

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 01 10 - General Instructions.
- .2 Section 07 84 00 - Firestopping.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22<sup>nd</sup> Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.1-12, Canadian Electrical Code, Part 1 (22<sup>nd</sup> Edition), Safety Standard for Electrical Installations. ESA OESC-2012, Ontario Electrical Safety Code, 25<sup>th</sup> Edition, Electrical Safety Authority 2012.
  - .3 CAN/CSA-C22.3 No. 1-10, Overhead Systems.
  - .4 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000V.
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE 100-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition. Institute of Electrical and Electronics Engineers.
  - .2 IEEE 1122-1998, IEEE Standard for Digital Recorders for Measurements in High Voltage Impulse Tests.

**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 1122.

**1.4 DESIGN REQUIREMENTS**

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

**1.5 SUBMITTALS**

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS.

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- .3 Shop drawings:
    - .1 Submit drawings with dimensioned layouts.
    - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, panels, accessories and other items that must be shown to ensure co-ordinated installation.
    - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
    - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
    - .5 If changes are required, notify the Departmental Representative of these changes before they are made.
  - .4 Quality Control: in accordance with Section 01 45 00 - Quality Control.
    - .1 Provide CSA certified equipment and material.
    - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities 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 Electrical Safety Authority upon completion of Work to Departmental Representative.
  - .5 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within five (5) days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

#### **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: Electrical Work to be carried out by qualified, licensed electricians or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualification.
  - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings:
  - .1 In accordance with Section 01 01 10 - General Instructions.

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- .2 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
    - .1 Upon completion of Work, after cleaning is carried out.
  - .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.
- 1.7 DELIVERY, STORAGE AND HANDLING**
- .1 Material Delivery Schedule: provide Departmental Representative with schedule within two (2) weeks after award of Contract.
  - .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management.
- Part 2 Products**
- 2.1 MATERIALS AND EQUIPMENT**
- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
  - .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is is not available, obtain special approval from the Electrical Safety Authority before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- 2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**
- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- 2.3 WARNING SIGNS**
- .1 Warning Signs: in accordance with requirements of the Electrical Safety Authority.
  - .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 either copper or aluminum conductors.
- 2.5 EQUIPMENT IDENTIFICATION**
- .1 Identify electrical equipment with nameplates and labels as follows:
    - .1 Nameplates: lamicoid 3 mm engraving sheet melamine, matt white finish face, black 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 and labels 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 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. \_\_\_\_" as directed by Departmental Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage.
- .9 Transformers: indicate capacity, primary and secondary voltages.

**2.6 WIRING IDENTIFICATION**

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

**2.7 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 and at five meter intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

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

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**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.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.
- .2 Inside of ventilation towers, install conduits in the central vertical service space. Minimize conduit attachments to ventilation tower masonry walls.

**3.2 NAMEPLATES AND LABELS**

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

**3.3 CONDUIT AND CABLE INSTALLATION**

- .1 Cut openings in the building walls or floors as required to install new cables and conduits.
- .2 Prior to cutting, carry out x-ray inspection and locate sleeves in accordance with Section 01 01 10 - General Instructions.
- .3 Install steel sleeves through cut openings in floor slab. Sleeves to extend 150 mm above floor level. Secure sleeve with a suitable steel floor flange and clamp.
- .4 Seal openings and provide fire stopping in accordance with Section 07 84 00 - Firestopping.

**3.4 LOCATION OF OUTLETS**

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

**3.5 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 Panelboards: as required by Code or as indicated.

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- .2 Receptacles: 400 mm.
  - .3 Light switches: 1200 mm.

### **3.6 CO-ORDINATION OF PROTECTIVE DEVICES**

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

### **3.7 FIELD QUALITY CONTROL**

- .1 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Power generating and distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 Systems: Fire Alarm Systems.
  - .6 Insulation resistance testing:
    - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
    - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
    - .3 Check resistance to ground before energizing.
- .2 Carry out tests in presence of Departmental Representative.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .4 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

### **3.8 CLEANING**

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

**END OF SECTION**

**Part 1        General**

**1.1        RELATED SECTIONS**

- .1    Section 01 00 10 - General Instructions.

**1.2        REFERENCES**

- .1    Canadian Standards Association (CSA International)
  - .1    CSA C22.1-12, Canadian Electrical Code, Part 1 (22<sup>nd</sup> Edition), Safety Standard for Electrical Installations.
  - .2    CSA C22.1-12, Canadian Electrical Code, Part 1 (22<sup>nd</sup> Edition), Safety Standard for Electrical Installations. ESA OESC-2012, Ontario Electrical Safety Code, 25<sup>th</sup> Edition, Electrical Safety Authority 2012.
  - .3    CSA C22.2 No. 0.3-09, Test Methods for Electrical Wires and Cables.
  - .4    CAN/CSA-C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
  - .5    CSA C22.2 No. 41-13, Grounding and Bonding Equipment.
  - .6    CSA-C22.2 No. 42-10, General Use Receptacles, Attachment Plugs and Similar Devices
  - .7    CAN/CSA C22.2 No.65-13, Wire Connectors.
  - .8    CAN/CSA-C22.2 No. 131-07(R2012), Type TECK 90 Cable.
  - .9    CAN3-C235-83(R2006), Preferred Voltage Levels for AC Systems, 0 to 50,000V.
- .2    Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1    IEEE 100-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition. Institute of Electrical and Electronics Engineers.
  - .2    IEEE 1122-1998, IEEE Standard for Digital Recorders for Measurements in High Voltage Impulse Tests.
- .3    Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
  - .1    EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .4    American Society for Testing and Materials International, (ASTM).
  - .1    ASTM B33-10, Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
  - .2    ASTM B172-10, Standard Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors.
  - .3    ASTM B174-10, Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
- .5    Insulated Cable Engineers Association, Inc. (ICEA), National Electrical Manufacturer's Association (NEMA)
  - .1    ANSI/NEMA WC70-2009 / ICEA-S-95-658-2009, Para 4.1.11. Power Cables, 2000 Volts or Less for the Distribution of Electrical Energy.

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**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 1122.

**1.4 DESIGN REQUIREMENTS**

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

**1.5 DESCRIPTION OF WORK**

- .1 Contractor is responsible to provide complete power, lighting and life safety systems to support the construction scaffolding and the structural and masonry work required.
- .2 The connection points for temporary construction power systems is indicated in the drawings. Contractor shall design and provide all equipment from the point of connection forward. The design of all electrical equipment shall meet the requirements identified herein and be tailored to the requirements of the structural and masonry contractors for the accomplishment of their work.
- .3 The construction scaffold will be of open mesh construction. There are no requirements for heating, ventilation or fire alarm devices within the scaffold structure. Lighting in the scaffolding shall comply with the requirements of the Canadian Electrical Code.
- .4 Electrical equipment, shall meet all requirements of the Canadian Electrical Code, and connect all on site construction offices or enclosures. Provide temporary telecom connections as required for all enclosures and to support security installations on the site.

