

**Part 1        General**

**1.1        GENERAL**

- .1        This Section covers items common to Sections of Division 26, 27 and 28. This section supplements requirements of Division 1.
- .2        Refer to Section 01 91 13 for commissioning requirements.

**1.2        CODES AND STANDARDS**

- .1        Do complete installation in accordance with CSA C22.1-2012, and local regulations, except where specified otherwise.
- .2        Abbreviations for electrical terms: to CSA Z85-1983.

**1.3        LOCKOUT/TAGOUT PROCEDURES**

- .1        Lockout/tag out procedures to conform to PWGSC standards, the Canada Labor Code and CSA Z460, latest edition.
- .2        Lockout and tag out my equipment prior to performing work.
- .3        CAN3 C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000V.

**1.4        CARE, OPERATION AND START-UP**

- .1        Instruct operating personnel in the operation, care and maintenance of all equipment.
- .2        Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .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 all aspects of its care and operation.

**1.5        VOLTAGE RATINGS**

- .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. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

**1.6        PERMITS, FEES AND INSPECTION**

- .1        Submit to the Electrical Inspection Department, Municipal Authority and supply authority the necessary number of drawings and specifications, for examination and approval prior

to commencement of work. Submit this information within twenty (20) working days of the award of Tender and provide the Departmental Representative with written notice at the time this has been submitted.

- .2 Provide the Departmental Representative with a copy of the electrical Inspection Department and supply Authority Plans Review Report, immediately upon receipt. No shop drawings will be reviewed prior to receipt of the Plans Review Report from the Contractor.
- .3 Obtain all necessary permits including an Electrical Wiring Permit for electrical work and Communications Cabling Permit for communications cabling work from the authority having jurisdiction, prior to commencement of work. Provide a copy of each permit to the Departmental Representative upon receipt. The permits are to be properly displayed on the work site.
- .4 Upon specific request, the Departmental Representative will provide, to the Contractor, up to a maximum of three (3) copies of the drawings and specifications required for submittal to the Electrical Inspection Department and Supply Authority. These drawings and specifications will be provided to the Contractor at no cost, unless specified otherwise.
- .5 Arrange for all required inspections to be conducted by the authority having jurisdiction. Provide a copy of all inspection reports to the Departmental Representative immediately upon receipt. Notify the Departmental Representative immediately of changes required by the authority having jurisdiction.
- .6 Furnish Certificates of Acceptance from authorities having jurisdiction upon completion of work. Include a copy in the Operation and Maintenance Manual.
- .7 Pay all associated fees, including necessary inspections and inspection department representation occurring outside normal working hours.

## **1.7 MATERIALS AND EQUIPMENT**

- .1 Provide materials and equipment in accordance with the specifications, drawings and all applicable certification organizations.
- .2 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the authority having jurisdiction.
- .3 Factory assemble control panels and component assemblies.
- .4 Unless otherwise indicated, the equipment listed on the project equipment schedules and shown on the drawings is the "basis of design equipment", the Contractor may utilize the alternates listed in the project documents or submit alternates for approval to this equipment that meet the technical and quality requirements of the project specifications. If there are necessary changes to any building system to accommodate these alternates, coordinate the changes and provide at no additional cost to the Contract.

## **1.8 FINISHES**

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.
  - .1 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non- galvanized hangers, racks and fastenings to prevent rusting.

## **1.9 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as specified herein.
- .2 Identification:
  - .1 All panels, disconnect switches, receptacles, voice/data, control panels, fire alarm devices, magnetic starters, TOL's, etc. are to be provided with "lamicoid" nameplates as further described herein. Care is to be taken to ensure that all plates are affixed true and level, and plumb in all instances.
  - .2 Affix nameplates to all "metal" surfaces with steel type "pop- rivets".
  - .3 Affix nameplates to other types of surfaces with contact type cement.
  - .4 Affix nameplates to building "exterior" surfaces with nylon inserts and self-tapping screws unless specifically indicated otherwise.
  - .5 Apply contact type cement to complete rear side of plate, as opposed to several locations or areas on same.
  - .6 Lamicoid nameplates installed on combination starters, magnetic starters, manual starter and all various systems controls, control panels, disconnect switches, etc., must contain the following information:
    - .1 Designated name of equipment.
    - .2 Designated name of power source.
    - .3 Branch circuit breaker number(s) where possible.
    - .4 Voltage(s).

EXHAUST FAN NO. 5  
PANEL H - CCT. NO. 17  
120V - PH

SUPPLY FAN NO. 3  
M.C.C. NO. 1  
600V - 3 PH

- .7 Lamicoid nameplates installed on fusible type disconnect switches are to also indicate maximum designated/designed fuse size.
- .8 Install lamicoid nameplates on all junction and/or pull boxes sized 150 mm x 150 mm and larger indicating name of system, designated panel name and electrical characteristics where applicable.
- .9 Install an additional "lamicoid" nameplate on all, or any piece of electrical equipment, or apparatus (i.e., Main Switchboard, CDP panels, Panelboards, etc.), that may contain overcurrent devices (i.e., circuit breakers and/or fuses), that have been designed for, and incorporate interrupting capacity sized "larger" than 10 KAIC.
- Example:  
Min, interrupting capacity of breakers  
installed in this panel to be not less  
than 22 KAIC
- Example:  
Min. interrupting capacity of fuses  
installed in this MCC to be not less  
than 100 KAIC
- .10 Install lamicoid nameplates above all types of receptacles and abutted directly to tops of their respective device plates. Identification is to indicate respective panel source complete with associated circuit breaker number(s) as per the following:
- .1 1.5mm x 13mm high complete with 6 mm white letters on black face, directly above all receptacles. Plate to be identical width as finish device plate.
- Example: PANEL H - 20
- .11 Identify lamicoid nameplates above 120V receptacles protected by GFCI circuit breakers, or GFCI type receptacles as per the following:
- .1 1.5mm thick x 19mm wide complete with 6 mm white letters on black face above all receptacles. Identical width as finish device plate
- Example: GFCI Protected Panel H-26).
- .12 All addressable fire alarm devices are to be lamicoid identified.
- .1 Lamicoid identification is to be chain hung on mechanical items (pressure switches, supervisory switches, etc.).
- .2 Lamicoid wording to match physical location and annunciator display

address.

- .13 Lamicoid 3mm thick plastic engraving sheet, white letters on black face, for all electrical systems except fire alarm which shall have red face with white letters.
- .1 1.5mm thick nameplates above receptacles as previously indicated, with top left and right corners to be rounded off.
- .2 Lettering on lamicoid nameplates are not to "start", nor "end" nearer than 13mm from either, or both ends of said plates. Size of lettering, including overall lengths of various plates shall be as indicated in the following chart.

