

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No.
  - .3 CAN3-C235-83 (R2010), 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 DEFINITIONS**

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

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop drawings:
  - .1 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
  - .2 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .3 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .4 If changes are required, notify Departmental Representative of these changes before they are made.
- .3 Certificates:
  - .1 Provide CSA certified equipment and material.
  - .2 Where CSA certified material and equipment are not available, submit such material and equipment to authority having jurisdiction for approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.

- .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .4 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

#### **1.4 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for
  - .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
  - .2 Operating instructions to include following:
    - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
    - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
    - .3 Safety precautions.
    - .4 Procedures to be followed in event of equipment failure.
    - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
  - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
  - .4 Post instructions where directed.
  - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
  - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 DESIGN REQUIREMENTS**

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

### **2.2 MATERIALS AND EQUIPMENT**

- .1 Equipment and material to be CSA certified. Where CSA certified equipment and material are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Factory assemble control panels and component assemblies.

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

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: as shown on mechanical drawings and specified in mechanical sections.

### **2.4 WARNING SIGNS**

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

### **2.5 WIRING TERMINATIONS**

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

### **2.6 EQUIPMENT IDENTIFICATION**

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

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters

Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Wording on nameplates to be approved by Departmental Representative prior to manufacture.
- .3 Allow for minimum of twenty-five (25) letters per nameplate.
- .4 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .5 Identify equipment with Size 3 labels engraved;
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

## 2.7 WIRING IDENTIFICATION

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

## 2.8 CONDUIT AND CABLE IDENTIFICATION

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

Type	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	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

## 2.9 FINISHES

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

**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
  - .1      Visually inspect substrate in presence of Departmental Representative.
  - .2      Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3      Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

**3.2                INSTALLATION**

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

**3.3                NAMEPLATES AND LABELS**

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

**3.4                CONDUIT AND CABLE INSTALLATION**

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

**3.5                LOCATION OF OUTLETS**

- .1      Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2      Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.
- .3      Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .4      Locate light switches on latch side of doors.
  - .1      Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

**3.6                MOUNTING HEIGHTS**

- .1      Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2      If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

- .3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1100 mm.
  - .2 Wall receptacles:
    - .1 General: 400 mm.
    - .2 In mechanical rooms: 1100 mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Fire Alarm Pullstations 1050 to 1150 mm AFF
  - .5 Fire Alarm horn/strobes 2000 to 2400 mm AFF or 150mm below ceiling.
  - .6 Card Access Readers: 1100 mm.

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

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

### **3.8 FIELD QUALITY CONTROL**

- .1 Conduct following tests,
  - .1 Circuits originating from branch distribution panels.
  - .2 Lighting and its control.
  - .3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
  - .4 Systems: fire alarm.
- .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 Manufacturers Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

### **3.9 SYSTEM STARTUP**

- .1 Instruct Departmental Representative in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturers factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

**3.10 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**END OF SECTION**

**PART 1 General**

**1.1 RELATED WORK**

- .1 Refer to all sections of the specification for related work.

**1.2 COORDINATION**

- .1 The existing building shall remain open and remain in normal operation during the construction period.
- .2 Contractor shall allow for off-hours work as required.
- .3 Where existing services or systems, such as electrical power, telephone system, data systems, fire alarm system, etc. are required to be disrupted and/or shut-down, coordinate the shut-downs with Departmental Representative and carry out the work at a time and in a manner acceptable to them. Carefully schedule all disruptions and/or shutdowns and ensure the duration of same is kept to the absolute minimum. Submit for review, a written concise schedule of each disruption at least 120 hours in advance of performing work and obtain written consent prior to implementing.
- .4 The airport building operates 24 hours/7 days a week. Electrical Contractor to provide temporary sources and connections required by the airport authorities and Departmental Representative to maintain services or systems during work in the existing building. Supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing equipment or system be damaged, make full repairs without extra cost, and to the satisfaction of the Departmental Representative.
- .5 Comply with instructions regarding working hours necessary to maintain the building in operation.
- .6 Refer to Note-1, Drawing E1 for direction and coordination on temporary heating.

**1.3 EXISTING DEVICES IN NEW CONSTRUCTION**

- .1 Disconnect and remove existing electrical equipment made obsolete due to the renovations. Remove associated wiring and conduits back to source panel.
- .2 Where existing devices (receptacles, switches, etc.) are presently mounted on a wall which will be covered with a new finish, provide an extension ring, coverplate, etc., as required, to mount the device to the new wall finish.
- .3 Identify all existing electrical equipment to remain, which is located in or on portions of existing walls, ceilings or floors being modified and/or demolished or conflicting with other new or existing equipment, devices shall be relocated to the nearest wall. This equipment shall include pumps, communications equipment, cabinets, lighting, panels, switches, fire alarm and life safety devices, receptacles, etc.



- .4 Where existing conduits, which are in use, pass vertically or horizontally through a wall being demolished, relocate those conduits and conceal in a new wall or surface mount in a service area. Extend conduit, wiring, etc. as required.
- .5 Identify work or equipment installation/removal located in designated/special walls and inform Departmental Representative for directions before commencing work.
- .6 Where new ductwork or mechanical components on ceilings are to be installed, relocate all existing ceiling mounted devices down or to suit new ceiling. This equipment shall include but not be limited to smoke detectors, heat detectors, speakers, luminaires, etc. Extend existing conduit and wiring as required.
- .7 All existing junction boxes in walls and ceiling spaces required to maintain existing circuits shall remain accessible.
- .8 Include all costs to x-ray existing floors or building surfaces to be drilled or sleeved to ensure no existing services are severed or damaged. Damages could be very serious. Any damages resulting from failure to x-ray (or scan) is the Contractor's responsibility.