**Part 2 Products**

**2.1 MATERIALS AND EQUIPMENT**

- .1 Material and equipment to be CSA certified.

**2.2 WIRE AND BOX CONNECTORS 0 - 1000V**

- .1 Clamps or connectors for armoured cable, flexible conduit as required to: CAN/CSA-C22.2 No. 18.

**2.3 CONSTRUCTION WIRES**

- .1 Provide watertight wiring systems throughout the construction scaffolding as required for 600V and 120/208V distribution.
- .2 Provide conductors for circuits protected at 40 amperes and higher with insulation as follows:
  - .1 At 250 V and lower, RW90
  - .2 At greater than 250 V and less than 750 V in sizes up to #3 AWG = RW90



- .3 For wiring systems at greater than 250 V and less than 750 V in sizes above #3 AWG, RWU 90 1000V.
- .4 For circuits protected at less than 40 amperes Copper conductors: size as indicated, with thermoplastic insulation type TWU or TWH, as indicated, rated at 600 V.
- .5 Colour Coding:
  - .1 Two (2) conductors, (1 phase): 1 black, 1 white
  - .2 Three (3) conductor, (1 phase): 1 black, 1 red, 1 white
  - .3 Three (3) conductor, 3 phase: 1 red (phase A), 1 black (phase B), 1 blue (phase C)
  - .4 Four (4) conductor, (3 phase): 1 red (phase A), 1 black (phase B), 1 blue (phase C), 1 white (neutral)
  - .5 Ground wire: green
- .3 Teck Cable:
  - .1 Cable: to CAN/CSA-C22.2 No. 131.
  - .2 Conductors:
    - .1 Grounding conductor: copper.
    - .2 Circuit conductors: copper, size as indicated.
  - .3 Insulation:
    - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V, as indicated.
  - .4 Inner jacket: polyvinyl chloride material.
  - .5 Armour: interlocking galvanized steel.
  - .6 Overall covering: thermoplastic polyvinyl chloride material.
  - .7 Fastenings:
    - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
    - .2 Channel type supports for two or more cables at 900 mm centers or cable tray, as indicated.
    - .3 Threaded rods: 6 mm dia. to support suspended channels, or cable tray.
  - .8 Connectors:
    - .1 Watertight approved for TECK cable
- .4 Armoured Cables:
  - .1 Conductors: insulated, copper, size as indicated.
  - .2 Type: AC90.
  - .3 Armour: interlocking type fabricated from galvanized steel strip.
  - .4 Connectors: malleable steel.

## **2.4 WIRING TERMINATIONS**

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

## **2.5 ELECTRICAL ENCLOSURES/ DISTRIBUTION KIOSKS**

- .1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish.

- .2 Removable enclosure panels with formed edges, galvanised steel external fasteners removable only from inside enclosure.
- .3 Enclosure equipped with hot dipped galvanised mounting rails 1 m adjustable horizontally and vertically to enable mounting of equipment at any location within housing.
  - .1 Rails: 14 mm holes and 50 x 14 mm slots on 100 mm centres for horizontal adjustment.
  - .2 Holes in side panel flanges in 60 mm increments for vertical adjustment.
- .4 Cover: tamperproof, bolt-on, domed to shed water.
- .5 Doors: minimum dimensions to allow access as indicated, hinged (concealed hinges), 3- point latching, with padlocking means.
- .6 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, and vermin.
- .7 Enclosure construction such as to allow any configuration of single or ganged enclosures.

## **2.6 GROUNDING AND LIGHTNING PROTECTION**

- .1 Grounding equipment to: CSA C22.2 No. 41.
- .2 Lightning protection systems to: CAN/CSA-B72-M87(R2013)
- .2 Provide grounding for all temporary equipment installation as well as lightning protection system for the tower roofs and scaffolding during construction. Connect to existing rooftop lightning protection systems and ground rods at grade.
- .3 System to consist of metallic air terminals, lightning conductors connecting air terminals to ground and interconnected ground electrodes, and/or ground cables.
- .5 System and circuit, equipment, grounding conductors, bare stranded copper, un-tinned, soft annealed, un-armoured, Size #3/0 AWG.
- .6 Insulated grounding conductors to Section 26 05 21 - Wires and Cables (0 - 1000V).
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
  - .1 grounding and bonding bushings,
  - .2 protective type clamps,
  - .3 compression type conductor connectors,
  - .4 bonding jumpers, straps,
  - .5 pressure wire connectors
  - .6 compression-type bonding and connections with pure wrought-copper compression devices, factory filled with inhibiting compound or with appropriate all bronze or copper mechanical devices and shall meet current CSA C22.2 No.41.

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**2.7 BOXES, OUTLETS, CONDUIT BOXES**

- .1 Outlet boxes, conduit boxes and fittings are based on CSA C22.2 No. 18.
- .2 Size boxes in accordance with CSA C22.1, Canadian Electrical Code, Part 1.
- .3 Support boxes independently of connecting conduits.

**2.8 RECEPTACLES**

- .1 Provide receptacles as required for electrical, mechanical and structural/masonry equipment and work.
- .2 Receptacles to be protected from water ingress or to be of waterproof type.

**2.9 LIGHTING**

- .1 Provide temporary construction lighting throughout the scaffold and work area to meet the requirements of the Canadian Centre for Occupational Health and Safety.
- .2 Minimum lighting in general construction areas shall be 50 lux.
- .3 Provide a minimum of 100 lux of lighting in general construction plant shops.
- .4 Provide a minimum of 300 lux of lighting at first aid stations.
- .5 Construction lighting to be switched by timer control.
- .6 Provide additional lighting as required by structural and masonry work. Lighting distribution system to be flexible to allow for connection of additional lighting.
- .7 Lighting equipment to be protected from water ingress or to be of waterproof type.

**2.10 EMERGENCY AND EXIT LIGHTING**

- .1 Provide minimum illumination at all stairwells in the scaffold that is not switched on timers. Lighting to be a minimum of 10lux.
- .2 Mark exit stairwells from scaffold with one red light bulb or other signage.

**2.11 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with temporary nameplates and labels.
- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- .4 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .5 Terminal cabinets and pull boxes: indicate system and voltage.
- .6 Transformers: indicate capacity, primary and secondary voltages.

## **2.12 WIRING IDENTIFICATION**

- .1 Maintain phase sequence and colour coding throughout.
- .2 Colour coding: to CSA C22.1.

