminum 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.

### 3.3 Cleaning

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

**End of Section**

**1. GENERAL****1.1 References**

- .1 CAN/CSA C22.2 No.51-14 Armoured cables
- .2 CAN/CSA C22.2 No.131-14 Type TECK cable
- .3 CAN/CSA-C22.2 No.65 Wire Connectors
- .4 CAN/CSA-C22.2 No.18.1-13 Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware

**1.2 Definition**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.3 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop drawings
  - .1 Submit drawings of all types of cables and wires to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .3 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

**1.4 Quality Assurance**

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

**1.5 Delivery, Storage and Handling**

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

## 2. PRODUCTS

### 2.1 Building Wires

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 1 000 V insulation of cross-linked thermosetting polyethylene material rated RWU90 XLPE.
- .3 Copper conductors: size as indicated, with thermoplastic insulation type TWH rated at 600 V.

### 2.2 Teck 90 Cable

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conductors:
  - .1 Grounding conductor: copper as indicated.
  - .2 Circuit conductors: copper size as indicated.
- .3 Insulation:
  - .1 Cross-linked polyethylene XLPE.
  - .2 Rating: 600 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.
- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 1500 mm centers.
  - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
  - .1 Watertight, approved for TECK cable.

### 2.3 Armoured Cables

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

## 2.4 Control Cables

- .1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
  - .1 Insulation: thermoplastic.
  - .2 Sheath: thermoplastic jacket.
- .2 Type: low energy 300 V control cable: solid annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
  - .1 Insulation: PVC.
  - .2 Shielding: tape coated with paramagnetic material wire over each pair.
  - .3 Overall covering: PVC jackets.

## 3. EXECUTION.

### 3.1 Field Quality Control

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of the 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 in accordance with Section 33 71 73.02 - Underground Electrical Service.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .3 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .4 Conductor length for parallel feeders to be identical.
- .5 Lace or clip groups of feeder cables at pull boxes and termination points.
- .6 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .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.
  - .2 In underground ducts in accordance with Section 33 71 73.02 Underground Electrical Services.

**3.4 Installation of Teck 90 Cable (0 -1000 V)**

- .1 Install Teck cables from housing to sheds underground as indicated.
- .2 Install cable exposed, securely supported by straps.

**3.5 Installation of Armoured Cables**

- .1 Install armoured câbles to connect smoke alarm devices as indicated.
- .2 Group cables wherever possible on channels.

**3.6 Installation of Control Cables**

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

**3.7 Cleaning**

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

**End of Section**

**1. GENERAL****1.1 References**

- .1 CAN/CSA-C22.2 No.65-13 Wire Connectors
- .2 CAN/CSA-C22.2 No.41-13 Grounding and Bonding Equipment

**1.2 Definition**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.3 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings for all types of connectors and terminations to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

**1.4 Quality Assurance**

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

**1.5 Delivery, Storage and Handling**

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

2. PRODUCTS

2.1 **Connectors and Terminations**

- .1 Copper compression connectors to CSA C22.2 No.65 as required sized for conductors.

3. EXECUTION

3.1 **Installation**

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

3.2 **Cleaning**

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

**End of Section**



## 1. GENERAL

### 1.1 References

- .1 ANSI/IEEE 837 Standard for Qualifying Permanent Connections used in Substation Grounding

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province within Canada.
  - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
  - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4 Indicate on drawings clearances for operation, maintenance, and replacement of equipment devices.
  - .5 If changes are required, notify the Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of work, load balance report as described in PART 3 – LOAD BALANCE.

### 1.4 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the province in which work is to be executed.
  - .1 Employees registered in provincial apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

## 1.5 Delivery, Storage and Handling

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

## 2. PRODUCTS

### 2.1 Materials

- .1 Plate electrode: copper surface area 0,4 m<sup>2</sup>, 1,5 mm thick.
- .2 Conductors: bare, stranded, tinned soft annealed copper wire, size No. 4/0 AWG and 2/0 AWG for ground bus, metal structures, motors and ground connections.
- .3 Conductors: 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.
- .4 Conductors: pvc insulated coloured green, stranded [un] [tinned] soft annealed copper wire No. 10 AWG for grounding meter and relay cases.
- .5 Bolted removable test links.
- .6 Accessories: non-corroding, 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 Thermit welded type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.
- .7 Wire connectors and terminations: as indicated.

## 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 Ground fences to grounding system independent of station ground.

- .3 Install connectors and cadweld in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors during and after construction.
- .5 Make buried connections, and connections to electrodes, structural steel work, using copper welding by thermit process or permanent mechanical connectors to ANSI/IEEE 837.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Use tinned copper conductors for aluminum structures.
- .8 Do not use bare copper conductors near un-jacketed lead sheath cables.

### 3.2 Electrode Installation

- .1 Install ground plate electrodes. Make grounding connections to main entrance equipment.

### 3.3 Equipment Grounding

- .1 Install grounding connections as indicated to typical station equipment including: metallic water main, line sky wire, neutral,. Non current carrying parts of: motors, circuit breakers . Cable sheaths, raceways, pipe work, screen guards. Meter and relay cases. Any exposed building metal, within or forming part of station enclosure. Fences and outdoor lighting.
- .2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.
- .3 Connect metallic piping (water, oil, air, etc.) inside station to main ground bus at several locations, including each service location within station. Make connections to metallic water pipes outside station to assist in reduction of station ground resistance value.

### 3.4 Neutral Grounding

- .1 Connect distribution neutral using 600 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 and neutrals of potential transformers and service banks are bonded directly to transformer neutral and not to main station ground.
- .2 Interconnect electrodes and neutrals at each grounding installation.

### 3.5 Grounding in Permafrost

- .1 The grounding system has to be in accordance with permafrost grounding.

**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 the Representative and local authority having jurisdiction.
- .4 Perform test before energizing electrical system.
- .5 Provide step-and-touch potential calculations using measured station ground resistance measurements. Submit test result and inspection certificate before energizing electrical system.

**End of Section**

## 1. GENERAL

### 1.1 References

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE 837-02 IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA C22.2 No. 04-04(R2013) Bonding of Electrical Equipment.
- .3 CAN/CSA 22.2 No. 41-13 Grounding and Bonding Equipment.
- .4 CAN/CSA-C22.2 No. 65-13 Wire Connectors.

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings of all components to be installed. Submit 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.
  - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .3 Indicate on drawings clearances for operation, maintenance, and replacement of equipment devices.
  - .4 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.

### 1.4 Quality Assurance

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

- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

## 1.5 **Delivery, Storage and Handling**

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

## 2. **PRODUCTS**

### 2.1 **Equipment**

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

### 3. EXECUTION

#### 3.1 Installation - General

- .1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .8 Install separate ground conductor to outdoor lighting standards.
- .9 Connect building structural steel and metal siding to ground by welding copper to steel.
- .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.
- .12 Ground secondary service pedestals.

#### 3.2 Equipment Grounding

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

#### 3.3 Grounding Busbar

- .1 Install copper grounding busbar mounted on insulated supports on wall of electrical room and communication equipment room.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground busbar with individual bare stranded copper connections size 2/0AWG, unless otherwise indicated.
- .3 Grounding busbars in telecommunication rooms must be used only for telecommunication equipments.

**3.4 Communication Systems**

- .1 Install grounding connections for telephone and telecommunication systems as follows:
  - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
  - .2 Install grounding connections for telecommunication cabinet in room 105A.

**3.5 Field Quality Control**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Using an earth ground tester similar to «Fluke 1630 Earth Ground Clamp», test the grounding loops around the buildings at each connection on the loop between the loop and each building column as well as the connection between the substation and the loop, and record the readings to be transmitted to the Departmental Representative.
- .5 Disconnect ground fault indicator during tests.

**3.6 Cleaning**

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

**End of Section**



## 1. GENERAL

### 1.1 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.2 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop drawings
  - .1 Submit drawings for all types of supports and hangers to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .3 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

### 1.3 Quality Assurance

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

### 1.4 Delivery, Storage and Handling

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

## 2. PRODUCTS

### 2.1 Hanger and Support

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted.
- .2 One-hole and two-holes steel straps.
- .3 Steel threaded rods and clips.

### 3. EXECUTION

#### 3.1 Installation

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels at 1.5 m on centre 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 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Departmental Representative.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .12 Statically supported and vibration isolated equipment and systems must be installed per Section 23 05 49.01 Seismic Restraint Systems (SRS) – type P2 Buildings.

#### End of Section

## 1. GENERAL

### 1.1 References

- .1 CAN/CSA C22.2 No.4-M1989(R009) Cutout, Junction and Pull Boxes
- .2 CAN/CSA C22.2 No.76-14 Splitters
- .3 CAN/CSA C22.1-12 Canadian Electrical Code, Part 1, 22th Edition

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Shop drawings
  - .1 Submit drawings for all the equipments and components to be installed.
  - .2 Indicate on drawings clearances for operation, maintenance, and replacement of equipment devices.
  - .3 If changes are required, notify the Departmental Representative of these changes before they are made.
- .3 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

### 1.4 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

### 1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- 2. PRODUCTS
  - 2.1 **Splitters**
    - .1 Not applicable.
  - 2.2 **Junction and Pull Boxes**
    - .1 Construction:welded steel enclosure.
    - .2 Covers Flush Mounted: 25 mm minimum extension all around.
    - .3 Covers Surface Mounted: screw-on turned edge covers.
  - 2.3 **Current Transformer Cabinet**
    - .1 Coordinate the dimensions with Qulliq Energy Corporation
    - .2 CSA Type 3R enclosure.
    - .3 Smooth, continuously welded seams without knockouts, cutouts or holes.
    - .4 Heavy gauge continuous hinges.
    - .5 Three (3) point padlocking door handle.
    - .6 Seamless poured-in place gasket for IP65.
    - .7 Grounding stud inside enclosure.
    - .8 Mounting channels welded inside enclosure.
    - .9 Dimensions: as required by Qulliq Energy Corporation.
- 3. EXECUTION
  - 3.1 **Splitter Installation**
    - .1 Not applicable.
  - 3.2 **Junction and Pull Boxes Installation**
    - .1 Install pull boxes in inconspicuous but accessible locations.
    - .2 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

**3.3 Current Transformer Cabinet**

- .1 Install wall mounted cabinet in the electrical room.
- .2 Install the current transformer inside the cabinet, coordinate the installation with Qulliq Energy Corporation.

**3.4 Identification**

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating voltage and phase, or as indicated.

**3.5 Cleaning**

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

**End of Section**

**1. GENERAL****1.1 References**

- .1 CAN/CSA C22.2 No.18.1-13 Metallic outlet boxes.
- .2 CAN/CSA C22.1-12 Canadian Electrical Code, Part 1, 22th Edition

**1.2 Definition**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.3 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings of all equipments to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

**1.4 Quality Assurance**

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

**1.5 Delivery, Storage and Handling**

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

## 2. PRODUCTS

### 2.1 Outlet and Conduit Boxes General

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

### 2.2 Galvanized Steel Outlet Boxes

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

### 2.3 Conduit Boxes

- .1 Cast FS aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices complete with vaportight aluminum cover, spring door type for single receptacle L6-30R.

### 2.4 Fittings - General

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

### 2.5 Service Fittings

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

**3. EXECUTION**

**3.1 Installation**

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

**3.2 Cleaning**

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

**End of Section**



## 1. GENERAL

### 1.1 References

- .1 CSA C22.2 No. 18.3-12 – Conduit, Tubing and Cable Fittings.
- .2 CSA C22.2 No. 85-14 – Rigid PVC Boxes and Fittings.
- .3 CSA C22.2 No. 45-M1981 (R2003) – Rigid Metal Conduit.
- .4 CSA C22.2 No. 83-M1985 (R2013) – Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2-06 (R2011) – Rigid PVC Conduit.
- .6 CSA C22.2 No. 56-13 – Flexible Metal Conduit and Liquid-tight Flexible Metal Conduit.
- .7 CSA C22.2 No. 2420-09 – Belowground Reinforced Thermosetting Resin Conduit and Fittings.
- .8 CSA C22.2 No. 227.3 – Non-Metallic Mechanical Protection Tubing.

