

## PART 1 GENERAL

### 1.1 REFERENCES

- .1 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.
- .2 Reference Standards:
  - .1 CSA Group
    - .1 CSA C22.1-15, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations.
    - .2 CSA C22.2
    - .3 CAN3-C235-83(R2015), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
  - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
    - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit for review electrical isolation plan identifying areas of the building and phasing of electrical isolations to provide for safe disconnection and removal of all electrically powered equipment and devices within the facility.
- .4 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Submit insulation resistance test results and H 9.
  - .3 Permits and fees: in accordance with General Conditions of contract.
- .5 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
    - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

### 1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
  - .1 In accordance with general conditions and notes on drawings, provide record of disposal for all PCB containing materials including ballasts and transformers.

### 1.4 DEMOLITION

- .1 General
  - .1 Entire facility is to be electrically isolated from the existing supply feed to permit removal of all equipment in a safe and orderly manner.
  - .2 Coordinate requirements with other trades to isolate equipment to permit removals.
  - .3 All existing electrical equipment and devices are to be completely disconnected and removed including all associated conduit, wiring, enclosures, etc.
  - .4 Isolate systems for removal in accordance with Health and Safety requirements.
  - .5 Confirm equipment has been de-energized and isolated for removal by other trades.
  - .6 Provide clear indication where systems have been isolated and where systems remain energized to prevent accidental contact with energized systems.
- .2 Mechanical Equipment
  - .1 For all mechanical equipment in the facility:
    - .1 Isolate service to mechanical equipment at source and lock off.
    - .2 Equipment will be isolated from and locked off either at the source panel or MCC level or further upstream.
    - .3 As upstream panels are isolated and locked out, downstream sources can be clearly identified as de-energized and locks removed.
    - .4 Test and confirm isolation at equipment.
- .3 Telecommunications Infrastructure
  - .1 Completely remove and dispose of all remaining components of the telecommunications system including but not limited to equipment, cabling, conduit, service jacks, cable tray, racking, etc.
  - .2 All material from the service entry through to the utilization points in the facility are to be removed.
- .4 Branch Devices and Connected Equipment
  - .1 Isolate service to rooms/devices and lock off at source panel or at distribution panel upstream.
  - .2 As upstream panels are isolated and locked out, downstream sources can be clearly identified as de-energized and locks removed.
  - .3 Test and confirm isolation at equipment.
  - .4 Electrical contractor shall confirm through testing that equipment is de-energized.

- .5 Lighting
  - .1 Isolate disconnect and remove fixtures.
  - .2 Fixtures original to the facility will have to be evaluated for PCB ballasts by opening fixtures and comparing ballasts.
  - .3 Recycle lamps with appropriate recycling facility and provide record documentation.
  - .4 Dispose of any PCB Ballasts in accordance with regulations and provide record documentation.
- .6 Exterior Lighting
  - .1 Provide new supply feed from Brooke Claxton building (to be confirmed on drawings).
  - .2 Disconnect and remove existing underground supply feed.
  - .3 Disconnect and remove fixtures and poles indicated on drawings.
- .7 Electrical Distribution equipment (Switchboards, Panelboards, MCCs)
  - .1 Isolate equipment in order to permit phased demolition.
  - .2 Isolate panels supplying isolated circuits to permit removal.
  - .3 Remove branch wiring/bus ducts/conduit and all associated material.
  - .4 Remove panels and separate waste and recyclable materials in line with waste management mandate.
- .8 Distribution Transformers
  - .1 Isolate transformer at source and lock out.
  - .2 Remove all associated wiring and conduit.
  - .3 Separate waste and recyclable materials in line with waste management mandate.
- .9 Power Transformers
  - .1 Isolate and lock out transformers either at EHC main switchgear or as part of MV system decommissioning (through isolation at Brooke Claxton and Standards lab).
  - .2 Drain transformers and handle oil in accordance with prescribed PCB handling procedures.
  - .3 Remove transformers from site and separate waste and recyclable materials in line with waste management mandate.
- .10 Emergency Generators and Transfer Switch
  - .1 Drain fuel system and dispose of/recycle fuel in accordance with combustible fuel handling procedures.
  - .2 Isolate building from electrical supply.
  - .3 Isolate normal supply to transfer switch.
  - .4 Contractor is responsible to salvage unit or separate waste and recyclable materials in line with waste management mandate.
- .11 MV Feeders
  - .1 Coordinate isolation of EHC building ensuring MV system is configured (through switching operations) to supply all the buildings on the campus with an open point in the system at the EHC.
  - .2 Isolate and lock out cables 10 and 39 supplying the EHC in Brooke Claxton and Standards Lab.

