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**PART 1      GENERAL**

**1.1            RELATED SECTIONS**

- .1      Section 01 11 00 – Summary of Work.
- .2      Section 01 73 00 – Execution Requirements.
- .3      Section 21 05 01 – Common Work Results-Mechanical.
- .4      Section 22 13 17 – Drainage Waste and Vent Piping – Cast Iron and Copper.
- .5      Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
- .6      Section 23 07 13 – Duct Insulation.
- .7      Section 25 05 01 – EMCS: General Requirements.
- .8      Section 26 05 00 – Common Work Results-Electrical.

**1.2            REFERENCES**

- .1      American National Standards Institute (ANSI)
  - .1      ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  - .2      ANSI C2, National Electrical Safety Code.
  - .3      ANSI/NFPA 70, National Electrical Code.
- .2      Canadian Standards Association (CSA)
  - .1      CSA C22.1, Canadian Electrical Code, Part 1.
  - .2      CAN/CSA C22.3 No.1, Overhead Systems.
  - .3      CSA C22.3 No. 7, Underground Systems.

**1.3            SYSTEM DESCRIPTION**

- .1      Electrical:
  - .1      Provide power wiring from emergency power panels where emergency power is

provided to EMCS field panels. If no emergency power provided, install UPS Device. 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's including main control centre BECC.
- .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 Department Representative before commencing work.
- .6 All control wiring 50 V and less for equipment supplied by Division 25 will be the responsibility of Division 25- Integrated Automation Contractor. Conduit and wire associated with this is the responsibility of Division 25.

.2 Mechanical:

- .1 Pipe taps required for EMCS equipment will be supplied and installed by Mechanical Division.
- .2 Wells and control valves shall be supplied by EMCS Contractor and installed by Mechanical.
- .3 Installation of air flow stations, dampers, and other devices requiring sheet metal trades to be mounted by Mechanical. Costs to be carried by designated trade.

.3 VAV Terminal Units.

- .1 Air flow probe for VAV boxes to be supplied and installed under Mechanical Division. Air flow dp sensor, actuator and associated VAV controls to be supplied and installed by EMCS contractor. Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators to be the responsibility of EMCS contractor. Coordinate air flow adjustments with balancing trade.

.4 Structural:

- .1 Special steelwork as required for installation of work.

## **1.4 PERSONNEL QUALIFICATIONS**

.1 Qualified factory trained supervisory personnel to:

- .1 Continuously direct and monitor all work.
- .2 Attend site meetings.

## **1.5 EXISTING CONDITIONS**

- .1 Cutting and Patching: refer to Section 01 73 00 – Execution Requirements supplemented as specified herein.
- .2 Repair all surfaces damaged during execution of work.
- .3 Turn over to Department Representative existing materials removed from work not identified for re-use.

## **PART 2 PRODUCTS**

### **2.1 PIPING**

- .1 Domestic H&CWS: refer to Section 22 11 18-Domestic Water Piping Copper.
- .2 Sanitary, storm water: refer to Section 22 13 17- Drainage Waste and Vent Piping – Cast Iron and Copper.
- .3 Refrigeration: refer to Section 23 23 00 - Copper Tubing and Fittings Refrigerant.
- .4 Hangers and supports: refer to Section 23 05 29– Hangers and Supports for HVAC Piping and Equipment.

### **2.2 SPECIAL SUPPORTS**

- .1 Structural grade steel, primed and painted after construction and before installation.

### **2.3 WIRING**

- .1 As per requirements of Electrical Divisions.
- .2 For 50V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 600V. Colour code to CSA 22.1.
- .3 For wiring under 50 volts 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: #18AWG or 20AWG stranded twisted pair.

- .4 Analog input and output: shielded #18 minimum solid copper or #20 minimum stranded twisted pair. Wiring must be continuous without joints.
- .5 More than 4 conductors: #22 minimum solid copper.
- .5 Terminations:
  - .1 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.

## **2.4 CONDUIT**

- .1 As per requirements of Electrical Division.
- .2 Electrical metallic tubing to CSA C22.2 No. 03. Flexible and liquid tight flexible metal conduit to CSA C22.2 No.56. Rigid steel threaded conduit to CSA C22.2 No. 45.
- .3 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.
- .4 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.
- .5 Outlet boxes: 100 mm minimum, square.
- .6 Conduit boxes, fittings:
  - .1 Bushings and connectors: with nylon insulated throats.
  - .2 With push pennies to prevent entry of foreign materials.
- .7 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.
- .8 Fittings for thin wall conduit:
  - .1 Connectors and couplings: steel, set screw type.