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings of all equipments and components to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

### 1.4 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

**1.5 Delivery, Storage and Handling**

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

**1.6 Waste Management and Disposal**

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

**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.

**2.2 Conduits**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, aluminum threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

**2.3 Conduit Fastenings**

- .1 One hole steel straps to secure surface conduits 53 mm and smaller.
  - .1 Two hole steel straps for conduits larger than 53 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

## 2.4 Conduit Fittings

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.
- .2 Ensure factory "ells" where 90 degrees bends for 27 mm and larger conduits.
- .3 Watertight connectors and couplings for EMT.
  - .1 Set-screws are not acceptable.

## 2.5 Expansion Fittings for Rigid Conduit

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 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.
- .4 Expansion and deflection fitting assembly, PVC rigid conduit.

## 2.6 Fish Cord

- .1 Polypropylene.

## 3. EXECUTION

### 3.1 Manufacturer's Instructions

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

### 3.2 Installation

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Surface mount conduits as indicated.
- .4 Use rigid aluminum threaded conduit except where specified otherwise.
- .5 Use electrical metallic tubing (EMT) except in cast concrete.
- .6 Use rigid pvc conduit underground.
- .7 Use flexible metal conduit for connection to motors in dry areas.

- .8 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .9 Minimum conduit size for lighting and power circuits: 21 mm.
- .10 Install EMT conduit from branch circuit panel to outlet boxes located in crawl space.
- .11 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Mechanically bend steel conduit over 21 mm diameter.
- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install fish cord in empty conduits.
- .15 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.

### 3.3 Surface Conduits

- .1 In mechanical, electrical, telecommunication rooms and in areas where no finish on walls and ceilings is provided, run conduits on surface.
- .2 Run parallel or perpendicular to building lines.
- .3 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .4 Run conduits in flanged portion of structural steel.
- .5 Group conduits wherever possible on surface channels.
- .6 Do not pass conduits through structural members except as indicated.
- .7 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### 3.4 Concealed Conduits

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

### 3.5 Conduits in Cast-in-Place Concrete

- .1 Not applicable.

**3.6 Conduits Underground**

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

**3.7 Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**End of Section**

## 1. GENERAL

### 1.1 References

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

### 1.2 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

## 2. PRODUCTS

### 2.1 Cable Protection

- .1 38 x 140 mm planks pressure treated with clear 5% pentachlorophenol solution, water repellent preservative.

### 2.2 Markers

- .1 Inside building, concrete type cable markers: 600 x 600 x 100 mm with words: «cable, joint or conduit impressed in top surface», with arrows to indicate change in direction of cable and duct runs.

## 3. EXECUTION

### 3.1 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts 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 of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

### 3.3 Markers

- .1 Mark cable every 150 m along duct runs and changes in direction.
- .2 Mark underground splices.
- .3 Where markers are removed to permit installation of additional cables, reinstall existing markers.

### 3.4 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 Pre-acceptance tests:
  - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
  - .2 Check insulation resistance after each splice and/or 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.
  - .3 High Potential (Hipot) Testing.
    - .1 Conduct hipot testing at 100% of original factory test voltage in accordance with manufacturer's.
  - .4 Leakage Current Testing:
    - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
    - .2 Hold maximum voltage for specified time period by manufacturer.
    - .3 Record leakage current at each step.
- .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.

**3.5 Cleaning**

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

**3.6 Protection**

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

**End of Section**



**1. GENERAL****1.1 References**

- .1 CSA C22.2 No.56-13 Flexible metallic conduit and liquid-tight flexible metal conduit.

**2. PRODUCTS**

- .1 Motors supplied and installed by other trades.

**3. EXECUTION****3.1 Manufacturer's Instructions**

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

**3.2 Installation**

- .1 Dry out motor if dampness present in accordance with manufacturer's instructions.
- .2 Make wiring connections.
  - .1 Use liquid tight PVC jacketed flexible conduit between rigid conduit and motor.
- .3 Make flexible conduit long enough to permit movement of motor over entire length of slide rails.
- .4 Check for correct direction of rotation, with motor uncoupled from driven equipment.
- .5 Supply and install adaptor for motor connection.
- .6 Supply and install thermistor relay unit in corresponding starter compartment, as required.
- .7 Connect thermistor from motor to relay unit in starter, if supplied.

**3.3 Field Quality Control**

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

**3.4 Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**End of Section**

**1. GENERAL****1.1 References**

- .1 CSA C22.2 No.205-12 Signal equipment.
- .2 CAN/CSA C22.1-12 Canadian Electrical Code, Part 1, 22th Edition.

**1.2 Definition**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

**1.3 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings of equipment.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

**1.4 Quality Assurance**

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

**1.5 Delivery, Storage and Handling**

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

## 2. PRODUCTS

### 2.1 Materials

- .1 Photocontrol having the following features:
  - .1 Turn on at 10 to 50 lux;
  - .2 Turn off at 30 to 150 lux
  - .3 Turn ON and OFF: adjustable by moving a slide cover without tools
  - .4 Time delay: ON and OFF
  - .5 Temperature range: -40° to +60° C
  - .6 Fail mode: ON
  - .7 Switch: SPST
  - .8 Rating: 1800 W minimum, 120 V
  - .9 Works with LED lamps.
  - .10 Housing: heavy duty die cast zinc housing with threaded base for 16 mm conduit mounting.
- .2 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. Half size contactors not accepted.
  - .3 Breaker combination contactor as indicated.
  - .4 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
  - .5 Mount in NEMA Enclosure 12 unless otherwise indicated.
  - .6 Include following options in cover:
    - .1 Green indicating lamp.
    - .2 Hand-Off-Auto selector switch.
  - .7 Control transformer.

## 3. EXECUTION

### 3.1 Manufacturer's Instructions

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

### 3.2 Installation

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.
- .2 Install photocontrol facing North as indicated.
- .3 Install and connect the digital time clock as indicated.

### 3.3 Field Quality Control

- .1 Site Tests:
  - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

- .2      Actuate control units in presence of the Departmental Representative to demonstrate lighting circuits are controlled as designated.

**End of Section**

**1. GENERAL****1.1 Reference Standards**

- .1 CSA Group (CSA)
  - .1 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.

**1.2 Action and Informational Submittals**

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for network lighting controls and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
  - .2 Provide detailed sequence of operations describing system functions.
  - .3 Indicate on drawings:
    - .1 Complete assembly.
    - .2 Contact surfaces.
    - .3 Construction features.
    - .4 Wiring diagrams.

**1.3 Closeout Submittals**

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

**1.4 Delivery, Storage and Handling**

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions 01 61 00- Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect network lighting controls from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 1.5 Warranty

- .1 Manufacturer's warranty, with manufacturer start-up: 4 years warranty from date of acceptance:
  - .1 First two years:
    - .1 100 percent replacement parts coverage, 100 percent manufacturer labor coverage to troubleshoot and diagnose a lighting issue.
    - .2 First-available on-site or remote response time.
    - .3 Remote diagnostics for applicable systems.
  - .2 Last two years:
    - .1 Remote response time.
    - .2 Remote diagnostics for applicable systems.
  - .3 Telephone technical support: available 24 hours per day, 7 days per week, excluding manufacturer holidays.

## 2. PRODUCTS

### 2.1 COMPONENTS

- .1 Components: to CSA C22.1.
- .2 Designed for dimming and tuning lighting control.
- .3 Sensor modules.
- .4 Lighting control module.
- .5 Lighting management hub.
- .6 Lighting management system software.
- .7 Control stations.
- .8 Low-voltage control interfaces.
- .9 Wiring.
- .10 Accessories.

### 2.2 Lighting Control Module

- .1 Provide lighting control modules as indicated or as required to control the loads as indicated.
- .2 General Requirements:
  - .1 Listed to UL 508 as industrial control equipment.
  - .2 Delivered and installed as a listed factory-assembled panel.
  - .3 Passively cooled via free-convection, unaided by fans or other means.
  - .4 Mounting: Surface.
- .3 Connects to lighting management hub via RS485 cable.
- .4 LED status indicators confirm communication with occupancy sensors, daylight sensors, and IR receivers.

- .5 Contact Closure Input:
  - .1 Directly accept contact closure input from a dry contact closure or sold-state output without interface to:
    - .1 Activate scenes.
      - .1 Scene activation from momentary or maintained closure.
    - .2 Enable or disable after hours.
      - .1 Automatic sweep to user-specified level after user-specified time has elapsed.
      - .2 System will provide occupants a visual warning prior to sweeping lights to user-specified level.
      - .3 Occupant can reset timeout by interacting with the lighting system.
    - .3 Activate or deactivate demand response (load shed).
      - .1 Load shed event will reduce lighting load by user-specified amount.
- .6 Emergency Contact Closure Input:
  - .1 Turn all zones to full output during emergency state via direct contact closure input from UL 924 listed emergency lighting interface, security system or fire alarm system.
  - .2 Allow configurable zone response during emergency state.
  - .3 Disable control operation until emergency signal is cleared.
- .7 Supplies power for control link for keypads and control interfaces.
- .8 Distributes sensor data among multiple lighting control modules.
- .9 Capable of being controlled via wireless sensors and controls.
- .10 Digital Fixture Lighting Control Modules:
  - .1 Provides two-way feedback with digital fixtures for energy monitoring, light level status, lamp failure reporting, and /driver failure reporting.
  - .2 Provide testing capability using manual override buttons.
  - .3 Each low-voltage digital communication link to support up to 64 LED drivers.
  - .4 Product(s):
    - .1 **Lutron EcoSystem Energi Savr Node; Model QSN-2DALI-S: Two DALI Digital Links.**
  - .5 Equivalent to acceptable product: Wattstopper, Cristal Controls.

### 2.3 Lighting Management Hubs

- .1 Provided in a pre-assembled NEMA listed enclosure with terminal blocks listed for field wiring.
- .2 Connects to controls and power panels via RS485.
- .3 Enables light management software to control and monitor compatible dimming drivers, power panels, power modules, and window treatments.
  - .1 Utilizes Ethernet connectivity to light management computer utilizing one of the following methods:
    - .1 Dedicated network.
    - .2 Dedicated VLAN.
    - .3 Shared network with Building Management System (BMS).
    - .4 Corporate network where managed switches are configured to allow multicasting and use of IGMP.

- 
- .4 Integrates control station devices, power panels, preset lighting controls, and external inputs into a single customizable lighting control system with:
    - .1 Multiple Failsafe Mechanisms:
      - .1 Power failure detection via emergency lighting interface.
      - .2 Protection: Lights go to full on if ballast wires are shorted.
      - .3 Distributed architecture provides fault containment. Single hub failure or loss of power does not compromise lights and shades connected to other lighting management hubs.
    - .2 Manual overrides.
    - .3 Automatic control.
    - .4 Central computer control and monitoring.
    - .5 Integration with BMS via BACnet.
  - .5 Furnished with astronomical time clock.
  - .6 Maintains a backup of the programming in a non-volatile memory capable of lasting more than ten years without power.
  - .7 BACnet Integration Licence
    - .1 Provide ability to communicate by means of native BACnet IP communication (does not require interface) to lighting control system from a user-supplied 10BASE-T or 100BASE-T Ethernet network.
    - .2 Requires only one network connection per system.
    - .3 Lighting control system to be BACnet Test Laboratory (BTL) listed.
    - .4 Basic BACnet integration license:
      - .1 The BACnet integrator can command:
        - .1 Area light output.
        - .2 Area enable or disable after hours mode.
        - .3 Daylighting level.
        - .4 Area occupied and unoccupied level
        - .5 Occupancy sensor timeouts.
    - .5 BACnet Integration can monitor
      - .1 Area on/off status.
      - .2 Area occupancy status.
      - .3 Area fault.
        - .1 Lamp failures.
        - .2 Control devices not responding.
      - .4 Area load shed status.
      - .5 Area instantaneous energy usage and maximum potential power usage.
      - .6 Energy savings broken out by strategy (occupancy, timeclock, daylighting, personal control, tuning, load shed) down to the individual area.
      - .7 Enable/Disable:
        - .1 Daylighting.
        - .2 Timeclocks.
      - .8 Daylighting level.
      - .9 Light levels from photo sensors or Radio Window sensors.
      - .10 Area occupied and unoccupied level.
      - .11 Occupancy sensor timeouts.



