

<u>1 GENERAL</u>	.1	This Section covers items common to Sections of Division 26, 27, 28. This section supplements requirements of Division 1.
	.2	Read this Section in conjunction with all other contract documents.
<u>2 REFERENCES</u>	.1	CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000V.
	.2	CSA-C22.1-12, Canadian Electrical Code, Part 1 (22nd edition), Safety Standard for Electrical Installations.
	.3	CSA Z85-1983, Abbreviations for Electrical Terms.
	.4	EEMAC Y1-2-1979, Standard for Performance Specification for Finishing Systems for Outdoor Electrical Equipment.
	.5	EEMAC 2Y-1-1958, Standard for CEMA Light Grey Colour for Indoor Switchgear.
	.6	CSA B44-10/ASME A17.1, Safety Code for Elevators.
<u>3 CARE, OPERATION AND STARTUP</u>	.1	Instruct Departmental Representative and 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.
<u>4 VOLTAGE RATINGS</u>	.1	Operating voltages: to CAN3-C235.
	.2	Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal

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| 4 | <u>VOLTAGE RATINGS</u>
(Cont'd) | .2 | (Cont'd)
operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment. |
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| 5 | <u>PERMITS, FEES</u>
<u>AND INSPECTION</u> | .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. |
| | | .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. Display permits 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 otherwise specified. |
| | | .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. |
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5 PERMITS, FEES AND INSPECTION
(Cont'd)

.7 Pay all associated fees for permits, fees and inspection.

6 MATERIALS AND EQUIPMENT

.1 Provide materials and equipment in accordance with Section 01 61 00.

.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.

7 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.

.2 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.

8 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates and labels as specified herein.

.2 Identification:

.1 All switchboards, panels, disconnect switches, receptacles, voice/data/CATV/Multimedia outlets/P.A. Speakers, MCC's, transformers, control panels, fire alarm devices, magnetic starters, TOL's, etc. are to be provided with lamicaid nameplates as further described herein. Confirm that all plates are affixed true and level, and plumb in all instances.

8 EQUIPMENT
IDENTIFICATION
(Cont'd)

- .2 Identification:(Cont'd)
- .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 distribution panelboards, motor control centres, splitter troughs and transformers to indicate the following:
 - .1 Designated name of equipment.
 - .2 Amperage of overcurrent protection device.
 - .3 Voltages, number of phases and wires.
 - .4 Designation of power source.

Example

PANEL A - 225 AMPS
120/208V - 3PH - 4W
FED FROM MAIN SWITCHBOARD 'SB-1'

- .7 Lamicoid nameplates installed on combination starters, magnetic starters, manual starter and all various systems controls, control panels, disconnect switches, etc., shall 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. 1	SUPPLY FAN NO. 1
PANEL A - CCT. NO. 10	M.C.C. NO. 1
120V - 1-Phase	600V - 3-Phase

- .8 Lamicoid nameplates installed on fusible type disconnect switches are to also indicate maximum designated/designed fuse size.
- .9 Install lamicoid nameplates on all junction and/or pull boxes sized 150 mm x 150 mm and larger indicating name of system,

8 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 Identification:(Cont'd)

.9 (Cont'd)

designated panel name and electrical characteristics where applicable.

.10 Lamicoid nameplates are to be installed adjacent to each overcurrent devices located in switchboards, CDP panels, etc. They need only indicate designated name and/or number of equipment they feed. Unused O.C. devices are to be identified as SPARE(S).

.11 Lamicoid nameplates installed on main service entrance switches, or main entrance switchboards to indicate the following information on minimum size 150 mm x 50 mm plate complete with two lines of 13 mm high lettering (Size #8 nameplate)

Example:

MAIN BREAKER 400 AMPS
600/347V, 3PH, 4W

Example:

MAIN SWITCH 400 AMPS
120/208V, 3PH, 4W

.12 Install an additional lamicoid nameplate on all, or any piece of electrical equipment, or apparatus (i.e., Main Switchboard, CDP panels, Panelboards, Motor Control Centres. etc.), that contain overcurrent devices (i.e., circuit breakers and/or fuses), that have been designed for, and incorporate interrupting capacity greater than 10 kA I.C.

Example:

Min. interrupting capacity of breakers installed in this panel to be not less than 22 kA I.C.

Example:

Min. interrupting capacity of fuses installed in this MCC to be not less than 100 kA I.C.

.13 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 black letters on white core, directly above all receptacles. Plate to be identical width as finish device plate.

- 8 EQUIPMENT IDENTIFICATION (Cont'd)
- .2 Identification: (Cont'd)
- .13 (Cont'd)
- .1 (Cont'd)

Example: PANEL 'A' CCT.20

.14 Identify receptacles intended for computer, electronic or other sensitive types of electronic equipment etc., as per following:

- .1 1.5mm thick x 19mm wide complete with 6 mm black letters on white core above all receptacles. Identical width as finish device plate.

Example: For computer use only
PANEL 'A' - CCT.24

.15 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 black letters on white core above all receptacles. Identical width as finish device plate (EXAMPLE: GFCI Protected Panel 'A' CCT.24).

.16 Apply lamicoid nameplate(s) for power/voice/data/CATV/CCTV/multimedia outlets/P.A. specific devices directly to face of finish plate.

- .1 1.5mm thick x 19mm wide complete with 6mm black letter on white cove above all receptacles. Identical width as finish device plate.

.17 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 Manual pull station lamicoid plate to be similar to typical receptacle lamicoid plate.
.3 Lamicoid working to match physical location and annunciator display address.

.18 Lamicoid 3mm thick plastic engraving sheet, white face, black core, for all electrical systems except Fire Alarm: Fire Alarm to have red face with white core.

- .1 1.5mm thick nameplates above receptacles as previously indicated, with

8	EQUIPMENT	.2	Identification:(Cont'd)
IDENTIFICATION		.18	(Cont'd)
(Cont'd)		.1	(Cont'd)

top left and right corners to be rounded off.

8 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 Identification:(Cont'd)
.18 (Cont'd)

.2 Lettering on lamicoid nameplates shall not 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 Provide and install lamicoid nameplates on, or adjacent to, all various systems' control panels, equipment racks and/or cabinets complete with information as indicated. Nameplates to reflect individual system's assigned name, and where applicable, indicate both designated panel name and associated branch circuit breaker number(s).

.1 Fire alarm panels

.2 Security (CCTV) units/panels

.3 Energy management racks/panels

.4 Television panels

.5 Communication racks/panels

.6 Low voltage lighting relay panels

(EXAMPLE: LIGHTING RELAY PANEL #1 - LPA - 01).

.7 PA (Public Address) System.

.7 Control Transformers:

.1 Concealed control transformers located within ceiling spaces to have lamicoid nameplates installed adjacent to same indicating their identified system, primary

8 EQUIPMENT
IDENTIFICATION
(Cont'd)

- .7 Control Transformers:(Cont'd)
 - .1 (Cont'd)
power source including designated panel name,
complete with associated branch circuit
breaker number(s).
 - .2 Install second plate with identical
information on underside of room grid system
or access opening frame directly below control
transformer, so as to identify its concealed
location directly above same.
 - .3 Identify control transformers installed
in either control cabinets or on walls
adjacent to same, with lamicoid nameplates
containing information as previously
indicated.
- .8 Junction and pull boxes: indicate system and
voltage.
- .9 Co-ordinate names of equipment and systems
with other trades to ensure that equipment
identification is consistent.
- .10 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. List to be neatly
written using black indelible marker.
- .11 All electrical junction boxes, pull boxes,
and conduit fittings are to be colour coded
as follows:
 - .1 Apply colour coding prior to pulling
conductors into boxes.
 - .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.

9 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

9 WIRING
IDENTIFICATION
(Cont'd)

- .1 (Cont'd)
pass. Labels to be installed 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:
Phase A - Red
Phase B - Black
Phase C - Blue
Neutral - White
Bond - Green
Ground - Green
Isolated Ground - Green c/w yellow strip
- .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 e.g.: "Panel "P-1" - CCT.03". Identify all neutral conductors bonding and ground conductors to indicate the phase conductor with which they are associated.

10 CONDUIT AND
CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables. Boxes are to be coloured inside and outside where one colour is required. Boxes are to be coloured 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.

10 CONDUIT AND
CABLE IDENTIFICATION
(Cont'd)

- .2 Code with plastic tape or 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.

System	Primary Colour	Secondary Colour
0-50 volts	VIOLET	-
51 volts 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
Cable Television	YELLOW	WHITE
Computer (data only)	BLACK	WHITE
Voice and Data	BLUE	WHITE
CCTV	GREEN	WHITE

- .4 All various system junction and/or pull boxes etc., where located above ceiling grid system to have location identified 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. The same type of discs to be installed on ceiling or wall access cover plates.

6mm discs are all white in colour. 6mm to be affixed to center or middle of of 19mm discs as system colours indicates.

	<u>Outer</u> 19mm Discs	<u>Inner</u> 6mm Discs
Various Systems		
0 to 50 volts	VIOLET	
51 to 240 volts	YELLOW	
241 to 600 volts	ORANGE	
Fire Alarm	RED	
Telephone (voice only)	BLACK	

10 CONDUIT AND .4 (Cont'd)
CABLE IDENTIFICATION
(Cont'd)

	<u>Outer</u>	<u>Inner</u>
P.A. and Intercom	BLUE	
Security	BROWN	
Ground or Bond	GREEN	
Cable Television	YELLOW	WHITE
Energy Management	RED	WHITE
Computer (data only)	BLACK	WHITE
Voice and Data	BLUE	WHITE
CCTV	GREEN	WHITE
Other	BROWN	WHITE

- .5 Provide a legend of colour coding, mounted under plexiglass cover. Install in main electrical room.

11 WIRING
TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for copper conductors only.
- .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.