## **2.13 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 and at five meter intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
Other Communication Systems	Green	Blue
Other Security Systems	Red	Yellow

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install systems in accordance with CSA C22.3 No.1 except where specified otherwise.

### **3.2 NAMEPLATES AND LABELS**

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

### **3.3 CONDUIT AND CABLE INSTALLATION**

- .1 Cut openings in the building walls or floors as required to install new cables and conduits.
- .2 Prior to cutting, carry out x-ray inspection and locate sleeves in accordance with Section 01 01 10 - General Instructions.
- .3 Seal openings and provide fire stopping in accordance with Section 07 84 00 - Firestopping
- .4 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .5 Do not use supports or equipment installed for other trades for conduit or cable support except with the permission of the other trade.
- .6 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with the manufacturer's installation recommendations.

- .7 Fasten exposed conduit or cables to scaffolding or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.

### **3.4 LOCATION OF OUTLETS**

- .1 Locate outlets as required for use by structural and masonry work. Provide flexibility in outlet installation to allow for relocation or extension to access all areas of the scaffolding.

### **3.5 CO-ORDINATION OF PROTECTIVE DEVICES**

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

### **3.6 INSTALLATION OF ELECTRICAL ENCLOSURES**

- .1 Install electrical enclosures on roofs with insulation between the roof and the structure. Provide temporary means of securing devices, to be removed at the end of construction.

### **3.7 EQUIPMENT GROUNDING**

- .1 Install the complete permanent, continuous system and circuit, equipment, grounding systems including conductors, connectors and accessories as indicated to conform to the requirements of the Departmental Representative and the local Authority Having Jurisdiction over installation.
- .2 Install connectors to the manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Install grounding connections to typical equipment included in, but not necessarily limited to the following list. Service equipment, transformers, switchgear, frames of motors, starters, enclosure and metal cladding work, and distribution panels.
- .5 Perform ground continuity and resistance tests using method appropriate to the site conditions and to the approval of the Departmental Representative and local Authority Having Jurisdiction over installation.

### **3.8 FIELD QUALITY CONTROL**

- .1 Where applicable, conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 Distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.

- .5 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing.
- .2 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

**END OF SECTION**

**Part 1        General**

**1.1           RELATED SECTIONS**

- .1    Section 01 01 10 - General Instructions.
- .2    Section 26 05 00 - Common Work Results for Electrical.
- .3    Section 26 05 21 - Wires and Cables (0-1000 V).
- .4    Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

**1.2           REFERENCES**

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

**1.3           WASTE MANAGEMENT AND DISPOSAL**

- .1    Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management.
- .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 wiring materials from landfill to metal recycling facility as approved by the Departmental Representative.

**Part 2        Products**

**2.1           MATERIALS**

- .1    Pressure type wire connectors to: CAN/CSA C22.2 No.65, with current carrying parts of copper alloy sized to fit copper conductors as required.
- .2    Copper long barrel compression connector as required by conductor size.
- .3    Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1    Connector body and stud clamp for stranded round copper conductors.
  - .2    Clamp for stranded round copper conductors.
  - .3    Stud clamp bolts.

- .4 Bolts for copper conductors.
- .4 Insulation (tubing, boots and end caps)
  - .1 Heat shrink insulators:
    - .1 Moisture proof
    - .2 Thermally stabilized cross-linked polyolefin
    - .3 Self-sealing adhesive insulator with 3 to 1 expansion
    - .4 Rated 1000 V, 90°C.
  - .5 Clamps or connectors for armoured cable, flexible conduit as required to: CAN/CSA-C22.2 No.18.

**Part 3      Execution**

**3.1          INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
  - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
  - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA C22.2 No.65.
  - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

**END OF SECTION**



**Part 1        General**

**1.1           RELATED SECTIONS**

- .1    Section 01 01 10 - General Instructions
- .2    Section 26 05 00 - Common Work Results for Electricity.
- .3    Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.
- .4    Section 26 05 29 - Hangers and Supports for Electrical Systems.
- .5    Section 26 05 31 - Splitters, Junctions, Pull Boxes and Cabinets.
- .6    Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .7    Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**1.2           REFERENCES**

- .1    American Society for Testing and Materials International, (ASTM).
  - .1    ASTM B33-10, Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
  - .2    ASTM B172-10, Standard Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors.
  - .3    ASTM B174-10, Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
- .2    Canadian Standards Association (CSA International)
  - .1    CSA C22.1-12, Canadian Electrical Code, Part 1 (22<sup>nd</sup> Edition), Safety Standard for Electrical Installations
  - .2    CSA C22.2 No. 0.3-09, Test Methods for Electrical Wires and Cables.
  - .3    CAN/CSA-C22.2 No. 131-07(R2012), Type TECK 90 Cable.
- .3    Insulated Cable Engineers Association, Inc. (ICEA), National Electrical Manufacturer's Association (NEMA)
  - .1    ANSI/NEMA WC70-2009 / ICEA-S-95-658-2009, Para 4.1.11. Power Cables, 2000 Volts or Less for the Distribution of Electrical Energy.

**1.3           PRODUCT DATA**

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

**1.4           WASTE MANAGEMENT AND DISPOSAL**

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

- .3 Collect and separate for disposal all 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 as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

## **Part 2 Products**

### **2.1 BUILDING WIRES**

- .1 Conductor material (wire in conduit): Annealed commercial grade, 98% conductivity, copper. #14 to #10 AWG solid; #8 and larger - stranded.
- .2 Unless otherwise shown on the drawings or specified herein, provide conductors for circuits protected at 40 amperes and higher with insulation as follows:
  - .1 At 250 V and lower, RW90
  - .2 At greater than 250 V and less than 750 V in sizes up to #3 AWG = RW90
  - .3 For wiring systems at greater than 250 V and less than 750 V in sizes above #3 AWG, RWU 90 1000V.
  - .4 For circuits protected at less than 40 amperes Copper conductors: size as indicated, with thermoplastic insulation type TWU or TWH, as indicated, rated at 600 V.
  - .5 Colour Coding:
    - .1 Two (2) conductors, (1 phase): 1 black, 1 white
    - .2 Three (3) conductor, (1 phase): 1 black, 1 red, 1 white
    - .3 Three (3) conductor, 3 phase: 1 red (phase A), 1 black (phase B), 1 blue (phase C)
    - .4 Four (4) conductor, (3 phase): 1 red (phase A), 1 black (phase B), 1 blue (phase C), 1 white (neutral)
    - .5 Ground wire: green
- .3 Refer to Specifications Section 28 31 00 for fire alarm wiring requirements.