- .8 Integration with other devices over Ethernet via Telnet.
- .9 Control other devices over Ethernet via TCP or Telnet by sending device specific strings.
- .10 **Product: Lutron Quantum Light Management Hub.**
- .11 Equivalent to acceptable product: Wattstopper, Cristal Controls.

## 2.4 Lithing Management System Software

- .1 Provide system software license and hardware that is designed, tested, manufactured, and warranted by a single manufacturer. The computer for the building management system is provided in the section 28 23 00.
- .2 Configuration Setup Software:
  - .1 Suitable to make system programming and configuration changes using a graphical floor plan view or a generic system layout.
  - .2 Windows-based, capable of running on either central server or a remote client over TCP/IP connection.
  - .3 Publish Graphical Floor Plan: Allows the user to publish new graphical floor plan files, allowing users to monitor the status of lights, occupancy of areas, and daylighting status.
  - .4 Back-Up Project Database: Allows the user to back up the project database that holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
  - .5 Publish Project Database: Allows the user to send a new project database to the server and download the new configuration to the system. The project database holds all the configuration information for the system, including keypad programming, area scenes, daylighting, occupancy programming, emergency levels, night lights, and time clock.
  - .6 Allows manufacturer (either remotely or with on-site service call) to:
    - .1 Capture system design:
      - .1 Geographical layout.
      - .2 Load schedule zoning.
      - .3 The following paragraph would only be included if motorized shades are to be controlled by the lighting control system.
      - .4 Shade grouping.
      - .5 Equipment schedule.
      - .6 Equipment assignment to lighting management hubs.
      - .7 Daylighting design.
    - .2 Define the configuration for the following in each area:
      - .1 Lighting scenes.
      - .2 The following paragraph would only be included if motorized shades are to be controlled by the lighting control system.
      - .3 Shade group presets.
      - .4 Control station devices.
      - .5 Interface and integration equipment.
      - .6 Occupancy/after hours.
      - .7 Partitioning.
      - .8 Daylighting.
      - .9 Emergency lighting.
      - .10 Night lights.

- .3 Startup:
  - .1 Addressing.
  - .2 Daylighting.
  - .3 Provide customized conditional programming.
- .3 Control and Monitor Software:
  - .1 **Product: Lutron Quantum Vue.**
  - .2 General Requirements:
    - .1 Web-based; runs on most HTML5 compatible browsers (including Internet Explorer, Chrome, and Safari).
    - .2 Supports multiple platforms and devices; runs from a tablet, desktop, laptop, or smartphone; optimized for displays of 1024 by 768 pixels or higher.
    - .3 User interface supports multi-touch gestures such as pinch to zoom, drag to pan, etc.
    - .4 Utilizes HTTPS (industry-standard certificate-based encryption and authentication for security).
    - .5 All functionality listed below must be available via a single application.
  - .3 Sequence of operations:
 

Digitally addressable fixtures shall have two input address, one for correlated colour temperature (CCT) and one for intensity. This allows for independent control of CCT and intensity to allow for shifts in CCT without affect intensity and dimming of the luminaires without affecting CCT. Luminaires which are controlled by warm/cool channels or use DALI type 8 are not allowed. Lighting control software shall be floorplan based and allow for independent control of CCT and intensity. The control systems shall automatically shift the CCT throughout the day as follows

	<b><i>CCT</i></b>
<b><i>5:30AM</i></b>	<i>2000K</i>
<b><i>6AM</i></b>	<i>2700K</i>
<b><i>6:30AM</i></b>	<i>3025K</i>
<b><i>7AM</i></b>	<i>3350K</i>
<b><i>7:30AM</i></b>	<i>3680K</i>
<b><i>8AM</i></b>	<i>4000K</i>
<b><i>8:30AM</i></b>	<i>4360K</i>
<b><i>9:00AM</i></b>	<i>4710K</i>
<b><i>9:30AM</i></b>	<i>5070K</i>
<b><i>10:00AM</i></b>	<i>5430K</i>
<b><i>10:30AM</i></b>	<i>5790K</i>
<b><i>11:00AM</i></b>	<i>6140K</i>
<b><i>11:30AM</i></b>	<i>6500K</i>
<b><i>12:00PM</i></b>	<i>6550K</i>
<b><i>12:30PM</i></b>	<i>6600K</i>
<b><i>1:00PM</i></b>	<i>6650K</i>
<b><i>1:30PM</i></b>	<i>6700K</i>

	<b><i>CCT</i></b>
<b><i>2:00PM</i></b>	<i>6600K</i>
<b><i>2:30PM</i></b>	<i>6500K</i>
<b><i>3:00PM</i></b>	<i>6190K</i>
<b><i>3:30PM</i></b>	<i>5880K</i>
<b><i>4:00PM</i></b>	<i>5560K</i>
<b><i>4:30PM</i></b>	<i>5250K</i>
<b><i>5:00PM</i></b>	<i>4940K</i>
<b><i>5:30PM</i></b>	<i>4600K</i>
<b><i>6:00PM</i></b>	<i>4310K</i>
<b><i>6:30PM</i></b>	<i>4000K</i>
<b><i>7:00PM</i></b>	<i>3560K</i>
<b><i>7:30PM</i></b>	<i>3130K</i>
<b><i>8PM</i></b>	<i>2700K</i>
<b><i>8:30PM</i></b>	<i>2350K</i>
<b><i>9PM</i></b>	<i>2000K</i>

CCT to be calibrated with fixture measurements by fixture manufacturer. Two wall controls will be provided in each area. One wall control will override CCT with preset levels for 6700K, 3500K, and 2000K as well as raise/lower of CCT. The CCT override will last one hour before going back to the CCT the luminaires would have been at based on the schedule. Between 9PM and 5:30AM the overridden level always goes back to 2000K. The luminaires will shift back to this level over ten seconds. The other wall control will set intensity of 100%, 50%, and 0% as well as raise/lower of intensity.

- .4 System Navigation and Status Reporting:
  - .1 Performed using graphical floor plan view or a generic system layout.
  - .2 Graphical Floor Plan View: Utilizes customized CAD based drawing of the building. Pan and zoom feature allows for easy navigation; dynamically adjusts the details presented based on zoom level.
  - .3 Area, scene, and zone names can be changed in real time.
  - .4 Adjustments can be made based on area type.
- .5 Control of Lights:
  - .1 Control and monitor zone/area lights.
    - .1 Area lights can be monitored for on/off status.
    - .2 All lights in an area can be turned on/off or sent to a specific level.
    - .3 For areas that have been zoned, these areas may be sent to a predefined lighting scene, and individual zones may be controlled.
    - .4 Area lighting scenes can be renamed and modified in real-time, changing the levels that zones go to when a scene is activated.
    - .5 High and low end of area lighting can be tuned/trimmed.
  - .2 Control and monitor area partition status from a graphical floor plan.

- 
- .6 Daylighting:
    - .1 Daylighting can be enabled/disabled. Can be used to override the control currently taking place in the space.
    - .2 The following is particularly useful when new departments move into a space.
    - .3 Daylight calibration can be adjusted for each daylit area.
    - .4 Daylight status can be monitored.
    - .5 Monitor energy savings due to daylight harvesting down to an individual area.
  - .7 Scheduling: Schedule time of day and astronomic time clock events to automate functions.
    - .1 Adjust or disable a single occurrence of a repeating scheduled event.
    - .2 Easily monitor and adjust scheduled events using a weekly calendar view.
  - .8 Reporting: Provide reporting capability that allows the building manager to gather real-time and historical information about the system as follows:
    - .1 Energy Reports: Show a comparison of cumulative energy used over a period of time for one or more areas.
    - .2 Power Reports: Show power usage trend over a period of time for one or more areas.
    - .3 Energy Density Report: Show energy usage in W/sq ft.
    - .4 Energy Savings By Strategy Report: Show energy savings for any area broken down by strategy (tuning, occupancy, daylighting, scheduled events, personal control, and load shedding).
    - .5 Activity Report: Show what activity has taken place over a period of time for one or more areas. Activity includes occupant activities (e.g. wall controls being pressed), building manager operation (e.g. controlling/changing areas using the control and monitor tool), and device failures (e.g. keypads or ballasts that are not responding).
    - .6 Sensor Level Report: Shows the light level in footcandles of any photosensor in the system.
    - .7 Alert Activity Report: Capable of generating historical reports of all alert activity within the system.
  - .9 Diagnostics: Allows the building manager to check on the status of all equipment in the lighting control system. Devices to be listed with a reporting status of OK, missing, or unknown.
  - .10 Alerts and Alarms: Monitors the system for designated events/triggers and automatically generates alerts according to configured response criteria.
    - .1 Capable of monitoring for the following events/triggers:
      - .1 A failed piece of equipment (e.g. ballast, control, sensor, etc.); alert cleared when equipment is replaced.
      - .2 A lamp outage (for compatible driver digital electronic dimming ballasts only); alert cleared when lamp is replaced.
      - .3 Low battery conditions in battery-operated sensors and controls; alert cleared when battery is replaced.
      - .4 Luminaires with lamp operating hours in excess of designated time.
      - .5 A load shed event; alert generated for beginning and end of trigger.
      - .6 Energy usage higher than designated threshold target.
      - .7 Potential light level condition discrepancies (daylight sensors not agreeing with expected lighting status).
      - .8 Potential sensor failures (Radio Window sensors that have not seen a change in light level).
    - .2 View alerts on a customized graphical floor plan.

- .3 Capable of generating alerts through visible changes in software or through email messages.
- .4 Capable of customizing the frequency of alerts and providing notifications immediately or through daily, weekly, or monthly summaries.
- .5 Capable of sending different alerts to different system users.
- .6 Capable of generating historical reports of all alert activity within the system.
- .11 Administration:
  - .1 Users: Allows new user accounts to be created and existing user accounts to be edited.
  - .2 Supports Active Directory (LDAP) tying user accounts to network accounts.
  - .3 Area and feature access can be restricted based on login credentials with assigned levels of access rights (Monitor, Control Only, Control and Edit, Admin) and customized access levels available.
  - .4 Quick Controls: Create shortcuts to activate customized system-wide actions, such as updating lighting and/or shade levels.
  - .5 Provides control/monitoring of partition status to automatically reconfigure how the space operates based on the partition's open/closed status.
  - .6 Variables: Used for custom program of a system and/or to signal a third party system. Any change may cause a change in the behavior of the system.
  - .7 View the current state of system variables across subsystems.
  - .8 Update the current variable state across all subsystems.
  - .9 Device Lock/Unlock: Allows the building manager to lock control station devices to prevent building occupants from activating their programming (button presses), until they are unlocked.
    - .1 Keypads can be locked to help ensure occupants cannot change light and shade levels in a public space during specific events or business hours.
    - .2 Keypads can be unlocked after events/during after hours to allow maintenance, cleaning, security, and others to perform their tasks without needing to contact a building manager.
- .12 Product: **Lutron Q-Design.**
- .13 Equivalent to acceptable product: Wattstopper, Cristal Controls.

## 2.5 Control Stations

- .1 Provide control stations with configuration as indicated or as required to control the loads as indicated.
- .2 Wired Control Stations:
  - .1 General Requirements:
    - .1 Power: Class 2 (low voltage).
    - .2 Provide stainless steel faceplates.
    - .3 Engraving must be durable when exposed to cleaning and normal wear.
    - .4 Borders, logos, and graduations to use laser engraving or silk-screened graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.
    - .5 Finish: White.
  - .2 Single-Scene or Zoned Wired Control:
    - .1 Turn an individual fixture or group of fixtures on and off.
    - .2 Raise and lower light levels.
    - .3 Recall favorite light levels.