- .3 Introduce splice in MV cables in manhole 36.
- .4 Re-configure/balance campus load by moving open point through discussions/coordination with responsible site staff.
- .5 Remove cable duct bank and cap and seal entries into manhole.
- .12 Service Tunnel
  - .1 Trace circuits for any equipment with unknown sources.
  - .2 Isolate sources and pull all conduit and wiring back to the main tunnel in nearest junction box.
  - .3 Ensure remaining tunnel services are unaffected by removals.

## PART 2 PRODUCTS

### 2.1 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.

### 2.2 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Material and equipment to be CSA certified. Factory assemble control panels and component assemblies.

### 2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of Departmental Representative. Clearly identify systems and equipment which are energized and not suitable for removal/demolition.

### 2.4 WIRING TERMINATIONS

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

### 2.5 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.

## 2.6 CONDUIT AND CABLE IDENTIFICATION

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

	Prime	Auxiliary
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red

## PART 3 EXECUTION

### 3.1 INSTALLATION

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

### 3.2 NAMEPLATES AND LABELS

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

### 3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install cables, conduits and fittings close to building structure to minimize impact on usable space within the ceiling cavity.

### 3.4 FIELD QUALITY CONTROL

- .1 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
  - .1 MV cabling and splices to be tested in accordance with drawing notes.
  - .2 Lighting and its control.

- .3 Insulation resistance testing:
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Check resistance to ground before energizing.
- .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 operation.

### 3.5 CLEANING

- .1 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

## PART 1 GENERAL

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes, and Fittings.
  - .2 CSA C22.2 No.65-13, Wire Connectors (Tri-National standard, with UL 486A-486B and NMX-J-543-ANCE), Includes Update No. 1 (2013).
- .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)

### 1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition 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 and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

## PART 2 PRODUCTS

### 2.1 MATERIALS

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

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PART 3      EXECUTION

3.1            INSTALLATION

- .1 Remove insulation carefully from ends of conductors 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 CSA C22.2 No.65.
  - .2 Install fixture type connectors and tighten. Replace insulating cap.

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END OF SECTION



## PART 1 GENERAL

### 1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 - Common Work Results for Electrical.
- .2 Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.

### 1.2 PRODUCT DATA

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

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management.

## 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 RWU90 XLPE, jacketed.

### 2.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local Authority Having Jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

### 2.3 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Section 26 05 43.01 Installation of Cables in Trenches and in Ducts - Underground Electrical Service.
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .4 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .5 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

### 2.4 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
  - .1 In electro metallic tubing (EMT) conduit in underground ducts in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.

## PART 3 EXECUTION

### 3.1 NOT USED

- .1 Not used.

## PART 1 GENERAL

### 1.1 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition 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 and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused metal 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 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster 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 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface mounting of two or more conduits use channels at 1 m on centre spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 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 work for conduit or cable support.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.
- .13 Fasten electrical supports only to steel structure. Do not fasten electrical supports to underside of steel deck.

## PART 1 GENERAL

### 1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA C22.2 No. 18-98 (R2003), Outlet Boxes, Conduit Boxes, and Fittings.
  - .2 CSA C22.2 No. 45.1-07 (R2012), Electrical Rigid Metal Conduit - Steel (Tri-National standard, with UL 6 and NMX-J-534-ANCE-2007).
  - .3 CSA C22.2 No. 56-13, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-M1985 (R2013), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2-06 (R2011), Rigid PVC (Unplasticized) Conduit, Update No. 1 (2011).
  - .6 CSA C22.2 No. 227.3-15, Mechanical Protection Tubing (MPT) and Fittings (Bi-National standard, with UL 1696).

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

### 1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2      PRODUCTS2.1            CABLES AND REELS

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

2.2            CONDUITS

- .1      Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2      Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .3      Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .4      Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.3            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 m on centre.
- .4      Threaded rods, 6 mm diameter, to support suspended channels.
- .5      Conduit to be supported by structural steel and open web steel joists.

2.4            CONDUIT FITTINGS

- .1      Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.  
Coating: same as conduit.
- .2      Ensure factory "ells" where 90 degrees bends for 50 mm and larger conduits.
- .3      Steel set screw connectors for EMT.

2.5 FISH CORD

- .1 Polypropylene.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms, in unfinished areas.
- .3 Use electrical metallic tubing (EMT) in all areas except where specified otherwise.
- .4 Use rigid pvc conduit underground and exterior to building, in crawl space.
- .5 Use flexible metal conduit for connection to motors in dry areas, connection to surface or recessed fluorescent fixtures, work in movable metal partitions.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .7 Minimum conduit size for lighting and power circuits: 19 mm.
- .8 Bend conduit cold:
  - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 19 mm diameter.
- .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.