12 MANUFACTURERS
AND CSA LABELS

- .1 Visible and legible after equipment is installed.

13 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.

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| <u>14 SINGLE LINE
ELECTRICAL
DIAGRAMS</u> | .1 | Provide single line electrical diagrams under plexiglass as follows:
.1 Electrical distribution system: locate in main electrical room and local electrical room.
.2 Include a legend of colour coding for the various systems identified in item 10-conduit and cable identification. |
| | .2 | Drawings: Full drawing size from most recent drawing set, in main electrical room and 610mm x 610mm (minimum) size drawing in the penthouse. |
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| <u>15 LOCATION OF
EQUIPMENT</u> | .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 wherever possible. |
| | .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 unless otherwise indicated. Locate disconnect devices in mechanical and elevator machine rooms on latch side of the door. |
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| <u>16 MOUNTING HEIGHTS</u> | .1 | Mounting height of equipment is from finished floor to centreline of equipment unless specified or otherwise indicated. |
| | .2 | If mounting height of equipment is not specified or indicated, verify before proceeding with installation. |
| | .3 | Mounting heights for devices to conform with NBC and NS Building Code regulations for Barrier Free design. |
| | .4 | Install electrical equipment at following heights unless otherwise indicated.
.1 Local switches: 1200mm
.2 Wall receptacles:
.1 General: 460mm
.2 Above top of continuous baseboard heater: 200mm, minimum 460mm AFF. |
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16 MOUNTING HEIGHTS .4
(Cont'd)

- (Cont'd)
- .2 Wall receptacles:(Cont'd)
 - .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, data and CATV outlets:
 - .1 General: 460mm
 - .2 Above top of continuous baseboard heater: 200mm, minimum 460mm 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 Security keypads: 1200mm
 - .8 Pin/Prox readers: 1200mm
 - .9 Wall mounted motion sensors: 150mm below finished ceiling.

17 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of Work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

18 CONDUIT AND
CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: schedule 40 steel pipe or plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

18 CONDUIT AND
CABLE INSTALLATION
(Cont'd)

- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.
- .4 Arrange and pay for holes through exterior walls and roof to be flashed and made weatherproof.

19 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.

20 FIELD QUALITY
CONTROL

- .1 Conduct and pay for following tests:
 - .1 Distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system and lighting control 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.

21 COORDINATION OF PROTECTIVE DEVICES	.1	Confirm circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
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PART 1 - GENERAL

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| <u>1.1 REFERENCES</u> | .1 | CSA C22.2 No. 65-2013, Wire Connectors, Tri-National Standard, with UL 486A-486B and NMX-J-543-ANCE-03. |
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PART 2 - PRODUCTS

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| <u>2.1 MATERIALS</u> | .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 | Fixture type splicing connectors: with current carrying parts of copper and copper alloy sized to fit copper conductors #10 AWG or less. |
| | .3 | Clamps or connectors for armoured cable, liquid tight flexible metal conduit. |

PART 3 - EXECUTION

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| <u>3.1 MATERIALS</u> | .1 | Make connections and terminations electrically and mechanically secure. Sizes of connectors to be as per manufacturer's recommendations for various sizes and combinations of wire sizes. |
| | .2 | Make joints required in branch wiring #10 and smaller utilizing "twist-on" type connectors as manufactured by "Ideal" (colour coded wirenut) of "Marrettes" #31, #33 or #35, or approved equivalents. |
| | .3 | Make joints for all other wiring utilizing "Thomas & Betts" colour keyed compression type connectors #5400 series c/w TBM series compression tools. A first layer of compound type tape to be followed by an additional layer of "Scotch" #33 vinyl tape. Approved alternative for wire connections up to, and including #6 may be colour coded wing-nut as manufactured by "Ideal". |
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3.1 MATERIALS <u>(Cont'd)</u>	.4 Marrette type connectors to be plier tightened.
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PART 1 - GENERAL

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| <u>1.1 REFERENCES</u> | .1 | CSA C22.2 No. 0.3-2009, Test Methods for Electrical Wires and Cables. |
| | .2 | CSA C22.2 No. 208-03 (R2008), Fire Alarm and Signal Cable. |
| | .3 | CSA C22.1-2012, Canadian Electrical Code (CEC). |
| <u>1.2 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| <u>1.3 OPERATION AND MAINTENANCE DATA</u> | .1 | Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00. |
| <u>1.4 RELATED WORK</u> | .1 | Electrical General Requirements: Section 26 05 00. |

PART 2 - PRODUCTS

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| <u>2.1 BUILDING WIRES</u> | .1 | Conductors: to be soft drawn stranded copper (of 98% conductivity). 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 | Copper conductors sized as indicated or as required by C.E.C., with 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RWU90-XLPE. |
| <u>2.2 TECK 90 CABLE</u> | .1 | Conductors:
.1 Grounding conductors: stranded copper.
.2 Circuit conductors: stranded copper, size as indicated. |
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- 2.2 TECK 90 CABLE (Cont'd)
- .2 Insulation:
 - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V.
 - .3 Inner jacket: polyvinyl chloride material.
 - .4 Armour: interlocking aluminum.
 - .5 Overall covering: polyvinyl chloride (PVC), heat, flame and moisture resistant material.
 - .6 Connectors:
 - .1 Non-hazardous areas: Thomas & Betts Star Teck aluminum connectors or Crouse-Hinds or Appleton approved equivalent, complete with aluminum locknut.
 - .7 Multi-conductor TECK cable ampacity is to be de-rated in accordance with the Canadian Electrical Code (based on number of conductors in cable assembly, ambient temperature, etc.).
- 2.3 ARMOURED CABLES
- .1 Conductors: 600 V insulated (RW90 XLPE), copper (of 98% conductivity), size as indicated, minimum #12 AWG.
 - .2 Type: AC90.
 - .3 Armour: interlocking type fabricated from aluminum strip.
 - .4 Connectors: designed for cable.
- 2.4 CONTROL CABLES
- .1 Type LVT: two (2) soft annealed copper conductors, sized as indicated, with thermoplastic insulation, outer covering of thermoplastic jacket.
 - .2 Control circuit wiring 50V and less: CAT 6 (colour to suit system, see Section 26 05 00). FT6 rated when run in free-air.
- 2.5 FIRE ALARM CABLES
- .1 Type FAS 105 to CSA C22.2 No. 208, PVC insulation, size and quantity of conductors as indicated, 105°C flame retardant, Red PVC outer jacket. FT6 rated.
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PART 3 - EXECUTION

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|--|---------|---|-------|---------|--------|---------|--------|--------|--------|--------|---------|--------|----------|--------|----------|--------|
| <u>3.1 VOLTAGE DROP</u> | .1 | Unless cable or wire sizes are indicated or noted on the electrical drawings, all 15A, 120VAC branch circuits size based on the following table. Length includes vertical drop. De-rated multi-conductor TECK cable sizes, if larger, will supersede the following table. | | | | | | | | | | | | | | |
| | | <table> <tr> <td>0-20m</td> <td>#12 AWG</td> </tr> <tr> <td>21-35m</td> <td>#10 AWG</td> </tr> <tr> <td>36-55m</td> <td>#8 AWG</td> </tr> <tr> <td>56-90m</td> <td>#6 AWG</td> </tr> <tr> <td>91-140m</td> <td>#4 AWG</td> </tr> <tr> <td>141-180m</td> <td>#3 AWG</td> </tr> <tr> <td>181-215m</td> <td>#2 AWG</td> </tr> </table> | 0-20m | #12 AWG | 21-35m | #10 AWG | 36-55m | #8 AWG | 56-90m | #6 AWG | 91-140m | #4 AWG | 141-180m | #3 AWG | 181-215m | #2 AWG |
| 0-20m | #12 AWG | | | | | | | | | | | | | | | |
| 21-35m | #10 AWG | | | | | | | | | | | | | | | |
| 36-55m | #8 AWG | | | | | | | | | | | | | | | |
| 56-90m | #6 AWG | | | | | | | | | | | | | | | |
| 91-140m | #4 AWG | | | | | | | | | | | | | | | |
| 141-180m | #3 AWG | | | | | | | | | | | | | | | |
| 181-215m | #2 AWG | | | | | | | | | | | | | | | |
| <u>3.2 INSTALLATION OF BUILDING WIRES</u> | .1 | Install wiring as follows:
.1 In conduit systems in accordance with Section 26 05 34. | | | | | | | | | | | | | | |
| | .2 | The feeder neutral for all branch circuit panels which feed computerized equipment shall be rated to 200% of phase conductors. | | | | | | | | | | | | | | |
| <u>3.3 INSTALLATION OF TECK 90 CABLE - 1000V</u> | .1 | Install cables where indicated on drawings and herein. All mounting hardware will be galvanized steel. | | | | | | | | | | | | | | |
| | .2 | Group cables wherever possible on hanging assemblies, as specified in Section 26 05 29. | | | | | | | | | | | | | | |
| | .3 | Cables to be supported independently of supports used for equipment of other trades; do not support from, or secure cables to any mechanical piping. | | | | | | | | | | | | | | |
| | .4 | Install cables in neat and professional manner, so as to conserve headroom. | | | | | | | | | | | | | | |
| | .5 | Cables shall enter all wall mounted equipment from the top. | | | | | | | | | | | | | | |
| | .6 | Do not locate cables less than 300mm parallel to steam or hot water lines with minimum 100mm at crossovers. | | | | | | | | | | | | | | |

3.4 INSTALLATION OF FIRE ALARM CABLES .1 Install fire alarm cables in metallic conduit (EMT, unless otherwise indicated).

3.5 INSTALLATION OF ARMOURED CABLES .1 Group cables wherever possible.

.2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

.3 Install AC-90 cable as per the following guidelines:

.1 Do not use AC90 for panel feeders or branch circuit wiring that originates in the Level 300 MCTS Operations Room UPS and Emergency Power panels.