NAMEPLATE SIZES

Size 1	9mm x	50mm	1 line	5mm high letters
Size 2	13mm x	70mm	1 line	6mm high letters
Size 3	16mm x	75mm	2 lines	5mm high letters
Size 4	19mm x	90mm	1 line	9mm high letters
Size 5	6mm x	90mm	2 lines	13mm high letters
Size 6	25mm x	100mm	1 line	13mm high letters
Size 7	25mm x	100mm	2 lines	6mm high letters
Size 8	50mm x	150mm	2 lines	13mm high letters

- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for average of forty (40) letters per nameplate and label.
- .5 Identification to be English.
- .6 Junction and pull boxes: indicate system and voltage.
- .7 Co-ordinate names of equipment and systems with other trades to ensure that equipment identification is consistent.
- .8 In addition to required nameplates and colour coding, junction boxes to have the panel and circuit numbers of all wiring contained within listed on the coverplate. Neatly write list using black indelible marker.
- .9 Colour code all electrical junction boxes, pull boxes and conduit fittings as follows:
- .1 Apply colour coding prior to installation of boxes/equipment.
- .2 Where primary colour only is indicated:
- .1 Colour inside and outside of box.
- .2 Colour all cover plates.
- .3 Where primary and secondary colours are indicated:

- .1 Paint inside and outside of box with the primary colour.
  - .2 Diagonally apply to each half of the cover plate the primary and secondary colours.
- .10 Where a lamicoid identified item is installed above an accessible ceiling, provide two (2) lamicoid plates, one (1) at the item location and one (1) directly below on the underside of the ceiling.

#### **1.10 WIRING IDENTIFICATION**

- .1 Identify wiring with self-laminating, permanently mechanically imprinted labels on both ends of each conductor and cable utilized. Identify conductors and cables in each junction or pull box through which they pass. Install labels in a "flagged" manner around individual conductors.
- .2 Maintain phase sequence and colour coding throughout.
- .3 All conductors are to have their insulation colors identified as follows:
  - .1 Phase A - Red
  - .2 Phase B - Black
  - .3 Phase C - Blue
  - .4 Neutral - White
  - .5 Bond - Green
  - .6 Ground - Green
- .4 Color coded "Conductor Insulation" as per the following:
  - .1 All sizes of phase conductors up to and including #2AWG.
  - .2 All sizes of neutral, bond and/or ground conductors up to and including #3/0AWG.
  - .3 Approved colored tapes in lieu of insulation coloring may be used to identify conductors that exceed sizes as previously indicated. Labelling is to take place at both ends of all runs at a minimum of 300mm from terminations, in addition to within all boxes between both ends of the run.
- .5 Use colour coded wires in communication cables, matched throughout system.
- .6 Indicate panel and circuit number of all phase conductors i.e.: "Panel "A" - cct 3". Identify all neutral conductors bonding and ground conductors to indicate the phase conductor with which they are associated.

## 1.11 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables. Colour boxes inside and outside where one colour is required. Colour boxes on inside only where two colours are required. Metal cover plates are to have both colours applied diagonally where two colours are required. Paint entire cover plate where one colour is required.
- .2 Code with paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m intervals.
- .3 Colours: 25mm wide prime colour and 19mm wide auxiliary colour.

<u>System</u>		<u>Primary Colour</u>	<u>Secondary Colour</u>
0-50 volts	VIOLET	-	
51 to 240 volts	YELLOW	-	
241-600volts		ORANGE	-
Fire alarm		RED	-
Telephone (Voice only)		BLACK	-
Public Address and Intercom		BLUE	-
Ground or Bond		GREEN	-
Security		BROWN	-
Mech. Controls		RED	WHITE
Computer (data only)		BLACK	WHITE
Voice and Data		BLUE	WHITE

- .4 Identify the location of various system junction and/or pull boxes etc., where located above ceiling grid system, on underside or room side of t- bar spline, with (19mm) or (6mm on 19mm) self-adhering colour coded circular shaped discs, affixed directly to spline in close proximity to where concealed box is located. Install the same type of discs on ceiling or wall access cover plates. 6mm discs are all white in colour. Affix 6mm to center or middle of 19mm discs as system colours indicates.

<u>Various Systems</u>	<u>19mm Discs</u>	<u>6mm Discs</u>
0 to 50 volts	VIOLET	-
51 to 240 volts	YELLOW	-
241 to 600 volts	ORANGE	-
Fire Alarm	RED	-
Telephone (voice only)	BLACK	-
Ground or Bond	GREEN	-
Energy Management	RED	WHITE
Computer (data only)	BLACK	WHITE
Voice and Data	BLUE	WHITE

Other

WHITE

- .5 Where boxes are not concealed, disks are to be fastened directly to outside of boxes after architectural painting is complete. Coverplates for such boxes are to have each branch circuit number neatly identified inside of the coverplate.

## **1.12 WIRING TERMINATIONS**

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.
- .2 Label all branch circuit wiring including phase conductors, neutral, ground and/or bonding conductors to be done on both ends of all circuit wires plus in any junction and pull boxes located between ends. Use write-on self laminating labels. Wrap around conductor in a "U" fashion.

## **1.13 MANUFACTURERS AND CSA LABELS**

- .1 Visible and legible after equipment is installed.

## **1.14 WARNING SIGNS**

- .1 As specified and to meet requirements of Electrical Inspection Department and Departmental Representative.
- .2 Porcelain enamel decal signs, minimum size 170mm x 250mm.

## **1.15 LOCATION OF EQUIPMENT**

- .1 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes. Do not install boxes back to back in the same stud space.
- .2 Change location of equipment at no extra cost or credit, providing distance does not exceed 3m, and information is given before installation.
- .3 Locate light switches on latch side of doors.

## **1.16 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 Mounting heights for devices to conform with NBCC regulations for Barrier Free design.

- .4 Install electrical equipment at following heights unless otherwise indicated.
  - .1 Local switches: 1200mm
  - .2 Wall receptacles:
    - .1 General: 450mm
    - .2 Above top of continuous baseboard heater: 200mm, minimum 450mm AFF.
    - .3 Above top of counters or counter backsplash: 150mm
    - .4 In mechanical rooms: 1200mm
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Wall mounted telephone and data outlets:
    - .1 General: 450mm
    - .2 Above top of continuous baseboard heater: 200mm, minimum 450mm AFF.
    - .3 Above top of counters or counter backsplash: 150mm
    - .4 In mechanical rooms: 1200mm
  - .5 Fire alarm stations: 1200mm
  - .6 Fire alarm signals: 2300mm
  - .7 Wall mounted emergency lighting and exit signs 2300mm.

#### **1.17 CONDUIT AND CABLE INSTALLATION**

- .1 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

#### **1.18 FIRESTOPPING**

- .1 Provide firestopping and smoke sealing of all cable, cabletrough or conduit penetrations through fire resistant separations as specified in Section 07 84 00.

#### **1.19 FIELD QUALITY CONTROL**

- .1 Conduct and pay for 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 system.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing.
  - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
  - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
  - .3 Check resistance to ground before energizing.
- .4 Carry out tests in presence of Departmental Representative.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit typed test results for Departmental Representative's review and inclusion in the Operation and Maintenance Manual.

