

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCE STANDARDS

- .1 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.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 DEFINITIONS

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

1.4 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 electrical components and include product characteristics, performance criteria, physical size, finish and limitations.
  - .3 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.
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.4 If changes are required, notify Departmental Representative of these changes before they are made.

.4 Certificates:

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and material is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

.5 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

.6 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

## 1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for all electrical equipment 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.

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- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

## 1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 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 from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse pallets, crates, padding, and packaging materials as specified in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 DESIGN REQUIREMENTS

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

## 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 and 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. CSA certification required for the entire assembly.

## 2.3 WARNING SIGNS

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

## 2.4 WIRING TERMINATIONS

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

## 2.5 EQUIPMENT IDENTIFICATION

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

### NAMEPLATE SIZES

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

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 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.
- .9 Panels, controllers: indicate type of equipment, voltage, phase, pole, current, point of supply and load controlled.
- .10 Receptacles: indicate panel and branch circuit number. Locate on wall immediately above receptacle.

## 2.6 WIRING IDENTIFICATION

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

## 2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
  - .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
  - .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.
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Type	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

## 2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1-1958.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

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

### 3.3 NAMEPLATES AND LABELS

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

### 3.4 CONDUIT AND CABLE INSTALLATION

- .1 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

### 3.5 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

### 3.6 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
  - .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
  - .3 Install electrical equipment at following heights unless indicated otherwise.
    - .1 Local switches: 1400 mm.
    - .2 Wall receptacles:
      - .1 General: 300 mm.
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- .2 Above top of counters or counter splash backs: 175 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Data outlets: 300 mm.
- .5 Fire alarm horn strobe: 2100 mm.
- .6 Emergency lights: 2000 mm.
- .7 Exit lights: Wall mounted at 2000 mm.

### 3.7 CO-ORDINATION OF PROTECTIVE DEVICES

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

### 3.8 FIELD QUALITY CONTROL

- .1 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, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Circuits originating from branch distribution panels.
  - .2 Lighting and its control.
- .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.

### 3.9 SYSTEM STARTUP

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

### 3.10 CLEANING

- .1 Progress Cleaning: 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.



## 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 off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of thei section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

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

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
  - .1 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 bushing stud connectors in accordance with NEMA.

#### 3.3 CLEANING

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCE STANDARDS

- .1 CSA C22.2 No. 0.3-09(R2014), Test Methods For Electrical Wires and Cables.

1.3 PRODUCT DATA

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

PART 2 - PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper , size as indicated.
  - .2 Type: AC90.
  - .3 Armour: interlocking type fabricated from aluminum strip.
  - .4 Type: ACWU90 PVC flame retardant jacket over armour for this project wet locations.
  - .5 Connectors: anti short connectors.
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### 2.3 CONTROL CABLES

- .1 Type: 600 V stranded annealed copper conductors, sizes as indicated:
  - .1 Insulation: RW90 (x-link).
  - .2 Shielding: metallized tapes over conductors.
  - .3 Overall covering: thermoplastic jacket.

## PART 3 - EXECUTION

### 3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.

### 3.2 GENERAL CABLE INSTALLATION

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

### 3.3 INSTALLATION OF BUILDING WIRES

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

1.2 REFERENCES

- .1 CSA Group:
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

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

1.4 CLOSEOUT SUBMITTALS

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

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:
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- .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT

- .1 Grounding conductors: bare stranded copper, tinned, medium-hard drawn (MHD) size as indicated.
- .2 Insulated grounding conductors: green, copper conductors, size as indicated.
- .3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Protective type clamps.
  - .3 Bolted type conductor connectors.
  - .4 Bonding jumpers, straps.
  - .5 Pressure wire connectors.
- .4 Insulated grounding conductors: green, type TWH.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Run ground wire in each 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 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

### 3.3 EQUIPMENT GROUNDING

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

### 3.4 COMMUNICATION SYSTEMS

- .1 Install grounding connections for communication system as follows:
    - .1 Bond and ground all cabinets, outlet boxes, conduits, riser cable, cable tray, and racks in accordance with CEC Section 10 and manufacturer's instructions.
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### 3.5 FIELD QUALITY CONTROL

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

### 3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 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 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 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 Province of Nova Scotia, Canada.