.2 USE AC90 for branch circuit wiring in dry locations except otherwise indicated.

.3 The grouping together of AC-90 cables to form a bundle for securing purposes is acceptable providing the following procedures are adhered to:

.1 In addition to securing type AC-90 cables at 1.5m intervals to structure, multiple or bundled groups of armoured cables must be tye-wrapped together at mid-point between each structure support, or every 760mm and secured to structure at 1.5m intervals, and also secured together (between each structure point) at 1.5m intervals.

.2 Limit grouping of AC-90 cables to a maximum of eight (8) current carrying conductors, including associated oversized neutral conductors where phase sharing occurs.

.4 The following examples incorporate uses of both, common and dedicated (separate) branch circuit neutral conductors:

.1 Maximum of two (2) runs of #12/4 conductor cables, including common (oversized) branch circuit neutral in each.

.2 Maximum of two (2) runs of #12/3 conductor cables, including (oversized) branch circuit neutrals (if not 3 phase, 3 wire), plus one run of #12/2 cable.

.3 Maximum of four (4) runs of #12/2 conductor cables, each including a separate, dedicated branch circuit neutral conductor.

3.5 INSTALLATION .3
OF ARMOURED CABLES
(Cont'd)

(Cont'd)

.5 Where dedicated or separate branch circuit neutral conductors are non phase sharing, they need not be sized larger than phase conductors they accompany unless specifically indicated otherwise.

.6 Originate AC-90 fixture feeds from the sides of outlet boxes and not from the box cover. Where three (3) and/or four (4) fixture drops extend from any one outlet box, the box must not be sized smaller than 119mm² square.

.7 A fixture drop is defined as that portion of AC-90 cable or flexible conduit being used to make final connection between accessible type junction or outlet box located in ceiling space (above T-Bar ceiling only) and its respective light fixture.

.1 Fixture drops are not to exceed 4.5m in total length unless specifically indicated otherwise.

.2 There will be not more than four (4) drops permitted to be fed from any one box regardless of its size. Secure AC-90 cables used for fixture drops within 300mm of the junction box. Each light fixture is to be complete with its own separate fixture drop originating from a junction box located within same ceiling of room as fixture. An exception will be recessed down lights which may be wired from one fixture to another if they have integral junction boxes and the luminaire access opening is 150mm or greater in diameter.

.3 Wire light fixtures with a separate whip emanating from an overhead junction box within a T-bar ceiling space.

.4 #12 AWG type AC-90 armoured cables may be used where total fixture drop loads do not exceed the following:

.1 Maximum of 5000 watts @ 347 volts using #12 AWG drop.

.2 Maximum of 1800 watts @ 120 volts using #12 AWG drop.

.8 Provide separate pig-tail type leads in each light fixture junction/outlet box for final connections to fixture drops. Connect pig-tail leads to light fixture line and associated neutral conductors.

.9 Install in accordance with Installation of Cables: General.

- 3.6 INSTALLATION OF CONTROL CABLES
- .1 Install control cables in conduit.
 - .2 Ground control cable shield where required.
 - .3 Install insulated bonding conductor (minimum #12AWG Stranded Copper, green RW90 insulation) in conduit for control systems less than 50V.

- 3.7 INSTALLATION OF CABLES: GENERAL
- .1 Cables to be supported 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. Inspection will be by the Departmental Representative. Correct any unacceptable Work at no cost to the Owner.
 - .4 Install cables parallel and perpendicular to building lines.
 - .5 Secure cables to underside of metal decking wherever practicable.
 - .6 Exposed wiring at panels to be neatly marshalled from panel to finished ceiling space using suitably sized (minimum 450mm wide) ladder type cable tray.
 - .7 Ty-rap branch circuit phase conductors and neutral (where applicable) at the closest point of entry within all panelboards, pull boxes, junction boxes, MCC's and switchboards.
 - .8 Stranded conductors are to be twisted together at each termination.
 - .9 Do not notch or cut structural members of wood frame construction to accommodate wiring installation.
 - .10 Provide mechanical protection as required to protect wiring from damage from mechanical fasteners (nails, screws etc).
 - .11 Drill individual holes for wiring and cables penetrating wood frame floor joists. Locate
-

- 3.7 INSTALLATION OF CABLES: GENERAL
(Cont'd)
- .11 (Cont'd)
holes in centre third of joist depth. Space
holes a minimum of 25 mm and not less than one
diameter apart.
- .12 Obtain permission of Strucutural Engineer
prior to drilling where more than 4 holes must
be clustered or adjacent to structural
connections.

PART 1 - GENERAL

- 1.1 REFERENCES .1 CSA C22.2 No. 41-07, Grounding and Bonding Equipment (Bi-National Standard with UL 467).

PART 2 - PRODUCTS

- 2.1 EQUIPMENT .1 Clamps for grounding of conductor: size as required and suitable for application.
- .2 Rod electrodes: galvanized steel 19mm dia by 3m long.
- .3 Direct buried grounding conductors: bare stranded copper of 98% conductivity, soft annealed, size as indicated.
- .4 Insulated grounding and bonding conductors: soft drawn stranded copper of 98% conductivity, type RW90 (green coloured insulation as indicated in 26 05 00, item 9 - Wiring Identification).
- .5 Ground bus: copper, minimum size 6mm x 75mm x 600mm size and as indicated, complete with insulated supports, fastenings, connectors.
- .6 Ground connections to take place on the ground bus are 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.
- .7 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 Bonding jumpers, straps.
- .5 Pressure wire connectors.
- .8 Copper compression type, long barrel, two hole type lugs unless specified otherwise.

2.1 EQUIPMENT .9 Copper compression type connectors (cable to
(Cont'd)

2.2 MANUFACTURERS .1 Acceptable manufacturers: FCI-Burndy
Corporation, Erico Inc., Thomas & Betts,
Ilsco.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install complete permanent, continuous
GENERAL 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 conductors from
mechanical injury.

.4 Make buried connections, and connections to
electrodes using copper welding by thermit
process or inspectable copper crimp type
compression connectors.

.5 Use mechanical connectors for grounding
connections to equipment provided with lugs
except grounding terminations in 600V
switchboards, 600V CDP panels, 600V MCC's to
be copper, compression type, long barrel, two
hole connectors.

.6 Soldered joints not permitted.

.7 Install insulated bonding conductor in all
conduits.

.8 Make grounding connections in radial
configuration only, with connections
terminating at single grounding point as
indicated. Avoid loop connections.

.9 Secure 'feed' bonding conductor (wrapped
around unbroken) to the grounding screw of
each outlet/device box, before connecting to

3.1 INSTALLATION
GENERAL
(Cont'd)

- .9 (Cont'd)
the other grounding conductors and/or
providing a "pig-tail" lead for device
terminations.
- .10 All ground/bond wires to be twisted together
with a screw-on type wire connector, and then
placed in the rear of the outlet box.
- .11 Bond EMT wall stubs or sleeves to ground as
per the latest CEC requirements.

3.2 ELECTRODES

- .1 Install rod electrodes and make grounding
connections.
- .2 Bond separate, multiple electrodes together.
- .3 Use size #2/0 AWG copper conductors for
connections to electrodes unless otherwise
indicated.
- .4 Make special provision for installing
electrodes that will give acceptable
resistance to ground value where rock or sand
terrain prevails. Ground as indicated.

3.3 SYSTEM AND
CIRCUIT GROUNDING

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

3.4 EQUIPMENT
GROUNDING

- .1 Install grounding connections to typical
equipment included in, but not necessarily
limited to following list: service equipment,
transformers, switchgear, duct systems, frames
of motors, motor control centres, starters,
control panels, building steel work,
generators, cellular floor headers and cells
and fittings, distribution panels, outdoor
lighting, metallic waste water piping systems,
metallic rain water leader systems, metallic
gas fuel piping systems.

3.5 GROUNDING BUS

- .1 Where existing electrical rooms and
telecommunications rooms are provided with a
ground bus, make ground connections to that
bus.

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|---------------------------------------|----|--|
| <u>3.5 GROUNDING BUS
(Cont'd)</u> | .2 | Ground items of electrical equipment to ground bus as indicated herein and on the Drawings. |
| | | |
| <u>3.6 COMMUNICATION
SYSTEMS</u> | .1 | Telecommunications: provide grounding and bonding in accordance with BICSI Telecommunications Distribution Methods Manual (TDMM), 12th Edition. |
| | | |
| <u>3.7 FIELD QUALITY
CONTROL</u> | .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. |

PART 1 - GENERAL

Not Applicable

PART 2 - PRODUCTS

2.1 SUPPORT
CHANNELS

- .1 U shape, size 40mm x 40mm, 2.7mm thick galvanized steel, surface mounted, suspended or set in poured concrete walls and ceilings unless otherwise indicated.
- .2 Standard rolled structural steel shapes, plates and pre-fabricated components to form a complete assembly.

2.2 CABLE TIES

- .1 The use of cable ties for supporting purposes is not permitted. Cable ties can only be used to hold various system cables "in place".
- .2 Nylon flame retardent, low smoke cable tie. Size as required.
- .3 Nylon flame retardant, low smoke cable tie mounting bracket. Mechanical fastening type only; adhesive mounts not acceptable.