#### **1.4 SCHEDULE OF WORK**

- .1 Confirm Schedule of work and include all requirements to conform to it.

### **PART 2 Products**

#### **2.1 MATERIALS**

- .1 Provide all materials required for the complete interface and reconnection installation as herein described and as indicated on the drawings.
- .2 New wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturer's requirements and instructions.
- .3 Add modules, switches, hardware, software, etc., in any existing control panels as required, Electrical Contractor to allow for modifications and extend existing systems to the new or designated areas.

### **PART 3 Execution**

#### **3.1 INSTALLATION**

- .1 Install boxes, conduit and wiring through existing areas as required for the new installation.
- .2 Patch and repair walls and ceilings in existing building that have been damaged or cut open due to the new electrical installation.

- .3 Patch and make good existing walls which are to remain where existing electrical devices have been removed.
- .4 Where new cables or conduits have been installed through existing fire rated walls, seal opening around cables and conduit to maintain fire rating.

END OF SECTION

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CAN/CSA-C22.2 No.18-98 (R2003), Outlet Boxes, Conduit Boxes and Fittings.
  - .2 CAN/CSA-C22.2 No.65-03 (R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .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 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 MATERIALS**

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

- .3 Clamps or connectors for TECK cable as required to: CAN/CSA-C22.2 No.18.

### **Part 3 Execution**

#### **3.1 EXAMINATION**

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

#### **3.2 INSTALLATION**

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

#### **3.3 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**END OF SECTION**

## **Part 1            Products**

### **1.1                BUILDING WIRES**

- .1      Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2      Copper conductors: size as indicated, with 1000 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Non Jacketted.

### **1.2                TECK 90 CABLE**

- .1      Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2      Conductors:
  - .1          Grounding conductor: copper.
  - .2          Circuit conductors: copper, size as indicated.
- .3      Insulation:
  - .1          Ethylene propylene rubber EP.
  - .2          Cross-linked polyethylene XLPE.
  - .3          Rating:, 1000 V.
- .4      Inner jacket: polyvinyl chloride material.
- .5      Armour: interlocking galvanized steel.
- .6      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 35 mm centers.
  - .3          Threaded rods: 6 mm diameter to support suspended channels.
- .7      Connectors:
  - .1          Watertight, approved for TECK cable.

### **1.3                ARMOURED CABLES**

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

## **Part 2            Execution**

### **2.1                FIELD QUALITY CONTROL**

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

- .2 Perform tests before energizing electrical system.

## **2.2 GENERAL CABLE INSTALLATION**

- .1 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .6 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

## **2.3 INSTALLATION OF BUILDING WIRES**

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

## **2.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)**

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed, securely supported by straps.

## **2.5 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible on channels.
- .2 AC90 cable to be used in dry locations only for connection to final device from conduit system. Maximum run of AC90 cable to be 1500mm.

# **Part 3 Execution**

## **3.1 FIELD QUALITY CONTROL**

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

## **3.2 GENERAL CABLE INSTALLATION**

- .1 Install cable in trenches as indicated.
- .2 Lay cable in cable trays if necessary.

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

### **3.3 INSTALLATION OF BUILDING WIRES**

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

### **3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)**

- .1 Group cables wherever possible on channels.
- .2 Install cable exposed where necessary, securely supported by staples, straps or hangers.

### **3.5 INSTALLATION OF ARMOURED CABLES**

- .1 Group cables wherever possible on channels.

### **3.6 INSTALLATION OF ALUMINUM SHEATHED CABLE**

- .1 Group cables wherever possible on channels.

### **3.7 INSTALLATION OF CONTROL CABLES**

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

### **3.8 INSTALLATION OF SHEATHED CABLE**

- .1 Install straps and box connectors to cables as required.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No.41-13, Grounding and Bonding Equipment (Tri-National Standard, with NMX-J-590ANCE and UL 467).
  - .3 CSA C22.2 No.65-13, Wire connectors (Tri-National Standard, with UL 486A-486B NMX-J-543-ANCE).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for connectors and terminations and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for connectors and terminations for incorporation into manual.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instruction.
- .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, in dry location, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect connectors and terminations from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

**Part 2 Products**

**2.1 CONNECTORS AND TERMINATIONS**

- .1 Copper long barrel compression connectors to CSA C22.2 No.65 as required sized for conductors.
- .2 Contact aid for aluminum cables where applicable.



**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 connectors and terminations 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 stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2      Bond and ground as required to CSA C22.2No.41.

**3.3                CLEANING**

- .1      Progress Cleaning:
  - .1      Leave Work area clean at end of each day.
- .2      Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Refer to all sections of the specification for related work.

**1.2 REFERENCES**

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA International

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

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

**1.4 CLOSEOUT SUBMITTALS**

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

**1.5 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size to electrically conductive underground water pipe.

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

### **Part 3 Execution**

#### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
  - .1 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 INSTALLATION GENERAL**

- .1 Test for permanent, continuous grounding system including, conductors, connectors, accessories. Correct if necessary. Where EMT is used, run ground wire in conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections if necessary, and connections to conductive water main, electrodes, using copper welding by thermit process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 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.
- .8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .9 Avoid loop connections.

- .10 Bond single conductor, metallic armoured cables to cabinet at supply end.
- .11 Ground secondary service pedestals.

### **3.3 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to secondary 120/600 V system.

### **3.4 EQUIPMENT GROUNDING**

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

### **3.5 GROUNDING BUS**

- .1 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG.