### **2.2 TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
  - .1 Grounding conductor: copper.
  - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
  - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000 V, as indicated.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel.

- .6 Overall covering: thermoplastic polyvinyl chloride material.
- .7 Fastenings:
  - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two or more cables at 900 mm centers or cable tray, as indicated.
  - .3 Threaded rods: 6 mm dia. to support suspended channels, or cable tray.
- .8 Connectors:
  - .1 Watertight approved for TECK cable

### **2.3        ARMOURED CABLES**

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from galvanized steel strip.
- .4 Connectors: malleable steel

## **Part 3       Execution**

### **3.1        INSTALLATION OF BUILDING WIRES**

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

### **3.2        INSTALLATION OF CONDUCTORS IN CONDUIT**

- .1 Conductors:
  - .1 Minimum wire size shall be #12 AWG unless otherwise specified.
  - .2 The current carrying capacity of the circuit conducts shall be equal to or better than shown on the drawings.
  - .3 Neutral Wire: full capacity continuous throughout its length.
  - .4 When load or breaker ratings are greater than 15A, the conditions shall be as indicated or of capacity equal to the load or breaker trip size as determined by the Canadian Electrical Code.
  - .5 Provide pigtails at all outlets for fixtures and wiring devices. All neutrals and branch circuits shall be connected in each outlet box to avoid a break in the neutral or the circuit wire when fixture or wiring device is disconnected.
  - .6 All branch circuit connections shall be made with an approved connector applied with a proper tool.
  - .7 Run a green insulated ground wire in all power and branch circuit EMT conduits. At each junction, pull and outlet box make a 360° loop of the stripped (insulation) uncut conductor under the ground screws.
  - .8 Size all branch wiring circuits to minimum #10 AWG which are greater in length than 30 metres. Provide conductor size as

required to limit voltage drop at full circuit load to less than 3%.

.2 Testing and Commissioning:

.1 Complete the following insulation resistance tests on the new feeders:

- .1 Megger circuits, feeders and equipment up to 350 V with a 500-V instrument.
- .2 Megger 350-600-V circuits, feeders and equipment with a 1000-V instrument.
- .3 Check resistance to ground before energizing.
- .4 Carry out the tests in the presence of the Departmental Representative.
- .5 Provide the instruments, meters, equipment and personnel required to conduct the tests during and at the conclusion of the project.
- .6 Submit the typewritten test results for the Departmental Representative's review.

**3.3 INSTALLATION OF TECK CABLE 0-1000V**

- .1 Install cables in cabletroughs.
- .2 Terminate cables in accordance with Section 26 05 20- Wire and Box Connectors - 0-1000V.

**END OF SECTION**

**Part 1        General**

**1.1           RELATED SECTIONS**

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

**1.2           REFERENCES**

- .1       Canadian Standards Association, (CSA International).
  - .1       CSA C22.2 No. 41-13, Grounding and Bonding Equipment

**1.3           WASTE MANAGEMENT AND DISPOSAL**

- .1       Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management.
- .2       Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3       Collect and separate for disposal all 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 as approved by Departmental Representative.
- .5       Fold up metal banding, flatten and place in designated area for recycling.

**Part 2        Products**

**2.1           MATERIALS**

- .1       Grounding equipment to:    CSA C22.2 No. 41.

**2.2           EQUIPMENT**

- .1       System and circuit, equipment, grounding conductors, bare stranded copper, un-tinned, soft annealed, un-armoured, Size #3/0 AWG.
- .2       Insulated grounding conductors to Section 26 05 21 - Wires and Cables (0 - 1000V).
- .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       compression type conductor connectors,
  - .4       bonding jumpers, straps,
  - .5       pressure wire connectors

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- .6 compression-type bonding and connections with pure wrought-copper compression devices, factory filled with inhibiting compound or with appropriate all bronze or copper mechanical devices and shall meet current CSA C22.2 No.41.

### **Part 3 Execution**

#### **3.1 INSTALLATION GENERAL**

- .1 Install the complete permanent, continuous system and circuit, equipment, grounding systems including conductors, connectors and accessories as indicated to conform to the requirements of the Departmental Representative and the local Authority Having Jurisdiction over installation.
- .2 Install connectors to the 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 are not permitted.
- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or exterior of flexible conduit.
- .7 Make grounding connections in radial configuration only.
- .8 Bond single conductor, metallic armoured cables to cabinet at supply end and provide non-metallic entry plate at load end.
- .9 Provide a separate green-insulated ground conductor in every feeder and branch conduit.
- .10 Provide separate green-insulated ground conductor in every conduit to all devices and fixtures.
- .11 Ground panels and transformers to local ground bus. Connect each ground bus to the building ground loop at the nearest location.

#### **3.2 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to the neutral of the secondary 600-V system as indicated.

#### **3.3 GROUNDING BUS**

- .1 Install copper ground bus mounted on insulated supports on wall of generator enclosure.
- .2 Ground to electrical equipment with insulated stranded copper conductor size 2/0.

**3.4 EQUIPMENT GROUNDING**

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list. Service equipment, transformers, switchgear, frames of motors, starters, enclosure and metal cladding work, and distribution panels.

**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 the site conditions and to the approval of the Departmental Representative and local Authority Having Jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Test all joints including threaded conduits connection used as ground.  
  
DC resistance shall be no greater than 5 milliohms per joint or connection.
- .5 Submit the test report to the Departmental Representative.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

**1.2 REFERENCES**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, (22<sup>nd</sup> Edition), **Safety Standard for Electrical Installations.**

**1.3 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 01 10 - General Instructions.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal all packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

**Part 2 Products**

**2.1 SUPPORT CHANNELS**

- .1 Provide galvanized steel support channels.
- .2 U-shaped, size 37 x 25 mm thick, surface mounted and suspended as required.

**2.2 THREADED ROD HANGERS**

- .1 Provide galvanized steel threaded rod hangers throughout.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Secure equipment to solid masonry with lead anchors.
- .2 Secure equipment to poured concrete with self-drilling expandable inserts.



- .3 Secure equipment to hollow masonry walls with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems.
  - .1 Support individual cable or conduit runs with 12 mm diameter threaded rods and spring clips.
  - .2 Support two (2) or more cables or conduits on channels supported by 12 mm diameter threaded rod hangers where direct fastening to building structure is impractical.
- .7 For surface mounting of two (2) or more conduits, use channels at 1500 mm OC spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated, or as required, to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with the permission of the other trade and the approval of the Departmental Representative.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with the manufacturer's installation recommendations.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 01 10 - General Instructions.
- .2 Section 26 05 00 - Common Work Results for Electrical
- .3 Section 26 05 34 - Conduits, Conduit Fastening and Fittings

**1.2 REFERENCES**

- .1 CSA C22.1-12, Canadian Electrical Code, Part 1, (22<sup>nd</sup> Edition),  
**Safety Standard for Electrical Installations.**

**1.3 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 00 10 - General Instructions.
- .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.