- .3 Product: **Lutron Pico Wired Control**.
- .4 Equivalent to acceptable product: Wattstopper, Cristal Controls.

## 2.6 **Wired sensor module**

- .1 The wired sensor module is a ceiling-mounted device that integrates wired sensors and controls through the lighting control module.
- .2 Communicate sensor information to wired low-voltage digital link for use by compatible devices.
- .3 Capabilities of the following module: Up to 4 wired sensors per module.
- .4 Provide low-voltage control interfaces as indicated or as required to control the loads as indicated.
- .5 Connects to lighting management hub via RS485.
- .6 Product: Sensor module with wired inputs only; **Lutron Model QSMX-4W-C**.
- .7 Equivalent to acceptable product: Wattstopper, Cristal Controls.

## 2.7 **Cable Sets**

- .1 Provide all control cables needed for the network lighting controls.
- .2 Connects the control station to wired sensor module via 3#18AWG cable.
- .3 Connects the fixtures to Lighting Control module via 2#12AWG+2#18AWG cable.
- .4 Connects the wired sensor modules to lighting management hub via RS485 cable (GRX-CBL-46L).

## 2.8 **Central Control**

- .1 Complete with one end connected with mini quick-connector for connection to Smart-Light enclosure control port. Other end complete with locknutless box connector and prepared with 36 inch tails for connection to central control panel.

## 3. EXECUTION

### 3.1 **Examnation**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for network lighting controls installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of 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 system and components in accordance with manufacturer's instructions.
- .2 Install starter cables to circuit outlet boxes and connect to power circuit and energize.
- .3 Install Smart-Light enclosures as shown on drawings and connect starter cable to power-in plug.
- .4 Connect joiner cables to each of power-out receptacles to first luminaire of controlled circuit as shown.
- .5 Install joiner cables between interceptors in fixtures or equipment. Allow extra cable to facilitate removal and relocation of fixtures or equipment.
- .6 Install blanking plugs in unconnected receptacles.
- .7 Integrally moulded thermoplastic components to match colour identification system (i.e. black for normal power, red for emergency power).
- .8 Install low voltage switch kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.
- .9 Install sensor kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.
- .10 Install central control kit from each or grouped Smart-Light enclosure to central control panel as shown on drawings.
  - .1 Connect to control port of Smart-Light as indicated.
  - .2 Connections within central control panel as instructed by control manufacturer.

### 3.3 Field Quality Control

- .1 On completion of installation, manufacturer representative shall be notified to carry out site inspection and report any inconsistencies to the Departmental Representative. Corrections are to be implemented to comply with manufacturer's report.

### 3.4 Cleaning

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

### 3.5 Protection

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

### 3.6 Site Test and Inspection

- .1 Perform verification inspections and test in presence of Departmental Representative.
  - .1 Provide all necessary tools, ladders and equipment.
  - .2 Ensure appropriate subcontractor and manufacturer's representatives specialists are present for verification.
- .2 Testing :
  - .1 Verify that system is fully operational and meets all system performance requirements of this specification.
  - .2 Submit to Departmental Representative 2 copies of recorded system test measurements, along with pretest certification.
- .3 Performance testing:
  - .1 Make only operator adjustments required to show proof of performance.
  - .2 Test to demonstrate and verify that installed system complies with installation and technical requirements of this specification under operating conditions.
  - .3 Test results to be evaluated by Departmental Representative as either acceptable or unacceptable.
  - .4 Departmental Representative and Contractor to tour areas to insure that Systems and Subsystems are installed in place for proof of performance testing.

### 3.7 Training

- .1 The supplier is responsible for organizing and training session for at least two days of formation, hands-on training on site, using the purchased and installed system. This training shall cover all aspects of system operation, management and troubleshooting. The cost of this training shall be included in the tender price. The date must be planned and coordinated with the Departmental Representative.

### 3.8 As built drawings

- .1 The supplier shall furnish such shop drawings and diagrams as are reasonably required to clarify the details of work included in this tender.
- .2 At the conclusion of the project, the supplier shall provide one (1) set of "as built" drawings which indicate, for example, the location of all supplied equipment in the system, all electrical box identifications, and cable identifications as installed under the terms and conditions of the final contract.

### 3.9 Miscellaneous Hardware

- .1 Any miscellaneous hardware items, such as connectors, cable plugs, mounting brackets, not specified in this document but which are required to make up a fully operational system shall be provided by the supplier as part of his tender.



**3.10 Commissioning**

- .1 The supplier shall be responsible for verifying that each component of the system is fully operational and in conformity with the requirements specified within this document. He shall also be responsible for ensuring that all elements function together as a system in accordance with this document.
- .2 Commissioning shall be done in a phased manner as the installation of field equipment proceeds. It shall not be necessary for the computer to be installed and operational in order for commissioning of the system to begin. All field equipment shall be capable of being installed and programmed to operate in a stand-alone mode prior to installation of the computer.

**End of Section**

## 1. GENERAL

### 1.1 References

- .1 CSA International
  - .1 CAN/CSA-C22.2 No.47-13, Air-Cooled Transformers (Dry Type).
  - .2 CSA C9-02(R2007), Dry-Type Transformers.
  - .3 CAN/CSA-C802.2-12, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA).

### 1.2 Action and Informational Submittals

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

### 1.3 Closeout Submittals

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

### 1.4 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect dry type transformers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 2. PRODUCTS

### 2.1 Design Description

- .1 Design description:
  - .1 Type: ANN.
  - .2 3 phase, kVA as indicated, 600 V delta input, 120/208 V wye output, 60 Hz.
  - .3 Voltage taps: standard.

- .4 Insulation: Class 220, 150 degrees C temperature rise.
- .5 Basic Impulse Level (BIL): standard.
- .6 Hipot: standard.
- .7 Average sound level: standard
- .8 Impedance at 17 degrees C: standard
- .9 Enclosure: CSA type 3R with removable metal front panel.
- .10 Mounting: floor or wall, as indicated.
- .11 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .12 Copper windings.
- .13 Winding configuration to be as noted on drawings.
- .14 Harmonic Mitigating Phase Shifting transformers as indicated on drawings.
- .15 K-Rated Transformers as indicated on drawings.
- .16 Voltage Regulation to be 4% or better.

## 2.2 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 7.
- .3 Nameplate wording: as indicated on drawings.

## 3. EXECUTION

### 3.1 Examination

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

### 3.2 Installation

- .1 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.

- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

### **3.3 Cleaning**

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

### **3.4 Protection**

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

**End of Section**

## 1. GENERAL

### 1.1 References

- .1 CAN/CSA-C22.1 – Canadian Electrical Code, Part 1, 22th Edition

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings of all equipments to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.

### 1.4 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

### 1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 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.
- .4 Current transformer cabinet, Junction box, Pull box, Splitter box: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets, size as indicated.

## 3. EXECUTION

### 3.1 Examination

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

### 3.2 Installation

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

**3.3 Cleaning**

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

**End of Section**

## 1. GENERAL

### 1.1 References

- .1 CAN/CSA-C22.2 No.29-11 – Panelboards and Enclosed Panelboards.

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings of all equipments and components to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of work, load balance report as described in PART 3 – LOAD BALANCE.

### 1.4 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

### 1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.



- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 2. PRODUCTS

### 2.1 Panelboards

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
  - .1 Install circuit breakers in panelboards before shipment.
  - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 CSA Type 3R enclosure.
- .3 600 V panelboards; bus bracing and breakers rated 22 KA.
- .4 250 V panelboards: bus and breakers rated for 10 000 A (symmetrical) interrupting capacity or as indicated.
- .5 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.
- .6 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .7 Minimum of 2 flush locks for each panel board.
- .8 Two keys for each panelboard and key panelboards alike.
- .9 Copper bus with neutral of same ampere rating of mains.
- .10 Mains: suitable for bolt-on breakers.
- .11 Trim with concealed front bolts and hinges.
- .12 Trim and door finish: baked enamel.
- .13 Isolated ground bus.
- .14 Include grounding busbar with 3 terminals for bonding conductor equal to breaker capacity of the panel board.

### 2.2 Breakers

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping or electronic tripping unit in panelboards as indicated.

- .3 Main breaker with electronic tripping unit: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position is open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated for each panelboard. Turn over unused lock-on devices to the Departmental Representative.
- .5 Lock-on devices for breakers feeding: receptacles as indicated, and fire alarm, clock outlet, emergency lighting and, stairway circuits and as indicated in the panel schedule.

### 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 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

## 3. EXECUTION

### 3.1 Examination

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

### 3.2 Installation

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00 - Rough Carpentry. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.
- .5 For each panelboard, provide three (3) additional empty conduits from the panel to a pull box located under the slab or above the suspended ceiling, for future use.
- .6 Circuit boards must be installed and wired in each panelboard by the panel manufacturer.

**3.3 Cleaning**

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

**3.4 Protection**

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

**End of Section**

## 1. GENERAL

### 1.1 References

- .1 CAN/CSA-C22.2 No.65-13 Wire Connectors.
- .2 CAN/CSA-C22.2 No.18.1-13 Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .3 CSA C22.2 No.42-10 General use receptacles, attachment plugs and similar wiring devices.
- .4 CSA C22.2 No.111-10 General use snap switches.
- .5 CSA C22.2 No.42.1-13 Cover plates for flush-mounted wiring devices.
- .6 CSA C22.2 No.55-M1986(R2012) Special Use Switches.
- .7 International Electrotechnical Commission
  - .1 IEC 60309 Pin and Sleeves Wiring Devices

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings of all wiring devices types to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

### 1.4 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

## 1.5 Delivery, Storage and Handling

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

## 2. PRODUCTS

### 2.1 Switches

- .1 **All switches are to be Specification grade, white color.**
- .2 Switch single pole, 15 A, 120 V, back and side wire up to 10AWG wire, White.
- .3 Specification grade, 15 A 120 V three way switches, back and side wire up to 10AWG.
- .4 Single pole combination switch and pilot light, 15 A, 120 V, back and side wire up to 10AWG wire.
- .5 Occupancy sensing wall switch in 180 degrees, over a detection area of 25 m2, via ultrasonic and passive infrared and ultrasonic technology, with light level and manual override.
- .6 Switches of one manufacturer throughout project.

### 2.2 Receptacles

- .1 **All receptacles are to be Specification grade, tamper resistant, white color.**
- .2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
  - .1 White urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and riveted grounding contacts.
- .3 Single receptacles CSA type 5-20 R, 125 V, 20 A, U ground with following features:
  - .1 White urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Four back wired entrances, 2 side wiring screws.
- .4 Other receptacles with ampacity and voltage as indicated.
- .5 Ground Fault receptacles receptacle CSA type 5-20 R, 20A, 120V, test and reset buttons, White.

- .6 Receptacles of one manufacturer throughout project.
- .7 **Receptacles connected on emergency circuits must be red.**

### 2.3 Special Wiring Devices

- .1 Combined disconnect/receptacle.
  - .1 Disconnect switch and receptacle in one compact non-metallic enclosure.
  - .2 Watertight enclosure IP67.
  - .3 Horsepower rated disconnect switch mounted on DIN rail.
  - .4 Lockable handle.
  - .5 Watertight conduit hub and ground plate.
  - .6 Capture neoprene gasket on cover.
  - .7 Enclosure housing with brass inserts and stainless steel screws.
  - .8 Adjustable mounting feet.
  - .9 Three (3) molded-in conduit drill points.
  - .10 Pre-wired IEC pin and sleeve receptacle.
  - .11 Replaceable spring-loaded liftcover with gasket.
  - .12 Two-stage interlocking mechanism:
    - .1 Switch cannot be turn ON until plug is completely engaged.
    - .2 Plug cannot be removed until the switch is turned OFF.
  - .13 Colour coded rating pad and receptacle mount.
  - .14 Rating:
    - .1 60A, 3P/4W/600V/3 Phases.
  - .15 Combined disconnect/receptacle must be supplied with mating plug.
- .2 Intelligent Parking Lot Controller
  - .1 Cast metal case with weather proof cover.
  - .2 Receptacle 15A, 120V, for car block heater.
  - .3 Microprocessor and temperature sensors
  - .4 Four (4) indicating LED : two (2) red and two (2) green.
  - .5 Electronics embedded in weatherproof elastomer block.
  - .6 Handles two (2) circuits with factory programming.
  - .7 Mounts on FS back box.
  - .8 IPLC no. M210-15, or equivalent.