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 Do not support equipment from T-bar ceiling support. Provide independent supports as necessary.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

3.1 INSTALLATION
(Cont'd)

- .6 Fasten exposed conduit or cables within a maximum of 1m of each outlet box, junction box, pull box, cabinet or conduit fittings with spacing between supports as per CEC to building construction, conduit type and support system using straps.
 - .1 One-hole straps to secure surface conduits and cables smaller than 41mm.
 - .2 Two-hole straps for conduits and cables 41mm and larger.
 - .3 Conduit straps to be zinc plated steel.
- .7 Suspended support systems for conduits:
 - .1 Support individual conduit runs with minimum 12mm dia. continuously threaded rods and spring clips.
 - .2 Support two (2) or more conduits on u-shaped support channels supported by minimum 12mm dia. threaded rod hangers (trapeze style) where direct fastening to building construction is impractical.
 - .3 Continuously threaded rods to be zinc plated steel.
 - .4 Space channels in accordance with the CEC for the smallest conduit installed (maximum 1.5m spacing).
 - .5 Install washer and nut on both upper and underside of channel.
- .8 For surface mounting of two or more conduits, use channels spaced at 1.5m (center-to-center) spacing (maximum).
- .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 Confirm adequate support for raceways and cables, drop vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or cable ties to support or secure raceways or cables.
- .12 Do not use non-electrical equipment 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.

3.1 INSTALLATION
(Cont'd)

- .14 Fasten individual and multiple runs of armoured cables to structure and in bundles using cable ties 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 9 mm threaded rod, nuts and flat washers. Secure threaded rods 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 (22,500mm² and smaller).
 - .2 Two (2) rods required for boxes sized 22,500mm² and larger, up to and including those sized 300mm x 300mm (90,000mm²).
 - .3 Minimum of four (4) rods required for all boxes sized larger than 90,000mm²
 - .4 All excess rod is to be cut-off within 13mm of channel bottom.
- .16 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 from mid point of all 90° bends.
- .17 Maximum spacings between conduit support channels shall be as dictated by smallest size conduit(s) being supported and/or secured to same.
- .18 Touch up all field cut galvanized steel supports with galvanizing paint.

PART 1 - GENERAL

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| <u>1.1 SHOP DRAWINGS
AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data for cabinets in accordance with Section 01 33 00. |
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PART 2 - PRODUCTS

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| <u>2.1 SPLITTERS</u> | .1 | Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. |
| | .2 | Main and branch lugs or Connection bars to match required size and number of incoming and outgoing conductors as indicated. |
| | .3 | At least three spare terminals on each set of lugs in splitters less than 400 A. |
|
<u>2.2 JUNCTION AND
PULL BOXES</u> | .1 | Type C: welded steel construction, hinged cover, catch with hasp. Provision for locking. Surface or flush mounting as indicated. |
| | .2 | Type D: welded steel construction with screw-on flat covers for surface mounting. Size cover a minimum of 25mm larger than the actual box dimensions. Surface or flush mounting as indicated. |
| | .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 shall be complete with screw cover. |
| | .4 | Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes. |
| | .5 | Single gang sectional type devices boxes being used in steel stud walls for the installation of both metallic and non-metallic type cables, shall not be sized smaller than 250cm ² , complete with wrap around type bracket. |

<u>2.2 JUNCTION AND PULL BOXES (Cont'd)</u>	.6	Two or more flush installed sectional boxes ganged together, or boxes sized 100mm ² and larger (intended for devices) are to have an additional support bracket installed on opposite side of box not presently secured to metal stud.
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<u>2.3 CABINETS</u>	.1	Type E: sheet steel, hinged screw-to-lock, door and return flange overlapping sides, handle, and catch, for surface mounting.
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<u>2.4 EXTERIOR CABINETS</u>	.1	NEMA 4X, hinged screw-to-lock door for surface mounting.
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PART 3 - EXECUTION

<u>3.1 SPLITTER INSTALLATION</u>	.1	Install splitters and mount plumb, true and square to the building lines.
	.2	Extend splitters full length of equipment arrangement except where indicated otherwise.

<u>3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION</u>	.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 760mm 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. Refer to Section 26 05 29 for number of threaded rods.

- 3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION
(Cont'd)
- .6 Junction or outlet boxes feeding a maximum of two fixture drops shall not be sized smaller than 100mm square.
- .7 Concealed boxes located in the ceiling spaces above suspended type ceilings are not to be installed greater than 762mm above the finished ceiling elevation.
- .8 Junction boxes larger than 150mm x 150mm used in branch circuit wiring are to be complete with bonding terminal stripes.
- .9 Bond all metallic pull boxes with bonding conductor.
- 3.3 IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00.

PART 1 - GENERAL

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| <u>1.1 REFERENCES</u> | .1 | CSA C22.1-2012, Canadian Electrical Code, Part 1. |
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PART 2 - PRODUCTS

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| <u>2.1 OUTLET AND CONDUIT BOXES GENERAL</u> | .1 | Size boxes in accordance with CSA C22.1. |
| | .2 | 100mm square or larger outlet boxes as required for special devices. |
| | .3 | Gang boxes where wiring devices are grouped. |
| | .4 | Blank cover plates for boxes without wiring devices. |
| | .5 | Combination boxes with barriers where outlets for more than one system are grouped. |
| <u>2.2 SHEET STEEL OUTLET BOXES</u> | .1 | Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76mm x 50mm x 38mm or as indicated. 100mm square outlet boxes when more than one conduit enters one side with extension and tile rings as required. |
| | .2 | Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 100mm x 54mm x 47mm. |
| | .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. |
| <u>2.3 MASONRY BOXES</u> | .1 | Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls. |

- 2.4 CONCRETE BOXES .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
- 2.5 FLOOR BOXES .1 PVC type Thomas & Betts 640P series double gang. Accessories to be provided include brass activation kit for carpet floor and brass flip-up cover plate and all fittings to make a complete installation.
- 2.6 CONDUIT BOXES .1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for all surface wiring of switches, receptacle, thermostats and similar devices mounted.
- 2.7 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.

3.1 INSTALLATION
(Cont'd)

- .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.
- .9 Install concealed boxes in accessible locations.
- .10 Flush installed 100mm or 120mm square box being used as a pull box or junction box to 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 Boxes to be connected to AC-90 cables are to be specifically made for only AC-90 cables.
- .13 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.

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. 45.1-07, Electrical Rigid Metal Conduit - Steel (Tri-National Standard, with UL 6 and NMJ-J-534-ANCE-2007).

.2 CSA C22.2 No. 56-2004(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.3 CSA C22.2 No. 83-1985(R2008), Electrical Metal Tubing.

.4 CSA C22.2 No. 211.2-2006(R2011), Rigid PVC (Unplasticized) Conduit.

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

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|---------------------|----|--|
| <u>2.1 CONDUITS</u> | .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 | Rigid pvc conduit, fittings; couplings and connectors: to CSA C22.2 No. 211.2. |
| | .4 | Flexible aluminum conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56. |

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| <u>2.2 CONDUIT FASTENINGS</u> | .1 | One hole straps to secure surface conduits smaller than 41mm. Two hole straps for conduits 41mm and larger. Straps to be zinc plated (galvanized) steel. |
| | .2 | Beam clamps to secure conduits to exposed steel work. |
| | .3 | Channel type supports for two (2) or more conduits at 1.5m oc. |
| | .4 | 12mm dia threaded rods to support suspended channels. |

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| <u>2.3 CONDUIT FITTINGS</u> | .1 | Fittings: manufactured for use with conduit specified. Coating: same as conduit. |
| | .2 | Conduit fittings (LB, LL and LR) are to be used for 90° bends. "Ells" or corner pulling "Elbows" are prohibited. |
| | .3 | Connectors, fittings and couplings for EMT: use steel set-screw type. |
| | .4 | Rain-tight or waterproof type connectors shall be used on all vertical conduit runs to connecting equipment in areas with sprinkler heads. |
| | .5 | Screw on plastic or metal (malleable) type bushings for conduit ends. |
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| <u>2.4 EXPANSION
FITTINGS FOR RIGID
CONDUIT</u> | .1 | Weatherproof expansion fittings with internal bonding assembly suitable for 200mm linear expansion. |
| | .2 | Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 21mm deflection in all directions. |
| | .3 | Weatherproof expansion fittings for linear expansion at entry to panel. |

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|----------------------|----|--------------------------------------|
| <u>2.5 FISH CORD</u> | .1 | Polypropylene: minimum 3mm diameter. |
|----------------------|----|--------------------------------------|

PART 3 - EXECUTION

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|-------------------------|----|--|
| <u>3.1 INSTALLATION</u> | .1 | Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. Install as high as possible to underside of structure. |
| | .2 | Conceal conduits except in mechanical and electrical service rooms and in unfinished areas (excluding tenant spaces). |
| | .3 | Use electrical metallic tubing (EMT) in dry areas and where not subjected to damage. Do not use EMT in cast concrete. |
| | .4 | Use EMT for branch circuit wiring from the MCTS Operations Room UPS and Emergency power panels on Level 300. |
| | .5 | Use rigid hot dipped galvanized steel threaded conduit outdoors, in wet/damp areas (water entry and pilot plant rooms) and where subjected to damage. |
| | .6 | Use rigid PVC conduit underground and below concrete floor slabs: minimum size 27mm dia. |
| | .7 | Use liquid tight flexible metal conduit for connection to motors and other vibrating and/or mechanical equipment including but not limited to the following: dry type transformers, valves, motorized dampers, unit heaters, chillers, HVAC equipment, sprinkler system controls, etc. |
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3.1 INSTALLATION
(Cont'd)

