

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 91 00 - Commissioning - Mechanical and Electrical Installation.

### **1.2 REFERENCES**

- .1 American National Standards Institute (ANSI).
  - .1 ANSI C2, National Electrical Safety Code.
- .2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME).
  - .1 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .3 American National Standards Institute (ANSI)/National Fire Protection Association (NFPA).
  - .1 ANSI/NFPA 70, National Electrical Code.
- .4 Canadian Standards Association (CSA)/CSA International.
  - .1 CSA C22.1, Canadian Electrical Code, Part 1.
  - .2 CSA C22.2, Canadian Electrical Code, Part 2.
  - .3 CAN/CSA C22.3 No. 1, Networks.
  - .4 CAN/CSA C22.3 No. 7, Underground Networks.
  - .5 CSA 22.2 No. 45, Rigid Steel Conduits.

### **1.3 SYSTEM DESCRIPTION**

- .1 Electrical:
  - .1 Provide power wiring from emergency panels to EMCS field panels. Circuits to be for exclusive use of EMCS equipment. Panel breakers to be identified on panel legends tagged and locks applied to breaker switches.
  - .2 Hard wiring between field control devices and EMCS field panels.

- .3 Communication wiring between EMCS field panels and OWS, including main control centre.
  - .4 Modify existing starters to provide for EMCS as indicated in I/O Summaries and as indicated.
  - .5 Refer to wiring diagrams included as part of flow diagrams. Trace existing control wiring installation and provide updated wiring schematics including additions and/or deletions to control circuits for approval by Departmental Representative before commencing Work.
- .2 Mechanical:
- .1 Pipe taps required for EMCS equipment will be supplied and installed according to the applicable sections.
  - .2 Wells and control valves shall be supplied by EMCS Contractor and installed according to the applicable sections.
  - .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be installed according to the applicable sections.

## 1.4 PERSONNEL QUALIFICATIONS

- .1 Qualified supervisory personnel to:
  - .1 Continuously direct and monitor all work.
  - .2 Attend site meetings.

## **PART 2 - PRODUCTS**

### 2.1 WIRING

- .1 As per requirements of Division 26.
- .2 For 70 V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600 V. Colour code to CSA 22.1.
- .3 For wiring under 70 V use FT6 rated wiring where wiring is not run in conduit. All other cases use FT4 wiring.

.4 Sizes:

- .1 120V Power supply: To match or exceed breaker, size #12 minimum.
- .2 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
- .3 Field wiring to digital device: At least 20AWG stranded twisted pair.
- .4 Analog input and output: Shielded #20 minimum stranded twisted pair. Wiring must be continuous without joints.

.5 Terminations:

- .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

## 2.2 CONDUIT

- .1 As per requirements of Division 26.
- .2 Conduits must have a minimum of 20 mm (0.79 in) diameter.
- .3 Electrical metallic tubing to CSA C22.2 83. Flexible and liquid tight flexible metal conduit to CSA C22.2 56. Rigid steel threaded conduit to CSA C22.2 45.
- .4 Junction and Pull Boxes: Welded steel.
  - .1 Surface mounting cast FS: Screw-on flat covers.
  - .2 Flush mounting: Covers with 25 mm minimum extension all round.
- .5 Cabinets: Sheet steel, for surface mounting, with hinged door, latch lock, 2 keys, complete with perforated metal mounting backboard. Panels to be keyed alike for similar functions and or entire Contract as approved.
- .6 Outlet boxes: 100 mm minimum, square.
- .7 Conduit Boxes, Fittings:
  - .1 Bushings and connectors: With nylon insulated throats.
  - .2 With push pennies to prevent entry of foreign materials.
- .8 Fittings for Rigid Conduit:
  - .1 Couplings and fittings: Threaded type steel.

- .2 Double locknuts and insulated bushings: Use on sheet metal boxes.
- .3 Use factory "ells" where 90 degree bends required for 25 mm and larger conduits.
- .9 Fittings for Thin Wall Conduit:
  - .1 Connectors and couplings: Steel, set screw type.

## **2.3 WIRING DEVICES, COVER PLATES**

- .1 Conform to CSA.
- .2 Receptacles:
  - .1 Duplex: CSA type 5-15R.
  - .2 Single: CSA type 5-15R.
  - .3 Cover plates and blank plates: Finish to match other plates in area.

## **2.4 SUPPORTS FOR CONDUIT, FASTENINGS, EQUIPMENT**

- .1 Solid Masonry, Tile, and Plastic Surfaces: Lead anchors or nylon shields.
  - .1 Hollow masonry walls, suspended drywall ceilings: Toggle bolts.
- .2 Exposed Conduits or Cables:
  - .1 50 mm diameter and smaller: One-hole steel straps.
  - .2 Larger than 50 mm diameter: Two-hole steel straps.
- .3 Suspended Support Systems:
  - .1 Individual cable or conduit runs: Support with 6 mm diameter threaded rods and support clips.
  - .2 Two or more suspended cables or conduits: Support channels supported by 6 mm diameter threaded rod hangers.

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## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Conduits for wiring.
  - .1 All wiring must be installed in EMT conduits.
  - .2 Use rigid conduits and weatherproof joints for conduits installed outside the building.

### **3.2 SUPPORTS**

- .1 Install special supports as required and as indicated.