#### **1.20 COORDINATION OF PROTECTIVE DEVICES**

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

#### **1.21 DEMONSTRATION, OPERATING AND MAINTENANCE INSTRUCTIONS**

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting and servicing all systems and equipment, during regular work hours, prior to acceptance.
- .2 Use as-built drawings, operation and maintenance manual, audio visual aids, etc. as part of instruction materials.
- .3 Allow for a minimum of two (2) eight hour working days to provide instruction and demonstration. This is in addition to training specified elsewhere.

#### **1.22 WASTE MANAGEMENT AND DISPOSAL**

- .1 Collect, separate and recycle all site generated waste materials in accordance with Section 01 74 22 - Construction Waste Management.

**Part 2 Products**

Not applicable.

**Part 3 Execution**

Not applicable.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CSA C22.2 No. 65-2013, Wire Connectors.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Pressure type wire connectors with current carrying parts of copper sized to fit copper conductors as required. Provide for all panels including main switch board and main transformer.
- .2 Spring type pressure wire connectors: with current carrying parts of copper and copper alloy sized to fit copper conductors 10 AWG or less. Connectors to be complete with appropriate size insulating cap.
- .3 Clamps or connectors for armoured cable, liquid tight flexible metal conduit.
- .4 Bushing stud connectors are not acceptable.

**Part 3 Execution**

**3.1 MATERIALS**

- .1 Make all connections and terminations electrically and mechanically secure. Sizes of connectors shall be as per manufacturer's recommendations for various sizes and combinations of wire sizes.
- .2 Make all joints required in branch wiring #10 and smaller utilizing spring type pressure wire connectors. Wire connectors are to be plier tightened. Cap is to completely fit or cover all enclosed conductors as required.
- .3 Make joints for all other wiring utilizing colour keyed compression type connectors complete with compression tools. Apply a first layer of compound type tape followed by an additional layer of vinyl tape. Approved alternative for wire connections up to, and including #6 may be colour coded wing-nut.

**END OF SECTION**

## **Part 1 General**

### **1.1 RELATED WORK**

- .1 Electrical General Requirements: Section 26 05 00.

### **1.2 REFERENCES**

- .1 CSA C22.2 No. 0.3-2009, Test Methods for Electrical Wires and Cables.
- .2 CSA C22.2 No. 208-03(R2013), Fire Alarm and Signal Cable.

### **1.3 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00.

### **1.4 OPERATION AND MAINTENANCE DATA**

- .1 Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00.

## **Part 2 Products**

### **2.1 BUILDING WIRES**

- .1 Conductors: to be soft drawn copper of 98% conductivity; stranded for 12 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors sized as indicated or as required by C.E.C., with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90-XLPE.
- .3 Grounding and bonding conductors sized up to and including #10 AWG are to have green coloured RW90 cross linked insulation. Type TW75 green coloured insulation is acceptable for sizes #8 AWG and larger.

### **2.2 ARMOURED CABLES**

- .1 Conductors: insulated, copper, size as indicated, minimum #12 AWG.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors: designed for cable.
- .5 Cable ties to Section 26 05 29 - Fastening and Supports.
  - .1 6mm dia threaded rods to support suspended channels.

## **2.3 FIRE ALARM SYSTEM**

- .1 Type FAS 105 to CSA C22.2 No. 208, PVC insulation, size and quantity of conductors as indicated. Red PVC outer jacket.
- .2 Provide fire alarm cables in accordance with the system manufacturer's recommendations.

## **2.4 LIGHTING CONTROL SYSTEM**

- .1 CAT5e Telecommunications structured cabling
- .2 White in colour
- .3 Plenum Rated

## **2.4 SOUND MASKING SYSTEM**

- .1 14/2AWG stranded speaker wire
- .2 Plenum Rated

## **Part 3 - Execution**

### **3.1 INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34.

### **3.2 INSTALLATION OF FIRE ALARM CABLES**

- .1 Install fire alarm cables in EMT.
- .2 Fire alarm cabling will be permitted to be installed in flexible metal conduit for final connection to various fire alarm devices installed upon flush mounted outlet boxes in finished ceiling tiles and to sprinkler devices. Liquid-tight flexible metal conduit is not exceed 5m in total length.

### **3.4 INSTALLATION OF ARMOURED CABLES**

- .1 Only use armoured cable runs for final connections to light fixtures. Do not exceed 2.0m in length.

### **3.5 INSTALLATION OF CABLES: GENERAL**

- .1 Support cables independently of supports used for equipment of other trades; do not support from or secure cables to ductwork, piping and ceiling hanger wires.

- .2 Do not lay cables on top of suspended ceiling grids and tiles.
- .3 Install cables in a neat and professional manner, so as to conserve headroom. Correct any unacceptable work at no additional cost to the Contract.
- .4 Install cables parallel and perpendicular to building lines.
- .5 Secure cables to underside of metal decking.
- .6 Make the tie-wrapping of the neutral conductor with its respective phase conductors at the closest point of entry within all panelboards, pull boxes, junction boxes and outlet boxes, etc.
- .7 All branch circuits which do not have neutral conductors are to have their respective phase conductors type-wrapped together in accordance with above.
- .8 Twist together all stranded conductors prior to any types of terminations taking place, but not necessarily limited to: receptacles, light switches, neutral terminal strips, bonding terminal strips, circuit breakers, disconnect switches, starters, contactors, relays, all types of termination lugs, panelboards, etc.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED WORK**

- .1 Wires and Cables 0-1000V: Section 26 05 21

**1.2 REFERENCES**

- .1 IEEE 837-2002, Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA C22.2 No. 41-2007(R2013), Grounding Equipment.

**Part 2 - Products**

**2.1 EQUIPMENT**

- .1 Clamps for grounding of conductor: size as required and suitable for application.
- .2 Insulated grounding and bonding conductors: soft drawn stranded copper of 98% conductivity, type RW90 (green coloured insulation as indicated in 26 05 00, item 10 - Wiring Identification).
- .3 Ground connections to take place on the ground bus to be as follows:
  - .1 For wire sizes 6 AWG and smaller: copper, one-hole, short barrel (single crimp) lugs.
  - .2 Wire larger than 6 AWG to be two-hole, long barrel (dual crimp) lugs.
- .4 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.
- .5 Copper compression type, long barrel, two hole type lugs unless specified otherwise.
- .6 Copper compression type connectors (cable to cable, cable to ground rod, etc.).

## **2.2 MANUFACTURERS**

- .1 Acceptable manufacturers: FCI- Burndy Corporation, Erico Inc., Thomas & Betts, IlSCO.

## **Part 3 Execution**

### **3.1 INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Conform to the requirements of the Departmental Representative, applicable codes and the local electrical inspection authority having jurisdiction.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding and bonding conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes using inspectable copper crimp type compression connectors.
- .5 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install insulated bonding conductor in all conduits.
- .8 Connect building structural steel to ground as indicated on the drawings.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .11 Ground secondary service pedestals.
- .12 The 'feed' bonding conductor shall be secured (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors and/or providing a "pig-tail" lead for device terminations.
- .13 Twist together all ground/bond wires with a screw-on type wire connector, and then placed in the rear of the outlet box.
- .14 Bond all conduits containing insulated ground conductor(s) at both ends.
- .15 Bend radius of all grounding/bonding conductors to a minimum of 200mm diameter.