- .8 Minimum conduit size for lighting, power and control circuits: 21mm.
 - .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .10 Mechanically bend steel conduit over 21mm dia.
 - .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
 - .12 Install fish cord in empty conduits.
 - .13 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
 - .14 Dry conduits out before installing wire.
 - .15 Install insulated copper bonding conductor in all conduit runs. Minimum size: #14 AWG or Table 16 of C.E.C. which ever is larger.
 - .16 Non-connected PVC or steel raceways protruding up through open bottoms of free-standing equipment require PVC bell ends and steel type "ground bushings" installed on ends of respective types of conduits.
 - .17 Install bushings in all EMT and rigid galvanized steel conduits sized 35mm and larger before pulling in conductors.
 - .18 Raintight EMT connectors and couplings are to be used on the vertical portion of conduit runs where terminating into tops of electrical equipment in areas with sprinkler heads and in wet areas.
 - .19 Rigid PVC conduit shall be FT4 rated.
 - .20 Install a conduit drop to each flush installed device box in all walls. For cables to be run in free air (telecommunications, etc), stub the conduit out of the wall into the accessible ceiling space of the room containing the flush installed device box.
 - .21 For EMT wall stubs, install steel EMT connectors complete with plastic or grounding
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|------------------------------|---|
| 3.1 INSTALLATION
(Cont'd) | .21 (Cont'd)
type bushings screwed on same. CSA approved
EMT plastic end cap bushings may also be used. |
| | .22 All conduit wall stubs and associated boxes
are to be adequately bonded to ground per CEC
requirements. |
| | .23 Do not install conduits in concrete floor
slabs. Install conduits below concrete floor
slabs. |
| 3.2 SURFACE
CONDUITS | .1 Run parallel or perpendicular to building
lines. |
| | .2 Locate conduits behind infrared or gas fired
heaters with 1.5m clearance. |
| | .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. |
| 3.3 CONCEALED
CONDUITS | .1 Run parallel or perpendicular to building
lines. |
| | .2 Conduits to be installed above the bottom of
the concrete ceiling drop panel. |
| 3.4 CONDUITS
UNDERGROUND | .1 Slope conduits to provide drainage. |
| | .2 Waterproof joints (pvc excepted) with heavy
coat of bituminous paint. |
| | .3 Where RPVC conduits emerge above floors,
provide mechanical protection as required but
not less than to a minimum of 150 mm above the
slab. |
| | .4 Below slab conduits shall be installed in
trenches not less than 300mm from underside of
concrete floor slab to bottom of trench. |

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3.4 CONDUITS	.4	(Cont'd)
UNDERGROUND		Provide minimum 50mm of freshwater sand all
(Cont'd)		around conduits.

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 NFPA 70B-2013, Recommended Practice for Electrical Equipment Maintenance.
 - .2 ASTM B633-2013, Specification for Electro-deposited Coatings of Zinc on Iron and Steel
 - .3 ASTM A653-2011, Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process
 - .4 ASTM A123-2012, Specification for Zinc (Hot Galvanized) Coatings on Iron and Steel
 - .5 ASTM A510-2013, Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
 - .6 CSA C22.1-2012, Canadian Electrical Code
 - .7 NEMA VE 2-2006, Cable Tray Installation Guidelines
- 1.2 DRAWINGS
- .1 The drawings, which constitute a part of these specifications, indicate the general route of the wire basket support systems. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.
 - .2 Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Make field surveys as part of his work prior to submitting system layout drawings.
- 1.3 SUBMITTALS
- .1 Submit information as specified in Section 01 33 00.
 - .2 Submittal Drawings: Submit drawings of wire basket and accessories including connector
-

- | | | |
|---|----|--|
| <u>1.3 SUBMITTALS
(Cont'd)</u> | .2 | Submittal Drawings:(Cont'd)
assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps and hold down plates showing accurately scaled components. |
| | .3 | Product Data: Submit manufacturer's data on wire basket support system including, but not limited to, types, materials, finishes and inside depths. |
| <u>1.4 QUALITY
ASSURANCE</u> | .1 | NFPA Compliance Comply with NFPA 70B, for installation of cable tray systems. |
| <u>1.5 DELIVERY,
STORAGE AND
HANDLING</u> | .1 | Deliver wire basket support systems and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment. |
| | .2 | Store wire basket and accessories in original cartons and in clean dry space; protect from weather and construction traffic. |

PART 2 - PRODUCTS

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| <u>2.1 WIRE BASKET
SECTIONS AND
COMPONENTS</u> | .1 | General: Provide wire basket of types and sizes indicated; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features. |
| | .2 | Materials and Finishes: Material and finish specifications for each wire basket type are as follows:
.1 Electroplated Zinc: Make straight sections from steel meeting the minimum mechanical properties of ASTM A510 and complete with electro-plated zinc in accordance with ASTM B633.
.2 Pre-Galvanized Zinc: Coat wall brackets and other pre-galvanized accessories with zinc in accordance with ASTM A653. |
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2.1 WIRE BASKET
SECTIONS AND
COMPONENTS
(Cont'd)

- .2 Materials and Finishes:(Cont'd)
 - .3 Electro-Galvanized Zinc: Coat support accessories and miscellaneous hardware in accordance with ASTM B633 SC3. All threaded components in accordance with ASTM B633 SC1.
- .3 Have cable exit "waterfalls" manufactured from same manufacturer.
- .4 Straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.
- .5 Wire basket and associated hardware utilized must be from a single manufacturer.

2.2 TYPE OF WIRE
BASKET SUPPORT
SYSTEM

- .1 All straight section longitudinal wires to be straight (with no bends).
- .2 Make wire basket of high strength steel wires and formed into a standard 50mm x 100mm wire mesh pattern with intersecting wires welded together. Round wire ends along wire basket sides (flanges) during manufacturing for safety of cables and installers.
- .3 Wire basket sizes must conform to the following nominal criteria:
 - .1 Furnish straight sections in standard 3.05m lengths.
- .4 Wire basket to have a 100mm usable loading depth by 300mm wide.
- .5 Field form all fittings as needed.
- .6 Splicing assemblies to be the bolted type using serrated flange locknuts. Hardware to be either yellow zinc dichromate in accordance with ASTM B633 or AISI Type 304 Stainless Steel.
- .7 Wire basket supports to be center support hangers, trapeze hangers or wall brackets as manufactured by same manufacturer as the basket tray.
- .8 Support trapeze hangers or center support hangers by 10mm (3/8") diameter rods.

2.2 TYPE OF WIRE .9 Furnish special accessories as required to
BASKET SUPPORT protect, support and install a wire basket
SYSTEM support system.
(Cont'd)

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install wire basket as indicated; in
accordance with recognized industry practices
and (NEMA VE-2). Confirm the cable tray
equipment complies with requirements of
applicable portions of NFPA 70B and NECA's
"Standards of Installation" pertaining to
general electrical installation practices.

.2 Coordinate wire basket with other electrical
work as necessary to properly interface
installation of wire basket runway with other
work.

.3 Provide sufficient space encompassing wire
basket to permit access for installing and
maintaining cables.

.4 Installation of basket type tray is only
permitted within the Main Communications Room
and Remote Communications Rooms.

.5 Do not run wire basket through fire rated
wall or floor assemblies.

.6 Bond isolated sections together.

.7 Install basket such that it does not
compromise the communication equipment
isolated ground system.

.8 Install waterfall type cable drop at each
telecommunications rack to match cable
quantity and locations.

3.2 TESTING .1 Test wire basket support systems to confirm
electrical continuity of bonding and grounding
connections, and to demonstrate compliance
with specified maximum grounding resistance.
See NFPA 70B, Chapter 18, for testing and test
methods.

3.2 TESTING (Cont'd)	.2	Manufacturer will provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1.
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PART 1 - GENERAL

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| 1.1 RELATED
SECTIONS | .1 | Electrical General Requirements: Section 26 05 00. |
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PART 2 - PRODUCTS

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| 2.1 CABLE
PROTECTION | .1 | Protection materials and methods as indicated on drawings. |
|-------------------------|----|--|

PART 3 - EXECUTION

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|---------------------------------------|----|---|
| 3.1 CABLE
INSTALLATION IN
DUCTS | .1 | Install cables as indicated in ducts. |
| | .2 | Do not pull spliced cables inside ducts. |
| | .3 | Install multiple cables in duct simultaneously. |
| | .4 | Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension. |
| | .5 | To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation. |
| | .6 | Before pulling cable into ducts and until cable ends are properly terminated, seal ends of lead covered cables with wiping solder, seal ends of non- leaded cables with moisture seal tape. |
| | .7 | After installation of cables, seal duct ends with duct sealing compound. |
| 3.2 FIELD QUALITY
CONTROL | .1 | Perform tests in accordance with Section 26 05 00 - Electrical General Requirements. |
| | .2 | Perform tests using qualified personnel. Provide necessary instruments and equipment. |
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- 3.2 FIELD QUALITY CONTROL
(Cont'd)
- .3 Check phase rotation and identify each phase conductor of each feeder.
 - .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
 - .5 Pre-acceptance tests.
 - .1 After installing cable but before terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each termination to ensure that cable system is ready for acceptance testing.
 - .6 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.
 - .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.

PART 1 - GENERAL

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| <u>1.1 SOURCE QUALITY CONTROL</u> | .1 | Provide manufacturer's factory test certificates. |
| | .2 | Submit written test results to Departmental Representative. |
| | | |
| <u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u> | .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. |
| | .3 | Submit shop drawings for surge protection device and digital metering. |
| | | |
| <u>1.3 OPERATION AND MAINTENANCE DATA</u> | .1 | Provide operation and maintenance data for panelboards, surge protection device and digital metering for incorporation into manual specified in Section 01 78 00. |
| | .2 | Include panel schedules. |

PART 2 - PRODUCTS

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| <u>2.1 PANELBOARDS</u> | .1 | Panelboards: product of one manufacturer. |
| | .2 | 250 and 600 V panelboards: bus and breakers rated as indicated, short circuit current rating (RMS momentary symmetrical) 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. |
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<u>2.1 PANELBOARDS (Cont'd)</u>	.5	Two (2) keys for each panelboard and key panelboards alike.
	.6	Tin-plated copper bus. Neutral to be 200% 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	Panelboards rated 225A and less will not be less than 508mm in width. Panelboards rated more than 225A shall not be less than 914mm wide x 280mm deep.
<u>2.2 BREAKERS</u>	.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 Owner.
<u>2.3 EQUIPMENT IDENTIFICATION</u>	.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.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install panels secure and plumb to walls or floors with appropriate fasteners and anchors.
 - .2 Install floor mounted panels on concrete housekeeping pad. Pad to be nominal 100mm high and extend 25mm (minimum) beyond the equipment enclosure.
 - .3 Connect neutral conductors to common neutral bus with respective neutral identified.
 - .4 Bond panel to ground.
 - .5 Enter and connect panel feeder and branch circuit wiring.
 - .6 Perform tests and record results.
 - .7 Install panel identification.