1.4 DELIVERY, STORAGE AND HANDLING

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

PART 2 - PRODUCTS

2.1 SPLITTERS

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
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- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

## 2.2 JUNCTION AND PULL BOXES

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

## 2.3 CABINETS

- .1 Construction: welded sheet steel hinged door, latch lock 2 keys and catch
- .2 Type E Empty: flush mounting.

## PART 3 - EXECUTION

### 3.1 SPLITTER INSTALLATION

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

### 3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

### 3.3 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00- Common Work Results for Electrical .
- .2 Identification Labels: size 2 indicating system name.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1, 23rd Edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
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- .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 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63 mm with two double clamps to take non-metallic sheathed cables.
- .2 Weatherproof outlets complete with cast metal coverplate with sprin return device lid. Cover plates exposed to the weather tobe marked "Extra Duty".

### 2.4 FITTINGS - GENERAL

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

## PART 3 - EXECUTION

### 3.1 INSTALLATION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-C22.2 No.18.2-06 Nonmetallic Outlet Boxes (R2016), Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No.45.1-07(R2012) or C22.2No. 45.2-08(R2013), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83 -M1985(R2013), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2-06(R2016), Rigid PVC (Unplasticized) Conduit.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
  - .1 Test reports: submit certified test reports.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and 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.
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- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

## PART 2 - PRODUCTS

### 2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Rigid pvc conduit: to CSA C22.2 No. 211.2.

### 2.2 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 Threaded rods, 6 mm diameter, to support suspended channels.

### 2.3 CONDUIT FITTINGS

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

### 2.4 FISH CORD

- .1 Polypropylene.
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### PART 3 - EXECUTION

#### 3.1 MANUFACTURER'S INSTRUCTIONS

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

#### 3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Use electric metallic tubing except where specified otherwise.
- .3 Minimum conduit size for lighting and power circuits: as per CSA.C22.1-15.
- .4 Install rigid metal conduit from branch circuit panel to outlet boxes located in mezzanine floor.
- .5 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .6 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .7 Install fish cord in empty conduits.
- .8 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .9 Dry conduits out before installing wire.

#### 3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
  - .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
  - .3 Run conduits in flanged portion of structural steel.
  - .4 Group conduits wherever possible on surface channels.
-

- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

#### 3.4 CONCEALED CONDUITS

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

#### 3.5 CLEANING

- .1 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.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 50 00 - Lighting.

1.2 REFERENCE STANDARDS

- .1 CSA International
  - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
  - .2 CSA 22.2 No. 205-17, Signalling Equipment.

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 network lighting controls and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
  - .2 Indicate on drawings:
    - .1 Complete assembly.
    - .2 Contact surfaces.
    - .3 Construction features.
    - .4 Wiring diagrams.

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 network lighting controls for incorporation into manual.
-

## 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 network lighting controls from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 COMPONENTS

- .1 Components: to CSA C22.1.
- .2 Designed for lighting control up to and including 120 V 16 amp.
- .3 Integrally moulded thermoplastic control wire, colour coded black for normal and red for emergency circuits.
- .4 Certified to make or break under full rated load.
- .5 0-10V Relay Load Controllers.
- .6 Colour LED Touchscreen complete with DC power supply.
- .7 Cable sets consisting of starter cables, joiner cables, and control cables.
- .8 Vacancy Sensor Kits.

### 2.2 0-10V RELAY LOAD CONTROLLER

- .1 Compliant to CSA 22.2 No. 205.
-

- .2 120V, 16A relay control and 0-10V dimming capability.
- .3 Data wiring using CAT5e/CAT6 with RJ45 connectors or 18-22AWG twisted pair RS-485 compatible cabling.
- .4 Operational control curve for LED lighting.
- .5 16 Gauge steel galvanized construction.

### 2.3 CABLE SETS

- .1 Factory assembled and integrally moulded.
- .2 Four metre minimum lengths. Allow 2 metre extra cable for relocation of fixtures and equipment where required.
- .3 Low voltage cables: one end prepared for field installation with locknutless box connector and six inch tails with mini-quick connector prepared for connection to Colour LED Touchscreen, occupancy sensors kit or 0-10V control relays.
- .4 Stranded CAT5e or BELDEN 1502r/1052p.