### 2.4 Cover Plates

- .1 **High impact nylon, white colour to suit device, for indoor and dry location.**
- .2 **Stainless steel for technical rooms.**
- .3 Weather cover, die-cast aluminum, duplex opening, self-closing lids, complete with installation hardware and gasket, suitable for receptacle or switch.
- .4 Cover plates from one manufacturer throughout project.

### 3. EXECUTION

#### 3.1 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of the Departmental Representative.
  - .2 Inform the 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 the 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.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Where split receptacle has one portion switched, mount vertically and switch upper portion.
  - .3 Install GFI and AFI type receptacles as indicated.
- .3 Cover plates:
  - .1 Install suitable common cover plates where wiring devices are grouped.
  - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

#### 3.3 Cleaning

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

**End of Section**

**1. GENERAL****1.1 References**

- .1 CSA C22.2 No.106-05(R2010) HRC Miscellaneous Fuses.

**1.2 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings of each type of fuses to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

**1.3 Quality Assurance**

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

**1.4 Delivery, Storage and Handling**

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

**1.5 Extra Materials**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Six spare fuses of each type and size installed up to and including 200 A.



2. PRODUCTS

2.1 **Fuse Types**

- .1 Class J fuses.
  - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type J2, fast acting.
- .2 Fuses: product of one manufacturer.

3. EXECUTION

3.1 **Installation**

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Install spare fuses in fuse storage cabinet.

**End of Section**

## 1. GENERAL

### 1.1 References

- .1 CAN/CSA-C22.2 No.5-13 Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings for each type of breakers.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
- .5 All moulded case circuit breakers must come from the same manufacturer.
- .6 The contractor must provide signed documents by which the manufacturer supplying the moulded case circuit breakers confirms that the breakers are original, new and manufactured in North America or Mexico. Used, repaired, rebuilt or counterfeit moulded case breakers are not acceptable.

### 1.4 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

### 1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 2. PRODUCTS

### 2.1 Breakers General

- .1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .4 Circuit breakers to have minimum 10 kA symmetrical rms interrupting capacity rating for panel 120/208V, or as indicated.
- .5 Circuit breakers to have minimum 22 kA symmetrical rms interrupting capacity rating for panel 347/600V, or as indicated.
- .6 All moulded circuit breakers are new; repaired, rebuilt or counterfeit breakers are not acceptable.
- .7 **Provide moulded-case circuit breakers, ground-fault circuit-interrupters.**
- .8 **Provide moulded-case circuit breakers, arc-fault circuit-interrupters.**

### 2.2 Thermal Magnetic Breakers

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

## 3. EXECUTION

### 3.1 Installation

- .1 Install circuit breakers as indicated.

### 3.2 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.

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

**End of Section**

## 1. GENERAL

### 1.1 References

- .1 CAN/CSA-C22.2 No.4-04(R2009) - Enclosed and Dead-Front Switches
- .2 CSA C22.2-39-13 Fuseholder assemblies

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit drawings for each type of switches.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

### 1.4 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

### 1.5 Delivery, Storage and Handling

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

## 2. PRODUCTS

### 2.1 Disconnect Switches

- .1 Fusible or Non-fusible heavy duty disconnect switch in CSA enclosure type 1 or as indicated on drawings, to CAN/CSA-C22.2 No.4, size as indicated on drawing.
- .2 Fusible and non-fusible switches are 100% load break and 100% load make rated.
- .3 Horsepower rated.
- .4 Non-fusible switches are 100% fully rated.
- .5 Triple padlocking *capability* in “On”-“Off” switch position.
- .6 Mechanically interlocked door to prevent opening when handle in ON position.
- .7 Switches are provided with safety interlock to prevent placing the switch in the ON position when the door is opened.
- .8 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .9 Fuseholders: to CSA C22.2 No.39 suitable without adaptors, for type and size of fuse indicated.
- .10 Quick-make, quick-break action.
- .11 ON-OFF switch position indication on switch enclosure cover.
- .12 **Complete with 2 normally open and 2 normally closed auxiliary contacts.**

### 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 nameplate.

**3. EXECUTION****3.1 Examination**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of 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 disconnect switches complete with fuses if applicable.
  - .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.

**3.3 Cleaning**

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

**3.4 Protection**

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

**End of Section**

**1. GENERAL****1.1 References**

- .1 International Electrotechnical Commission (IEC)
  - .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.
- .2 CSA International
  - .1 CSA C22.2 No.14-13 Industrial Control Equipment.

**1.2 Action and Informational Submittals**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Territory of Nunavut, Canada.
    - .2 Provide shop drawings for each type of starter to indicate:
      - .1 Mounting method and dimensions.
      - .2 Starter size and type.
      - .3 Layout and components.
      - .4 Enclosure types.
      - .5 Wiring diagram.
      - .6 Interconnection diagrams.

**1.3 Closeout Submittals**

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.
- .3 Extra Materials:
  - .1 Provide listed spare parts for each different size and type of starter.
    - .1 3 contacts, stationary.
    - .2 3 contacts, movable.
    - .3 1 contact, auxiliary.
    - .4 1 control transformers.
    - .5 1 operating coil.
    - .6 2 fuses.
    - .7 10% indicating lamp bulbs used.



**1.4 Delivery, Storage and Handling**

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

**2. PRODUCTS****2.1 Materials**

- .1 Starters: to IEC 947-4 with AC4 utilization category.

**2.2 Manual Motor Starters**

- .1 Single Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 One Three overload heaters, manual reset, trip indicating handle.
- .2 Accessories:
  - .1 Pushbutton Toggle Key switch: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating light: standard heavy duty oil tight type and colour as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

**2.3 Full Voltage Magnetic Starters**

- .1 Magnetic combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
  - .1 Contactor solenoid operated, rapid action type.
  - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3 Wiring and schematic diagram inside starter enclosure in visible location.
  - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include fused disconnect switch motor circuit interrupter circuit breaker with operating lever on outside of enclosure to control disconnect motor circuit interrupter circuit breaker, and provision for:
  - .1 Locking in "OFF" position with up to 3 padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Pushbuttons Selector switches: standard heavy duty oil tight labelled as indicated.
  - .2 Indicating lights: standard heavy duty oil tight type and color as indicated.
  - .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

## 2.4 Control Transformer

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

## 2.5 Accessories

- .1 Pushbutton: heavy duty, oil tight as required.
- .2 Selector switches: heavy duty, oil tight as required.
- .3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

## 2.6 Finishes

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

## 2.7 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label, white plate, black letters, size 5 engraved as indicated.

## 3. EXECUTION

### 3.1 Installation

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

### 3.2 Field Quality Control

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

**3.3 Cleaning**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

**End of Section**

**1. GENERAL****1.1 References Standards**

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE C62.41-2002, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 ASTM International Inc.
  - .1 ASTM F1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .3 CSA Group (CSA).
- .4 CAN/CSA-C22.2 No.65 Wire Connectors.
- .5 CAN/CSA-C22.2 No.18.1-13 Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .6 EEMAC 1Y-2 Bushing Stud Connectors and Aluminum Adapters.
- .7 ICES-005-07, Radio Frequency Lighting Devices.
- .8 Underwriters' Laboratories of Canada (ULC).

**1.2 Action and Informational Submittals**

- .1 Provide submittals in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide complete photometric data for approval by Departmental Representative.
- .3 Samples:
  - .1 Provide samples for approval by Departmental Representative.
- .4 Quality assurance submittals: provide following in accordance with Section 01 45 00- Quality Control :
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
- .5 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

**1.3 Quality Assurance**

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

- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in provincial apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

#### 1.4 **Delivery, Storage and Handling**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

### 2. **PRODUCTS**

#### 2.1 **Lamps**

- .1 Light Emitting Diodes (LED) as indicated in luminaire description.

#### 2.2 **Ballasts**

- .1 Not applicable.

#### 2.3 **LED Drivers**

- .1 Drivers for LED modules as indicated in luminaire description.

#### 2.4 **Finishes**

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

#### 2.5 **Optical Control Devices**

- .1 As indicated in luminaire description.

## 2.6 Luminaires

## .1 Type L1-04:

- .1 Description: Dynamic White suspended direct/indirect LED luminaire, to be suspended on aircraft cables from ceiling. Open aperture design with fully luminous interior. No horizontal lenses or diffusers. No direct view of the light source.
- .2 Housing: Anodised, extruded and machined architectural grade aluminium. Stainless steel fasteners.
- .3 Mounting method : Suspended by stainless steel aircraft cable. Site adjustable with cable grippers.
- .4 Optics : Anidolic optical structures with linear light extraction elements. Precision extruded high transmittance clear acrylic lenses. Dynamic white LED array with range from 2700-6500K.
- .5 Lighting Distribution: Diffuse 15% Up, 85% Down.
- .6 Enclosure rating: Dry locations.
- .7 Enclosure color: Clear anodized.
- .8 **Driver: 120V integral electronic driver, dimmable and color temperature control. Driver Lumenetix, eldoLED DUALdrive LightShape or equivalent. The driver must be 100% compatible with the Network lighting control system, to be coordinated with the control supplier.**
- .9 LV power cords and aircraft cables: to be coordinated, variable from 1,5 meter to 3.
- .10 Light source: LEDs source, 38 watts/4ft, 4550 lumens/4ft. Tested in accordance with LM-79/LM-80 8 (results and calculated per IESNA TM-21-11 methodology). 200 000hrs@L70.
- .11 Color temperature: Dynamic white LED (variable from 2700°K to 6500 °K).
- .12 Light output: 4550 Lumens/4ft or higher at 25°C.
- .13 Power and Voltage: 38W/4ft at 120V, 60 Hz.
- .14 Dimensions: Length: 1230mm x Width: 83 mm x Height: 79 mm.
- .15 Fixture weight = ± 3.6 Kg/4ft.
- .16 Operating Temperature: max.: 35°C.
- .17 Controls: Network lighting control (dimmable and color temperature control).
- .18 Standard Certification: CSA.
- .19 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.
- .20 Typical appearance for type L1-04:



- .21 Acceptable Product :
  - .1 Lumenpulse serie FLUXWERX model PF1-F-D-D-W2-A-04-S-M-12 (Network lighting control driver).
- .22 Equivalent to acceptable product: Axis Lighting, Lumenwerx.

- .2 Types L1-06:
  - .1 Dimensions: Length: 1828mm x Width: 83 mm x Height: 79 mm.
  - .2 Typical appearance for type L1-06:



- .3 Acceptable Product :
  - .1 Lumenpulse serie FLUXWERX model PF1-F-D-D-W2-A-06-S-M-12 (Network lighting control driver).
  - .4 Equivalent to acceptable product: Axis Lighting, Lumenwerx.
- .3 Type L1A:
  - .1 Description: Suspended direct/indirect LED luminaire, to be suspended on aircraft cables from ceiling. Open aperture design with fully luminous interior. No horizontal lenses or diffusers. No direct view of the light source.
  - .2 Housing: Anodised, extruded and machined architectural grade aluminium. Stainless steel fasteners.
  - .3 Mounting method : Suspended by stainless steel aircraft cable. Site adjustable with cable grippers.
  - .4 Optics : Anidolic optical structures with linear light extraction elements. Precision extruded high transmittance clear acrylic lenses.
  - .5 Lighting Distribution: Diffuse 15% Up, 85% Down.
  - .6 Enclosure rating: Dry locations.
  - .7 Enclosure color: Clear anodized.
  - .8 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.
  - .9 LV power cords and aircraft cables: to be coordinated, variable from 1,5 meter to 3.
  - .10 Light source: LEDs source, 38 watts, 4550 lumens. Tested in accordance with LM-79/LM-80 8 (results and calculated per IESNA TM-21-11 methodology). 200 000hrs@L70.
  - .11 Color temperature: 3000°K.
  - .12 Light output: 4550 Lumens or higher at 25°C.
  - .13 Power and Voltage: 38W at 120V, 60 Hz.
  - .14 Dimensions: Length: 1230mm x Width: 83 mm x Height: 79 mm.
  - .15 Fixture weight = ± 3.6 Kg.
  - .16 Operating Temperature: max.: 35°C.
  - .17 Controls: Switch On/Off.
  - .18 Standard Certification: CSA.
  - .19 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.

