

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 01 – General Requirements.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2 CAN3-C235-83 (R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
  - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
  - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**1.3 DEFINITIONS**

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

**1.4 DESIGN REQUIREMENTS**

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

**1.5 SUBMITTALS**

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

**1.6 QUALITY ASSURANCE**

- .1 Qualifications: electrical work to be carried out by qualified licensed electricians who hold valid Master Electrical Contractor license or apprentices as per the conditions of Provincial Act respecting manpower vocational training and qualifications.

- .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.

## **1.7 WASTE MANAGEMENT AND DISPOSAL**

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## **1.8 SYSTEM STARTUP**

- .1 Instruct PWGSC 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.
- .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.

## **Part 2 Products**

### **2.1 MATERIALS AND EQUIPMENT**

- .1 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 - SUBMITTALS.
- .2 Factory assemble control panels and component assemblies.

### **2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Verify nameplate ratings on all equipment prior to installation. Report any discrepancies to PWGSC Representative.

### **2.3 WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of PWGSC Representative.
- .2 Ensure that all electrical equipment is field marked to warn of potential electric shock and arc flash hazards as per CSA C22.1, Rule 2-306.

### **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 thick plastic engraving sheet, matt 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 and labels to be approved by PWGSC Representative prior to manufacture.
  - .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
  - .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
  - .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
  - .7 Terminal cabinets and pull boxes: indicate system and voltage.
  - .8 Transformers: indicate capacity, primary and secondary voltages.

**2.6 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 Colour code conduits, boxes and metallic sheathed cables.
- .5 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .6 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
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Blue	
Other Communication Systems	Green	Blue
Fire Alarm	Red	

Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

## 2.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
  - .1 Paint outdoor electrical equipment "equipment green", Munsell 9GY 1.5/2.6. Finish to IEEE C57.12.28.
  - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

## Part 3 Execution

### 3.1 INSTALLATION

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

### 3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.
- .2 Provide typewritten updated panel schedules upon completion of work.

### 3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

### 3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with 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.

### 3.5 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 Local switches: 1400 mm.
  - .2 Wall receptacles:
    - .1 General: 300 mm.
    - .2 Above top of continuous baseboard heater: 200 mm.
    - .3 Above top of counters or counter splash backs: 175 mm.
    - .4 In mechanical rooms: 1400 mm.
  - .3 Panelboards: as required by Code or as indicated.

### **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:
  - .1 Power distribution system including phasing, voltage, grounding and load balancing.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
  - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .5 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 PWGSC 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.
  - .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.

### **3.8 CLEANING**

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

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- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

**3.9 CUTTING AND PATCHING**

- .1 Cutting and patching and associated costs for Div. 26 shall be the responsibility of Div. 26; confirm the location of all holes with the General Contractors prior to starting work.
- .2 Seal all penetrations through floors with fire stopping.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Division 01 – General Requirements.

**1.2                REFERENCES**

- .1            Canadian Standards Association (CSA International):
  - .1            CAN/CSA-C22.2 No.18.3-12, Conduit, Tubing and Cable Fittings.
  - .2            CAN/CSA-C22.2 No.65-13, Standard for Wire Connectors (5th Edition) (National Standard with UL 486A-486B).
- .2            National Electrical Manufacturers Association (NEMA)

**1.3                SUBMITTALS**

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

**1.4                CLOSEOUT SUBMITTALS**

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

**Part 2            Products**

**2.1                MATERIALS**

- .1            Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper or copper alloy aluminum alloy sized to fit copper conductors as required.
- .2            Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper or copper alloy sized to fit copper conductors 10 AWG or less.

**Part 3            Execution**

**3.1                INSTALLATION**

- .1            Remove insulation carefully from ends of conductors cables and:
  - .1            Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
  - .2            Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Division 01 - Requirements.

**1.2                REFERENCES**

- .1            Canadian Standards Association (CSA International).
  - .1            CSA C22.2 No. 0.3-09 Test Methods for Electrical Wires and Cables, Includes update No. 1 (2010).

**1.3                PRODUCT DATA**

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

**1.4                WASTE MANAGEMENT AND DISPOSAL**

- .1            Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**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 or RWU90.