### 2.4 COLOUR LED TOUCHSCREEN

- .1 Allows customizable independent dimming control of at least 5 lighting groups.
- .2 Capable of storing at least 3 programmable lighting scenes.
- .3 Surface mounted backlit screen, dimmable, 16 bit colour depth.
- .4 Minimum 512 MB of non-volatile memory.
- .5 Inputs/Outputs:
  - .1 RS-485 port, RJ12 or screw terminals.
  - .2 RJ45 Ethernet port.
  - .3 Reset Switch.
- .6 DIN rail mounted DC power supply in CSA Type 12 enclosure, sized as per manufacturer.

### 2.5 VACANCY SENSOR KIT

- .1 Technology: passive infrared (PIR) detection for both major and minor motion detection without need to change sensor's sensitivity threshold.
-

- .2 Field of View: 360 degrees.
- .3 Coverage selected to suit specific areas and mounting heights.
- .4 Mounting: ceiling-mount. Device to come complete with appropriate mounting bracket for ceiling type/material.
- .5 Adjustable Timeout Setting: 1 minute to 30 minutes.
- .6 Clearly visible method of indication to verify motion is being detected during testing.
- .7 One RS-485 serial port for integration into lighting control network.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for 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 0-10V control relays for each control group and connect starter cable to power-in plug.
  - .4 Connect joiner cables to each of power-out receptacles to first luminaire of controlled circuit.
-

- .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 colour LED Touchscreen and low voltage cables as shown on drawings and connect to control ports of controlled circuits.
- .9 Install occupancy sensor kits and low voltage cables as shown on drawings and connect to control ports of controlled circuits.

### 3.3 SCENE PROGRAMMING AND COMMISSIONING

- .1 Allow at least two days to program lighting scenes with Departmental Representative. Programmer with experience that has been approved by the lighting control manufacturer. At a minimum, the following three lighting scenes presents are to be programmed to the Departmental Representative's approval and selectable using the colour LED touchscreen:
    - .1 'Cleaning' Lighting Scene:
      - .1 Lighting control groups 'x', 'y' and 'z' are at maximum or near-maximum brightness for cleaning and maintenance purposes.
      - .2 Occupancy sensors have automatic-on, automatic-off functionality for all control groups.
    - .2 'Boardroom' Lighting Scene:
      - .1 Lighting control group 'x' is at maximum or near-maximum brightness.
      - .2 Lighting control group 'y' is at moderate brightness.
      - .3 Lighting control groups 'z' is turned off.
      - .4 Occupancy sensors have automatic-on, automatic-off functionality for control groups 'x' and 'y'.
    - .3 'Wine Tasting' Lighting Scene:
      - .1 Lighting control groups 'x', 'y' and 'z' are at moderate brightness.
      - .2 Occupancy sensors have automatic-on, automatic-off functionality for all control groups.
-

### 3.4 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.

### 3.5 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 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### 3.6 PROTECTION

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

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PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 -Submittal Procedure.
- .2 Section 23 09 33 - Electric and Electronic Control System for HVAC
- .3 Section 26 05 00 - Common Work Results for Electrical

1.2 REFERENCE STANDARDS

- .1 CSA International
  - .1 CAN/CSA-C22.2 No.47 -13 Air-Cooled Transformers (Dry Type).
  - .2 CSA C9-02(R2016), Dry-Type Transformers.
  - .3 CAN/CSA-C802.2-12, Minimum Efficiency Values for Dry Type Transformers R2017.

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 dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

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

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.
-

- .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.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 DESIGN DESCRIPTION

- .1 Isolation Transformer:
  - .1 Type: ANN.
  - .2 3 phase, 7.5 kVA, 208 V input, 208 V output, 60 Hz.
  - .3 Voltage taps: standard.
  - .4 Basic Impulse Level (BIL): standard.
  - .5 Hipot: standard.
  - .6 Average sound level: standard
  - .7 Impedance at 17 degrees C: standard
  - .8 Enclosure: CSA Type 3R, removable metal front panel.
  - .9 Mounting: wall.
  - .10 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
  - .11 Copper windings.