PART 1 - GENERAL

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| <u>1.1 REFERENCES</u> | .1 | CAN/CSA C22.2 No. 42-10, General Use Receptacles, Attachment Plugs and Similar Wiring Devices. |
| | .2 | CAN/CSA C22.2 No. 55-M1986(R2008), Special Use Switches. |
| | .3 | CAN/CSA C22.2 No. 111-10, Standard-use Snap Switches (Bi-National Standard with UL 20). |
| <u>1.2 SHOP DRAWINGS</u> | .1 | Submit shop drawings for each device and coverplate type as per specification Section 01 33 00. |
| <u>1.3 OPERATIONAL AND MAINTENANCE DATA</u> | .1 | Provide operation and maintenance data for wiring devices for incorporation into manual specified in Section 01 78 00. |

PART 2 - PRODUCTS

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|---------------------|----|--|
| <u>2.1 SWITCHES</u> | .1 | Design S1: <ul style="list-style-type: none">.1 20A, 120V, specification grade single pole or two way switches as indicated..2 Manually-operated general purpose AC switches with following features:<ul style="list-style-type: none">.1 Terminal holes approved for #10 AWG wire..2 Silver alloy contacts..3 Urea or melamine molding for parts subject to carbon tracking..4 Suitable for back and side wiring..5 Ivory nylon, heavy duty toggle..6 Integral ground terminal..3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads..4 Switches of one manufacturer throughout project. |
|---------------------|----|--|
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- 2.1 SWITCHES (Cont'd)
- .2 Design S2: Motor rated manual control switch with the following features:
- .1 Nominal 30A, 250 V rating;
 - .2 Single or three phase as indicated;
 - .3 Surface mounting CSA 3R enclosure;
 - .4 Lockable in open position.
- 2.2 RECEPTACLES
- .1 Design R1:
- .1 General purpose duplex receptacles, specification grade CSA type 5-15R, 125V, 15A, U-ground, with following features:
 - .1 Ivory urea molded housing.
 - .2 Suitable for #10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight (8) back wired entrances, four (4) side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Isolated ground receptacles where indicated.
 - .7 Grey nylon face for all technical power receptacles, white for all others.
- .2 Design R2:
- .1 Duplex receptacles, specification grade CSA type 5-20 R(T-Slot), 125 V, 15/20A, U ground, with following features:
 - .1 Ivory urea molded housing.
 - .2 Suitable for #10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight (8) back wired entrances, four (4) side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Isolated ground receptacles where indicated.
 - .7 White nylon face.
- .3 Design R3:
- .1 GFI duplex receptacles. Specification grade, CSA type 5-15R, 125V, 15A, U-Ground with the following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for #10 AWG for back and side wiring.
 - .3 Eight (8) back wired entrances, four (4) side wiring screws.
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- 2.2 RECEPTACLES
(Cont'd)
- .3 Design R3:(Cont'd)
- .1 (Cont'd)
- .4 Triple wipe contacts and riveted grounding contacts.
- .5 Ivory nylon face.
- .6 GFI test and reset buttons.
- .7 Leakage current: Class A, 5mA.
- .4 Design R4:
- .1 GFI duplex receptacles: Specification grade, CSA type 5-20R(T-Slot), 125V, 15/20A, U-ground with the following features:
- .1 Ivory urea moulded housing.
- .2 Suitable for #10 AWG for back and side wiring.
- .3 Eight (8) 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 Leakage current: Class A, 5mA.
- .5 Other receptacles with ampacity and voltage as indicated.
- .6 Receptacles of one manufacturer throughout project.
- 2.3 COVER PLATES
- .1 Cover plates for wiring devices.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Brushed stainless steel plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Cast aluminum "in use" weather-proof cover plates.
-

2.4 LIGHT CONTROL
DEVICES

- .1 Provide lighting control devices including dimmers, occupancy/vacancy sensors, day light sensor and power packs to control lighting fixtures as indicated.
- .2 Dimmers:
 - .1 Low voltage wall box dimmer switches to control 0-10V signals to lighting fixture either directly to fixture or interfaced with power packs.
 - .2 Full range dimmer raise-lower control, with preset and on-off switch.
- .3 Occupancy/Vacancy Sensors:
 - .1 Wall box, ceiling or bracket mounted sensor as indicated.
 - .2 Line voltage and low voltage devices as required to suit application.
 - .3 Passive infrared detection technology.
 - .4 Detection Range:
 - .1 170 degrees horizontal for wall box devices.
 - .2 360 degrees for ceiling devices.
 - .5 Control functions to be field selectable for:
 - .1 Automatic on and off.
 - .2 Automatic off only.
 - .3 Adjustable time settings for both minimum on time and delay to off.
- .4 Indoor Daylight Control Sensors:
 - .1 Low voltage wall mounted device to control 0-10V signals to lighting fixtures either directly to fixture or interfaced with power packs.
 - .2 Device to track available day light within space and adjust light output of fixtures to satisfy illumination set point.
 - .3 Compatible with other lighting control devices within space.
 - .4 Switches lighting off when ambient day light is above set point.
 - .5 Integral delay buffer to compensate for transient day light conditions.
- .5 Power Packs:
 - .1 Provide power packs to interface with lighting control sensors, dimmers and day lighting sensors and lighting fixtures as required.
 - .2 Devices to be plenum rated.
 - .3 16mm conduit nipple for box mounting.

2.4 LIGHT CONTROL .5
DEVICES
(Cont'd)
PART 3 - EXECUTION

Power Packs:(Cont'd)
.4 Factory terminated pig-tails for
connection of field wiring.

3.1 INSTALLATION .1

Switches:

- .1 Install single throw switches with handle in "UP" position when switch closed.
- .2 Install switches in gang type outlet box when more than one (1) switch is required in one location.
- .3 Mount toggle switches at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
- .4 Recess switches in finished areas.
- .5 Install Type S2 manual motor controls switch at each air conditioning outdoor unit; located switch within 1500 mm of AC unit.

.2 Receptacles:

- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
- .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
- .4 Mount receptacles with "U" ground up for vertically mounted and neutral slot at top for horizontally mounted receptacle.
- .5 "Pigtail" type leads are to be installed 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.
- .6 Receptacles shall be recessed in finished areas.

.3 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.

3.1 INSTALLATION <u>(Cont'd)</u>	.4	Demonstrate successful operation of all devices and record results and set points at time of completion.
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PART 1 - GENERAL

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|---|----|--|
| <u>1.1 REFERENCES</u> | .1 | CAN/CSA C22.2 No. 248, SET, 2000, Low Voltage Fuses Complete Set. |
| <u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data in accordance with Section 01 33 00. |
| <u>1.3 MAINTENANCE MATERIALS</u> | .1 | Three (3) spare fuses of each type and size. |
| <u>1.4 DELIVERY AND STORAGE</u> | .1 | Ship fuses in original containers. |
| | .2 | Do not ship fuses installed. |
| | .3 | Store fuses in original containers in moisture free location. |

PART 2 - PRODUCTS

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|--------------------------|----|--|
| <u>2.1 FUSES GENERAL</u> | .1 | Fuses: product of one manufacturer. |
| | .2 | Low voltage fuses, types as specified, shall be CSA certified in accordance with CSA Standard C22.2 No. 248. |
| <u>2.2 FUSE TYPES</u> | .1 | All fuses shall be high rupturing capacity (HRC) type, minimum 200kA interrupting rating (momentary RMS symmetrical). |
| | .2 | Class J:
.1 Fuses rated 1 to 600 amperes, 600 Vac, shall be CSA certified Class J in accordance with Standard C22.2 No. 248.8.
.2 Where a time delay characteristic is required, fuses shall carry 500% of their ampere rating for not less than 10 seconds and shall be clearly labeled "time delay". |
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2.2 FUSE TYPES
(Cont'd)

- .3 Class CC:
.1 Fuses rated 1 to 30 amperes, 600 Vac, shall be CSA certified Class CC in accordance with Standard C22.2 No. 248.4.
.2 Where a time delay characteristic is required, fuses shall carry 200% of their ampere rating for not less than 12 seconds.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
.2 Confirm correct fuses are fitted to physically matched mounting devices.
.3 Confirm correct fuses are fitted to assigned electrical circuit.
.4 Ensure fuse size is correctly identified on equipment.
.5 For feeder circuit fuses, use fast acting Class J fuses unless otherwise noted.
.6 For full voltage non-reversing motor starters, full voltage reversing motor starters, full voltage multi-speed motor starters and transformers, use time delay Class J fuses.
.7 For solid state, reduced voltage motor soft starters, use Class HSJ time delay fuses (15A and above) and fast acting Class J fuses (less than 15A).
.8 For 600Vac control circuits, use Class CC type fuses. Use time delay Class CC fuses upstream of control transformers and solenoids.