**2.2                CONTROL CABLES**

- .1            Type: LVT: soft annealed copper conductors, sized as indicated with PVC insulation and outer PVC jacket.
- .2            Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated with polyethylene insulation and outer PVC jacket, rated FT-6.
- .3            Type: 600 V stranded annealed copper conductors, sizes as indicated with XLPE insulation and outer PVC jacket.

**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 CONTROL CABLES**

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

**END OF SECTION**

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**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Division 01 – General Requirements.
- .2            Section 26 05 00 – Common Work Results for Electrical.

**1.2                REFERENCES**

- .1            Canadian Standards Association (CSA International)
  - .1            CSA C22.2 No. 0.4-04 (R2013), Bonding of Electrical Equipment.
  - .2            CSA C22.2 No. 41-13, Grounding and Bonding Equipment.

**Part 2            Products**

**2.1                EQUIPMENT**

- .1            Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .2            Insulated grounding conductors: green, copper conductors, type RW90 XLPE, size as indicated.
- .3            Ground bus: 6 mm thick copper, size as required, complete with insulated supports, fastenings, connectors.
- .4            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.

**Part 3            Execution**

**3.1                INSTALLATION GENERAL**

- .1            Install complete permanent, continuous grounding system including, bus bar, conductors, connectors, and accessories. Where EMT is used, run green insulated ground wire in conduit.
- .2            Install connectors in accordance with manufacturer's instructions.
- .3            Protect exposed grounding conductors from mechanical injury.
- .4            Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5            Soldered joints not permitted.

- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

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

- .1 Install system and circuit grounding connections to neutral of 208/120V system.

### **3.3 EQUIPMENT GROUNDING**

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

### **3.4 GROUNDING BUS**

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

### **3.5 COMMUNICATION SYSTEMS**

- .1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
  - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
  - .2 Sound, fire alarm, and security systems to manufacturer's recommendations.

### **3.6 FIELD QUALITY CONTROL**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 01 – General Requirements.

**1.2 WASTE MANAGEMENT AND DISPOSAL**

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended, or set in poured concrete walls and ceilings.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Secure equipment to finished masonry, drywall, and tile surfaces with nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
  - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .6 For surface mounting of two or more conduits use channels at 1.5 m on centre spacing.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1      Division 01 – General Requirements.
- .2      Section 26 05 00 – Common Work Results for Electrical.

**1.2                SUBMITTALS**

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

**1.3                WASTE MANAGEMENT AND DISPOSAL**

- .1      Waste management and disposal to be in accordance with 01 74 21 - Construction/ Demolition Waste Management and Disposal.

**Part 2            Products**

**2.1                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 turned edge covers.

**Part 3            Execution**

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

- .1      Install pull boxes in inconspicuous but accessible locations.
- .2      Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

**3.2                IDENTIFICATION**

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

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section Division 01 – General Requirements.

**1.2                REFERENCES**

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

**1.3                WASTE MANAGEMENT AND DISPOSAL**

- .1            Waste management and disposal to be 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.
- .4            Blank cover plates for boxes without wiring devices.

**2.2                STEEL SHEET OUTLET BOXES**

- .1            Electro-galvanized steel utility boxes for connection to surface-mounted EMT conduit, minimum size 102 x 54 x 48 mm.

**2.3                MASONRY BOXES**

- .1            Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

**2.4                CONDUIT BOXES**

- .1            Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

**2.5                FITTINGS - GENERAL**

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

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**Part 3 Execution**

**3.1 INSTALLATION**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Division 01 – General Requirements.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No. 18.1-13 Metallic Outlet Boxes
  - .2 CSA C22.2 No. 45.1-07 (R2012), Electrical Rigid Metal Conduit-Steel.
  - .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 CAN/CSA C22.2 No. 227.3-05 (R2010), Nonmetallic Mechanical Protection Tubing (NMPT).

**1.3 SUBMITTALS**

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

**1.4 WASTE MANAGEMENT AND DISPOSAL**

- .1 Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2 Products**

**2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .5 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.3.

**2.2 CONDUIT FASTENINGS**

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

### **2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

### **2.4 EXPANSION FITTINGS FOR RIGID CONDUIT**

- .1 Weatherproof expansion fittings for linear expansion at entry to panel.