### **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.

### **3.7 CLEANING**

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

**END OF SECTION**

**Part 1 General**

**1.1 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 hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

**1.2 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 SUPPORT CHANNELS**

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

**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 hangers and supports 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 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 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.
- .7 Suspended support systems.
  - .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  - .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels as per CEC spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 This Section covers items common to Sections of Division 26. This section supplement requirements of Division 1.

**1.2 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, 24th Edition.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 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 shop drawings.

**Part 2 Products**

**2.1 SPLITTERS**

- .1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Terminations: main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

**2.2 JUNCTION AND PULL BOXES**

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

**2.3 CABINETS**

- .1 Construction: welded sheet steel hinged door, latch and catch.

**Part 3 Execution**

**3.1 SPLITTER INSTALLATION**

- .1 Mount plumb, true and square to building lines.

- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

### **3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

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

### **3.3 IDENTIFICATION**

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

**END OF SECTION**



**Part 1            General**

**1.1                REFERENCE STANDARDS**

- .1        CSA Group (CSA)
  - .1        CSA C22.1-18, Canadian Electrical Code, Part 1, 24th Edition.

**1.2                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals.

**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.
- .5        347 V outlet boxes for 347 V switching devices.
- .6        Combination boxes with barriers where outlets for more than one system are grouped.

**2.2                GALVANIZED STEEL OUTLET BOXES**

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

**2.3                CONDUIT BOXES**

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

**2.4                FITTINGS - GENERAL**

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

**Part 3            Execution**

**3.1                INSTALLATION**

- .1       Support boxes independently of connecting conduits.
- .2       Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .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 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CAN/CSA C22.2 No. 18-98 (R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  - .2 CSA C22.2 No. 45-M1981 (R2003), Rigid Metal Conduit.
  - .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No. 83-M1985 (R2003), Electrical Metallic Tubing.
  - .5 CSA C22.2 No. 211.2-M1984 (R2003), Rigid PVC (Unplasticized) Conduit.
  - .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product data: submit manufacturer's printed product literature, specifications and datasheets.
  - .1 Submit cable manufacturing data.
- .2 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.

**Part 2 Products****2.1 CONDUITS**

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.

**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 200 mm on centre.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

**2.3 CONDUIT FITTINGS**

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

**2.4 FISH CORD**

- .1 Polypropylene.

**Part 3 Execution****3.1 MANUFACTURERS INSTRUCTIONS**

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

**3.2 INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms.
- .3 Use rigid hot dipped galvanized steel threaded conduit except where specified otherwise.
- .4 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.
- .5 Use explosion proof flexible connection for connection to explosion proof motors.
- .6 Install conduit sealing fittings in hazardous areas.
  - .1 Fill with compound.
- .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 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .11 Install fish cord in empty conduits.
- .12 Remove and replace blocked conduit sections.
  - .1 Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.

### **3.3 SURFACE CONDUITS**

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

### **3.4 CLEANING**

- .1 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 Refer to Section 26 05 00 - Common Work Results - Electrical for related Sections applicable to this Project.

**1.2 REFERENCES**

- .1 Refer to Section 26 05 00 - Common Work Results - Electrical for references applicable to this project.

**1.3 SECTION INCLUDES**

- .1 Seismic restraints for electrical systems including, but not limited to lighting, distribution, transformers, fire alarm, main distribution switches, uninterruptible power supply (UPS), exit lighting, cabletrays, etc.

**1.4 SYSTEM DESCRIPTION**

- .1 This Section of the Specification defines the seismic bracing requirements of electrical equipment and ancillaries. The bracing of these systems must be independent of other operational and functional components of the building.

**1.5 SUBMITTALS**

- .1 Provide certified professionally sealed shop and placement drawings for all electrical equipment and equipment assemblies, including runs of cable trays and conduit/cable racks showing the methods of attachment to the particular structure for each piece of equipment and assembly and provide anchorage/attachment details approved and sealed by a Newfoundland and Labrador Registered Professional Engineer for review by the Departmental Representative. Submit samples of materials required to complete the seismic restraint work for review if and when required. Arrange and pay for the Professional Engineer who designed all anchorage/attachments to inspect same on site (note that multiple inspections will be required as the work progresses) and to provide typewritten Inspection Reports to the Departmental Representative throughout construction and to provide "Letters of Assurance and Conformance" with the specified Codes, Standards and Bylaws.
- .2 Calculations sealed by a Professional Engineer registered in Newfoundland and Labrador shall be provided for the seismic restraint design shown on the shop drawings. Shop drawings shall show the equipment type, manufacturer's name, model number and weight of equipment to be restrained.

## **1.6 GENERAL**

- .1 All equipment installed throughout the building shall meet the Seismic requirements for the Province of Newfoundland and Labrador, the Municipality of Wabush and as outlined.
- .2 Requirements for seismic restraint outlined in Section 26 05 48 shall be the minimum accepted.
- .3 Supply all labour, material and equipment required and necessary to isolate (noise/vibration) and seismically restrain electrical equipment as specified herein and guarantee the function of the materials and equipment supplied.
- .4 All electrical connections to vibration isolated equipment shall be made with flexible conduit or other flexible means acceptable to the Departmental Representative so as not to restrict the maximum anticipated movement of the equipment under seismic excitation movement.
- .5 Seismic restraining devices shall be provided to restrain all electrical and related equipment.
- .6 Use of the manufacturer's isolation package is acceptable provided it meets the requirements of this Specification.
- .7 Provide vibration isolation for equipment or parts connected rigidly to the isolated equipment of this section.
- .8 In the event that inadequate isolation is provided by the manufacturer's isolation package, the supplier shall be responsible for improving the isolation to an acceptable standard at no additional cost to the Departmental Representative.