### 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: '3 PHASE ISOLATION TRANSFORMER FOR TEMPERATURE CONTROLLERS'.
-

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION

- .1 Mount dry type transformers on wall.
- .2 Ensure adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Make primary and secondary connections in accordance with wiring diagram.
- .7 Energize transformers after installation is complete.

#### 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 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
    - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
-

### 3.4 PROTECTION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCE STANDARDS

- .1 CSA International
  - .1 CSA C22.2 No.29-15, Panelboards and Enclosed Panelboards.

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 panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
  - .2 Include on drawings:
    - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.
- .4 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
      - .1 Return removed equipment to Departmental Representative.

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 panelboards for incorporation into manual.
-

## 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 panelboards from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
    - .1 Install circuit breakers in panelboards before shipment.
    - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
  - .2 250 and 600 V panelboards: bus and breakers rated for 65kA (symmetrical) interrupting capacity or as indicated.
  - .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
  - .4 Panelboards: surface mounted, mains, number of circuits, and number and size of branch circuit breakers as indicated.
  - .5 Minimum of 2 locks for each panel board.
  - .6 Two keys for each panelboard and key panelboards alike.
-

- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel.
- .11 Include grounding busbar with 3 of 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 in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top of panel to suit cable entry.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.
- .5 Lock-on devices for fire alarm circuits.

## 2.3 EQUIPMENT IDENTIFICATION

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

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 53 - Miscellaneous 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 loads to circuits.
- .5 Connect neutral conductors to common neutral bus.

#### 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.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 28 20 - Ground Fault Circuit Interrupters - Class "A".

1.2 REFERENCE STANDARDS

- .1 CSA International
  - .1 CSA C22.2 No.42-10 (R2015), General Use Receptacles, Attachment Plugs and Similar Devices. (R2015)
  - .2 CAN/CSA No.42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 Special Use Switch.
  - .4 CSA C22.2 No.111-10 (R2015), General-Use Snap Switches (Bi-national standard, with UL 20(R2015)).

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 wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.

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 wiring devices for incorporation into manual.
-

## 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 Storage and Handling Requirements:
  - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .3 Develop Waste Reduction Workplan related to Work of this Section and in accordance with Section.
- .4 Packaging Waste Management: remove for reuse and return by crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 SWITCHES

- .1 20 A, 120 V, single pole, three-way switches to: CSA C22.2 No. 55 and CSA C22.2 No. 111.
  - .2 Manually-operated general purpose AC switches with following features:
    - .1 Terminal holes approved for No. 10 AWG wire.
    - .2 Silver alloy contacts.
    - .3 Urea or melamine moulding for parts subject to carbon tracking.
    - .4 Suitable for back and side wiring.
    - .5 Ivory toggle.
    - .6 Dimmable and weatherproof where indicated.
  - .3 Toggle operated fully rated for LED Luminaires, and up to 80% of rated capacity of motor loads and heating loads.
  - .4 Switches of one manufacturer throughout project.
-

## 2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-20 R, 125 V, 20 A, U ground, to:  
CSA C22.2 No.42 with following features:
  - .1 Ivory 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.
- .2 Combination Duplex Receptacle/Outlet and USB Charger:
  - .1 Duplex receptacle: CSA Type 5-20R, 125V, 20A.
  - .2 USB charger: Two(2) 2.0 Type A USB Chargers, 3.6 Amps, 5VDC.
  - .3 Side wired and back wired entrances.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles from one manufacturer throughout project.

## 2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, 1 mm thick cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated. Weatherproof cover plates to be marked "Extra Duty".

## 2.4 FLOOR BOX

- .1 Floor box shall be recessed in concrete floor at locations indicated on drawings. Provide boxes with all necessary components to permit recessed installation in concrete floor.
    - .1 Box to maintain partition between power and communication cabling/devices.
    - .2 Recessed box shall contain device outlets that will not obstruct the floor area. All wiring to be in conduit within concrete floor.
-

.3 Box shall be minimum 4-Gang including up to four(4) receptacles or communication outlets. 16-Gauge galvanized stamped steel bases.