### **3.2 SYSTEM AND CIRCUIT GROUNDING**

- .1 Install system and circuit grounding connections to neutral of secondary systems.

### **3.3 EQUIPMENT GROUNDING**

- .1 Install grounding/bonding 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, outdoor lighting, metallic waste water piping systems, metallic rain water leader systems, metallic gas fuel piping systems.

### **3.4 GROUNDING BUS**

- .1 Install copper grounding bus mounted on insulated supports in electrical and telecommunications rooms.
- .2 Ground items of electrical equipment to ground bus as indicated herein and on the Drawings.

### **3.5 COMMUNICATION SYSTEMS**

- .1 Telecommunications: provide grounding and bonding in accordance with BICSI Telecommunications Distribution Methods Manual (TDMM), 12th Edition.

### **3.6 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements.
- .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 Where applicable, disconnect ground fault indicator during tests.

**END OF SECTION**

**Part 1 General**

Not applicable.

**Part 2 Products**

**2.1 SUPPORT CHANNELS**

- .1 U shape, size 40mm x 40mm, galvanized steel, surface mounted, suspended or set in poured concrete walls and ceilings unless otherwise indicated.

**Part 3 Execution**

**3.1 INSTALLATION**

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 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. Provide additional supports as necessary.
- .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 within 1m of each outlet box, junction box, pull box, cabinet or conduit fittings with spacing between supports as per CEC to building construction or support system using straps.
  - .1 One-hole zinc plated steel straps to secure surface conduits and cables smaller than 41mm.
  - .2 Two-hole zinc plated steel straps for conduits and cables 41mm and larger.
  - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
  - .1 Support individual cable or conduit runs with 9mm dia threaded rods and spring clips.
  - .2 Support two (2) or more cables or conduits on channels supported by 9mm dia threaded rod hangers where direct fastening to building construction is impractical.

- .8 For surface mounting of two or more conduits use channels at 1.5m oc 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 Verify there is 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.
- .13 Install fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Fasten individual and multiple runs of armoured cables to structure and in bundles as permitted in 26 05 21 - Wire and Cables 0-1000 Volts.
- .15 Various suspended types of junction, pull and/or outlet boxes as well as conduits, are to be supported with minimum size 9mm threaded rod, nuts and flat washers. Threaded rods to be secured to boxes with one flat washer and nut installed on both sides of box.
  - .1 One (1) rod required for all type boxes sized 150mm x 150mm and smaller (22,500mm<sup>2</sup> and smaller).
  - .2 Two (2) rods required for boxes sized 22,500mm<sup>2</sup> and larger, up to and including those sized 300mm x 300mm (90,000mm<sup>2</sup>).
  - .3 Minimum of four (4) rods required for all boxes sized larger than 90,000mm<sup>2</sup>.
- .16 Cut off all excess rod within 13mm of channel bottom. In addition to C.E.C. minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300mm and mid-point of "all" 90 bends. Maximum spacings between conduit support channels will be as dictated by smallest size conduit(s) being supported and/or secured to same.
- .17 In addition to the CEC minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one (1) additional support rod installed not greater than 300mm from midpoint of all 90 bends. Maximum spacings between conduit support channels will be dictated by smallest size conduit(s) being supported and/or secured to same.

**END OF SECTION**

**Part 1 General**

**1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data for cabinets in accordance with Section 01 33 00.

**Part 2 - Products**

**2.1 JUNCTION AND PULL BOXES**

- .1 Type C: welded steel construction, hinged cover, catch with hasp. Provision for locking. Surface mounting.
- .2 Type D: welded steel construction with screw-on flat covers for surface mounting. Surface or flush mounting as indicated. Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Junction and pull boxes larger than 125mm x 125mm shall be Type "E", complete with continuously hinged door. Junction and pull boxes 125mm x 125mm and smaller to be complete with screw cover.
- .4 Single gang "sectional" type devices boxes being used in steel stud walls for the installation of both metallic and non-metallic type cables, not to be sized smaller than 250cm, complete with wrap around type bracket.
- .5 Two (2) or more flush installed sectional boxes, ganged together on boxes sized 100mm<sup>2</sup> and larger (intended for devices), are to have an additional support bracket installed on opposite side of box, not presently secured to metal stud.
- .6 Where larger sized devices or other types of "flush" outlet or junction boxes may be required, use suitably sized 100mm x 100mm deep or 118 mm square boxes complete with appropriate sized extension tile rings. The use of plaster rings in lieu of tile type extension rings is not acceptable.
- .7 Junction boxes 150mm x 150mm used in branch circuit wiring are to be complete with bonding terminal strips.

**2.2 CABINETS**

- .1 Type E: sheet steel, hinged screw- to-lock, door and return flange overlapping sides, handle, and catch, for surface mounting.

**Part 3 - Execution**

**3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.

- .2 Mount cabinets with top not higher than 2m above finished floor.
- .3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.
- .4 Where located above accessible ceiling systems, locate enclosures within 750mm (30") of ceiling.
- .5 Suspend enclosures on 9mm plated steel threaded rod or rods secured to enclosure with one flat washer and one nut on both sides of box.
- .6 Provide number of threaded rod supports as follows:
  - .1 Boxes up to 120mm square: one (1) rod.
  - .2 Boxes from 120mm to 200mm square: two (2) rods.
  - .3 Boxes with dimensions above 200mm: four (4) rods.
- .7 Concealed junction or outlet boxes feeding a maximum of two (2) fixture drops must not be sized smaller than 100mm<sup>2</sup>.
- .8 Bond pull boxes and cabinets to ground utilizing a bonding conductor.

### **3.2 IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Identify the location of concealed boxes installed above drywall ceilings or behind walls on the room side of access opening frames with properly colour coded identification disks.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 CSA C22.1-2012, Canadian Electrical Code, Part 1.

**Part 2 Products**

**2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with CSA C22.1.
- .2 100 mm square or larger outlet boxes as required for all devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.

**2.2 SHEET STEEL OUTLET BOXES**

- .1 Electro-galvanized steel flush device boxes for flush installation, minimum size 100mm square and c/w extension and tile rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface- mounted conduit, minimum size 100mm square.
- .3 100mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 100mm square outlet boxes with extension and tile rings for flush mounting devices in finished walls.

**2.3 CONDUIT BOXES**

- .1 Cast FS or FD ferrous alloy boxes with factory-threaded hubs and mounting feet for all surface wiring of devices (switches, receptacle, thermostats and similar devices) installed lower than 2.4m AFF. Matching steel type FS metal device plates specifically made for FS and FD boxes are to utilize four (4) point fastening.