- .20 Typical appearance for type L1A:




- .21 Acceptable Product :  
.1 Lumenpulse serie FLUXWERX model PF1-F-D-D-30-A-04-S-F2-M-12.  
.22 Equivalent to acceptable product: Axis Lighting, Lumenwerx.

.4 Type L2:

- .1 Description: Indoor, recessed 2x2 LED panel light with lightweight aluminum frame. The frame houses three layers, LED chips, a light guide and an opal PMMA lens for soft illumination.  
.2 Housing: Aluminum frame with anti-static thermoplastic coating.  
.3 Mounting method: Mounting with spring clips brackets on housing sides; to ceiling framing.  
.4 Optics: Opal PMMA lens. The fixture lens provides 110° beam spread.  
.5 Lighting Distribution: symmetrical diffuse  
.6 Accessories: Recessed mounting clips for use with LED panel.  
.7 Enclosure rating: Dry locations  
.8 Enclosure color: White  
.9 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.  
.10 Light source: LEDs, 40 watts, 4200 lumens/603x603mm. Tested in accordance with LM-79/LM-80 8 (results and calculated per IESNA TM-21-11 methodology). Designed to 50 000hrs@L70.  
.11 Light output: 4200 Lumens or higher at 25°C.  
.12 Color temperature at 3000°K and CRI >=80.  
.13 Power and Voltage: 40W at 120V, 60 Hz;  
.14 Dimensions: Square form, Length: 603 mm x Width: 603 mm x Height: 10 mm (48 mm total height with the driver).  
.15 Operating Temperature: max.: 40°C.  
.16 Controls: Switch On/Off.  
.17 Standard Certification: CSA  
.18 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.  
.19 Typical appearance for type L2:





- .20 Acceptable Product :
- .1 Liteline model LEDP-22-WH-30-40-120/277.
- .21 Equivalent to acceptable product: RayonLED, STANPRO.
- .5 Type L3-04:
- .1 Description: Dynamic White Cove linear LED luminaire, to be surface mount.
- .2 Housing: Extruded aluminium and die cast aluminum end cap.
- .3 Mounting method : Surface mount.
- .4 Optics : SurroundLite optics with 180 degree distribution. Dynamic white LED array with range from 2700-6500K.
- .5 Lighting Distribution: Diffuse 15% Up, 85% Down.
- .6 Enclosure rating: Dry locations.
- .7 Enclosure color: Clear anodized.
- .8 **Driver: 120V integral electronic driver, dimmable and color temperature control. Driver Lumenetix or equivalent. The driver must be 100% compatible with the Network lighting control system, to be coordinated with the control supplier.**
- .9 Light source: LEDs source, 13.5 watts/ft, 1100lumens/ft. Tested in accordance with LM-79/LM-80 8 (results and calculated per IESNA TM-21-11 methodology). 50 000hrs@L80.
- .10 Color temperature: Dynamic white LED (variable from 2700°K to 6500 °K).
- .11 Light output: 1100 Lumens/feet or higher at 25°C.
- .12 Power and Voltage: 13.5W/feet at 120V, 60 Hz.
- .13 Dimensions: Length: 1230mm x Width: 90 mm x Height: 41 mm.
- .14 Fixture weight = ± 2.7 Kg.
- .15 Operating Temperature: max.: 35°C.
- .16 Controls: Network lighting control (dimmable and color temperature control).
- .17 Standard Certification: CSA.
- .18 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.
- .19 Typical appearance for type L3-04:
- 
- .20 Acceptable Product :
- .1 Axislighting serie CovePerfect model: CCH-SL-1100-80-CL2-W-120((Network lighting control driver).
- .21 Equivalent to acceptable product: Lumenpulse, Philipps, Lithonia.
- .6 Types L3-02:
- .1 Description: Same characteristic as type L3-04, except for the following features:
- .2 Dimensions: Length: 609mm x Width: 90 mm x Height: 41 mm.

- .3 Typical appearance for type L3-02:



- .4 Acceptable Product :

.1 Axislighting serie CovePerfect model: CCH-SL-1100-80-CL2-W-120((Network lighting control driver).

- .5 Equivalent to acceptable product: Lumenpulse, Philipps, Lithonia.

- .7 Types L3-05:

.1 Description: Same characteristic as type L3-04, except for the following features:

.2 Dimensions: Length: 1524mm x Width: 90 mm x Height: 41 mm.

- .3 Typical appearance for type L3-05:



- .4 Acceptable Product :

.1 Axislighting serie CovePerfect model: CCH-SL-1100-80-CL2-W-120((Network lighting control driver).

- .5 Equivalent to acceptable product: Lumenpulse, Philipps, Lithonia.

- .8 Type L4:

.1 Description: Architectural Downlight, round 100mm apertume for general lighting distribution recessed in tile or gypsum ceiling. Design for new construction. Light engine, optics, and driver accessible from below ceiling.

.2 Enclosure: 16-gauge galvanised steel construction, standard 51mm aperture throat to accommodate all standard and extra-thick ceilings and provide flexibility in mounting within grid. Housing and trim to be supplied as one complete unit.

.3 Housing finish: Initial color within a 3-step MacAdam Ellipse.

.4 Mounting method: Recessed in tile or gypsum ceiling ceiling. When use in tile ceiling, T - bar clips are included. Provided with quick mounting brackets and carrying channels.

.5 Optics: Low brightness parabolic spun Alzak aluminum cone, 2mm thick with polished radius and continuous self-flange.

.6 Enclosure rating: Dry location

.7 Enclosure color: White

.8 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.

.9 Light source: High efficiency and performance LEDs mixing the light from red and unsaturated yellow LEDs to create beautiful, warm, white light. 60,000 hour rated life (defined as 70% lumen maintenance.).

.10 Color temperature: 3000 °K.

.11 Light output: Initial Delivered Lumens 2500 lumens or higher at 25°C Ambient.

.12 Power and Voltage: 29 W at 120V, 60 Hz; P.F.: >0.9

- .13 Dimensions: Round form, diameter: 133mm mm x Height: 168mm.
- .14 Controls: Switch On/Off.
- .15 Standard Certification: ETL or cUL
- .16 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.
- .17 Typical appearance for type L4:



- .18 Acceptable Product :
  - .1 Gotham, model: EVO-30-25-4AR-WD-LSS-120-EZ10
- .19 Equivalent to acceptable product: Axis Lighting, Philips, Lithonia.

- .9 Type L5:
  - .1 Description: Suspended direct LED strip, to be suspended on cables from ceiling.
  - .2 Housing: Channel and cover are formed from code-gauge, cold-rolled steel.
  - .3 Housing finish: Baked white enamel and five-stage phosphate pre-treatment
  - .4 Mounting method: Suspended by aircraft cable with hook.
  - .5 Optics: Diffuse lens.
  - .6 Lighting Distribution: Diffuse 100% Down.
  - .7 Enclosure rating: Damp locations.
  - .8 Enclosure color: White
  - .9 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.
  - .10 Light source: LEDs, 42 watts. Tested in accordance with LM-79-08/LM-80 (results and calculated per IESNA TM-21-11 methodology). Designed to 100 000hrs@L70.
  - .11 Color temperature: 3500 °K.
  - .12 Light output: 3000 Lumens or higher at 25°C.
  - .13 Power and Voltage: 42W at 120V, 60 Hz
  - .14 Dimensions: Length: 1222mm x Width: 8.3 mm x Height: 8.9 mm.
  - .15 Fixture weight = ± 3.6 Kg.
  - .16 Operating Temperature: max.: 35°C.
  - .17 Controls: Switch On/Off.
  - .18 Standard Certification: CSA
  - .19 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.

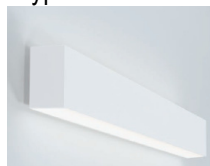
- .20 Typical appearance for type L5:




- .21 Acceptable Product :  
.1 Lithonia Lighting, model ZL2N-L48-3000LM-MDD-MVOLT-35K-80CRI-WH-ZACVH  
.22 Equivalent to acceptable product:  
.1 Philips, Cooper, Hubbell.

- .10 Type L6:

- .1 Description: Wall mounted direct/indirect double optic linear LED luminaire with integral line voltage driver. Fixtures are slim footprint with no visible LED dots or socket shadows.  
.2 Housing: Extruded aluminum housing with cast aluminum end caps  
.3 Housing finish: Electro-statically applied polyester powder coat finish.  
.4 Mounting method: Wall mounted.  
.5 Optics: Frosted extruded acrylic lens with wide flood direct/indirect optic.  
.6 Enclosure rating: Dry location with IK05 rating.  
.7 Enclosure color: White.  
.8 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.  
.9 Light source: LEDs, 6 watts/ft, direct 492 lumens/305mm, indirect 506 lumens/ft. Tested in accordance with LM-79-08/LM-80 (results and calculated per IESNA TM-21-11 methodology). Designed to 100 000hrs@L70.  
.10 Color temperature: 3000°K.  
.11 Light output: direct 985 lumens/ft, indirect 492 lumens/ft or higher at 25°C.  
.12 Power and Voltage: Direct 12W/ft, indirect 6W/ft at 120V, 60 Hz.  
.13 Dimensions: Length: 1216 mm, Width: 115 mm x Height: 84 mm.  
.14 Fixture weight = 0.95 kg/314mm  
.15 Operating Temperature: max.: -25 to 50°C.  
.16 Controls: Switch On/Off.  
.17 Standard Certification: CUL  
.18 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.  
.19 Typical appearance for type L6:



- .20 Acceptable Product :  
.1 LUMENPULSE serie Lumenline Direct/Indirect, model LLI2S-WM-DI-120-SU4-dHO30K-WFL- iRO30K-WFL-DIM-WH

- .21 Equivalent to acceptable product:
  - .1 Axis Lighting, Lithonia Lighting, Philipps.
- .11 Type L7:
  - .1 Description: Surface mounted fixture to use for under cabinet task lighting with on/off rocker switch.
  - .2 Housing: Aluminum housing.
  - .3 Mounting method: surface mounted to millwork.
  - .4 Optics: Frosted acrylic lens
  - .5 Lighting Distribution: Diffuse direct
  - .6 Enclosure rating: Damp location
  - .7 Enclosure color: White
  - .8 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.
  - .9 Light source: 7.5watts/ft, 420lumens/ft. Tested in accordance with LM-79-08/LM-80 (results and calculated per IESNA TM-21-11 methodology). Designed to 50 000hrs@L70.
  - .10 Color temperature at 3000°K and CRI >=90.
  - .11 Light output: 67lumens/ft or higher at 25°C.
  - .12 Power and Voltage: 6W/ft at 120V, 60 Hz;
  - .13 Dimensions: Width: 9.2 mm x Height: 2.54 mm, Length: as indicated in drawings.
  - .14 Fixture weight = 0.66kg
  - .15 Operating Temperature: max.: -25 to 50°C.
  - .16 Controls: on/off rocker switch.
  - .17 Standard Certification: CUL
  - .18 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.
  - .19 Typical appearance for type L7:
 
- .20 Acceptable Product :
  - .1 Lithonia Lighting, model UCLD-30K-90CRI-SWR-WH (Length as indicated in drawings, to be coordinated with furniture).
- .21 Equivalent to acceptable product: Philips, Cooper, Hubbell.
- .12 Type L9:
  - .1 Description: Vandal resistant Outdoor LED wall pack fixture. Fixture with full cut-off optics to achieve completely unobtrusive illumination. It provides water protection in the form of a drip cap over the doorway.
  - .2 Housing: Marine grade extruded aluminum.
  - .3 Housing Finish: Polyester powder coat.
  - .4 End caps: Die-cast marine grade aluminum continuously welded to housing. All welds ground smooth.