PART 1 - GENERAL

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| <u>1.1 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| | .2 | Include circuit breaker types, ratings, magnetic adjustment ranges and time-current characteristic curves for breakers with ampacity of 225 A and over. LSIG adjustment ranges to be included for LSIG breakers. |
| <u>1.2 OPERATION AND MAINTENANCE DATA</u> | .1 | Provide operation and maintenance data for circuit breakers for incorporation into Manual specified in Section 01 78 00. |
| | .2 | Include matrix for individual circuit breaker settings for all breakers with adjustable settings. |

PART 2 - PRODUCTS

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| <u>2.1 BREAKERS GENERAL</u> | .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 pole breakers shall have single handle. |
| | .3 | Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating. |
| | .4 | Circuit breakers with interchangeable trips as indicated. |
| | .5 | Circuit breakers to have interrupting capacity as indicated on the Drawings. |
| | .6 | GFI branch breakers to be ground fault interrupter type (5mA maximum) for circuits as indicated on the Drawings. |

2.1 BREAKERS GENERAL (Cont'd)	.7	Circuit breakers for all lighting circuits shall be minimum 20A, unless otherwise indicated.
2.2 THERMAL MAGNETIC BREAKERS	.1	Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
2.3 MAGNETIC BREAKERS	.1	Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.
2.4 SOLID STATE TRIP BREAKERS	.1	Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self- powered shunt trip to provide inverse time current trip under overload condition, long time, short time, and instantaneous tripping for phase and ground fault short circuit protection. Settings to be individually adjustable.
2.5 OPTIONAL FEATURES	.1	Include: .1 On-off locking device for 10% of branch breakers and for all breakers supplying emergency lighting battery units and fire alarm devices.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install circuit breakers as required.
 - .2 Adjust circuit breaker settings to the values indicated on the manufacturer's supplied Coordination Study.

PART 1 - GENERAL

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| <u>1.1 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| | .2 | Include: <ul style="list-style-type: none"> .1 Dimensions. .2 Enclosure type. .3 Rating. .4 Accessories. |
| <u>1.2 OPERATION AND MAINTENANCE DATA</u> | .1 | Provide operation and maintenance data for disconnect switches for incorporation into manual specified in Section 01 78 00. |

PART 2 - PRODUCTS

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| <u>2.1 DISCONNECT SWITCHES</u> | .1 | Heavy duty, fusible and non-fusible, horsepower rated disconnect switch in CSA Enclosure type as indicated (minimum CSA type 1 with driphood) electrical ratings as indicated. |
| | .2 | Provision for padlocking in both the 'on' and 'off' switch position by three locks. |
| | .3 | Mechanically interlocked door to prevent opening when handle in ON position. |
| | .4 | Fuses: size as indicated, to Section 26 28 14 - Fuses - Low Voltage. |
| | .5 | Fuseholders: suitable without adaptors, for type and size of fuse indicated. |
| | .6 | Quick-make, quick-break action. |
| | .7 | ON-OFF switch position indication on switch enclosure cover. |
| | .8 | Auxiliary contacts for units supplying elevator equipment. |
| | .9 | 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 complete with fuses where required.

PART 1 - GENERAL

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|--------------------------------|----|--|
| <u>1.1 DESCRIPTION OF WORK</u> | .1 | This section specifies requirements for the supply and installation of surge protection devices. |
| | .2 | Unless otherwise indicated, SPDs shall be integrally mounted in switchboards, panel boards or other distribution equipment. |
| <u>1.2 RELATED WORK</u> | .1 | Service Entrance Switchboard: Section 26 24 02 |
| | .2 | Panelboards-Breaker Type: Section 26 24 17 |
| <u>1.3 REFERENCES</u> | .1 | IEEE C62.41.1-2002 and C62.41.2-2002, Surge Voltages in Low-Voltage AC Power Circuits. |
| | .2 | IEEE C62.45-2002, Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits. |
| | .3 | IEEE 1100-2005, Powering and Grounding Electronic Equipment. |
| | .4 | NEMA LS1-1992, Low Voltage Surge Protection Devices. |
| | .5 | OSHA, Occupational Safety and Health Association, Compliance Handbook 1992. |
| | .6 | UL 1283-2005, Standard for Safety for Electromagnetic Interference Filters. |
| | .7 | ANSI/UL 1449-2009, 3rd Edition, Surge Protection Devices. |
| <u>1.4 SHOP DRAWINGS</u> | .1 | Submit shop drawings in accordance with Section 01 33 00. |
| | .2 | Provide Shop Drawings with wiring diagrams, installation information, testing and maintenance procedures, and operational information for the transient protection system. |

1.4 SHOP DRAWINGS (Cont'd)	.3	Indicate: .1 Dimensional Drawing of each SPD type, Indicating proposed mounting arrangements. .2 Written functional description of the transient protection circuit in terms of components, configuration, design approach, and performance capability per NEMA LS1. .3 The means of connection of the SPD to the electrical distribution system per NEMA LS1 - 1992. .4 Manufacturer will provide ANSI/UL1449 data card showing the Voltage Protection Rating (VPR), system voltage, phases, modes of protection and nominal discharge current (In) for the specific catalog number submitted. .5 The devices shall be marked with the short circuit current rating. This rating shall meet or exceed the available fault current. Test data from an independent testing laboratory shall be provided to demonstrate the short circuit current rating has been tested on a complete device. .6 Submit test report data clearly demonstrating the maximum surge current rating has been tested on a complete SPD unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems. Manufacturers who cannot provide this data will not be considered. .7 Submit data demonstrating the complete SPD unit, including all overcurrent protection, is fully capable of a minimum repetitive surge current rating of 12,000 ANSI/IEEE C62.41, Category C3 (20kA) impulses without failure or a change in performance characteristics of more than 10%. .8 Written detailed response to each paragraph of the specification indicating that the proposed product meets or exceeds this specification. If specific paragraphs are not met, provide written explanation as to why not.
1.5 EXTENDED WARRANTY	.1	Manufacturer shall provide an extended product warranty for a period of not less than 10 years from the Date of Substantial Completion. Warranty shall cover unlimited replacement of system protection modules during warranty period. The first 5 years of this warranty shall include any field labor

<u>1.5 EXTENDED WARRANTY (Cont'd)</u>	.1	(Cont'd) required to perform repair or replacement work.
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<u>1.6 OPERATION AND MAINTENANCE DATA</u>	.1	Provide maintenance data for SPDs for incorporation into manual specified in Section 01 78 00.
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PART 2 - PRODUCTS

<u>2.1 ENVIRONMENTAL</u>	.1	General requirements: <ul style="list-style-type: none">.1 No audible noise shall be generated..2 Operating Conditions:<ul style="list-style-type: none">.1 30 - 130 Degrees F.2 15 - 85 Percent Humidity Non-Condensing
	.2	Integral Mount: the unit enclosure within the equipment shall meet the requirements of the equipment in which it is installed and shall not degrade the equipment ratings. SPDs integral to equipment shall be designed to mitigate the migration of faults within the SPD to the switchboard or panel.
	.3	Side mount enclosure: The unit shall have a heavy duty NEMA 12 dust-tight, drip-tight enclosure.

<u>2.2 SURGE SUPPRESSORS</u>	.1	General requirements: <ul style="list-style-type: none">.1 Rated for a 600Y/347 volt, 60 Hertz, 3-phase, 4-wire or 208Y/120Volt 60 Hertz, 3 phase 4-wire systems as indicated..2 Surge suppressors shall be in accordance with the following requirements:<ul style="list-style-type: none">.1 Unit to be parallel in design and connect in parallel to main switchboard. Each surge suppression element (MOV) shall be individually fused so that a failure of one element and/or fuse shall not affect other surge suppression elements..2 Unit to be ANSI/UL 1449, 3rd Edition recognized.
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- 2.2 SURGE .1 (Cont'd)
SUPPRESSORS .2 (Cont'd)
 (Cont'd) .3 Unit to provide maximum UL 1449 3rd
Edition Voltage Protection Rating (VPR)
for 600Y/347 Volt systems as follows:
 .1 N-G; L-N; L-G = 1500V
 .2 L-L = 3000V
-

2.2 SURGE
SUPPRESSORS
(Cont'd)

.1 (Cont'd)

.2 (Cont'd)

.4 For 208Y/120V systems as follows:

.1 N-G; L-N; L-G = 700V

.2 L-L = 1200V

.5 Unit to provide maximum surge current rating of amperes per mode (L-L, L-G) and amperes per phase based on ANSI/IEEE C62.41 standard 8 by 20 microsecond current waveform as indicated below:

Location

Category

C	250kA per phase: 125kA per mode
B	160kA per phase: 80 kA per mode
A	120kA per phase: 60kA per mode

.6 Unit to have a short circuit current rating of 50,000 amperes at rated voltage or greater.

.7 Unit to be UL 1283 listed as an electromagnetic interference filter and provide 50 Ohm noise attenuation of at least 40 dB at 100 kHz, 30 dB at 1 MHz, 35 dB at 10 MHz, and 50 dB at 100 MHz.

.8 Unit to include solid-state, long-life externally mounted LED visual status indicators that indicate the on-line status and operational integrity of each phase of the unit.

.9 Unit to have a Form C summary alarm output contact rated for at least 1 amp at 120VAC for remote annunciation of TVSS status.

.10 Unit to include a built-in, push-to-test feature that tests the integrity of all modules, MOVs and fuses in the system. Manufacturers that require an external test device to perform this feature will include the test set in this quotation.

.11 Unit to have an audible alarm with an alarm on/off switch to silence the alarm and a push to test switch to test the alarm function.

.12 An adjustable (resetable) counter will be provided to totalize transient voltage surges in both the normal and common mode. The counter will come complete with a 10-year battery back-up to maintain counts in the event of power loss.