### **2.5 FISH CORD**

- .1 Polypropylene.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Use electrical metallic tubing (EMT) except where conduit is cast in concrete or where conduit will be exposed to mechanical injury. Use rigid galvanized steel conduit if conduit may be subject to mechanical injury.
- .3 Use flexible metal conduit for connection to motors in dry areas.
- .4 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .5 Minimum conduit size for lighting and power circuits: 21 mm.
- .6 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .7 Mechanically bend steel conduit over 19 mm diameter.
- .8 Use a pipe bender to bend steel conduit up to 21 mm diameter. Use a hydraulic bender or factory bends for conduit larger than 21 mm in diameter.
- .9 Field threads on rigid conduit must conform to table 40 in the CEC.
- .10 Install fish cord in empty conduits.
- .11 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .12 Dry conduits out before installing wire.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on channels.
- .5 Do not pass conduits through structural members except as indicated.

- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

### **3.3 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.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section Div. 01 – General Requirements.

**1.2                REFERENCES**

- .1            ASTM International
  - .1            ASTM B317/B317M-07, Standard Specification for Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, Structural Profiles and Profiles for Electrical Purposes.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4                CLOSEOUT SUBMITTALS**

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

**1.5                DELIVERY, STORAGE AND HANDLING**

- .1            Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2            Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3            Storage and Handling Requirements:
  - .1            Store materials 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.

**Part 2            Products**

**2.1                INDOOR SERVICE POLES**

- .1            Indoor service pole assembly to meet requirements.
- .2            Indoor service poles: extruded aluminum sections to ASTM B317/B317M.
- .3            Nominal length of poles: to be from floor to ceiling, with plus 50 mm adjustment.
- .4            Service poles approximately 50 mm square with snap-on covers to provide access to wiring without removing unit. Barrier to isolate power from communication systems.
- .5            Include fastening accessories at top of pole to secure to inverted T-Bar ceiling using set screws to permit relocation.

- .1 Flange at ceiling to conceal wiring.
- .6 Metal sleeve at bottom of pole to conceal vertical adjustment.
  - .1 Include removable grip-tight devices for carpet and tile floors to prevent movement of poles.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install service poles as indicated on site; coordinate with PWGSC Representative.
- .2 Install service poles in accordance with manufacturer's recommendations. Secure to ceiling and to finished floor.
  - .1 Adjust length as required.
  - .2 Make power connections in junction box at top of pole.
- .3 Re-adjust service poles as required after telephone cables are installed.

**3.2 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

**3.3 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1     Division 01 – General Requirements.
- .2     Section 26 05 00 – Common Work Results – For Electrical.

**1.2                REFERENCES**

- .1     Canadian Standards Association International
  - .1     CSA C22.2 No. 42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2     CAN/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).

**1.3                SUBMITTALS**

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

**1.4                WASTE MANAGEMENT AND DISPOSAL**

- .1     Waste management and disposal to be in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

**Part 2            Products**

**2.1                SWITCHES**

- .1     15 A, 120 V, single pole, three-way, switches to: CSA C22.2 No.111.
- .2     Provide low voltage switches, where indicated, to match building standard.
- .3     Manually-operated industrial grade 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.
- .4     Dimmer switches to be 120V, 1000W rated slide dimming type.
- .5     Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .6     Switches of one manufacturer throughout project.

- .7 Acceptable manufacturers: Levitan, Hubbell, Cooper, Pass & Seymour.

## 2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 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 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
- .1 Ivory urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Four back wired entrances, 2 side wiring screws.
- .3 Weatherproof exterior receptacles to be NEMA 3R rated C/W weatherproof while in use cover.
- .4 Other receptacles with ampacity and voltage as indicated.
- .5 Receptacles of one manufacturer throughout project.
- .6 Acceptable manufacturers: Levitan, Hubbell, Cooper, Pass & Seymour.

## 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 Plastic ivory cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof while in use cover complete with gaskets as indicated.

## 2.4 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

## 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.
  - .2 Receptacles:
    - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
    - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical.
    - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
    - .4 Install GFI 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 Protect stainless steel cover plate; finish with paper or plastic film until painting and other work is finished.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Division 01 – General Requirements.

**1.2                REFERENCES**

- .1            Canadian Standards Association (CSA International)
  - .1            CSA C22.2 No. 5-13, 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                SUBMITTALS**

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

**1.4                WASTE MANAGEMENT AND DISPOSAL**

- .1            Waste management and disposal to be 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: to CSA C22.2 No. 5
- .2            Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3            Common-trip breakers: with single handle for multi-pole applications.
- .4            Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1            Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5            Circuit breakers with interchangeable trips as indicated.
- .6            Circuit breakers to have minimum 10 kA symmetrical rms interrupting capacity rating.