## **2.5 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.

## **2.6 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.

## **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.

### **3.2 PIPING**

- .1 Domestic H&CWS: refer to Section 22 11 18 –Domestic Water Piping Copper.
- .2 Sanitary, storm water: refer to Section 22 13 17- Drainage Waste and Vent Piping – Cast Iron and Copper.
- .3 Refrigeration: refer to Section 23 23 00 - Copper Tubing and Fittings Refrigerant..

- .4 Insulation: refer to Section 21 07 19 – Thermal Insulation for Piping and 23 07 13 – Thermal Insulation for Ducting.

### **3.3 MECHANICAL PIPING**

- .1 Install piping in accordance with Section 23 05 05 – Installation of Pipework.

### **3.4 SUPPORTS**

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

### **3.5 ELECTRICAL GENERAL**

- .1 Do complete installation in accordance with requirements of:
  - .1 Electrical Divisions, this specification.
  - .2 CSA 22.1 Canadian Electrical Code, latest edition.
  - .3 ANSI/NFPA 70.
  - .4 ANSI C2.
- .2 Fully enclose or properly guard electrical wiring, terminal blocks, high voltage (above 50 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 1000 and 2000 mm above finished floor wherever possible and adjacent to related equipment.
- .7 Protect exposed live equipment such as panel, mains, outlet wiring during construction for personnel safety.
- .8 Shield and mark live parts "LIVE 120 VOLTS" or other appropriate voltage.
- .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, 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.

### **3.6 CONDUIT SYSTEM**

- .1 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 fills not to exceed 40%. Design drawings do not show conduit layout.
- .2 Install conduits parallel or perpendicular to building lines, to conserve headroom and to minimize interference.
- .3 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Obtain approval from Owner's 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.
- .4 Locate conduits at least 150 mm from parallel steam or hot water pipes and at least 50 mm at crossovers.
- .5 Bend conduit so that diameter is reduced by less than 1/10th original diameter.
- .6 Field thread on rigid conduit to be of sufficient length to draw conduits up tight.
- .7 Limit conduit length between pull boxes to less than 30 m.
- .8 Use conduit outlet boxes for conduit up to 32 mm diameter and pull boxes for larger sizes.
- .9 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 Owner's Representative.
- .10 Install polypropylene fish cord in empty conduits for future use.
- .11 Where conduits become blocked, remove and replace blocked sections.
- .12 Pass conduits through structural members only after receipt of Department Representative's written approval.

- .13 Conduits may be run in flanged portion of structural steel.
- .14 Group conduits wherever possible on suspended or surface channels.
- .15 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.
- .16 Install terminal blocks or strips indicated in cabinets to Electrical Division.
- .17 Install bonding conductor for 120 volt and above in conduit.

### **3.7 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 Department 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.

### **3.8 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.

### **3.9 STARTERS, CONTROL DEVICES**

- .1 Install and make control connections as indicated. Power connections above 50V by Electrical Division.
- .2 Install correct over-current devices.
- .3 Identify each control wire, terminal for external connections with permanent number marking identical to diagram.
- .4 Performance Verification:
  - .1 Operate switches and controls to verify functioning.
  - .2 Perform start and stop sequences of contactors and relays.
  - .3 Check that interlock sequences, with other separate related starters, equipment and auxiliary control devices, operate as specified.

### **3.10 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.

### **3.11 TESTS**

#### **.1 General:**

- .1 Perform following tests in addition to tests specified Section 25 08 20 - EMCS: Warranty and Maintenance.
- .2 Give 14 days written notice of intention to test.
- .3 Conduct in presence of Department Representative and authority having jurisdiction.
- .4 Conceal work only after tests satisfactorily completed.
- .5 Report results of tests to Department Representative in writing.
- .6 Preliminary tests:
  - .1 Conduct as directed to verify compliance with specified requirements.
  - .2 Make needed changes, adjustments, replacements.
  - .3 Insulation resistance tests:
    - .1 Megger all circuits, feeders, equipment for 120 - 600V with 1000V 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 Department Representative and authority having jurisdiction.

### **3.12 IDENTIFICATION**

- .1 Refer to Section 25 05 54- EMCS: Identification.

**END OF SECTION**