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3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

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

3.5 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints.

3.6 CLEANING

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



## PART 1 GENERAL

### 1.1 REFERENCES

- .1 CSA International
  - .1 CAN/CSA-Z809-08(R2013), Sustainable Forest Management.
- .2 Forest Stewardship Council (FSC)
  - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.
- .3 Insulated Cable Engineers Association, Inc. (ICEA)
- .4 Sustainable Forestry Initiative (SFI)
  - .1 SFI-2015-2019 Standard.

### 1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Construction Waste Management:
    - .1 Submit project Waste Reduction Workplan highlighting recycling and salvage requirements.
    - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
- .3 Wood Certification: submit manufacturer's Chain-of-Custody Certificate number for CAN/CSA-Z809 or FSC or SFI certified wood.

### 1.3 DELIVERY, STORAGE AND HANDLING

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

- .4 Develop Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 19 - Construction/Demolition Waste Management.

## PART 2 PRODUCTS

### 2.1 CABLE PROTECTION

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

## PART 3 EXECUTION

### 3.1 EXAMINATION

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

### 3.2 CABLE INSTALLATION IN DUCTS

- .1 Install RWU90 wiring as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded, multiconductor control cables reel off in same direction during installation.

- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

### 3.3 FIELD QUALITY CONTROL

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

### 3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

### 3.5 PROTECTION

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

## PART 1 GENERAL

### 1.1 RELATED REQUIREMENTS

- .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.29-15, 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 19 - Construction/Demolition Waste Management.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by 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.
- .2 600/347 V panelboards: bus and breakers rated for 44 kA (symmetrical) interrupting capacity, as indicated, or as per ratings identified in short circuit study.
- .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 with neutral of same ampere rating as mains.
- .7 Mains: suitable for bolt-on breakers.
- .8 Recess trim with concealed front bolts and hinges.
- .9 Trim and door finish: baked grey enamel.
- .10 NEMA 3 sprinkler proof enclosure.

## 2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for receptacles, fire alarm clock outlet, emergency, door supervisory, intercom, stairway, exit and night light circuits.

## 2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus with respective neutral identified.

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END OF SECTION

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PART 1 GENERAL1.1 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-2013).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include time-current characteristic curves for breakers with ampacity of 100 A and over and with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management.
- .2 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Reduction Workplan.
- .3 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Reduction Workplan.

PART 2 PRODUCTS2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, and Accessory high-fault protectors: to CSA C22.2 No. 5.
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.

- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
  - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .5 Circuit breakers to have minimum 22 kA symmetrical rms interrupting capacity rating.

## 2.2 THERMAL MAGNETIC BREAKERS

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

## PART 3 EXECUTION

### 3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

## PART 1      GENERAL

### 1.1            REFERENCES

- .1 American National Standards Institute (ANSI)
  - .1 ANSI C82.1-04, For Lamp Ballast - Line Frequency Fluorescent Lamp Ballast.
  - .2 NEMA/ANSI C82.4-02 (R2007), Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.
- .2 ASTM International Inc.
  - .1 ASTM F1137-11e1, Standard Specification for Phosphate/Oil Corrosion Protective Coatings for Fasteners.
- .3 Canadian Standards Association (CSA International)
- .4 ICES-005-09, Radio Frequency Lighting Devices (RFLDs).
- .5 Institute of Electrical and Electronics Engineers (IEEE)
  - .1 IEEE C62.41.1-2002 (R2008), IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
  - .2 IEEE C62.41.2-2002/Cor 1-2012, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits/ Corrigendum 1: Deletion of Table A.2 and Associated Text.
- .6 Underwriters' Laboratories of Canada (ULC)

### 1.2            ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative.
  - .3 Photometric data to include: VCP Table where applicable and spacing criterion.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
  - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

### 1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management.
- .4 Divert unused metal materials from landfill to metal recycling facility.
- .5 Disposal and recycling of fluorescent lamps as per local regulations.
- .6 Disposal of old PCB filled ballasts.

## PART 2 PRODUCTS

### 2.1 FINISHES

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

### 2.2 LUMINAIRES

- .1 Fixture A:
  - .1 Pole mounted LED pathway light.
    - .1 127mm round diameter pole, 3658mm high pole.
    - .2 347V.
    - .3 40 LED engine.
    - .4 4000K colour temperature.
    - .5 Type V wide distribution.
    - .6 Low profile.

## PART 3 EXECUTION

### 3.1 INSTALLATION

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

### 3.2 WIRING

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

### 3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management.

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