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**Part 1            General**

**1.1            RELATED REQUIREMENTS**

- .1    Section 23 05 01 – Common Work Results for Mechanical.
- .2    Section 26 05 00 – Common Work Results for Electrical.

**1.2            REFERENCES**

- .1    Canadian Standards Association (CSA):
  - .1    CSA C22.1-21, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
  - .2    CSA C22.1HB-21, CE Code Handbook, an Explanation of Rules of the Canadian Electrical Code, Part 1.
  - .3    CSA C22.2 No. 18.2-06, Nonmetallic Outlet Boxes.
  - .4    CSA C22.2 No. 18-98 (R2003), Outlet Boxes, Fittings, and Associated Hardware.
  - .5    CSA C22.2 No. 40-M1989 (R2014), Cutout, Junction and Pull Boxes.
  - .6    CSA C22.2 No. 41-13(R2017), Grounding and Bonding Equipment (Bi-National Standard, with UL 467).
  - .7    CSA C22.2 No. 56-17, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .8    CSA C22.2 No. 65-18, Wire Connectors (Tri-National Standard, with UL 486A-486B and NMX-J-543-ANCE-03).
  - .9    CSA C22.2 No. 83-M1985 (R2017), Electrical Metallic Tubing.
  - .10    CSA C22.2 No. 83.1-07 (R2017), Electrical Metallic Tubing – Steel (Tri-National Standard, with UL 797 and NMX-J-536-ANCE-2007).
  - .11    CSA C22.2 No. 0.4-17, Bonding of Electrical Equipment.
- .2    Underwriters Laboratories (UL):
  - .1    UL 1 11<sup>th</sup> Edition (2020), Standard for Flexible Metal Conduit.

**1.3            SHOP DRAWINGS**

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

**1.4            OVERCURRENT PROTECTION**

- .1    Confirm overcurrent protection requirements of equipment supplied by Divisions 21, 23, 25 and 26 prior to installation.

**1.5            LOCATION OF CONDUIT**

- .1    Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.
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**Part 2            Products**

**2.1            PANELBOARD**

- .1 Existing 347/600V panelboard:
  - .1 Manufacturer: Schneider/Square D.
  - .2 Rating: 600/347 V, 3 phase, 3 wire, 400 A, short circuit current 18kA (rms symmetrical).
  - .3 Main Breaker Rating: 200A.

**2.2            MOULDED CASE CIRCUIT BREAKERS**

- .1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .2 Common-trip breakers: with single handle for multi-pole applications. Circuit breakers with interchangeable trips as indicated.
- .3 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

**2.3            CABLES AND REELS**

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

**2.4            BUILDING WIRES**

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG (including ground wires).
- .2 Copper conductors: size as indicated:
  - .1 For applications up to 250 V: with thermoplastic insulation type RW90 rated at 600V.
  - .2 For applications up to 600 V: with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

**2.5            CONDUITS**

- .1 Rigid galvanized steel threaded conduit.
- .2 Electrical metallic tubing EMT, with steel set screw couplings and connectors.
- .3 Liquid-tight flexible metal conduit.

**2.6            CONDUIT FASTENINGS**

- .1 One hole steel straps to secure surface conduits 50 mm and smaller.
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- .1 Two hole steel straps for conduits larger than 50 mm.
  - .2 One piece universal strut clamps to secure conduit to struts.
  - .3 Beam clamps to secure conduits to exposed steel work.
  - .4 Channel type supports for two or more conduits at 1.5 m oc.
  - .5 Six mm diameter threaded rods to support suspended channels.

## **2.7 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory “ells” where 90 degree bends are required for 25 mm and larger conduits.

## **2.8 FISH CORD**

- .1 Polypropylene.

## **2.9 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1HB.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .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.

## **2.10 JUNCTION AND PULL BOXES**

- .1 Size boxes in accordance with CSA C22.1HB
- .2 Construction: welded steel enclosure.
- .3 Covers Flush Mounted: 25mm minimum extension all around.
- .4 Covers Surface Mounted: screw-on flat covers.