## **PART 2 Materials**

### **2.1 SEISMIC RESTRAINTS**

- .1 The seismic restraints shall restrain the equipment in all directions and shall be sized to meet the appropriate Sp factor defined in Table 4.1.9.D of the current National Building Code and Commentary J of the Supplement to the current Code. Calculations bearing the seal of a qualified Professional Engineer must be submitted with the shop drawings to justify the stated seismic restraint requirements.
- .2 All attachment points and fasteners shall be capable of withstanding a load of three (3) times the sized capacity of the restraint. The equipment suppliers shall provide proof of conformance with this clause by means of shop drawings certified by a qualified Professional Engineer.
- .3 All neoprene isolators shall be bridge bearing rated type.

- .4 Test data shall be provided to the Departmental Representative, showing the load deflection curves up to 1.5 times the rated capacity of the restraint and certifying that neither the neoprene elements nor the restraint body sustained any deformation after release of load.
- .5 All restraints shall be adjusted to have clearances between 3mm and 6mm under normal operating conditions of the equipment.

## **PART 3 Execution**

### **3.1 GENERAL**

- .1 Cable trays, conduit, raceways or other connections shall be with flexibly connected to vibration isolated equipment or vibration isolated per above for a minimum of 9.1m from the equipment. If a flexible connection is used, it must accommodate without strain, the full range of movement of the isolated equipment.
- .2 Perforated pipe hangers shall not be used for any seismic supports.
- .3 Explosive type fasteners shall not be used. Rawl plugs and 6.3mm and 9.5mm inserts are acceptable.
- .4 The following is a list of electrical equipment and systems requiring seismic protection, however not limited to:
  - .1 Lighting and exit lighting
  - .2 Normal distribution system including dry-type transformers, sub-distributions, branch circuit panelboards, conduits and pull boxes, cabletray
  - .3 UPS power supply, conduits and pull boxes, cabletray
  - .4 Low voltage lighting control relay panels

### **3.2 LIGHTING**

- .1 Recessed luminaires shall be secured to the building structure (independent of ceiling tiles or gypsum board) via 12 Ga. hanger wires. Recessed fluorescent luminaires shall have four hangers located at corners.
- .2 All luminaire lenses shall be secured via Municipality of Wabush approved retaining clips.
- .3 All recessed downlights shall be secured to the building structure via one 12 gauge hanger wire.

### **3.3 DISTRIBUTION TRANSFORMERS**

- .1 Distribution transformers shall only be floor-mounted, never suspended from ceilings or walls.



- .2 Transformers shall be secured to the floor at all four corners with bolts (nuts, lock washers) cast into the concrete floor. Bolts shall be sufficient in length to penetrate housekeeping pads minimum 75mm into structural slab.
- .3 Provide vibration isolation for all transformers by means of bridge bearing neoprene isolators or open steel spring isolators.
- .4 The static deflection of vibration isolators for electrical transformers is 12mm. All isolators requiring a static deflection greater than 12mm (0.50 in.) shall be open spring isolators unless otherwise specified.

### **3.4 EXIT LIGHTING**

- .1 Exit signs installed in acoustic tile ceilings shall be secured to the tile with screws and steel strapping. Steel strapping shall be secured to building structure via 12 Ga. hanger wire.

### **3.5 DISTRIBUTION CENTRES**

- .1 All distribution centres shall be securely mounted to room walls. All walls shall have 19mm plywood backing installed behind drywall for mounting screws.

### **3.6 CABLETRAY**

- .1 Wall mounted cabletray supported by brackets shall have two (2) 12 Ga. steel hangers installed to the building structure per tray section.

END OF SECTION

**Part 1 General**

**1.1 STANDARDS**

- .1 Refer to Section 26 05 00 - Common Work Results for Electrical for standards applicable to this project.

**Part 2 Products**

**2.1 NAMEPLATES**

- .1 Lamacoid:
  - .1 White with black lettering for normal power
- .2 Refer to Section 26 05 00 - Common Work Results for Electrical for nameplate sizes.

**Part 3 Execution**

**3.1 MOTOR SURVEY**

- .1 Make a complete survey of all electrical motors. Number every motor, both single phase and three phase. Label every motor to show the motor number, the motor name and location of the starter. Example: 'Motor #41 Exhaust Fan #3, Starter in MCC#1'. Label every starter to show motor it controls and, where motor is not in same area, give location of motor. Identify voltage and panel being fed from.
- .2 For every motor and starter, fill in the form illustrated herein. List each motor on a separate 200 x 300 mm page. Provide three typed copies of this list in each maintenance manual prior to substantial completion. Where motors are controlled by more than one control device, prepare an accurate elementary diagram of the controls on a 200 x 300 mm sheet. Forms and diagrams are to be neatly typed and drafted.

**3.2 NAMEPLATES**

- .1 Securely screw to equipment, so as to be clearly visible.

### SURVEY OF MOTORS

Motor Name and Number: \_\_\_\_\_  
HP: \_\_\_\_\_ Amps: \_\_\_\_\_ Volts: \_\_\_\_\_ Phase: \_\_\_\_\_  
Service Factor: \_\_\_\_\_

### OPERATING CONDITIONS

No Load Amps: \_\_\_\_\_ Phase A: \_\_\_\_\_ Phase B: \_\_\_\_\_ Phase C: \_\_\_\_\_  
Operating Voltage: \_\_\_\_\_ A to B: \_\_\_\_\_ B to C: \_\_\_\_\_ C to A: \_\_\_\_\_  
Overload Size: \_\_\_\_\_  
Wire Size: \_\_\_\_\_

Special Controls and Remarks (Thermistor and Relay Type, Capacitors, etc.)