- .5 Mounting method: Wall mounted, designed to provide quick mounting to housing and secured with two captive stainless steel head TORX screws.
- .6 Lens frame: Marine grade heat treated extruded aluminum, clear anodises. Secured to fixture via integral concealed hinge and tree captive stainless steel TORX head screws.
- .7 Lens: UV stabilized diffused extruded polycarbonate.
- .8 Reflector: Electrostatically brightened anodised aluminum PVD coated and absolutely color free of iridescence. Shaped to provide full cutoff, LED point dispersion and maximum efficiency.
- .9 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.
- .10 Gaskets: Closed cell self-adhesive neoprene to provide watertight seal between fixture and wall and fixture and lens frame.
- .11 Controls: Control via exterior lighting control panel.
- .12 Color temperature: 3500°K and CRI >=70.
- .13 Light output: 1230 lumens/ ft or higher at 25°C.
- .14 Power and Voltage: 12 W/ft at 120V, 60 Hz; P.F.:>0.9, T.H.D.:<20% .
- .15 Dimensions: Length: 320mm x Width: 54 mm x Height: 36 mm.
- .16 Enclosure rating: Suitable for WET location.
- .17 Enclosure color: Silver.
- .18 Operating Temperature: Min.-40°C, max.: 40°C.
- .19 Standard Certification: cUL.
- .20 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.
- .21 Typical appearance for type L9:



- .22 Acceptable Product :
  - .1 Kenall, model FNL6-12-CC-CP-1-12L35K-DCC-1-120-9500
- .23 Equivalent to acceptable product:
  - .1 Philips, Lithonia, Cooper, Hubbell.
- .13 Type L11:
  - .1 Description: Exterior LED Downlight, square aperture for general lighting distribution recessed in exterior ceiling. Design for new construction. Light engine, optics, and driver accessible from below ceiling.
  - .2 Enclosure: 20 gauge steel, black powder coated finish. Housing and trim to be supplied as one complete unit.
  - .3 Mounting method: Recessed in exterior ceiling. Provided with quick mounting brackets and carrying channels.
  - .4 Enclosure rating: Wet location IP54.
  - .5 Enclosure color: White
  - .6 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.

- .7 Light source: High efficiency and performance LEDs mixing the light from red and unsaturated yellow LEDs to create beautiful, warm, white light. 50,000 hour rated life (defined as 70% lumen maintenance.).
- .8 Color temperature: 3500 °K.
- .9 Light output: Initial Delivered Lumens 1300 lumens or higher at 25°C Ambient.
- .10 Power and Voltage: 12 W at 120V, 60 Hz; P.F.: >0.8
- .11 Dimensions: Square form, 148mm x 148mm.
- .12 Controls: On/Off.
- .13 Standard Certification: ETL or cUL
- .14 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.
- .15 Typical appearance for type L11:

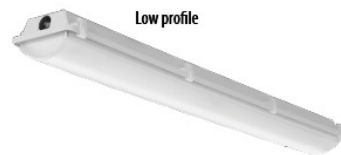


- .16 Acceptable Product :
  - .1 USAI Lighting, model BeveLED-LSTD4-9012-C3-35KS-50-GGBO-WIP54 c/w trim 3110INT-W-B1-S-10.
- .17 Equivalent to acceptable product: Philips, Lithonia.

.14 Type L12:

- .1 Description: Indoor/ Outdoor vapor resistant LED lighting fixture. Can be surface (wall/ceiling) or suspended mounted.
- .2 Housing: Non-conductive, non-corrosive housing. Smooth exterior surface for easy cleaning. Continuous closed cell, foam in-place gasket. Inner chassis parts are die-formed code gauge cold rolled steel.
- .3 Enclosure: IP 65 vapor resistant.
- .4 Housing finish: Inner chassis exterior - phosphate undercoating, baked white polyester enamel, 84% minimum reflectivity. White molded fiberglass reinforced polyester body. Two gasketed threaded (1/2" trade size) wet location hubs installed on ends.
- .5 Latches: ABS cam action latches. Lock-tight molded cam-action tension latches, securely clamps lens to fixture.
- .6 Mounting method: Surface.
- .7 Optics: High Impact DR acrylic molded lens. Injection molded, one piece impact resistant .125" starting thickness smooth virgin acrylic with crepe inner surface. Lens enclosure fully gasketed to seal fixture from dirt, moisture and other contaminates. Lighting channel has a high reflectance baked white enamel finish.
- .8 Enclosure rating: Dry or Wet Location UL1598.
- .9 Enclosure color: White
- .10 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.
- .11 Light source: High efficiency LEDs, 60,000 hour rated life at L70. (defined as 70% lumen maintenance.)
- .12 Color temperature at 3500°K and CRI >=80.
- .13 Light output: 4000 lumens or higher at 25°C Ambient.

- .14 Power and Voltage: 31 W at 120V, 60 Hz;
- .15 Dimensions: Length: 1263 mm, Width: 172 mm x Height: 106 mm.
- .16 Operating Temperature: max.: -30°C to 40°C.
- .17 Controls: Switch on/off.
- .18 Standard Certification: cETL or cUL.
- .19 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.
- .20 Typical appearance for type L12:



- .21 Acceptable Product :
  - .1 Lithonia Lighting, model FEM-448-4000-LPAFL-MD-120-GZ10-35K-8CRI
- .22 Equivalent to acceptable product: Philipps, Cooper, Hubbell.
- .15 Type L13:
  - .1 Description: Wall wash pendant lighting fixture.
  - .2 Housing: Die-cast aluminum housing.
  - .3 Housing finish: Powder coat finish.
  - .4 Mounting method: Rigid pendant stem mount, 5/8" diameter steel stem complete with canopy.
  - .5 Lighting Distribution: Wall wash.
  - .6 Enclosure rating: Dry location.
  - .7 Enclosure color: White
  - .8 Driver: Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.
  - .9 Color temperature at 3000°K and CRI >=80, R9>=10.
  - .10 Light output: 2400 lumens or higher at 25°C.
  - .11 Power and Voltage: 24W at 120V, 60 Hz;
  - .12 Dimensions: Cubic form, Length: 132 mm, Width: 132 mm x Height: 170 mm. Fixture weight = 2.5kg
  - .13 Controls: On/Off.
  - .14 Standard Certification: cUL
  - .15 Warranty: (5) years including LED boards and driver from the date of shipment to the site, each product will be free from any defects in materials and workmanship which cause the product to fail to operate in accordance with the product's performance specifications as they exist at the time of shipment.



- .16 Typical appearance for type L13:



- .17 Acceptable Product :

.1 USAI Lighting, serie BeveLED Block Wall Wash BLSW5-24C3-30KH-WH-PR3-UNV.

- .18 Equivalent to acceptable product: Philips, Lithonia, Cooper, Hubbell.

### 3. EXECUTION

#### 3.1 Installation

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

#### 3.2 Wiring

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

#### 3.3 Luminaire Alignment

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

#### 3.4 Lighting Control Sequences

- .1 Program and test all lighting control sequences.
- .2 In addition to base building commissioning, contractor must undertake to program, or subcontract a technician to program, the network lighting control system as per contractual documents/scripting instructions. All dynamic white fixture addresses must be compatible with the network lighting control. Following fixture and controller installation, scene intensity and sequencing must be reviewed and accepted on site by architect and client. Contractor or subcontracted technician is responsible for supplying necessary equipment to access controller and coordinating with Departmental Representative to review final settings.
- .3 To validate functionality of the lighting control system and the program sequence, simulate all different conditions apply to the lighting control system.
- .4 Produce a detailed report confirming lighting control sequence for each room.

**End of Section**

**1. GENERAL****1.1 Reference Standards**

- .1 CAN/CSA-C22.2 No.65 Wire Connectors.
- .2 CAN/CSA-C22.2 No.18.1-13 Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
- .3 EEMAC 1Y-2 Bushing Stud Connectors and Aluminum Adapters.
- .4 CAN/CSA C22.2 No.141-10 Emergency Lighting Equipment.

**1.2 Submittals**

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.

**1.3 Closeout Submittals**

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

**1.4 Delivery, Storage and Handling**

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

## 2. PRODUCTS

## 2.1 Equipment

- .1 Emergency Battery Unit:
  - .1 Emergency lighting equipment: to CSA C22.2 No.141.
  - .2 Supply voltage: 120 V, AC.
  - .3 Output voltage: 24 V DC.
  - .4 Capacity: 250 W minimum.
  - .5 Operating time: 30 minutes.
  - .6 Battery: sealed, maintenance free.
  - .7 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
  - .8 Solid state transfer circuit and integrated autodiagnostic function.
  - .9 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
  - .10 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
  - .11 Lamp heads: two (2) lamp, integral on unit remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED.
  - .12 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
  - .13 Finish: Rugged Steel.
  - .14 Auxiliary equipment:
    - .1 Test switch.
    - .2 Time delay relay.
    - .3 Battery disconnect device.
    - .4 AC input and DC output terminal blocks inside cabinet.
    - .5 Bracket.
    - .6 Direct AC connection.
    - .7 RFI suppressors.
    - .8 LED indicating the battery is charging.
    - .9 Test lamp.
  - .15 Typical appearance for battery unit:



- .16 Acceptable product: Lumacell, model RG24S-288-2LD14-ATN (Plus options).
- .17 Equivalent to acceptable product:
  - .1 Aimlite, Stanpro, Emergi-Lite
- .2 Remote Lamps:
  - .1 Emergency lighting equipment: to CSA C22.2 No.141.
  - .2 Supply voltage: 24VDC.

- .3 Lamp: MR16 LED, 24V-6W.
- .4 Impact-resistant surface-mounted fixture.
- .5 Twin head or single head with center body as indicated.
- .6 Typical appearance single head and double head:



- .7 Acceptable product:
  - .1 Single Head: Lumacell, model MQM-1-LD14.
  - .2 Double Head: Lumacell, model MQM-2-LD14.
- .8 Equivalent to acceptable product:
  - .1 Aimlite, Stanpro, Emergi-Lite

## 2.2 Wiring of Remote Heads

- .1 Conduit: type EMT, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Conductors: type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized in accordance with manufacturer's recommendations.

## 3. EXECUTION

### 3.1 Examination

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

### 3.2 Installation

- .1 Install emergency battery unit and remote mounted fixtures.
- .2 Direct heads.
- .3 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with manufacturer's recommendations.

### **3.3 Cleaning**

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

### **3.4 Protection**

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

**End of Section**

## 1. GENERAL

### 1.1 Reference Standards

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.141-15, Unit Equipment for Emergency Lighting.
  - .2 CSA C860-11 (R2016), Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA 101-2015, Life Safety Code.
- .3 International Organization for Standardization (ISO)
  - .1 ISO 3864-1-2011, Graphical symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings.
  - .2 ISO 7010-2011, Safety colours and safety signs - Registered safety signs.

### 1.2 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

### 1.3 Waste Management and Disposal

- .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 2. PRODUCTS

### 2.1 Standard Units

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: Durable extruded, one piece extruded aluminium housing and face plates.
- .3 Finish: White
- .4 Mounting method: Ceiling, end or wall mounted as indicated on drawings.
- .5 Sign: Standard with two pictogram films per face, for direction selection
- .6 Single or double faces as indicated on drawings.

- .7 Light source: White LED
- .8 Light output: To CSA-860
- .9 Power and Voltage: less than 2.5 W at 120V, 60 Hz;
- .10 Standard Certification: CSA
- .11 Typical appearance :



- .12 Acceptable product : Lumacell, Emergi-Lite, Stanpro.