## **2.11 WIRE AND BOX CONNECTORS**

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1 Connector body and stud clamp for stranded copper conductors.
- .3 Clamps or connectors for armoured cable as required.

## **2.12 SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.7 mm thick, surface mounted or suspended.
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**Part 3            Execution**

**3.1                INSTALLATION**

- .1      Confirm equipment locations and sizes as indicated on plans to ensure equipment will fit.
- .2      Secure floor and wall mounted equipment plum and square.
- .3      Connect supply and load feeders from all equipment.
- .4      Check factory made connections for secureness and electrical continuity.
- .5      Ensure adequate clearances around equipment for ventilation requirements and code.
- .6      Provide auxiliary equipment and connections as required.
- .7      Provide typed, dated panel directory for each affected panelboard on this project.

**3.2                MOULDED CASE CIRCUIT BREAKERS**

- .1      Provide schedule and coordinate the power shutdown of panels to Departmental Representative for breaker replacement.
- .2      Terminate wiring on load side and make connection to equipment.

**3.3                EQUIPMENT GROUNDING**

- .1      Install grounding connections to typical equipment included in, but not necessarily limited to following, transformers, starters, variable speed drives, disconnects, frames of motors, motor control centres, control panels, distribution panels and conduits etc.
- .2      Make grounding connections in radial configuration only, with connections terminating at a single grounding point. Avoid loop connections.
- .3      Bond single conductor, metallic armoured cables to cabinet at supply end with conductive plate, and provide non-metallic entry plate at load end.
- .4      Provide continuous ground conductor for raceways, outlets, and junction boxes for all systems.
- .5      Provide a ground conductor for all raceways.
- .6      Ground all systems raceways, provide ground bushings.
- .7      Ground all ductwork separated by flexible connections.

**3.4                CONDUIT SYSTEMS**

- .1      Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
  - .2      Use electrical metallic tubing EMT except in where indicated or specified elsewhere.
  - .3      Use liquid tight flexible metal conduit for connection to motors and for connection to equipment in damp, wet or corrosive locations.
  - .4      Minimum conduit size: 21 mm.
  - .5      Bend conduit cold. Replace conduit if kinked or flattened more than 1/10<sup>th</sup> of its original diameter.
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- .6 Mechanically bend steel conduit over 21 mm dia.
  - .7 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
  - .8 Dry conduits out before installing wire.
  - .9 Run parallel or perpendicular to building lines.
  - .10 Run conduits in flanged portion of structural steel.
  - .11 Group conduits wherever possible on channels.
  - .12 Do not pass conduits through structural members.
  - .13 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
  - .14 Ream raceways to remove burrs.
  - .15 Install fish cord in empty conduits.
  - .16 Provide fish cord in all empty raceways.

### **3.5 WIRING**

- .1 Install RW-90 conductors in raceways except as otherwise indicated.
- .2 Installation of type AC-90 will not be permitted, lighting fixtures shall be connected with EMT.
- .3 Leave minimum 200 mm length of conductor at junction and outlet boxes.
- .4 Splices shall not be pulled into conduits.
- .5 Provide approved wire pulling lubricants for cable installations in conduits.

### **3.6 OUTLET BOXES**

- .1 Support boxes independently of connecting conduits.
- .2 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .3 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .4 Provide circuit number identification on all junction boxes with electronically printed labels.
- .5 Identify systems for outlet boxes as required.

### **3.7 JUNCTION, PULL BOXES AND CABINETS**

- .1 Install pull boxes in inconspicuous but accessible locations. Coordinate interferences with Mechanical Trades.
  - .2 Mount cabinets with top not higher than 2m above finished floor except where indicated otherwise.
  - .3 Install pull boxes as required by CSA C22.1.
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**3.8 WIRE AND BOX CONNECTIONS**

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

**3.9 FASTENINGS AND SUPPORTS**

- .1 Secure equipment to hollow masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .3 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.
  - .4 One piece universal strut clamps to secure conduit to struts.
- .4 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.
- .5 For surface mounting of two or more conduits use channels at 1.5 m occasional spacing.
- .6 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .7 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .8 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .9 Do not use support or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .10 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.