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PREPARED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

END OF SECTION

**Part 1 General**

**1.1 STANDARDS**

- .1 Refer to Section 26 05 00 - Common Work Results - Electrical for standards applicable to this project.

**1.2 REQUIREMENTS**

Motor Size	Voltage System
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.1 1/2 HP (0.373 kW) and below	120V, 1Ø
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.2 3/4 HP (0.560 kW) and above	600V, 3Ø
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.3 Unless otherwise noted on drawings.	
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- .1 Provide a complete system of power wiring to motors and controls.
- .2 Unless specifically noted otherwise, wire and leave in operation all electrically operated equipment supplied under this Contract. Examine the drawings and shop drawings of all Divisions for the extent of electrically operated equipment supplied by other Divisions.
- .3 Where control wiring diagrams are shown illustrate typical control circuits applicable to the equipment. Control circuits may vary with different manufacturers of equipment. Verify all control circuits with the suppliers of the equipment and make any corrections that may be required.
- .4 Unless specifically noted otherwise, supply all pushbuttons, relays, starters, etc. necessary for the operation of equipment. Check all starters, relay coils and thermal elements to ensure that they provide the necessary protection for motors.
- .5 Do not operate motors and controls until approval is obtained from the trade providing equipment.
- .6 Examine drawings and shop drawings of other Divisions to obtain exact location of motors and equipment shown on other Division drawings and specifications. Where necessary, obtain conduit locations from other trades' drawings and shop drawings. The complete list of motors may not be shown on the electrical drawings.
- .7 Assist in placing in operation all mechanical equipment having electrical connections.
- .8 Provide three phase starters with primary and secondary fused 120 volt control transformers and overload relays.
- .9 In general, wiring for freezestats, firestats, EP switches, P.E. switches, dampers, temperature controllers, flow switches, solenoid valves, etc., for heating, ventilating and air conditioning equipment will be by the Mechanical Contractor, from control panels supplied and installed by the Mechanical Contractor. Provide terminations in starters and motor control centres for control wiring, so that starter control circuits may be extended

by Mechanical Contractor. Where 120 volt power is required for mechanical equipment, i.e.: for roll type filters, refrigerated aftercoolers, control cabinets, etc., wiring to the equipment terminals is the work of the Electrical Contractor. Electrical Contractor is to wire all 120 volt air handling unit internal lighting and receptacles, condensers and rooftop weatherproof outdoor receptacles.

- .10 Mechanical Contractors shall use certified tradespersons when working with electrical components.
- .11 Mechanical and Electrical Contractors shall coordinate requirements for final connections to mechanical equipment (HP, phase, voltage, starter, etc.) including review of all equipment shop drawings. Once equipment is on-site, verify nameplates and allow for changes in wiring and circuit protection if necessary at no extra cost for the owner.

## **Part 2 Products**

### **2.1 3Ø MOTOR DISCONNECT SWITCHES**

- .1 Industrial Type "A" having quick-make, quick-break visible blade mechanism, cover interlocks and padlocking switch in the closed or open position. Use EEMAC-4 enclosures outdoors, EEMAC-1 indoors and drip proof shield watertight for areas exposed to sprinklers. Switches to be kW rated heavy duty type.

### **2.2 120V 1Ø DISCONNECT SWITCHES**

- .1 Manual starter without overload relay.

### **2.3 208V 1Ø MOTOR DISCONNECT SWITCHES**

- .1 Manual starter without overload relay.

## **Part 3 Execution**

### **3.1 GENERAL**

- .1 For all motors, provide disconnect switches adjacent to the motors.
- .2 Wall mount disconnects adjacent to equipment or floor mount at motor locations. Wall mounted disconnects to be 1400 mm above floor.

### **3.2 CONTROL CABINETS & CONTROLS**

- .1 Verify the location of all control cabinets, and provide power wiring to each cabinet from the nearest electrical panel where not specifically shown from a particular panel.
- .2 Power wiring for mechanical equipment is the responsibility of the Electrical Contractor. Provide circuits and wiring to suit the Controls Subcontractor's requirements. All control power wiring requirements may not be specifically shown on the drawings.
- .3 All control wiring shall be run in conduit. Coordinate with Controls Subcontractor.

### **3.3 COMMISSIONING**

- .1 Do not start motors until the supplier of the equipment has verified that the electrical connection has been made in accordance with the nameplate information.
- .2 Extreme caution must be taken in connection of motors with nameplates having multiple connection diagrams i.e.: WYE-DELTA Start, MULTISPEED.
- .3 Be responsible for replacement of motors or other equipment damaged by starting-up prior to being checked by equipment supplier.

END OF SECTION

## **PART 1      General**

### **1.1      GENERAL REQUIREMENTS**

- .1      Provide Overcurrent and Coordination Study Arc Flash Study to supplement previous Electrical Upgrade project.
- .2      The completed Overcurrent and Coordination Study shall be prepared and include all time current characteristic curves plotted on log paper.
- .3      Provide studies in advance before ordering any distribution equipment.
- .4      The Overcurrent and Coordination Study and Arc Flash Hazard Study shall reflect the complete distribution systems including the equipment product data of 15kV, 600V and 120/208V distributions and all associated building protection devices.
- .5      The Overcurrent and Coordination Study and Arc Flash Hazard Study shall include a professional electrical engineer's stamp and statement which clearly confirming the selective and fully coordinated system permits maximum service continuity. Include all costs in contract.