**1.4 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 JUNCTION AND PULL BOXES**

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Exterior cabinets shall be sealed, gasketed, and of weatherproof construction with lockable doors and wire termination strips.

**Part 3 Execution**

**3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Only main junction and pull boxes are indicated on drawings.

Provide pull boxes so as not to exceed 30 m or three (3) 90° elbows of conduit run between pull boxes and not more than two (2) 90° elbows in feeder conduits, unless bends are long sweep type.

- .2 Install pull boxes in inconspicuous, but accessible locations.

### **3.2 IDENTIFICATION**

- .1 Install Size 2 identification labels indicating system name, voltage and phase in accordance with Section 26 05 00 - Common Work Results for Electrical.

**END OF SECTION**

**Part 1        General**

**1.1           RELATED SECTIONS**

- .1    Section 01 01 10 - General Instructions.
- .2    Section 26 05 00 - Common Work Results for Electrical.
- .3    Section 26 05 34 - Conduits, Conduit Fastening and Fittings.

**1.2           REFERENCES**

- .1    Canadian Standards Association (CSA International)
  - .1    CSA C22.1-12 Canadian Electrical Code, Part 1 (22<sup>nd</sup> Edition), Safety Standard for Electrical Installations
  - .2    CAN/CSA C22.2 18-98 (R2003), Outlet Boxes, Conduit Boxes, and Fittings.

**1.3           SUBMITTALS**

- .1    Provide submittals in accordance with Section 01 00 10 - General Instructions.

**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 - Waste Management.

**Part 2        Products**

**2.1           BOXES, OUTLETS, CONDUIT BOXES**

- .1    Outlet boxes, conduit boxes and fittings are based on CSA C22.2 No. 18.
- .2    Size boxes in accordance with CSA C22.1, Canadian Electrical Code, Part 1
- .3    Outlet conduit and junction boxes - general:
  - .1    100 mm square or larger outlet boxes as required for special devices.
  - .2    Gang boxes where wiring devices are grouped.
  - .3    Blank cover plates for boxes without wiring devices.
  - .4    Within the ventilation towers, all device boxes and outlet boxes shall be of cast ferrous alloy with hubs and mounting feet.

**2.2 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm unless otherwise indicated. 100 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 100 mm square outlet boxes with extension and plaster rings for flush-mounting devices in finished walls.

**2.3 FITTINGS FOR THINWALL CONDUIT**

- .1 All couplings and connectors at the sprinkler-proof equipment shall be steel-compression type (binding collar). For all other applications, steel set screw-type couplings and connectors shall be used. Cast type will not be acceptable.

**2.4 FITTINGS -GENERAL**

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of foreign materials.
- .3 Conduit outlet bodies for conduit up to 30 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

**2.5 CONDUIT BOXES**

- .1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for outlets connected to surface-mounted conduit.

**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 the entry of construction material.
- .3 For flush installations, mount outlets flush with the finished wall using plaster rings to permit wall finish to come within 5 mm of opening.
- .4 Provide correct size of openings in boxes for conduit and armoured cable connections. Reducing washers not allowed.
- .5 Install outlets in ventilation towers on railings for service platforms.

**END OF SECTION**

**Part 1        General**

**1.1           RELATED SECTIONS**

- .1    Section 26 05 00 - Common Work Results for Electrical.
- .2    Section 26 05 21 - Wire and Cables (0 - 1000 V).
- .3    Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

**1.2           REFERENCES**

- .1    Canadian Standards Association (CSA)
  - .1    CAN/CSA C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes and Fittings.
  - .2    CSA C22.2 No. 56-04 (R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .3    CSA C22.2 No. 83-M1985(R2013), Electrical Metallic Tubing.
  - .4    CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.

**1.3           SUBMITTALS**

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

**1.4           WASTE MANAGEMENT AND DISPOSAL**

- .1    Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management.
- .2    Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3    Collect and separate for disposal all 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 as approved by Departmental Representative.
- .5    Fold up metal banding, flatten and place in designated area for recycling.

**Part 2        Products**

**2.1           CONDUITS**

- .1    Electrical metallic tubing with couplings to CSA C22.2 No. 83.
- .2    Flexible and liquid-tight flexible metal conduit: to CSA C22.2 No.56.
- .3    Rigid PVC conduit: to CSA 22.2 No. 211.2.

**2.2 CONDUIT FASTENINGS**

- .1 One-hole galvanized steel straps to secure surface conduits 50 mm and smaller. Two-hole galvanized steel straps for conduits larger than 50 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two (2) or more conduits at 1500 mm OC.
- .4 12 mm diameter galvanized threaded rods to support suspended channels.

**2.3 CONDUIT FITTINGS**

- .1 Fittings for raceways: to CSA C22.2 No. 18.
- .2 Fitting manufactured for use with conduit specified.
- .3 Factory "ells" where 90° bends are required for 25 mm and larger conduits.
- .4 All couplings and connectors at shall be steel-compression type (binding collar).

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in space through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 In finished areas, run wiring concealed, except as otherwise specified or indicated on the drawings. Run exposed conduit neatly, parallel to building lines and maintain maximum headroom.
- .4 Use EMT conduit for all feeders and branch wiring within enclosures and in the building.
- .5 Use 600 mm liquid-tight flexible metal conduit for primary and secondary connection to dry-type transformers.
- .6 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .7 Mechanically bend steel conduit over 20 mm diameter.
- .8 Install polypropylene fish cord in all empty conduits.
- .9 Where conduits become blocked, remove and replace blocked section.
- .10 Dry conduits out before installing wire.
- .11 Provide expansion fittings at all building and shield expansion joints.

**3.2 SURFACE CONDUITS**

- .1 Line up all exposed raceways, parallel and at right angles to the building walls. Set plumb and level equipment accurately and align hanger rods. Function and appearance shall be to the Departmental Representative's satisfaction.
- .2 Locate conduits behind infrared or gas-fired heaters with 1500 mm clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on recessed channels. Surface or suspended channels may be used if unavoidable.
- .5 Do not pass conduits through structural members except as indicated and only with the Departmental Representative's permission for each case.

**3.3 MINIMUM CONDUIT SIZE**

- .1 The minimum conduit size shall be 20 mm.

**3.4 EXPANSION FITTINGS**

- .1 Conduit expansion fittings shall be provided on all conduits crossing structural expansion joints.
- .2 Install expansion fittings perpendicular to expansion joint.