**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 35mm 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 6mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Install flush mounted boxes in all finished areas unless otherwise indicated.
- .6 Install surface mounted boxes in service rooms and above ceilings unless otherwise indicated.
- .7 Install flush mounted boxes in outside of exterior walls unless otherwise indicated.
- .8 Install type FS or FD boxes for all outlets (regardless of system type involved) to be surfaced mounted less than 2.4m AFF.
- .9 Install concealed boxes in accessible locations.
- .10 Flush installed 100mm or 120mm square box being used as a pull box or junction box shall have installed a single or double gange tile ring and blank cover installed on the box.
- .11 Do not use sectional type boxes with rigid galvanized steel conduit, rigid PVC conduit or EMT.
- .12 In metal drywall partitions, install a short piece of metal stud (same width as wall) on non-supported side of box and secure to box.

**END OF SECTION**

**Part 1 General**

**1.1 LOCATION OF CONDUIT**

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

**1.2 REFERENCES**

- .1 CSA C22.2 No. 56-2004(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.  
.2 CSA C22.2 No. 83-1985(R2013), Electrical Metal Tubing.

**1.3 TRADE SIZE**

- .1 The following are Metric trade sizes and Imperial trade size equivalent based on CEC Metric Units.

<u>Metric (mm)</u>	<u>Imperial (inch)</u>
12	3/8
16	1/2
21	3/4
27	1
35	1-1/4
41	1-1/2
53	2
63	2-1/2
78	3
91	3-1/2
103	4
129	5
155	6

**1.4 RELATED WORK**

- .1 Section 26 05 29: Fastenings and Supports

**Part 2 Products**

**2.1 CONDUITS**

- .1 Rigid galvanized steel threaded conduit, fittings and connectors: to CSA C22.2 No. 45.1.  
.2 Electrical metallic tubing (EMT) with steel set screw couplings: to CSA C22.2 No. 83.  
.3 Flexible aluminum conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56.

## **2.2 CONDUIT FASTENINGS**

- .1 One whole steel straps to secure surface conduits smaller than 41mm. Two hole steel straps for conduits 41mm and larger.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5m oc.
- .4 9mm dia threaded rods to support suspended channels.

## **2.3 CONDUIT FITTINGS**

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Conduit fittings (LB, LL, LR) are to be used for 90 bends. "Ells", or corner pulling "Elbows" are prohibited.
- .3 Waterproof type connectors shall be used on all conduit runs connecting equipment.
- .4 Plastic screw on bushings for conduit ends.

## **2.4 GENERAL FITTINGS**

- .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 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

## **2.5 FISH CORD**

- .1 Polypropylene: minimum 3mm diameter.

## **Part 3 - Execution**

### **3.1 INSTALLATION**

- .1 Install conduits as high as possible to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in service rooms and in unfinished areas. Install conduits as high as possible and secured to building structure with approved supports.
- .3 Use rigid galvanized steel threaded conduit except for underground applications.

- .4 Use EMT for all concealed wiring below 300V.
- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.
- .6 Minimum conduit size for lighting and power circuits: 21mm.
- .7 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 21mm dia.
- .9 Install fish cord in empty conduits.
- .10 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .11 Dry conduits out before installing wire.
- .12 Install insulated copper bonding conductor in all conduit runs. Minimum size: #14 AWG or Table 16 of C.E.C. which ever is larger.
- .13 Install plastic bushings in all EMT sized 35mm and larger before pulling in conductors.
- .14 Use rain tight EMT connectors and couplings complete with o-rings on vertical portion of conduit runs where terminating into tops of electrical equipment.
- .15 Unless indicated otherwise, use liquid tight flexible metal conduit complete with matching connectors for final connection between EMT and applicable control device. Junction or pull boxes may also be used to make this transition.
- .16 Bond EMT conduit stubs to ground as required by the CEC.
- .17 Where construction consists of metal Q-deck and steel joists (non-roof deck), conduits are to be installed as follows:
  - .1 Between the top flange of a steel support structure and the Q-deck.
  - .2 Where conduit sizes preclude the above mentioned method, install as high as possible in the space to conserve headroom.

### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Run conduits in flanged portion of structural steel.
- .3 Group conduits wherever possible on suspended or surface channels.

- .4 Do not pass conduits through structural members except as indicated.
- .5 Do not locate conduits less than 76mm parallel to steam or hot water lines with minimum of 25mm at crossovers.

**END OF SECTION**

**Part 1            General**

**1.1            REFERENCES**

- .1        IEEE C62.41.1-2008, Guide on the Surge Environment in Low-Voltage AC Power Currents.
- .2        IEEE C62.45-2008, Recommended Practice on Surge Testing for Equipment Connects to Low-Voltage (1000V or less) AC Power Circuits.
- .3        UL 1283-2013, Electromagnetic Interference Filters.

**1.2            SHOP DRAWINGS**

- .1        Submit shop drawings in accordance with Section 01 33 00.
- .2        Drawings to include electrical detail of panel, branch breaker type, breaker quantity, ampacity, short circuit rating, bus materials and enclosure dimension.

**1.3            OPERATION AND MAINTENANCE DATA**

- .1        Provide operation and maintenance data for panelboards for incorporation into manual specified in Section 01 78 00.
- .2        Include panel schedules.

**Part 2 - Products**

**2.1            PANELBOARDS**

- .1        Panelboards: product of one manufacturer.
- .2        250 and 600 V panelboards: bus and breakers rated as indicated.
- .3        Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4        Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5        Two (2) keys for each panelboard and key panelboards alike.
- .6        Tin-plated copper bus. Neutral to be 100% rated of mains.
- .7        Mains: suitable for bolt-on breakers.
- .8        Trim with concealed front bolts and hinges.

- .9 Trim and door finish: baked grey enamel.
- .10 Minimum of one terminal screw on factory installed neutral bar for each circuit breaker position.
- .11 Panel boards rated above 400A to be 300mm deep and 900mm wide minimum.

## **2.2 BREAKERS**

- .1 Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10 % of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to the Departmental Representative.

## **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

## **2.4 STANDARD OF ACCEPTANCE**

- .1 Branch panels: Siemens P2.

## **2.5 ACCEPTABLE MANUFACTURERS**

- .1 Siemens
- .2 Cutler Hammer
- .3 Schneider

### **Part 3 - Execution**

#### **3.1           INSTALLATION**

- .1      Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2      Mount panelboards to height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
- .3      Connect loads to circuits.
- .4      Connect neutral conductors to common neutral bus with respective neutral identified.
- .5      Where more than one bonding terminal strip is present in one panel, hardwire both together using same size bonding conductor as the one that accompanies the panel feeder conductors.

**END OF SECTION**

**Part 1        General**

**1.1            REFERENCES**

- .1        CSA C22.2 No. 42-2010, General Use Receptacles, Attachment Plugs and Similar Wiring Devices.
- .2        CSA C22.2 No. 55-M1986(R2012), Special Use Switches.
- .3        CSA C22.2 No. 111-2010, General Snap Switches.

**1.2            SHOP DRAWINGS**

- .1        Submit shop drawings for each device and coverplate type as per specification Section 01 33 00.

**1.3            OPERATIONAL AND MAINTENANCE DATA**

- .1        Provide operation and maintenance data for wiring devices for incorporation into manual specified in Section 01 33 00.