### **1.2      REFERENCES**

- .1      Institute of Electrical and Electronics Engineers, Inc. (IEEE)
  - .1      IEEE 141 - Recommended Practice for Electrical Power Distribution and Coordination of Industrial and Commercial Power Systems.
  - .2      IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
  - .3      IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis.
  - .4      IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings.
  - .5      IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
  - .6      IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations.
- .2      The National Fire Protection Association (NFPA)
  - .1      NFPA 70 - National Electrical Code, latest edition.
  - .2      NFPA 70E - Standard for Electrical Safety in the Workplace.

### **1.3      SHOP DRAWINGS AND PRODUCT DATA**

- .1      Submittals shall be in accordance with Section 26 05 00 Common Work Results - Electrical.

- .2 Submit Coordination Study at the same time as the Distribution Equipment shop drawings are submitted.
- .3 Submit Arc Flash Hazard Study shop drawings at the same time as the Distribution Equipment shop drawings are submitted.

#### **1.4 WORK INCLUDED**

- .1 The information required to be plotted and part of the studies includes:
  - .1 Main feeder cables thermal damage curves including associated lengths.
  - .2 Symmetrical and asymmetrical fault current calculations verifying protection of various elements of the system.
  - .3 A summation chart showing all ratings and settings with reference to the appropriate curves.
  - .4 Recommendations and comments on the effectiveness of the coordination study.
  - .5 Protective devices associated with the largest motor.
  - .6 A system single line diagram indicating circuit identification, device numbers and equipment ratings.
  - .7 Drawings generated by a computer aided drafting system.
  - .8 New transformer thermal damage curves including impedance.
  - .9 All main feeders protective devices for coordination with Hydro Utility fuse to medium voltage feeder breakers and fuses.

#### **1.5 THE CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Submit a complete Short Circuit and Time-Current Coordination Study for the breakers and fuses provided under this contract.
  - .1 Include all upstream overcurrent protection up to and including the main breaker in the normal main distribution switch and up to and including the main breaker in the emergency main distributions.
  - .2 Curves shall be plotted on a standard log-log scale as time versus current values on 15kV and common 600 Volt base. It shall be the responsibility of the Division 26 contractor to provide time-current curves of all breakers, fuses, etc.
  - .3 The study shall:
    - .1 Select settings and characteristics for the protective devices in order to achieve maximum selectivity between devices during fault conditions (ie. the device nearest the fault will operate first, thus minimizing the interruption) and to provide proper protection for all distribution equipment, transformers, cable, etc.
    - .2 Determine the fault currents at critical points in the power system under the worst case conditions in order to ensure the adequacy of the electrical equipment and protective devices. Motor contribution is to be taken into account.
    - .3 Include all breakers in CDP type panelboards. Breaker settings shall be listed in the study for all breakers with adjustable trips.



- .4 In addition to the curves for the protective devices, each drawing shall show and include proper protection and coordination for:
  - .1 Transformer inrush points.
  - .2 Transformer full load currents.
  - .3 Transformer damage curves (single phase and three phase).
  - .4 Cable damage curves.
  - .5 The largest motor or motors likely to present coordination problems.
- .5 All required breaker settings shall be listed in table form including breaker details such as breaker type, trip rating, etc. All breakers with adjustable trips shall be included in this list.
- .6 Maximum available short circuit currents shall be listed for each bus. This listing shall also include the interrupting rating of the protective devices actually supplied in the contract.
- .7 In all cases use actual values for transformer impedance, cable types, cable sizes, cable lengths, available utility fault current, etc.
- .8 Identification names and numbers for breakers and distribution in the study shall match the identification shown on the contract documents.
- .9 The short circuit and coordination study shall be done by a Professional Engineer licensed in the Province of Newfoundland and Labrador and the study shall be signed and sealed by the Professional Engineer.
- .10 Ground fault curves shall be plotted on the same drawings as overcurrent curves to ensure proper coordination.
- .11 Where there is a generator set, the study shall include the generator breakers.
- .12 Where there is equipment such as power factor correction panels with incoming breakers include these breakers in the study.
- .13 As a minimum, the study shall be bound in a 3-ring loose leaf binder and shall include:
  - .1 A title sheet listing the study name, project name, project number, date, engineering company that prepared the study (including address and phone number), the engineers seal and signature, etc.
  - .2 Table of Contents.
  - .3 Purpose of the study.
  - .4 The criteria for determining proper selective coordination, protection, adequacy, etc. (eg. describe when coordination is achieved, minimum/maximum tripping times and current values, separation between curves, safety margins, damage curves, etc.).
  - .5 Summary stating that proper selective coordination, proper protection, adequacy of the equipment for the maximum available short circuit currents, etc. was achieved and listing any areas of compromise, potential problems, marginal adequacies, etc.
  - .6 Drawings of the breaker curves showing proper selective coordination, protection, adequacies, etc. On each drawing, include a single line diagram of the distribution for the curves shown on the drawing, breaker settings, etc.
  - .7 Maximum available short circuit currents at each bus.

- .14 The study shall be started immediately on award of contract and shall be submitted as a shop drawing for review in advance of distribution shop drawings.
  - .15 All breakers shall be set per the curves in the coordination study.
  - .16 The Short Circuit and Time-Current Coordination Study (revised to as-built conditions) shall be included in the Operating and Maintenance Manuals.
  - .17 A summation chart showing all ratings and settings with reference to the appropriate curves.
  - .18 Recommendations and comments on the effectiveness of the coordination study.
  - .19 A system single line diagram indicating circuit identification, device numbers and equipment ratings.
  - .20 Drawings generated by a computer aided drafting system. Drawings to be provided on Departmental Representative approved AutoCAD system and version.
- .2 Contractor Responsibilities:
- .1 Conduct studies recommended in this section as soon as possible to avoid projects delays.
  - .2 In the event that the studies indicate necessary changes to provide proper coordination, the distribution equipment Supplier and Contractor shall include allowance for the changes in power panels, circuit breaker sizes, trip settings, wire sizes, etc., to enable coordination with downstream devices. Include all costs in the contract price.
  - .3 The studies shall be completed and reviewed by the General Contractor and the electrical contractor prior to equipment being ordered, include revisions and then submit to the Departmental Representative for review along with the shop drawings.
- .3 Visit the site and commission the equipment settings with test instruments. Submit verification test results to the Departmental Representative.