.4 Each floor box indicated on drawing shall have:

.1 Four(4) duplex receptacles c/w cover plates.

.2 Four(4) CAT6 (jack and face plates shall be provided).

.5 Accept standard wall plate, 5-20R receptacles, and communication (CAT6).

.6 Fully finished interior to assist plugging and unplugging of devices.

.7 Cast aluminum floor box complete with 4-inch core through floor fitting, knockout size from 21 mm to 53 mm trade size. Core through floor fitting to be fire rated for at least 2 hours.

.8 Surface style cover with Solid Lid, die cast aluminum cover assembly designed to be used on top of floor covering and open 180 deg. and lie flat on the surface. Colour shall be black and c/w cable door.

## 2.5 SOURCE QUALITY CONTROL

.1 Cover plates from one manufacturer throughout project.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

### 3.2 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

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.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical unless indicated otherwise.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.4 Install GFCI 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.

### 3.4 PROTECTION

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

.2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.3 Repair damage to adjacent materials caused by wiring device installation.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCE STANDARDS

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

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers 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 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 circuit breakers indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
    - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
    - .3 Replace defective or damaged materials with new.
  - .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
-

## PART 2 - PRODUCTS

### 2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, and ground-fault circuit-interrupters: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers with interchangeable trips.
- .6 Circuit breakers to have minimum symmetrical rms interrupting capacity rating same as associated board. Series rating for breakers is not acceptable.

### 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- .1 Install circuit breakers as indicated in section 26 24 16.01, 3.2.

### 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 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Equipment and installation for ground fault circuit interrupters (GFCI).

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 26 05 00 - Common Work Results - for Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-C22.2 No.144-M91(R2015), Ground Fault Circuit Interrupters.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data and shop drawings.
- .3 Submit test report for field testing of ground fault equipment to Departmental Representative and a certificate that system as installed meets criteria specified herein.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
-

- .3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

## PART 2 - PRODUCTS

### 2.1 MATERIAL

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA-C22.2 No.144.
- .2 Components comprising ground fault protective system to be of same manufacturer.

### 2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Single or two pole ground fault circuit interrupter for 20240U, for 1 phase circuit c/w test and reset facilities.

### 2.3 GROUND FAULT PROTECTOR UNIT

- .1 Self-contained with 20A, 120 V circuit interrupter and duplex receptacle complete with:
  - .1 Solid state ground sensing device.
  - .2 Facility for testing and reset.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- .1 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.
-

### 3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - For Electrical and co-ordinate with Section 01 45 00 - Quality Control.
- .2 Arrange for field testing of ground fault equipment by Contractor before commissioning service.
- .3 Demonstrate simulated ground fault tests.

### 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.

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 00 - Common Work Results - for Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
  - .1 CAN/CSA C22.2 No.4-04 (R2014), Enclosed and Dead-Front Switches (Tri-National Standard With ANCE NMX-J-162-2004 and UL 98).
  - .2 CSA C22.2 No.39-13, Fuseholder Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .3 Fold up metal banding, flatten and place in designated area for recycling.
-

## PART 2 - PRODUCTS

### 2.1 DISCONNECT SWITCHES

- .1 Non-fusible, horsepower rated disconnect switch in CSA Enclosure Type 4 for applications in room 2045, Type 3 for all other indoor applications and Type 4X for outdoor applications, to CAN/CSA C22.2 No.4, size as required.
- .2 Provision for padlocking in off switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.
- .6 Motor starter to be marked as "Suitable for Motor Disconnect".

### 2.2 EQUIPMENT IDENTIFICATION

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

### 2.3 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results - For Electrical.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- .1 Install disconnect switches according to codes, standards mentioned in sub-sections and manufacturer recommendation.

### 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.
-



PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Requirements.

1.2 REFERENCES

- .1 NEMA ICS 2, Industrial Control and Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 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.
      - .7 Certifications and approvals.

1.4 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.
-

## 1.5 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 of packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- .1 Starters: to NEMA ICS 2.