**Part 2        Products**

**2.1            RECEPTACLES**

- .1        Design R1:
  - .1        General purpose duplex receptacles, specification grade CSA type 5- 15 R, 125 V, 15 A, U ground, with following features:
    - .1        Ivory urea molded housing for all power receptacles.
    - .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 riveted grounding contacts.
    - .6        Standard of Acceptance: Hubbell 5262-I Series.
    - .7        Approved Manufacturers:
      - .1        Hubbell
      - .2        Pass & Seymour
      - .3        Arrow Hart

.4 Leviton

.5 Bryant

.2 Design R2:

.1 Duplex receptacles, specification grade CSA type 5-20R(T-Slot), 125 V, 15/20A, U ground, with following features:

- .1 Ivory urea molded 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 riveted grounding contacts.
- .6 Ivory nylon face.
- .7 Standard of Acceptance: Hubbell 5362-N Series.
- .8 Acceptable Manufacturers:
  - .1 Hubbell
  - .2 Pass & Seymour
  - .3 Arrow Hart
  - .4 Leviton
  - .5 Bryant

.3 Design R3:

.1 GFCI duplex receptacles. Specification grade, CSA type 5-20R(T-Slot), 125V, 15A, U-Ground with the following features:

- .1 Ivory urea molded housing.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Eight back wired entrances, four side wiring screws.
- .4 Triple wipe contacts and riveted grounding contacts.
- .5 Ivory nylon face.

- .6 GFI test and reset buttons.
- .7 Standard of Acceptance: Hubbell GFR5252-I Series.
- .8 Approved Manufacturers:
  - .1 Hubbell
  - .2 Pass & Seymour
  - .3 Arrow Hart
  - .4 Leviton
  - .5 Bryant
- .4 Other receptacles with ampacity and voltage as indicated.
- .5 Receptacles of none manufacturer throughout project.
- .6 Acceptable materials:
  - .1 Hubbell
  - .2 Pass & Seymour
  - .3 Arrow Hart
  - .4 Leviton
  - .5 Bryant

## **2.2 COVER PLATES**

- .1 Cover plates for wiring devices.
- .2 Stainless steel, satin finish on flush mounted outlet boxes.
- .3 Galvanized pressed steel surface covers on surface mounted outlet boxes.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is require in one location.
  - .2 Mount receptacles at height specified in Section 26 05 00 – Electrical General

Requirements or as indicated.

- .3 Mount receptacles with "U" ground up for vertically mounted and neutral slot a top for horizontal mounted receptacle.
- .4 Install "Pigtail" type leads on conductors in all device or outlet boxes where feeding through to other receptacles.  
"Daisy-chain" or looping through of conductors from one device to another is not acceptable. Provide separate pigtail conductor leads for final termination to each receptacle for phase, neutral and bond conductors.
- .5 All receptacles are to be polarity tested.
- .2 Cover plates:
  - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes. Device leveler and retainer is an approved accessory for securing devices to flush installed device boxes.

**END OF SECTION**

**Part 1 General**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00.

**1.2 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for circuit breakers for incorporation into Manual specified in Section 01 78 00.

**Part 2 - Products**

**2.1 BREAKERS GENERAL**

- .1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 C ambient.
- .2 Multiple breakers to have single handle.
- .3 Circuit breakers to have interrupting capacity as indicated on the Drawings.

**2.2 MAGNETIC BREAKERS**

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

**2.3 OPTIONAL FEATURES**

- .1 Include:
  - .1 On-off locking device for 10% of branch breakers and all breakers supplying exit signs and fire alarm devices.

**2.4 GROUND FAULT CIRCUIT INTERRUPTER CIRCUIT BREAKERS**

- .1 Moulded case thermal magnetic circuit breaker with Class A ground fault protection

**Part 3 - Execution**

**3.1 INSTALLATION**

- .1 Install circuit breakers as required, factory install breakers in all panelboards.

**END OF SECTION**

**Part 1 General**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Include:
  - .1 Dimensions.
  - .2 Enclosure type.
  - .3 Rating.
  - .4 Accessories.

**1.2 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for disconnect switches for incorporation into manual specified in Section 01 78 00.

**Part 2 Products**

**2.1 DISCONNECT SWITCHES**

- .1 Heavy duty, fusible and non- fusible, horsepower rated disconnect switch in CSA Enclosure type as indicated (minimum CSA type 1 with drip hood) size as indicated.
- .2 Provision for padlocking in off switch position by three 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.
- .6 Acceptable manufacturers:
  - .1 Siemens.
  - .2 Cutler Hammer.
  - .3 Schneider.
- .7 Exterior mounted disconnect switches to be complete with NEMA 4X enclosure.
- .8 Viewing window to view open/close status of disconnect switch blades.

## **2.2 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Indicate name of load controlled voltage panel designation and circuit numbers on size 4 nameplate.

## **Part 3 Execution**

### **3.1 INSTALLATION**

- .1 Install disconnect switches where indicated.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 UL 508-2013, Industrial Control Equipment.

**1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate:
  - .1 Mounting method and dimensions.
  - .2 Starter size and type.
  - .3 Layout of identified internal and front panel components.
  - .4 Enclosure types.
  - .5 Wiring diagram for each type of starter.
  - .6 Interconnection diagrams.

**1.3 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 78 00.
- .2 Include operation and maintenance data for each type and style of starter.

**Part 2 Products**

**2.1 MATERIALS**

- .1 Starters: EEMAC E14-1
  - .1 Half size starters are not acceptable.
  - .2 IEC equipment not acceptable.
- .2 Acceptable manufacturers:
  - .1 Cutler Hammer
  - .2 Schneider
  - .3 Siemens

## **2.2 MANUAL MOTOR STARTERS**

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
  - .1 Switching mechanism, quick make and break.
  - .2 All phase conductors to have overload heaters, manual reset, trip indicating handle.
- .2 Accessories:
  - .1 Toggle switch: heavy duty labelled as indicated.
  - .2 Indicating light: LED and colour as indicated.
  - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

## **2.3 FULL VOLTAGE MAGNETIC STARTERS**

- .1 Magnetic and combination magnetic starters 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.
  - .5 Hand-off-auto selection switch in cover.
  - .6 LED pilot light indicating coil is energized.
  - .7 LED pilot light indicating unit is powered.
- .2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:
  - .1 Locking in "OFF" position with up to three (3) padlocks.
  - .2 Independent locking of enclosure door.
  - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
  - .1 Selector switches: heavy duty labelled as indicated.
  - .2 Indicating lights: L.E.D. type and color as indicated.

- .3 One (1) N/O and one (1) N/C spare auxiliary contacts unless otherwise indicated.
- .4 Provide solid state protection complete with single phasing protection.
- .5 Provide one (1) 24 VAC interposing relay complete with two (2) normally open and two (2) normally closed contacts mounted in starter enclosure. Connect relay as indicated.

## **2.4 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.

## **2.5 FINISHES**

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Electrical General Requirements.