## **1.6 ARC FLASH HAZARD ANALYSIS**

- .1 Scope
  - .1 The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract.
- .2 Submittals For Construction
  - .1 Arc flash labels shall be provided in hard copy only and affixed to the relevant equipment.
- .3 Qualifications
  - .1 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.
- .4 Studies

- .1 The contractor shall furnish an Arc Flash Hazard Analysis Study report and schematics (including calculations) per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.
- .5 Arc Flash Hazard Analysis
  - .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
  - .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
  - .3 The Arc-Flash Hazard Analysis shall include all significant locations in 600 volt systems fed from transformers equal to or greater than 125kVA where work could be performed on energized parts.
  - .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm<sup>2</sup>.
  - .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

- .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment locations. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculations will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculation on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
  - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
  - .2 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- .8 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- .9 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculations.
- .10 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- .11 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- .12 Incident energy and flash protection boundary calculations
  - .1 Arcing fault magnitude
  - .2 Protective device clearing time
  - .3 Duration of arc
  - .4 Arc flash boundary
  - .5 Working distance
  - .6 Incident energy

- .7 Hazard Risk Category
- .8 Recommendations for arc flash energy reduction
- .6 Field Adjustment
  - .1 Arc Flash Warning Labels
    - .1 The contractor of the Arc Flash Hazard Analysis shall provide a 3.5in. x 3.5in. thermal transfer type label of high adhesion polyester for each work location analyzed.
    - .2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to DEPARTMENTAL Representative and after any system changes, upgrades or modifications have been incorporated in the system.
    - .3 The label shall include the following information, at a minimum:
      - .1 Location designation
      - .2 Nominal voltage
      - .3 Flash protection boundary
      - .4 Hazard risk category
      - .5 Incident energy
      - .6 Working distance
      - .7 Engineering report number, revision number and issue date
    - .4 Labels shall be machine printed, with no field markings.
    - .5 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
      - .1 For each 600 volt panelboard, one arc flash label shall be provided.
      - .2 For each motor control centre, one arc flash label shall be provided.
      - .3 For each low voltage switchboard, one arc flash label shall be provided.
      - .4 For each switchgear, one flash label shall be provided.
      - .5 For medium voltage switches one arc flash label shall be provided.
    - .6 Labels shall be field installed by Electrical Contractor.
- .7 Contractor Responsibilities:
  - .1 In the event that the studies indicate necessary changes to provide proper coordination, the distribution equipment Supplier and Contractor shall include for the changes in circuit breaker sizes, trip settings, wire sizes, etc., to enable coordination with downstream devices. Include all costs in the contract price.
  - .2 The studies shall be completed and reviewed by the General Contractor and the Commissioning Officer prior to equipment being ordered, include revisions and then submit to the Consultant for review along with the shop drawings.
- .8 Visit the site and commission the equipment settings with test instruments. Submit verification test results to the Consultant.

**PART 2        Products**

- .1        Not used.

**PART 3        Execution**

- .1        Not used.

END OF SECTION

## **Part 1 General**

### **1.1 REFERENCES**

- .1 CSA International
  - .1 CAN/CSA C22.2 No.94.1-07, Enclosures for Electrical Equipment, Non Environment Considerations.
- .2 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .3 The Munsell System of Colour Notation.

### **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 electrical cabinets and enclosures and include product characteristics, performance criteria, physical size, finish and limitations.

### **1.3 CLOSEOUT SUBMITTALS**

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

### **1.4 DELIVERY, STORAGE AND HANDLING**

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

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Enclosure constructed with 2.7 mm thick minimum steel, with weather and corrosion resistant finish to CAN/CSA C22.2, Munsell Notation 7.5GY3.5/1.5, size as indicated.

- .2 Entire enclosure to be capable of withstanding maximum impact force of 86 MN/m<sup>2</sup> area without rupture of material.
- .3 Removable enclosure panels with formed edges, galvanized steel external fasteners removable only from inside enclosure.
- .4 Equip enclosure with hot dipped galvanized mounting rails 1m 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.
- .5 Cover: tamperproof, bolt-on, domed to shed water.
- .6 Door: 3 point latching, with padlocking means.
- .7 Ventilation panel constructed to allow air circulation yet preventing entry of foreign objects, wild life, and vermin.
- .8 Enclosure construction such as to allow configuration of single or ganged enclosures.
- .9 Enclosure capable of being shipped in knocked-down condition.

### **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 electrical cabinet and enclosure 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 Assemble enclosure in accordance with manufacturer's instructions and securely mount on building structure with channels, supports and fastenings.
- .2 Mount equipment in enclosure.
- .3 Label electrical cabinets and enclosure to Section 26 05 00 - Common Work Results for Electrical.

#### **3.3 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.



**END OF SECTION**

## **Part 1 General**

### **1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
  - .2 CAN/CSA C22.2 No.42.1-00 (R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  - .3 CSA C22.2 No.55-M1986 (R2008), Special Use Switches.
  - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

### **1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
  - .1 Indicate on drawings:
    - .1 Model number and finish.