### 2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type and rating, as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 One and two overload heaters, manual reset, trip indicating handle.
  - .3 Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 4 in room 2045, 3 for all other indoor applications and 4X for outdoor.
- .2 Accessories:
  - .1 Toggle switch: heavy duty oil tight labelled as indicated.
  - .2 Indicating light: heavy duty oil tight type and colour as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

### 2.3 FINISHES

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

### 2.4 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.

## 2.5 WARNING SIGNS

- .1 Provide warning signs (where applicable) in accordance with Section 26 05 00 - Common Work Results - For Electrical.

## PART 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 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.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 RELATED DOCUMENTS

- .1 The Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to Work of this section.

1.3 SCOPE

- .1 This section of the specifications covers the supply and installation of two spring driven cable reel assemblies which are to be used for extending and retracting a heavy duty #12 AWG cable rated for wet locations up to 10 m. Cable reels are to be mounted in room 2045 as indicated.
  - .1 Single output for with a rated capacity of 3.73kW (20 amps) at 208VAC, 1 phase, 60Hz.

1.4 GENERAL

- .1 A. Applicable publications - Publications listed below form a part of the specification to the extent referenced herein. The publications are referred to in the text by the basic designation only.
    - .1 ISO-9000 Quality Assurance
    - .2 Canadian Electrical Code, Part 1, C22.1-15 safety standard for electrical installations code.
  - .2 Requirements - Provide a cable reel with accessories, auxiliary equipment, and associated work as specified. The cable reel shall be a standard product of the manufacturer and shall be the manufacturers latest design that complies with the Specification requirements.
    - .1 Materials - Shall be new, unused and suitable for the purpose intended.
    - .2 Basic Assembly Design - The cable reel shall be designed as a modular assembly containing a reel, slip ring assembly and spring cable with accessories needed to form an operating reel system
    - .3 Provisions shall be made for lifting and moving the unit by means of a forklift.
-

.4 Terminals - Wiring terminals shall be selected to result in a secure bond between the wire and terminal. Circuits, which continue to field-wired components, shall terminate at suitably identified, easily accessible, terminal boards.

## 1.5 SUBMITTALS

- .1 Provide product data including electrical ratings, material finishes and technical data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide detailed mounted arrangement for each cable reel.
- .3 Provide maintenance data for components, including spring gear train, cable sheave and limit devices, etc.

## PART 2 - PRODUCTS

### 2.1 MAJOR COMPONENTS

- .1 The power and neutral conductors shall have an ampacity rating of 20 Amperes.
  - .2 CSA L8-20R 20 amp 480V female twist-lock connector body.
  - .3 Watertight assembly to CSA Type 4 or higher.
  - .4 Spring tension mechanism.
  - .5 Roller guide arm.
  - .6 Reversing controls.
  - .7 Slip Ring assembly
  - .8 Frame and mounting brackets.
  - .9 Cable and twist lock receptacle with matching plug.
  - .10 Cord stop.
  - .11 Power cable: Heavy duty #12 AWG, rated for wet locations, 10 meters in length minimum.
-

## 2.2 CHARACTERISTICS

- .1 The reel shall be included for the "off-the-floor" storage of the ground power cable.
- .2 The cable reel shall be mounted to concrete beam off roof system in room 2045 and according to manufacturer's recommendations.
- .3 The slip ring enclosure shall be a two-part heavy-duty steel construction allowing general maintenance of the complete assembly. The enclosure cover must be removable. The enclosure shall be rated for minimum CSA Type 4.
- .4 The speed of payout and rewind shall be adjustable as selected by the Departmental Representative.
- .5 Documentation: Plan Drawings and data sheets shall be submitted for approval. Finished Shop Drawings and Operation and Maintenance Manuals of the equipment "as installed" shall be provided.

## 2.3 WARRANTY

- .1 The manufacturer shall guarantee that its products will meet all applicable specifications and other specific product and work requirements including those of performance of this agreement and will be free from defects in material and workmanship. Warranty period shall be for one (1) year from substantial completion.

## 2.4 SAFETY

- .1 The entire assembly shall contain at a minimum components such as the motor, limit switches and junction boxes that are CSA approved.