**3.5 CLEANING**

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

**END OF SECTION**



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**Part 1      General**

**1.1      RELATED SECTIONS**

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

**1.2      REFERENCES**

- .1      CSA G40.20-04/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

**1.3      DEFINITIONS**

- .1      Operational Functional Components (OFCs) are non-structural building components, including architectural finishes, building service components (mechanical, plumbing, electrical and telecommunications) and building contents.
- .2      Importance Categories for Buildings: buildings (and their respective OFCs) are defined by the National Building code of Canada 2010.
  - .1      For seismic design, the importance categories for buildings are defined as normal, high and post disaster.
  - .2      For seismic design of OFCs, the importance categories are defined as normal , high and post-disaster with OFCs being nominally impacted after a design seismic event and repairable within two to three days and post-disaster with OFCs being fully functional after a design seismic event.
- .3      SRS: acronym for Seismic Restraint System.

**1.4      GENERAL DESCRIPTION**

- .1      This section covers design, supply and installation of complete SRS for all systems, equipment specified for installation on this project. This includes electrical light fixtures, transformers, battery, diesel generators, fire protection, conduit, communications, electrical equipment and systems, both vibration isolated and statically supported.
- .2      SRS to be fully integrated into, compatible with:
  - .1      Noise and vibration controls specified elsewhere in this project specification.
  - .2      Structural, mechanical, electrical design of project.
- .3      During seismic event, SRS to prevent systems and equipment from causing personal injury and from moving from normal position.
- .4      Design to be by Professional Engineer specializing in design of SRS and registered in Province of Ontario. Include all costs associated with this work as it relates to the electrical installations. Submit design sketches c/w professional stamp prior to start of installations, c/w installation requirements.

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**1.5 DESIGN CRITERIA**

- .1 Seismic restraint design for OFCs to meet National Building Code of Canada 2010, National Fire Code 2010 and National Plumbing Code 2010.
- .2 Building is defined as a 'post disaster building' with an importance factor  $I_c=1.5$ . Foundation class is  $F_a=.5$  for a Class 'A' soil. Spectral response factor is for Ottawa with a  $S_a(.2)=.66$  and a peak ground acceleration of .42.

**1.6 SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submittals to include:
  - .1 Full details of design criteria.
- .3 Submit additional copy of shop drawings and product data to Structural Engineer for review of connection points to building structure.

**1.7 MAINTENANCE DATA**

- .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 26 05 00 - Common Work Results for Electrical.

**1.8 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management.
- .2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .3 Fold up metal banding, flatten and place in designated area for recycling.

**Part 2 Products**

**2.1 SRS MANUFACTURER**

- .1 SRS to be from one manufacturer regularly engaged in production of same.

**2.2 GENERAL**

- .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to restrain seismic forces in all directions.
- .3 Fasteners and attachment points to resist same load as seismic restraints.

- 
- .4 SRS of conduit systems to be compatible with:
    - .1 Expansion, anchoring and guiding requirements.
    - .2 Equipment vibration isolation and equipment SRS.
  - .5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.
  - .6 Attachments to reinforced concrete structure:
    - .1 Use high strength mechanical expansion anchors.
    - .2 Drilled or power driven anchors not permitted.
  - .7 Seismic control measures not to interfere with integrity of firestopping.

## **2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS**

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

## **2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT, SYSTEMS**

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

- .2 Suspended equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Slack cable restraint system.
    - .2 Brace back to structure via vibration isolators and snubbers

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Attachment points and fasteners:
  - .1 To withstand same maximum load that seismic restraint is to resist and in all directions.
- .2 Install SRS at least 25 mm from all other equipment, systems, and services.
- .3 Miscellaneous equipment not vibration-isolated:
  - .1 Bolt through house-keeping pad to structure.
- .4 Co-ordinate connections with all disciplines.

#### **3.2 INSPECTION AND CERTIFICATION**

- .1 SRS to be inspected and certified by Manufacturer upon completion of installation.
- .2 Provide written report stamped by professional Engineer licensed in Ontario to Departmental Representative with signed certificate of compliance with the SRS design requirements

#### **3.3 COMMISSIONING DOCUMENTATION**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

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

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.184.1-96(R2011), Solid-State Dimming Controls (Bi-national standard with UL 1472 Updated 2003).

**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 exit light product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
  - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management.

**Part 2 Products**

**2.1 ACCEPTABLE MATERIALS**

- .1 The existing Senate lighting control system for television lighting is manufactured by Lightolier Optio. All new materials shall be manufactured by Lightolier to ensure compatibility with the existing lighting system.

**2.2 COMMERCIAL DIMMERS**

- .1 Commercial dimmers, mounted in racks: to CSA C22.2 No.184.1, designed to control brightness of incandescent lamps up to 2 kW, three phase and consisting of:
  - .1 Modules
    - .1 Dimmers to be two-circuit rated at 2000 watts each.
    - .2 Dual color LED indicators providing status information.
    - .3 Plug-in capability.
    - .4 Operating voltage: 120 V
    - .5 2 dimmers per module

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- .6 Manufacturer: Lightolier Optio - OPT20HP.
  - .2 Control panels:
    - .1 3 module panel (up to 12 circuits per panel).
    - .2 6 module panel (up to 24 circuits per panel)
    - .3 Output voltage: 120 V
    - .4 Supply voltage: 120 V
    - .5 Natural connection cooling
    - .6 Manufacturer: Lightolier Optio - OPT3120 Series and OPT6120 Series.
  - .2 Remote control station:
    - .1 Control station: connect to existing control system and provide complete commissioning and compatibility testing of existing controller and new dimmer racks.

### **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 dimmers in accordance with manufacturer's instructions.
- .2 Connect lamp circuits to dimmer.
- .3 Reconnect to existing remote monitoring station.

#### **3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Demonstrate that dimming systems are installed as indicated, and to match existing functionality.
- .3 Demonstrate that dimming systems:
  - .1 Operate as intended.
  - .2 That there are no problems in starting lamps, nor in keeping them lit.
  - .3 That they flicker-free at any setting of dimming intensity control.
- .4 Demonstrate that no audio, radio or TV interference is carried by system.
- .5 Commissioning:
  - .1 Commission system using commissioning agent, when installation has been completed.
  - .2 Perform commissioning after ballasts and controls have been installed and wiring has been connected and checked for proper continuity.
  - .3 Commissioning agent to calibrate and verify system operation for specified functions and controls.

**3.4           CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

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

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.29-2011, Panelboards and enclosed Panelboards.

**1.3 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management.
- .2 Remove from site and dispose of 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 the Departmental Representative.