## **2.6 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements.

# **Part 3 Execution**

## **3.1 INSTALLATION**

- .1 Install starters, connect power and control as indicated.
- .2 Confirm fuses and overload elements are correct for the actual loads. Obtain correct information from Divisions 21, 22 and 23 prior to ordering and setting overloads.
- .3 Coordinate with Controls contractor.

## **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements and manufacturer's instructions.
- .2 Operate switches, 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 required.
- .5 Provide test forms to Commissioning Agent for each motor starter confirming operation and settings.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 ANSI C82.1-2004, Specifications for Fluorescent Lamp Ballasts.
- .2 ANSI C62.41-2008, IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ANSI C62.45-2008, IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
- .4 CAN/CSA C654-2010, Fluorescent Lamp Ballast Efficiency Measurements.
- .5 NECA/ESNA 500-1998, Recommended Practice for installing indoor commercial lighting systems.
- .6 ANSI/IESNA RP1-2004; American national Standard practice for office lighting.
- .7 ASTM F1137-2011el, American Society for Testing and Materials Specification for phosphate/oil and phosphate/organic corrosion protective coatings for fasteners.
- .8 FCC CFR47; USA Federal Communications Commission Frequency allocations and radio treaty matters; general rules and regulations.
- .9 IESNA LM-79, Electrical and photometric Measurements of Solid State Lighting.
- .10 IESNA LM-80, Measuring Lumen Maintenance of LED Light Sources.
- .11 IESNA TM-21, Projecting Long Term Lumn Maintenance of LED Light Sources.

**1.2 RELATED WORK**

- .1 Submittal Procedures: Section 01 33 00

**1.3 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Submit shop drawings for the following:
  - .1 Luminaire.
  - .2 Lamp/engine for each luminaire type.
  - .3 Ballast/driver for each luminaire type.
- .3 Shop Drawings:
  - .1 Shop drawings shall clearly indicate the following:
    - .1 Luminaire ID number as identified in contract documents.
    - .2 Fixture specification as identified in Part 2 and on the drawings.
    - .3 Lamp specification as identified in Part 2 and on the drawings.
    - .4 Ballast specification as identified in Part 2 and on the drawings.
    - .5 Photometric data for each luminaire type.
    - .6 Energy data for lamps and ballasts.

- .4 Catalogue cuts lacking sufficient detail to indicate compliance with Contract documents will not be acceptable.
- .5 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative. Photometric data to include:
  - .1 VCP Table, spacing criterion;
  - .2 Total input watts;
  - .3 Candlepower summary, candela distribution, zonal lumen summary;
  - .4 Luminaire efficiency, C.I.E. type, coefficient of utilization;
  - .5 Lamp type;
  - .6 Lumen ratings
  - .7 Summary in accordance with IES procedures.
  - .8 Electronic IES file (provide on CD).

#### **1.4 OPERATION AND MAINTENANCE**

- .1 Provide operation and maintenance data for inclusion in the manual specified in Section 01 78 00.

#### **1.5 WASTE AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 22.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Store and seal emptied containers safely for disposal.
- .4 Disposal of fluorescent lamps.

### **Part 2 Products**

#### **2.1 LUMINAIRES**

- .1 Luminaires are specified on the drawings.

### **Part 3 Execution**

#### **3.1 INSTALLATION**

- .1 Locate and install luminaires as indicated. Provide and install all necessary hangars, supports, fittings, etc. as necessary for a complete installation.
- .2 Coordinate installation with all other services.

#### **3.2 WIRING**

- .1 Connect luminaires to lighting circuits as indicated.

- .2 Each light fixture to have a separate "fixture drop" installed and connected to hard wired junction box or outlet box in ceiling space.
- .3 Recessed and/or surface type fluorescent light fixtures are not to be wired in a "daisy-chain" manner or have their power sources looped between fixtures, unless the fixtures are installed end-to-end or house an integral junction box.

### **3.3 LUMINAIRE SUPPORTS**

- .1 Support luminaires independently of all other systems using an approved supporting method. Supporting luminaires from any part of the ceiling system is strictly prohibited.

### **3.4 LUMINAIRE ALIGNMENT**

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 26 05 00 – Lighting
- .2 Section 26 05 21 – Wires and Cables

**1.2 SUMMARY**

- .1 The lighting control system specified in this section shall be capable of providing time-based, sensor-based (both occupancy/vacancy and daylight), and manual lighting control.
- .2 The system shall be capable of turning lighting loads on/off as well as dimming lights.
- .3 All system devices shall be networked together enabling digital communication and shall be individually addressable.
- .4 The system architecture shall be capable of enabling stand-alone groups of devices to function in some default capacity if network connectivity to the greater system is lost.
- .5 The system architecture shall facilitate remote operation via a computer connection.
- .6 The system shall not require any centrally hardwired switching equipment.
- .7 The system shall be of wired architecture.
- .8 Recently renovated portions of the building utilize the Sensor Switch NLight system. All components shall be fully compatible with this system to function as described in item 2.1 of this section. Integration into the existing system is not in the scope of this project.

**1.3 SUBMITTALS**

- .1 Product datasheets including general device descriptions, dimensions, wiring details and nomenclature
- .2 Detailed riser diagrams showing interconnectivity of devices
- .3 Other Diagrams as needed for special operation or interaction with other system(s)
- .4 Hardware and Software Operation Manuals
- .5 Other operational descriptions as needed

**1.4. QUALITY ASSURANCE**

- .1 Products shall be manufactured by a company that is actively and primarily involved in the lighting controls industry with local representation and technical support.

## **Part 2        Products**

### **2.1        SYSTEM REQUIREMENTS**

- .1        System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.
- .2        Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- .3        Intelligent lighting control devices shall communicate digitally and possess RJ-45 style connectors.
- .4        Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.
- .5        Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
- .6        Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- .7        Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure.
- .8        Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone "bus power supplies" shall not be required in all cases.
- .9        All switching and dimming for a specific lighting zone shall take place within the devices located near the zone itself to facilitate system robustness and minimize wiring requirements.
- .10       System shall use "bridge" devices that route communication and distribute power for up to 8 directly connected lighting zones together.
- .11       Individual lighting zones shall be capable of being segmented into several "local" channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.
- .12       Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information.
- .13       System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space.