## 2.5 FACTORY TESTS

- .1 The manufacturer shall test every reel assembly to assure full compliance with the specification. Certification test sheets shall be sent to the Departmental Representative at the time of shipment of the unit. The Departmental Representative shall be notified fourteen (14) days in advance of such tests. The Departmental Representative reserves the right to witness tests and request additional tests that show compliance with the specifications.
-

### PART 3 - EXECUTION

#### 3.1 REEL MOUNTING

- .1 The reel shall be mounted in such a manner that no damage shall occur.

#### 3.2 ELECTROMAGNETIC COMPATIBILITY

- .1 Bonding:
  - .1 The chassis and enclosure shall be bonded to a single point.

#### 3.3 EQUIPMENT COMPATIBILITY

- .1 Contractor to ensure all 208V, 1 phase equipment being used in room 2045 is to have matching NEMA L8-20R male plugs. Contractor to replace existing male plugs on equipment with L8-20R male plug if required. Coordinate with Departmental Representative for applicable equipment.

#### 3.4 OPERATION AND MAINTENANCE MANUALS

- .1 Provide two (2) copies of the comprehensive Operation and Maintenance Manuals fourteen (14) days prior to Final Acceptance date.
- .2 The Manuals shall fully describe each product, system, or subsystem numbered logically and separated into sections and contained in rigid plastic binders with identification inserted in clear plastic insert pockets on front and spine portions of each binder.
- .3 The content of the Manuals shall be limited to information and data that specifically applied to products provided and shall include routine normal and special operating instructions and sequences. Also included shall be routine maintenance procedures and guides for troubleshooting, disassembly and reassembly instructions, and checking instructions along with a recommended spare parts list consisting of current prices and sources.

PART 1 - GENERAL1.1 RELATED REQUIREMENT

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 11 - Cleaning.
- .3 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Section 01 77 00 - Closeout Procedures.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
    - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
  - .2 ASTM International Inc.
    - .1 ASTM F1137-11E1, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
  - .3 Canadian Standards Association (CSA International)
  - .4 ICES-005-07, Radio Frequency Lighting Devices.
  - .5 Underwriters' Laboratories of Canada (ULC)
  - .6 IESNA LM-79-08, Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
  - .7 IESNA LM-80-15, IES Approved Method: Measuring Luminous Flux and Colour Maintenance of LED Packages, Arrays and Modules.
  - .8 IESNA TM-21-11, Projecting Long Term Lumen Maintenance of LED Light Sources + Addendum B.
-

### 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide complete photometric data prepared by independent testing laboratory for all luminaries for review by Departmental Representative.
  - .3 Photometric data to be IESNA LM79 compliant and shall include as a minimum the following information: Test Lab, Catalog Number, Description LED Manufacturer, Luminaire Output in Absolute Photometry, Driver Manufacturer and Model Number, Input Wattage, Space Criterion.
  - .4 Provide electronic IES files and Lamp Lumen Depreciation factors based on TM-21 calculations for each fixture type.
  - .5 Equivalents must meet the minimum standard of acceptance and approval will be determined by the specifier.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
  - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures and warranty information.

### 1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials 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: packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .4 Divert unused metal materials from landfill to metal recycling facility.
  - .5 Disposal and recycling of damaged or faulty LED drivers and or luminaires.
-

PART 2 - PRODUCTS

2.1 LED DRIVERS

- .1 LED Driver.
  - .1 Rating: 120 V, 60 Hz.
  - .2 Mounting:
    - .1 Railing Lights: driver to be installed in CSA Type 1 enclosure. Enclosure to be mounted in inconspicuous yet accessible location.
    - .2 For all other devices, driver to be integral to luminaire.
  - .3 Colour temperature and colour rendering index (CRI): refer to Luminaire Schedule.

2.2 FINISHES

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

2.3 OPTICAL CONTROL DEVICES

- .1 As indicated in drawings.

2.4 LUMINAIRES

- .1 As indicated in drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.
  - .1 See luminaire schedule on drawings for additional mounting information and requirements.