**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 250V panelboards: bus and breakers rated for minimum 10 kA symmetrical available fault.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Two keys for each panelboard and key panelboards alike.
- .6 Copper bus. Provide neutral or same rating for 250 Volt panels. Neutral is not required in 600 Volt panels.
- .7 Mains: suitable for bolt-on breakers.



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- .8 Panelboards for surface mounting.
  - .9 Trim with concealed front bolts and hinged trim cover.
  - .10 Trim and door finish: baked grey enamel.

## **2.2 BREAKERS**

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.

## **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.
- .3 Nameplate for each circuit in distribution panelboards size 2.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface wall mounted panelboards on channels fastened with suitable anchors. Provide suitable channel frame supports and floor plates with braces and anchors where installed on the open floor area.
- .3 Install wall-mounted panelboards at 1950 mm above finished floor unless indicated otherwise on the drawings.
- .4 Connect loads to circuits.
- .5 For 250 Volt panels connect neutral conductors to common neutral bus with respective neutral identified.

**END OF SECTION**

**Part 1        General**

**1.1           RELATED SECTIONS**

- .1    Section 26 05 00 - Common Work Results for Electrical.
- .2    Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

**1.2           REFERENCES**

- .1    Canadian Standards Association (CSA International)
  - .1    CSA-C22.2 No. 42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2    CSA-C22.2 No. 42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3    CSA-C22.2 No.55- M1986 (R2012), Special Use Switches.
  - .4    CSA-C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20), includes Update No. 1 (2012).

**1.3           SHOP DRAWINGS**

- .1    Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

**1.4           WASTE MANAGEMENT AND DISPOSAL**

- .1    Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management.
- .2    Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3    Collect and separate for disposal all 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 as approved by Departmental Representative.
- .5    Fold up metal banding, flatten and place in designated area for recycling.

**Part 2        Products**

**2.1           SWITCHES**

- .1    15 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.

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- .2 Silver alloy contacts.
  - .3 Urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 Brown toggle in ventilation tower areas.
  - .6 Black toggle in bathrooms.
  - .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
  - .4 Switches of one manufacturer throughout project.

## **2.2 RECEPTACLES**

- .1 Duplex receptacles, CSA Type 5-15 R, 125 V, 15 A, U ground, with the following features:
  - .1 Brown nylon-moulded housing. Red colour for all emergency circuits, orange for work stations.
  - .2 Suitable for No.10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight (8) back-wired entrances, four (4) side-wiring screws.
  - .5 Triple-wipe contacts and riveted grounding contacts (100% nickel plated).

## **2.2 COVER PLATES**

- .1 Cover plates for wiring devices.
- .2 Cover plates from one manufacturer throughout the project.
- .3 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .4 Provide nickel plating on cover plates in Senate bathrooms.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical as indicated.
- .2 Receptacles:
  - .1 Install receptacles in gang-type outlet box when more than one receptacle is required in one location.

- .2 Mount receptacles at the height specified in Section 26 05 00 - Common Work Results for Electrical.
- .3 Within the ventilation towers, provide cast ferrous alloy boxes for all receptacles to be surface mounted on the centre railing structure.
- .3 Cover plates:
  - .1 Protect the cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 24 16.01 - Panelboards Breaker Type.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA-C22.2 No.5-13, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

**1.3 SUBMITTALS**

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include time-current characteristic curves for breakers on 600 Volt system.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management.
- .2 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.
- .3 Separate for reuse and recycling and place in designated containers metal and plastic waste in accordance with Waste Management Plan.

**Part 2 Products**

**2.1 BREAKERS GENERAL**

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 All 600V distribution breakers shall be equipped with electronic trip units L.S.I. or L.S.I.G type as indicated on single line diagram.
- .5 600 V circuit breakers to have minimum 25,000 A symmetrical rms interrupting capacity rating.

**2.2 THERMAL MAGNETIC BREAKERS**

- .1 For general protection and control application. 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          INSTALLATION**

- .1      Install circuit breakers in low voltage switchgear and panelboards, as indicated.

**3.2          TESTING**

- .1      Using the manufacturers proprietary test set check breakers and test to confirm operation within published tolerances and set each breaker in accordance with the co-ordination study.

**END OF SECTION**

**Part 1        General**

**1.1           RELATED SECTIONS**

- .1    Section 01 01 10 - General Instructions.
- .2    Section 26 05 00 - Common Work Results for Electrical.

**1.2           REFERENCES**

- .1    Canadian Standards Association (CSA International).
  - .1    CSA C22.2 No.4-04(2009), Enclosed and Dead Front Switches.
  - .2    CSA C22.2 No.39-13,Fuseholder Assemblies.

**1.3           SUBMITTALS**

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

**1.4           WASTE MANAGEMENT AND DISPOSAL**

- .1    Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management.
- .2    Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3    Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and 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 as approved by Departmental Representative
- .5    Fold up metal banding, flatten and place in designated area for recycling.

**Part 2        Products**

**2.1           DISCONNECT SWITCHES**

- .1    Non-fusible, fusible, disconnect switch in CSA Enclosure 1, to CSA C22.2 No.4. Size as indicated. Horsepower rated.
- .2    Provision for padlocking in on-off switch position by three locks.
- .3    Mechanically interlocked door to prevent opening when handle in ON position.
- .4    Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.
- .5    Quick-make, quick-break action.
- .6    ON-OFF switch position indication on switch enclosure cover.

**2.2 EQUIPMENT IDENTIFICATION**

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

**Part 3 Execution**

**3.1 INSTALLATION**

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

**END OF SECTION**



**Part 1        General**

**1.1           RELATED REQUIREMENTS**

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

**1.2           REFERENCES**

- .1    Institute of Electrical and Electronics Engineers, Inc. (IEEE)
  - .1    IEEE 837-2002, Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2    CSA International
  - .1    CAN/CSA-B72-M87(R2013), Installation Code for Lightning Protection Systems.

**1.3           SUBMITTALS**

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

**1.2           WASTE MANAGEMENT AND DISPOSAL**

- .1    Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management.
- .2    Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3    Collect and separate for disposal all 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 as approved by Departmental Representative.
- .5    Fold up metal banding, flatten and place in designated area for recycling.

**Part 2        Products**

**2.1           MATERIALS**

- .1    Lightning Rods: copper solid rod.
- .2    Conductor: copper stranded, #6 gauge.
- .3    Fastenings and attachment straps: copper.
- .4    Ground electrodes: 3 m x 21 mm diameter copper coated steel.
- .5    Use copper conductors, terminals, connectors and fastenings for buildings sheathed in other than aluminum.
- .6    Connections: copper permanent mechanical connectors or inspectable wrought copper compression connectors to IEEE 837.