### **1.3 CLOSEOUT SUBMITTALS**

- .1 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturers 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, in dry location, indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

## **Part 2 Products**

### **2.1 SWITCHES**

- .1 20A, 120 V, single pole, switches.

- .2 Manually-operated general purpose AC switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine moulding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 White toggle.
- .3 Switches of one manufacturer throughout project.

## **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 White urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Break-off links for use as split receptacles.
  - .4 Eight back wired entrances, four side wiring screws.
  - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
  - .1 White urea moulded housing.
  - .2 Suitable for No. 10 AWG for back and side wiring.
  - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.

## **2.3 COVER PLATES**

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

## **2.4 SOURCE QUALITY CONTROL**

- .1 Cover plates from one manufacturer throughout project.

**Part 3 Execution**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with handle in UP position when switch closed.
  - .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.

**3.3 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**3.4 PROTECTION**

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

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

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 Not used

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide fuse performance data characteristics for each fuse type and size. Performance data to include: average melting time-current characteristics.
- .3 Shop Drawings:
  - .1 Provide shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet.

**1.4 EXTRA MATERIALS**

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

**Part 2 Products**

**2.1 FUSES - GENERAL**

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.

**2.2 FUSE TYPES**

- .1 Class L fuses.
  - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type L2, fast acting.
- .2 Class J fuses.
  - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type J2, fast acting.

- .3 Class R -R fuses.
  - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
  - .2 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .4 Class C fuses.

## **2.3 FUSE STORAGE CABINET**

- .1 Fuse storage cabinet, manufactured from 2.0 mm thick aluminum 750 mm high, 600 mm wide, 300 mm deep, hinged, lockable front access door finished in accordance with Section 26 05 00 - Common Work Results for Electrical.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically matched mounting devices.
  - .1 Install rejection clips for Class R fuses.
- .3 Ensure correct fuses fitted to assigned electrical circuit.
- .4 Where UL Class RK1 fuses are specified, install warning label "Use only UL Class RK1 fuses for replacement" on equipment.
- .5 Install spare fuses in fuse storage cabinet.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group (CSA)
  - .1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Include time-current characteristic curves for breakers.
- .3 Certificates:
  - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
    - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
  - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
  - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractors expense.
  - .4 Production certificate of origin must contain:
    - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
    - .2 Licensed dealers name and address and person of distributor responsible for Contractor s account.
    - .3 Contractor's name and address and person responsible for project.
    - .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
    - .5 Name and address of building where circuit breakers will be installed:
      - .1 Project title.
      - .2 End user's reference number.
      - .3 List of circuit breakers.



### **1.3 DELIVERY, STORAGE AND HANDLING**

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

## **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.

### **2.2 THERMAL MAGNETIC BREAKERS**

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

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION**

- .1 Install circuit breakers as indicated.

### **3.3 CLEANING**

- .1 Progress Cleaning:
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 CSA Group
  - .1 CAN/CSA-C22.2 No.4-04 (R2009 ), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
  - .2 CSA C22.2 No.39-13, Fuseholder Assemblies.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

**1.3 DELIVERY, STORAGE AND HANDLING**

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

**Part 2 Products**

**2.1 DISCONNECT SWITCHES**

- .1 Non-fusible, Horsepower rated disconnect switch in CSA enclosure NEMA 3R.
- .2 Provision for padlocking in on-off switch position by 3 locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Quick-make, quick-break action.
- .5 ON-OFF switch position indication on switch enclosure cover.

**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                EXAMINATION**

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

**3.2                INSTALLATION**

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

**3.3                CLEANING**

- .1      Progress Cleaning:
  - .1      Leave Work area clean at end of each day.
- .2      Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCE STANDARDS**

- .1 International Electrotechnical Commission (IEC)
  - .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

**1.2 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Product Data:
  - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Shop Drawings:
  - .1 Provide shop drawings for each type of starter to indicate:
    - .1 Mounting method and dimensions.
    - .2 Starter size and type.
    - .3 Layout and components.
    - .4 Enclosure types.
    - .5 Wiring diagram.
    - .6 Interconnection diagrams.

**1.3 CLOSEOUT SUBMITTALS**

- .1 Provide maintenance materials.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.
- .3 Extra Materials:
  - .1 Provide listed spare parts for each different size and type of starter.
    - .1 3 contacts, stationary.
    - .2 3 contacts, movable.
    - .3 1 contacts, auxiliary.
    - .4 2 control transformers.
    - .5 2 operating coil.
    - .6 2 fuses.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver materials to site in original factory packaging, labelled with manufacturers name, address.

## **Part 2            Products**

### **2.1                MATERIALS**

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

### **2.2                FULL VOLTAGE MAGNETIC STARTERS**

- .1        Magnetic of size, type, rating and enclosure type as indicated with components as follows:
  - .1        Contactor solenoid operated, rapid action type.
  - .2        Motor overload protective device in each phase, manually reset from outside enclosure.
  - .3        Wiring and schematic diagram inside starter enclosure in visible location.
  - .4        Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2        Accessories:
  - .1        Selector switches: oil tight, heavy duty labelled as indicated.
  - .2        Indicating lights: oil tight, heavy duty type and colour as indicated.
  - .3        2-N/O and 2-N/C spare auxiliary contacts unless otherwise indicated.

### **2.3                CONTROL TRANSFORMER**

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

### **2.4                ACCESSORIES**

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

### **2.5                FINISHES**

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

### **2.6                EQUIPMENT IDENTIFICATION**

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

**Part 3            Execution**

**3.1                INSTALLATION**

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

**3.2                FIELD QUALITY CONTROL**

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

**3.3                CLEANING**

- .1        Remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**