**2.2                THERMAL MAGNETIC BREAKERS DESIGN A**

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

**2.3                OPTIONAL FEATURES**

- .1            Include, where specified:

- .1 Shunt trip.
- .2 Auxiliary switch.
- .3 On-off locking device.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Install circuit breakers as indicated.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Division 01 – General Requirements.
- .2        Section 26 05 00 – Common Work Results for Electrical.

**1.2                REFERENCES**

- .1        Canadian Standards Association International
  - .1        CAN/CSA C22.2 No.144-M91 (R2011), Ground Fault Circuit Interrupters.
- .2        National Electrical Manufacturers Association (NEMA)
  - .1        NEMA PB 2.2-1999 (R2009), Application Guide for Ground Fault Protection Devices for Equipment.

**1.3                SUBMITTALS**

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

**Part 2            Products**

**2.1                MATERIALS**

- .1        Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144 NEMA PB 2.2.
- .2        Components comprising ground fault protective system to be of same manufacturer.

**2.2                BREAKER TYPE GROUND FAULT INTERRUPTER**

- .1        Single pole ground fault circuit interrupter for 15 A, 125 V, 1 phase circuit c/w test and reset facilities.

**Part 3            Execution**

**3.1                EXAMINATION**

**3.2                INSTALLATION**

- .1        Do not ground neutral on load side of ground fault relay.
- .2        Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

**3.3 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Demonstrate simulated ground fault tests.

**END OF SECTION**

**Part 1           General**

**1.1           RELATED REQUIREMENTS**

- .1    Division 01 – General Requirements.
- .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 (R201), 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    Waste management and disposal to be in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

**Part 2           Products**

**2.1           DISCONNECT SWITCHES**

- .1    Fusible and non-fusible, horsepower rated disconnect switch in CSA Enclosure type as indicated to CAN/CSA C22.2 No.4 size as indicated.
- .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 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 Division 01 – General Requirements.

**1.2 REFERENCES**

- .1 American National Standards Institute (ANSI)
  - .1 ANSI C82.11-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 Institute of Electrical and Electronics Engineers (IEEE)
  - .1 IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
  - .1 ASTM F1137-11e1, Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

**1.3 SUBMITTALS**

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

**Part 2 Products**

**2.1 LAMPS**

- .1 Incandescent lamps to be - clear, A19, 100 Watt with 1000 hour lamp life, rough-service rated; or as indicated.
- .2 Tungsten halogen lamps to be - clear, T-3, 300 Watt, RSC base, 2000 hour lamp life, 5000 lumens; or as indicated.
- .3 Fluorescent lamps to be - T8, 32 Watt, medium bi-pin, rapid-start, 3500 K, 30,000 hour lamp life, 2950 initial lumens, CRI 80; or as indicated.
- .4 Compact fluorescent lamps to be - 18 Watt, G24q-2 base, 12,000 hour lamp life, 12,000 initial lumens, 4100 K, CRI 80; or as indicated.

**2.2 BALLASTS**

- .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic and IC electronic dimmable.
  - .1 Rating: 125 V, 60 Hz, for use with 2-32W, rapid start lamps.
  - .2 Totally encased and designed for 40 degrees Celsius ambient temperature.
  - .3 Power factor: minimum 95 % with 95% of rated lamp lumens.
  - .4 Current crest factor: 1.7maximum.
  - .5 Harmonics: 10 % maximum THD.

- .6 Operating frequency of electronic ballast: between 42 kHz and 52 kHz to avoid interference with infrared devices and eliminate visible flicker.
- .7 Total circuit power: 62 Watts.
- .8 Ballast factor: greater than 0.90.
- .9 Sound rated: Class A.
- .10 Mounting: integral with luminaire.

### **2.3 FINISHES**

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

### **2.4 LUMINAIRES**

- .1 As indicated in fixture schedule on the drawings.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated.

### **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 LUMINAIRE VALIDATION**

- .1 Season lamps by operating at full intensity for 100 hours prior to final inspection. Fluorescent fixtures are to be operated in an ambient temperature above 18 degrees Celsius.

**END OF SECTION**