3.2 WIRING

- .1 Connect luminaires to lighting circuits.
-

### 3.3 LUMINAIRE SUPPORTS

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

### 3.4 LUMINAIRE ALIGNMENT

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

### 3.5 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.



- .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 emergency lighting from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## 1.6 WARRANTY

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months with no-charge replacement during the 5 years (pro-rate).

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
  - .2 Supply voltage: 120 V, AC.
  - .3 Output voltage: 12 V DC.
  - .4 Operating time: 30 minutes.
  - .5 Battery: sealed, maintenance free.
  - .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output.
  - .7 Solid state transfer circuit.
  - .8 Low voltage disconnect: solid state, modular.
  - .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
  - .10 Lamp heads: integral on unit remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 4 W, minimum 220 lumen minimum output.
  - .11 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.
-

- .12 Finish: to match existing.
- .13 Auxiliary equipment:
  - .1 Test switch.
  - .2 Battery disconnect device.
  - .3 AC input and DC output terminal blocks inside cabinet.
  - .4 Bracket.

## 2.2 WIRING OF REMOTE HEADS

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency 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 unit equipment and remote mounted fixtures.
  - .2 Direct heads.
  - .3 Connect exit lights to unit equipment.
  - .4 Ensure that emergency lighting circuit breaker is locked in ON position.
-

### 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, in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### 3.4 PROTECTION

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

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.141-15, Emergency Lighting Equipment.
  - .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 National Fire Protection Association (NFPA)
  - .1 National Building Code of Canada (2015).

1.3 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, cleaning procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

## PART 2 - PRODUCTS

### 2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860 , packaged in accordance with the Canadian Code for Preferred Packaging guidelines.
- .2 Housing: extruded aluminum housing, brush aluminum finish. Weatherproof as indicated.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps: Low power LED's.
- .5 Use running person type pictograms with green colour in accordance with NBCC.
- .6 Face plate to remain captive for relamping.
- .7 Supply voltage: 120 VAC.
- .8 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.
- .9 Ceiling mounted or wall mounted, as indicated.
- .10 Single face or double face, as indicated.

## PART 3 - EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

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

### 3.2 INSTALLATION

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

3.3 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.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 78 00 - Closeout Submittals.
- .4 Section 26 05 00 - Common Work Results - For Electrical.
- .5 Section 26 05 21 - Wires and Cables (0-1000 V).
- .6 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.46-2013, Electric Air-Heaters.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
    - .1 Submit product data sheets for unit heaters. Include:
      - .1 Product characteristics.
      - .2 Performance criteria.
      - .3 Mounting methods.
      - .4 Physical size.
      - .5 kW rating, voltage, phase.
      - .6 Cabinet material thicknesses.
      - .7 Limitations.
      - .8 Colour and finish.
      - .9 Control.
    - .2 Submit product data sheets for unit heaters.
      - .1 Include product characteristics, performance criteria, physical size, limitations and finish.
-

#### 1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

#### 1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan and in accordance with Section 01 74 20 -Waste Managing and Disposal.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .5 Collect, package and store existing unit heaters for either reuse, recycling or rebuilding and return to recycler in accordance with Waste Management Plan.

### PART 2 - PRODUCTS

#### 2.1 UNIT HEATERS

- .1 UH-1 and UH-2 5kW, 208 volts 3 phase.
  - .2 UH-3, UH-4 and UH-5, 3kW, 120 Volts single phase
  - .3 Ceiling / wall mount.
  - .4 CSA approved.
  - .5 Motor & Fan: fan size matched to power output of unit. Motor is heavy duty, continuous operation, totally enclosed, thermally protected with permanently lubricated ball bearings.
  - .6 Adjustable discharge louvers.
  - .7 Thermal Overload protection.
-

- .8 Disconnect switch.
- .9 Provide mounting accessories as required.
- .10 Elements: Mineral insulated copper coated steel sheath with aluminum brazed fins.
- .11 Cabinet Steel, Fitted with brackets for rod or wall mounting.
  - .1 Phosphatized and finished with baked enamel

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- .1 Ceiling mount horizontal heaters.
- .2 Make power and control connections.
- .3 Install all wiring in conduit.

#### 3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.