### 3. EXECUTION

#### 3.1 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for exit signs installation in accordance with manufacturer's 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 Manufacturer's Instructions

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

#### 3.3 Installation

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Connect emergency lamp sockets to emergency circuits.
- .4 Ensure that exit light circuit breaker is locked in on position.

#### 3.4 Cleaning

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.

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

**End of Section**



**1. GENERAL****1.1 Related Requirements**

- .1 Not used.

**1.2 Reference Standards**

- .1 Illuminating Engineering Society of North America
  - .1 IESNA RP-8-00(R2005) – Roadway Lighting
- .2 CSA Group
  - .1 CAN/CSA C653-13 Photometric performance of roadway and street lighting luminaires.
  - .2 CSA C22.2 No.206-17, Lighting Poles.

**1.3 Action and Informational Submittals**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for roadway lighting and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 Delivery, Storage and Handling**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect roadway lighting from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**2. PRODUCTS****2.1 Steel Poles**

- .1 Steel poles: to CSA C22.2 No.206 designed for underground wiring and:
  - .1 Steel pole for mounting on concrete base.
  - .2 Style: monotube, minimum 3.0 mm thick, round.
  - .3 Straight for one (1) luminaire mounting bracket.
  - .4 Horizontal tenon mount for single unit.
  - .5 Access door with flush cover with an opening of 51 mm by 114 mm that gives access to a copper grounding terminal and wiring; door provided with captive screws and neoprene gasket for waterproof closure, located at  $\pm 500$ mm from base of pole.

- .6 Pole size: Ø102mm round pole.
- .7 Pole height: 7620mm.
- .8 Decorative base cover - Composed of two steel parts that are mechanically held to the pole.
- .9 Anchor plate - Made of one piece of steel with a bolt circle of Ø216 mm.
- .10 Anchor bolts: four anchor bolts, 19mm x 609mm + 76mm Double nut.  
Bolt projection: 76mm. steel with shims, nuts and base covers.
- .11 Finish: All surfaces are chemically treated against corrosion through a multi-stage immersion process. The polyester powder finish is applied by a thermostatic process offering an excellent protection conforming to ASTM G7, D-2247 and B-117/D-1654 standards.
- .12 Colours: Textured black finish, same as luminaire.
- .13 Hardware : All exterior hardware is made of stainless steel.
- .14 Grounding lug : copper.
- .15 Pole shop drawing to be sealed by structural engineer.

## 2.2 Luminaire Mounting Brackets

- .1 Mounting brackets steel for specified luminaires:
  - .1 Single brackets as indicated.
  - .2 Arm extension length: see luminaire type for specific length.
  - .3 Type: cantilever single guy double guy Aframe single bend upsweep with underbrace double bend upsweep with underbrace straight pipe with underbrace.
  - .4 Single Double tapered davit type.

## 2.3 Luminaires

- .1 Type L10:
  - .1 Description: Luminaire with cast aluminum weatherproof housing for outdoor application, pole mount, full cut-off LED luminaire.
  - .2 Housing: Die Cast Aluminum.
  - .3 Lighting Distribution: IES distribution Type IV.
  - .4 Pole height: 7620 mm.
  - .5 Enclosure rating: IP66.
  - .6 Vibration resistance: 3G vibration rating that conforms to standards set forth by AINSI C136-31 testing includes vibration to 3G acceleration in three axes.
  - .7 Enclosure color: Silver.
  - .8 Driver: High efficiency constant current driver. Power Factor: >0.9, THD: <20%.
  - .9 Color temperature at 4000°K and CRI >=70.
  - .10 Light output: 9029 lumens or higher at 25°C.
  - .11 Power and Voltage: 70W at 120V, 60 Hz
  - .12 Dimensions: Square form, 529 x 510 mm.
  - .13 Fixture weight = 18.8 Kg.
  - .14 Arm: Decorative arm.
  - .15 Operating Temperature: max.: -40°C to 40°C.
  - .16 Controls: Lighting Control Panel (inside the building).
  - .17 Factory wired including integral driver terminated at terminal block.
  - .18 Standard Certification: cETL

- .19 Typical appearance for type L10:



- .20 Acceptable Product:  
 .1 Philips model P21-A3-1-4-70LA-NW-UNV-NP  
 .21 Equivalent to acceptable Product: CREE, SHREDER, KENALL.

### 3. EXECUTION

#### 3.1 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for roadway lighting 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 poles true and plumb, complete with brackets and arms in accordance with manufacturer's instructions.  
 .2 Install luminaires on pole davits 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.

#### 3.3 Cleaning

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

**End of Section**

## 1. GENERAL

### 1.1 References

- .1 CSA-C22.2 No. 130-03, Requirements for Electrical Resistance Heating Cables and Heating Device Sets (A National Standard of Canada (2004)).
- .2 CAN/CSA-C22.2 No. 130.2-93 – October 2000, Heat Cable Systems for Use in Other than Industrial Establishments.

### 1.2 Definition

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

### 1.3 Submittals

- .1 Submittals: in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product data: submit WHMIS MSDS.
- .3 Shop drawings
  - .1 Submit all electrical equipment shop drawings to be installed.
  - .2 If changes are required, notify the Departmental Representative of these changes before they are made.
- .4 Quality Control: in accordance with Section 01 45 00– Quality Control.
  - .1 Provide CSA certified equipment.
  - .2 Where CSA certified equipment is not available, submit such equipment to inspection authorities for approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of work, load balance report as described in PART 3 – LOAD BALANCE.

### 1.4 Quality Assurance

- .1 Quality Assurance: in accordance with Section 01 45 00– Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians, by a master electrician or by an electrical contractor who holds a valid license as per the conditions of the Act of the territory in which work is to be executed.
  - .1 Employees registered in apprentice program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

### 1.5 Delivery, Storage and Handling

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect equipment from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan in accordance with Section 01 35 21 - LEED Requirements.
- .5 Packaging Waste Management: in accordance with Section 01 35 21 - LEED Requirements.

## 2. PRODUCTS

### 2.1 Electric tracing cable

- .1 Resistive parallel circuit type: to CSA-C22.2 No.130, self-regulating with semi-conductive core heating element.
- .2 Polyolefin inner and outer insulation jackets, and suitable for cutting to length in field.
- .3 If pipe being traced is plastic, heat trace cable to have metallic grounding over braid of sufficient conductivity to carry fault current and secondary polyolefin extruded over jacket to CSA-C22.2 No.130.
- .4 Manufacturer to ensure that specified electric tracing cable and heat tracing conduit size are compatible, so that cable may be pulled in with relative ease.
- .5 Foresee an extra length of heating cable of 10 metres minimum for the connection inside of the building.
- .6 The outer jacket of the heating cable shall have the following markings:
  - .1 Heating cable model number
  - .2 Agency listings
  - .3 Meter mark
  - .4 Lot/Batch ID
- .7 Capacity
  - .1 The capacity is to be coordinated with mechanical division.
  - .2 Two (2) independent heating cables per 50 mm Ø pipe, capacity 5 w/m.
  - .3 Two (2) independent heating cables per 150 mm Ø pipe, capacity 8 w/m.

### 2.2 Heating Cable Connection Kits

- .1 Provide power connection, splice/tee and end seal kits compatible with selected heating cable.
- .2 Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires.

.3 Connection kits are rated NEMA 4X to prevent water ingress and corrosion. All components are UV stabilized.

.4 Connection kits are UL Listed and CSA Certified.

### 2.3 Multiple Circuit Distributed Digital Control System

.1 Low temperature sensor control: factory pre-set at 5.0°C.

.2 Attach high temperature sensor control to active zone of heat tracing cable and to serve as high temperature cut-out, factory pre-set at 29°C.

.3 Rigid case: the electronic thermostat heating cables controls will be mounted in a rigid case in metal or rigid plastic, waterproof, approved CSA "C", NEMA.

.4 Features include:

.1 Universal power supply allowing operation at 120 Vac without wiring modifications.

.2 Circuit breakers for 2 independent circuits with common neutral, that allows operation and provides a local means of disconnect.

.3 Internal ground fault detection circuitry eliminating the need for an external ground fault device. "Alarm only" or "alarm and trip" is activated when ground fault condition is present.

.4 Three temperature sensor inputs: TS1 for pipe temperature control, TS2 for pipe temperature control at second location on the piping system and TS3 to serve as a high temperature limit for plastic piping protection. An alarm is activated when an enabled "open" or "shorted" sensor signal is detected.

.5 Low temperature alarm on both controlling sensors TS1 and TS2. Alarm level is factory set at dedicated level for each sensor. Feature is enabled at customer request.

.6 On-off control with a 1°C temperature differential for accurate control.

.7 Override input (factory programmable): timed between 1-48 hours or non-timed. This feature forces the output "on" or "off" to suit the application.

.8 Auto-cycle function momentarily turns heating cable "on" at 24 hours interval to monitor ground fault condition of the load.

.9 One three-color LED indicator lamp mounted on the door of the controller operates as follows:

.1 **Green:** when illuminated, the power supply to the controller is "on" and the pipe temperature at the sensor is above the setpoint. When extinguished, the power supply is "off".

.2 **Amber:** when illuminated, the temperature controller is calling for heat.

.3 **Red:** when illuminated, this indicates that one of the alarms has been triggered. Controller is not calling for heat.

.4 **Amber and Red (alternating):** this indicates that one of the alarms has been triggered. Controller is calling for heat.

.10 Non-volatile memory retains all programmed parameters in the event of a power outage.

.11 Must be able to supply a minimum of 2 independent heating cables simultaneously.

.5 Sensor type: The temperature controller is factory programmed to operate with a 100 ohms Platinum RTD sensors or with a 2252 ohms thermistors. Sensor is equipped with 10m minimum lead wired.

.6 Valid temperature range: -40°C to +100°C.

- .7 Ground fault detection: Factory set to trip at 30 Ma current and generate an alarm signal.
- 2.4 **Terminal end seal kits: certified for installation in damp conditions to CSA-C22.2 No.130 and consisting of:**
  - .1 Self-regulating:
    - .1 Two (2) heat-shrinkable tubes.
- 2.5 **Power connection kits to CSA-C22.2 No.130: connect to pipe as indicated.**
  - .1 Self-regulating:
    - .1 Base;
    - .2 Top;
    - .3 Sealing gasket;
    - .4 Terminal block;
    - .5 Locknuts.
- 3. EXECUTION
- 3.1 **Manufacturer's Instructions**
  - .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- 3.2 **Installation**
  - .1 Seal heat trace channel at fittings and flanged joints, with silicone caulking.
  - .2 Cable conduit: in lengths as indicated.
    - .1 Splicing of heat-trace cable is not allowed unless approved by Departmental Representative.
  - .3 Install tracer cable conduit prior to installation of half shell joints, terminal seal kits, and power connector kits, thermostatic controllers, in accordance with system supplier's instructions and as indicated.
  - .4 Install heating cables (2) in tubing on pipe, one on top and the other one below.
  - .5 Install a NEMA 4X box of adequate size for outdoor storage of the Heating Cable Connection Kits, Electric tracing cable, Multiple Circuit Distributed Digital Control System, Terminal end seal kits, Power connection kits and Sensor lead wired.
  - .6 Provide adequate support for the NEMA 4X box.
- 3.3 **Field quality control**
  - .1 Site tests and inspections:
    - .1 Test electric heat tracing in accordance with cable suppliers' instructions and as follows:
      - .1 500 VDC insulation tester on each circuit for insulation value, and record readings before, during and after installation.

- .2 Resistance values not less than 10 megohms, regardless of length, in accordance with Table 24 of Canadian Electrical Code, Part 1.
- .3 Testing procedure: carried out by cable supplier and witnessed by Departmental Representative.
- .4 Should insulation resistance be less than ten megohms, determine and rectify cause of resistance drop, and then re-tests circuit.
- .5 Procedure to be repeated until acceptable values are attained.
- .6 All commissioning results will be recorded and presented to the Departmental Representative.

### 3.4 **Cleaning**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**End of Section**