### **3.3 ELECTRICAL GENERAL**

- .1 Do complete installation in accordance with requirements of:
    - .1 Division 26 and this specification.
    - .2 CSA 22.1 Canadian Electrical Code.
    - .3 ANSI/NFPA 70.
    - .4 ANSI C2.
  - .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage above 70 V contacts and mark to prevent accidental injury.
  - .3 Do underground installation to CAN/CSA C22.3 No. 7, except where otherwise specified.
  - .4 Conform to manufacturer's recommendations for storage, handling, and installation.
  - .5 Check factory connections and joints. Tighten where necessary to ensure continuity.
  - .6 Install electrical equipment between 1,000 and 2,000 mm above finished floor wherever possible and adjacent to related equipment.
  - .7 Protect exposed live equipment such as panel, mains, and outlet wiring during construction for personnel safety.
  - .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
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- .9 Install conduits, and sleeves prior to pouring of concrete.
- .10 Holes through exterior wall and roofs: Flash and make weatherproof.
- .11 Make necessary arrangements for cutting of chases, drilling holes and other structural work required to install electrical conduit, cable, pull boxes, and outlet boxes.
- .12 Install cables, conduits and fittings which are to be embedded or plastered over, neatly and closely to building structure to minimize furring.

### 3.4 CONDUIT SYSTEM

- .1 Install telecommunication cables in conduits.
- .2 Communication wiring shall be installed in conduit. Provide complete conduit system to link Building Controllers to BECC. Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems. Maximum conduit fill not to exceed 40%. Design drawings do not show conduit layout.
- .3 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .4 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Departmental Representative before starting such work. Provide complete conduit system to link field panels and devices with main control centre. Conduit size to match conductors plus future expansion capabilities as specified.
- .5 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .6 Bend conduit so that diameter is reduced by less than 1/10<sup>th</sup> original diameter.
- .7 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .8 Limit conduit length between pull boxes to less than 30 m.
- .9 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .10 Use flexible conduits to make the transition between control elements and the EMT conduits. Flexible conduits must not exceed 500 mm in length (20 in.).
- .11 Fastenings and supports for conduits, cables, and equipment:
  - .1 Provide metal brackets, frames, hangers, clamps and related types of support structures as indicated and as required to support cable and conduit runs.

- .2 Provide adequate support for raceways and cables, sloped vertically to equipment.
- .3 Use supports or equipment installed by other trades for conduit, cable and raceway supports only after written approval from Departmental Representative.
- .12 Install polypropylene fish cord in empty conduits for future use.
- .13 Where conduits become blocked, remove and replace blocked sections.
- .14 Pass conduits through structural members only after receipt of Departmental Representative written approval.
- .15 Conduits may be run in flanged portion of structural steel.
- .16 Group conduits wherever possible on suspended or surface channels.
- .17 Pull Boxes:
  - .1 Install in inconspicuous, but accessible locations.
  - .2 Support boxes independently of connecting conduits.
  - .3 Fill boxes with paper or foam to prevent entry of construction material.
  - .4 Provide correct size of openings. Reducing washers not permitted.
  - .5 Mark location of pull boxes on record drawings.
  - .6 Identify AC power junction boxes, by panel and circuit breaker.
- .18 Install terminal blocks or strips indicated in cabinets to Division 26.
- .19 Install bonding conductor for 120 V and above in conduit.

### 3.5 WIRING

- .1 Install multiple wiring in ducts simultaneously.
- .2 Do not pull spliced wiring inside conduits or ducts.
- .3 Use CSA certified lubricants of type compatible with insulation to reduce pulling tension.
- .4 Tests: use only qualified personnel. Demonstrate that:
  - .1 Circuits are continuous, free from shorts, unspecified grounds.
  - .2 Resistance to ground of all circuits is greater than 50 Megohms.

- .5 Provide Departmental Representative with test results showing locations, circuits, results of tests.
- .6 Remove insulation carefully from ends of conductors and install to manufacturer's recommendations. Accommodate all strands in lugs. Where insulation is stripped in excess, neatly tape so that only lug remains exposed.
- .7 Wiring in main junction boxes and pull boxes to terminate on terminal blocks only, clearly and permanently identified. Junctions or splices not permitted for sensing or control signal covering wiring.
- .8 Do not allow wiring to come into direct physical contact with compression screw.
- .9 Install ALL strands of conductor in lugs of components. Strip insulation only to extent necessary for installation.

### **3.6 WIRING DEVICES, COVER PLATES**

- .1 Receptacles:
  - .1 Install vertically in gang type outlet box when more than one receptacle is required in one location.
- .2 Cover Plates:
  - .1 Install suitable common cover plate where wiring devices are grouped.
  - .2 Use flush type cover plates only on flush type outlet boxes.

### **3.7 GROUNDING**

- .1 Install complete, permanent, continuous grounding system for equipment, including conductors, connectors, and accessories.
  - .2 Install separate grounding conductors in conduit within building.
  - .3 Install ground wire in all PVC ducts and in tunnel conduit systems.
  - .4 Tests: Perform ground continuity and resistance tests, using approved method appropriate to site conditions.
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### 3.8 TESTS

- .1 Perform following tests:
  - .1 Preliminary tests:
    - .1 Conduct as directed to verify compliance with specified requirements.
    - .2 Make needed changes, adjustments, and replacements.
    - .3 Insulation resistance tests:
      - .1 Measure all circuits, feeders, equipment for 120 - 600 V with 1,000 V instrument. Resistance to ground to be more than required by Code before energizing.
      - .2 Test insulation between conductors and ground, efficiency of grounding system to satisfaction of Departmental Representative and authority having jurisdiction.
  - .2 Give 14-day written notice of intention to test.
  - .3 Conduct in presence of Departmental Representative and authority having jurisdiction.
  - .4 Conceal Work only after tests satisfactorily completed.
  - .5 Report results of tests to Departmental Representative in writing.

**END OF SECTION**