**2.2           DESCRIPTION**

- .1    System to consist of metallic air terminals, lightning conductors connecting air terminals to ground and interconnected ground electrodes, and/or ground cables.

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**2.3 REGULATORY REQUIREMENTS**

- .1 System subject to: approval by authority having jurisdiction.

**2.4 CONSTRUCTION SCAFFOLD**

- .1 Provide lightning protection system as indicated. Interconnect to existing lightning protection system.

At completion of work, remove scaffolding lightning protection and reinstate lightning protection system on towers as indicated.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for lightning protection 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 lightning protection to CAN/CSA-B72.
- .2 Bond discharge conductors to service mast or other non-current-carrying electrical parts.
- .3 Submit certificate of installation to Departmental Representative.

**3.3 INSPECTION**

- .1 Obtain inspection certificate from Departmental Representative for discharge conductor passing through any fire supporting membrane.

**3.4 CLEANING**

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

**3.5 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 01 10 - General Instructions.
- .2 Section 26 05 00 - Common Work Results for Electrical.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C82.1-2004, American National Standard for Lamp Ballasts - Line Frequency Fluorescent Lamp Ballasts.
- .2 Institute of Electrical and Electronics Engineers (IEEE)
  - .1 IEEE C62.41-1991, IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 American Society for Testing and Materials (ASTM)
  - .1 ASTM F1137-11e1, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Waste Management.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal all 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 as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

**Part 2 Products**

**2.1 LAMPS**

- .1 LED lamps type A as per lighting schedule in section 2.4. Lamp features include:
  - .1 4000 k, 5W/ft ASHRAE standard light output, 100,000 hour lamp life, CRI 85+, 120V.
  - .2 LED fixtures shall be supplied with integral mounted driver, with 120V input, minimum 50,000 hour lamp life.

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- .2 Fluorescent lamps type B and C as per lighting schedule in section 2.4. Lamp features include:

- .1 Rapid start, 3500 k, 30,000 hour lamp life, 3100 initial lamp lumens, CRI 85.

## **2.2 BALLASTS**

- .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, rapid start low frequency hybrid electronic ballast to meet the following:

- .1 Rating: 120 V, 60 Hz, suitable for lamps selected.
- .2 Input total current harmonic distortion (THD) shall not exceed 10%.
- .3 Class A sound level rating.
- .4 Capable of starting at a minimum temperature of 10°C.
- .5 Minimum Power Factor of 0.97.
- .6 Lamp Current Crest Factor: shall not exceed 1.5 maximum during all modes of lamp operations.
- .7 Ballast Factor: 0.90 or greater for all normal operating conditions and configurations.
- .8 Ballast case temperature shall not exceed 25°C over 40° ambient.
- .9 Lamp light output shall not change more than ±10% with ±10% change in voltage applied to the ballast.
- .10 Total Circuit Power: 62 Watts.
- .11 Mounting: integral with luminaire.

## **2.3 FINISHES**

- .1 Baked enamel finish:
- .1 Conditioning of metal before painting:
- .1 For corrosion resistance conversion coating to ASTM F1137.
- .2 For paint base, conversion coating to ASTM F1137.
- .2 Metal surfaces of luminaire housing and reflectors finished with high gloss baked enamel to give smooth, uniform appearance, free from pinholes or defects.
- .3 Reflector and other inside surfaces finished as follows:
- .1 White, minimum reflection factor 85%.
- .2 Colour fastness: yellowness factor not above 0.02 and after 250 hours exposure in Atlas fade-o-meter not to exceed 0.05.
- .3 Film thickness, not less than 0.03 mm average and in no areas less than 0.025 mm.
- .4 Gloss not less than 80 units as measured with Gardner 60E gloss meter.
- .5 Flexibility: withstand bending over 12 mm mandrel without showing signs of cracking or flaking under 10 times magnification.

- .6 Adhesion: 24 mm square lattice made of 3 mm squares cut through film to metal with sharp razor blade. Adhesive cellulose tape applied over lattice and pulled. Adhesion satisfactory if no coating removed.

## **2.4 LUMINAIRES**

- .1 Type A LED luminaire design:
  - .1 No. of lamps: 1 strip.
  - .2 Strip light fixture with swivel mount to redirect lighting distribution.
  - .3 Extruded aluminum housing with tempered glass lens, silver finish.
  - .4 Nominal dimensions: 645mm, 949mm, or 1254mm length.
  - .5 Lamp design: LED ASHRAE 5W/foot.
  - .6 Driver ballast chamber: built-in.
  - .7 4000K Colour temperature
  - .8 CRI Value: 85+
  - .9 Operating Voltage: 120 Volt.
  - .10 3m long extended conductor to permit connection at floor-level mounted box.
- .2 Type B fluorescent luminaire design:
  - .1 No. of lamps: 1.
  - .2 1 x 24W T5 fluorescent lamp.
  - .3 Satin nickel finish.
  - .4 Ballast chamber: built-in.
  - .5 3500K Colour temperature
  - .6 CRI Value: 85
  - .7 Operating Voltage: 120 Volt.
- .3 Type C fluorescent luminaire design:
  - .1 No. of lamps: 1.
  - .2 1 x 26W TTT fluorescent lamp.
  - .3 White finish
  - .4 Specular Alzak reflector.
  - .5 152.4mm diameter.
  - .6 Ballast chamber: built-in.
  - .7 3500K Colour temperature
  - .8 CRI Value: 85
  - .9 Operating Voltage: 120 Volt.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated on Architectural drawings.
- .2 Install LED lights in ventilation towers on horizontal structural support by Division 5 at 2133mm above floor height.

**3.2 WIRING**

- .1 Connect luminaires to lighting circuits.

**3.3 LUMINAIRE ALIGNMENT**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 01 00 10 - General Instructions.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA C22.2 No.141-10, Unit Equipment for Emergency Lighting.
  - .2 CSA C860-11, Performance of Internally - Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA)
  - .1 NFPA (Fire) 101, Life Safety Code. 2012 Edition

**1.3 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.

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Management.

**Part 2 Products**

**2.1 EXIT LIGHT**

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing: Extruded aluminum housing, brush aluminum finish.
- .3 Face and back plates: die formed cold rolled steel.
- .4 Lamps: LED-12 Watt with over 500,000 hours of life.
- .5 Letters: 150 mm high x 19 mm wide, with 13 mm thick stroke, red, reading EXIT and SORTIE.
- .6 Face plate to remain captive for relamping.
- .7 Supply voltage: 120 V, ac.
- .8 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.

**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, NFPA standard and local regulatory requirements.
- .2      Connect fixtures to exit light circuits.
- .3      Ensure that exit light circuit breaker is locked in on position.

**END OF SECTION**