**2.2 CEILING MOUNTED OCCUPANCY SENSOR**

- .1 Passive dual technology (Infrared and Acoustic Sensing)
- .2 42m<sup>2</sup> sensing range
- .3 360 degree coverage pattern
- .4 Dual RJ-45 Jacks for networked lighting control system connectivity
- .5 White in colour

**2.3 WALL MOUNTED OCCUPANCY SENSOR SWITCH**

- .1 Passive dual technology (Infrared and Acoustic Sensing)
- .2 58m<sup>2</sup> sensing range
- .3 180 degree coverage pattern
- .4 Dual RJ-45 Jacks for networked lighting control system connectivity
- .5 Ivory in colour
- .6 Stainless steel decora coverplate

**2.4 WALL MOUNTED SWITCHING/DIMMING STATION**

- .1 "On/Off" momentary contact pushbutton
- .2 "Raise"/"Lower" momentary contact pushbuttons
- .3 Dual RJ-45 Jacks for networked lighting control system connectivity
- .4 Ivory in colour
- .5 Stainless steel decora coverplate

**2.5 WALL MOUNTED SWITCHING STATION**

- .1 "On" momentary contact pushbutton
- .2 "Off" momentary contact pushbutton
- .3 Dual RJ-45 Jacks for networked lighting control system connectivity
- .4 Ivory in colour
- .5 Stainless steel decora coverplate

**2.6 CONTROL RELAY POWER PACK C/W DIMMING**

- .1 16A latching relay rating at 347V
- .2 0-10V dimming output
- .3 16mm threaded chase nipple for mounting on junction box
- .4 Dual RJ45 jacks for networked lighting control system connectivity

**2.7 NETWORK BRIDGE**

- .1 Eight (8) RJ-54 ports to interconnect networked lighting control zones
- .2 347V power supply

- .3 Port identification label

## **Part 3 Execution**

### **3.1 EQUIPMENT INSTALLATION**

- .1 The lighting control system and associated components shall be installed and verified. This verification shall be completed by a Factory trained manufacturer's representative.
- .2 Install devices as per manufacturer's installation instructions
- .3 Wiring
  - .1 Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
  - .2 Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.
  - .3 Do not exceed manufacturer's recommendations for wire length for the system bus.

### **3.2 INSTALLATION AND SET-UP**

- .1 Coordinate all programming and operation requirements with the Departmental Representative prior to programming of the lighting control system functions.
- .2 Prior to substantial completion, arrange and provide a one-day instruction period to designated personnel, this shall be provided by a factory trained manufacturer's representative.
- .3 Set-up, commissioning of the lighting control system, and instruction includes:
  - .1 Confirmation of entire system operation and communication to each device.
  - .2 Confirmation of operation of individual devices, switches and occupancy sensors.
  - .3 Confirmation of system programming including appropriate control zone functionality.
  - .4 Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.
- .4 Test all low voltage cable for integrity and proper operation prior to turn over. Verify with system manufacturer all wiring and testing requirements.
- .5 Equipment shall be located so that it is readily accessible and not exposed to physical damage.

### **3.3 DOCUMENTATION**

- .1 Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the

identification number for placement of switches and location of occupancy sensors. Original to be given to the Departmental Representative

**END OF SECTION**

**PART 1 GENERAL**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Data to indicate system components, mounting method, source of power and special attachments.

**1.2 OPERATION AND MAINTENANCE DATA**

- .1 Submit operation and maintenance data for incorporation in the Manual specified in Section 01 78 00.

**PART 2 PRODUCTS**

**2.1 BATTERY UNIT AND REMOTE HEADS**

- .1 Refer to drawings for specifications.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install unit equipment and remote mounted fixtures as indicated.
- .2 Direct heads as indicated.
- .3 Make connections.
- .4 Test and verify operation of units upon loss and restoration of normal ac power. Verify 90 min. battery life upon loss of power.
- .5 Feed the emergency lighting system from the un-switched leg of the same circuit which feeds the normal lights in that area.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00.

**1.2 OPERATION AND MAINTENANCE DATA**

- .1 Submit operation and maintenance data for incorporation in the Manual specified in Section 01 78 00.

**1.3 REFERENCE**

- .1 CAN/CSA-C860-2011, Performance of Internally Lighted Exit Signs.

**PART 2 PRODUCTS**

**2.1 STANDARD UNITS**

- .1 Refer to drawings for specifications.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- .1 Install exit lights.
- .2 Connect fixtures to exit light circuits as indicated on the drawings.
- .3 Confirm that exit light circuit breaker is locked in on position.

**END OF SECTION**

**Part 1 General**

**1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Submit product data sheets for radiant heating panels. Include:
  - .1 Product characteristics.
  - .2 Performance criteria.
  - .3 Mounting methods.
  - .4 Physical size.
  - .5 kW rating, voltage, phase.
  - .6 Material thicknesses.
  - .7 Colour and finish.
- .3 Submit product data sheets for unit heaters. Include product characteristics, performance criteria, physical size, limitations and finish.

**1.2 CLOSEOUT SUBMITTALS**

- .1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01 33 00.

**PART 2 Products**

**2.1 ELECTRIC BASEBOARD**

- .1 Electrical ratings and their respective dimensions to be as indicated on the drawings.
- .2 Heating Element: tubular element, standard watt density
- .3 347V operation
- .4 24V Control transformer and control relay where indicated on the drawings
- .5 Finish: epoxy/polyester powder paint White
- .6 Standard of Acceptance:
  - .1 Ouellet. OFM
  - .2 Cromalox equivalent

.3 Stelpro equivalent

## **2.2 CABINET CONVECTOR**

- .1 Electrical ratings and their respective dimensions to be as indicated on the drawings.
- .2 Heating Element: Two tubular elements, standard watt density
- .3 Sloped top
- .4 347V operation
- .5 Control relay as indicated on the drawings
- .6 Finish: epoxy/polyester powder paint White
- .7 Standard of Acceptance:
  - .1 Ouellet. OPI
  - .2 Cromalox equivalent
  - .3 Stelpro equivalent

## **2.3 FORCED AIR CABINET UNIT HEATER**

- .1 Electrical ratings and their respective dimensions to be as indicated on the drawings.
- .2 Heating Element: Two tubular elements
- .3 Direct drive, factory lubricated variable speed squirrel-cage fan c/w fan delay.
- .4 347V operation
- .5 Finish: epoxy/polyester powder paint White
- .6 Standard of Acceptance:
  - .1 Ouellet. OCA
  - .2 Cromalox equivalent
  - .3 Stelpro equivalent

## **2.4 HIGH-DENSITY CABINET CONVECTOR**

- .1 Electrical ratings and their respective dimensions to be as indicated on the drawings.
- .2 Heating Element: Three tubular elements, high watt density

- .3 Sloped top
- .4 347V operation
- .5 Finish: epoxy/polyester powder paint White
- .6 Standard of Acceptance:
  - .1 Ouellet. OFM
  - .2 Cromalox equivalent
  - .3 Stelpro equivalent

## **2.5 DIGITAL THERMOSTAT**

- .1 24V Operation
- .2 Digital display of ambient temperature and setpoint
- .3 Fahrenheit and Celsius readout
- .4 Temperature setpoint raise and lower buttons and standby mode
- .5 Finish: epoxy/polyester powder paint White
- .6 Standard of Acceptance:
  - .1 Ouellet OTH824
  - .2 Cromalox equivalent
  - .3 Stelpro equivalent

## **PART 3 Execution**

### **3.1 INSTALLATION**

- .1 Install all electric heaters as indicated and in accordance with manufacturer's instructions.
- .2 For radiant panel heaters, ensure that manufacturer's mounting instructions for each fixture, including minimum distances from ceiling, walls or combustible materials, are followed.

- .3 Power and control connections are to be by Division 26 and Section 25 00 00.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests in accordance with Section 26 05 00.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Ensure that heaters and controls operate correctly.

**END OF SECTION**