2.2 SURGE .2 SPDs must not require any routine maintenance
SUPPRESSORS or parts replacement during their published
(Cont'd) lifetime.
PART 3 - EXECUTION

3.1 INSTALLATION .1 General requirements:
.1 All SPDs must be factory installed
integral with electrical assemblies unless
otherwise indicated.
.2 Install Category C location SPDs in
service entrance equipment.
.3 Install Category B location SPDs in
distribution panels.
.4 Install Category A location SPDs in
branch circuit panels.
.5 For side mounted SPDs conductors between
suppressor and point of attachment to
equipment shall be as short as possible, and
not exceeding 600 mm.
.6 Grounding: Suppressor ground shall be
bonded to the equipment grounding conductor
and service entrance ground.
.2 Arrange and pay for a factory certified
representative to set up and commission the
TVSS at site for proper operation to the
satisfaction of the Departmental
Representative. Document all testing and set
up and submit to Departmental Representative.
Assume that a minimum of one (1) day (not
including travel) will be required.
.3 Provide training of Owner operation and
maintenance of the device.

PART 1 - GENERAL

1.1 REFERENCES

- .1 ANSI C82.1-2011, Line Frequency Fluorescent Lamp Ballasts.
- .2 IEEE C62.41.2-2002, IEEE Recommended Practice on Characterization of Surges in Voltages in Low-Voltage (1000V and less) AC Power Circuits.
- .3 IEEE C62.45-2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits.
- .4 CAN/CSA C654-10, Fluorescent Lamp Ballast Efficacy Measurements.
- .5 NECA/ESNA 500-2006, Recommended Practice for Installing Indoor Commercial Lighting Systems (ANSI).
- .6 ANSI/IESNA RP1-2004; American National Standard Practice for Office lighting.
- .7 ASTM F1137-11, 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.

1.2 RELATED SECTIONS

- .1 Submittal Procedures: Section 01 33 00
- .2 Environmental and Waste Management Plans: Section 01 74 21
- .3 Closeout Submittals: Section 01 78 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 or light source for each luminaire type.

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| 1.3 SHOP DRAWINGS
AND PRODUCT DATA
(Cont'd) | .2 | (Cont'd) |
| | .3 | Ballast for each luminaire type. |
| | .3 | Shop Drawings: |
| | .1 | Shop drawings to clearly indicate the following: |
| | .1 | Luminaire ID number as identified in contract documents. |
| | .2 | Fixture specification as identified in Part 2. |
| | .3 | Solid State Light Sources or Lamp specification as identified in Part 2. |
| | .4 | Solid State Drivers or Ballast specification as identified in Part 2. |
| | .5 | Photometric data for each luminaire type. |
| | .6 | Energy data for light source and driver/ballast. |
| | .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;and |
| | .7 | Summary in accordance with IES procedures. |
| 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 21. |
| | .2 | Place materials defined as hazardous or toxic waste in designated containers. |

- 1.5 WASTE AND DISPOSAL (Cont'd)
- .3 Confirm emptied containers are sealed and stored safely for disposal away from children.
 - .4 Disposal of fluorescent lamps.

- 1.6 HIGH PERFORMANCE T8 LIGHTING SYSTEM
- .1 All 32W T8 lamps are to be listed as approved products in Efficiency Nova Scotia's "Smart Lighting Choices" program.
 - .2 All fluorescent lamps are to be within the TCLP criteria for classification as non-hazardous waste.

PART 2 - PRODUCTS

2.1 LAMPS

- .1 Linear Fluorescent Lamps:

Lamp Type	Wattage	Base	Initial Lumens	Rated Life h	Colour Temp.	CRI	Additional Information
T8	32W	Med Bipin	3,100	36,000	3,500K	86	

- ### 2.2 BALLASTS
- .1 Fluorescent Electronic Programmed Rapid Start ballast:
 - .1 Performance requirements:
 - .1 Electronic instant start.
 - .2 Independent Lamp Operation (ILO) for Instant Start ballasts allowing remaining lamps(s) to maintain full light output when one or more lamps fail.
 - .3 Auto restart circuitry in order to restart lamps without resetting power.
 - .4 Operate from 60 Hz input source of 120V or 347V as applicable with sustained variations of +/- 10% voltage and frequency with no damage to the ballast.
 - .5 High frequency electronic type and operate lamps at a frequency between 20 kHz and 30 kHz or above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.
 - .6 Power factor greater than 0.98 for primary lamp.
 - .7 Minimum ballast factor of 0.88 for primary lamp.

2.2 BALLASTS
(Cont'd)

- .1 (Cont'd)
 - .1 Performance requirements:(Cont'd)
 - .8 Lamp current crest factor of 1.7 or less in accordance with lamp manufacturer recommendations.
 - .9 Total harmonic distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.
 - .10 Class A sound rating for all 1200mm lamps and smaller.
 - .11 Minimum starting temperature of -18C (0F).
 - .12 Ability to tolerate sustained open circuit and short circuit output conditions without damage.
 - .13 Polychlorinated Biphenyl (PCB)free.
 - .2 Regulatory requirements:
 - .1 Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified.
 - .2 Meet or exceed ANSI C62.41 Category A for Transient protection.
 - .3 Meet or exceed ANSI C82.11 where applicable.
 - .4 Meet or exceed the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
 - .5 Ballast must meet or exceed the requirements of CSA Standard 654 for ballast efficiency.
 - .6 Provide ballast with integral leads color coded per ANSI C82.11.
 - .3 Warranty:
 - .1 Ballast to carry a five (5) year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a minimum case temperature of 70C.
- .2 Compact Fluorescent Electronic Ballast:
 - .1 Performance Requirements:
 - .1 Programmed Rapid Start.
 - .2 Auto restart circuitry in order to restart lamps without resetting power.
 - .3 Operate from 60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% voltage and frequency with no damage to the ballast.

2.2 BALLASTS
(Cont'd)

.2 (Cont'd)

- .1 Performance Requirements:(Cont'd)
 - .4 High frequency electronic type and operate lamps at a frequency above 50 kHz to eliminate visible flicker.
 - .5 Power factor greater than 0.95 for primary lamp.
 - .6 Minimum ballast factor of 1.00 for primary lamp application.
 - .7 Lamp current crest factor of 1.7 or less in accordance with lamp manufacturer recommendations.
 - .8 Total Harmonic Distortion (THD) of less than 10% when operated at nominal line voltage with primary lamp.
 - .9 Class A sound rating.
 - .10 Minimum starting temperature of -18C (0F) for primary lamp.
 - .11 Lamp EOL Protect Circuit.
 - .12 ability to tolerate sustained open circuit and short circuit output conditions without damage.
 - .13 Provide ballast with poke-in wire trap connectors color coded per ANSI C82.11.
- .2 Regulatory requirements:
 - .1 Polychlorinated Biphenyl (PCB) free.
 - .2 Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified.
 - .3 Underwriters Laboratories (UL) rated for use in air- handling spaces.
 - .4 Meet or exceed the requirements of ANSI C62.41 Category A for Transient protection.
 - .5 Meet or exceed the requirements of ANSI C82.11 where applicable.
 - .6 Meet or exceed the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- .3 Warranty:
 - .1 Ballast to carry a five (5) year warranty from date of manufacture against defects in material or workmanship, including replacement, for operation at a maximum case temperature of 75C.

- 2.3 SPARES
- .1 Provide 10% spare lamps of each type to a minimum quantity of ten (10).
 - .2 Provide 5% spare ballasts of each type to a minimum quantity of five (5).

- 2.4 LUMINAIRES
- .1 Refer to luminaire schedule on the drawings.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Locate and install luminaires as indicated.
 - .2 Coordinate installation with all other services.
 - .3 Each "lay-in" type fixture shall be capable of being raised upwards and moved laterally in any direction a minimum of not less than 610mm.

- 3.2 WIRING
- .1 Connect luminaires to lighting circuits as indicated.
 - .2 Each light fixture installed in acoustic (drop ceiling systems) ceiling 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 light fixtures (drop ceiling systems) ceiling 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.
 - .4 A maximum of four (4) drops is permitted from any single box, regardless of box size.
 - .5 AC-90 fixture drops may only be supported from T-Bar ceiling grid support wires with metal type clips, approved for this particular application. The use of tye-wraps is prohibited.

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| <u>3.2 WIRING</u>
<u>(Cont'd)</u> | <p>.6 If the luminaire opening in a non accessible ceiling is less than 150mm in diameter, provide a separate fixture drop.</p> <p>.7 Run fixture drops to an accessible junction box above an accessible ceiling or an access panel.</p> <p>.8 Fixture drops are not to exceed 5m in length.</p> |
| <u>3.3 LUMINAIRE</u>
<u>SUPPORTS</u> | <p>.1 For suspended ceiling installations, support luminaires independently of ceiling with threaded rods and metal channel or provide additional ceiling supports as required.</p> |
| <u>3.4 LUMINAIRE</u>
<u>ALIGNMENT</u> | <p>.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.</p> <p>.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.</p> |

PART 1 - GENERAL

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| <u>1.1 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| | .2 | Data to indicate unit specifications and components, mounting method, source of power and special attachments. |
| <u>1.2 OPERATION AND MAINTENANCE DATA</u> | .1 | Submit operation and maintenance data for incorporation in the Manual specified in Section 01 78 00. |

PART 2 - PRODUCTS

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| <u>2.1 WARRANTY</u> | .1 | All emergency lighting units to have a minimum ten (10) year life warranty. |
| <u>2.2 BATTERY UNIT - TYPE EM-1</u> | .1 | Supply voltage: 120VAC. |
| | .2 | Output voltage: 12Vdc. |
| | .3 | Operating time: four (4) hours continuous operation, based on full DC load. |
| | .4 | Battery: sealed, maintenance free, ten (10) year life warranty. |
| | .5 | Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations. |
| | .6 | Solid state transfer circuit. |
| | .7 | Low voltage disconnect: solid state, modular, operates at 80% battery output voltage. |
| | .8 | Signal lights: L.E.D. solid state, for 'AC Power ON' and 'High Charge'. |
| | .9 | Lamp heads: integral on unit, 345 horizontal and 180 vertical adjustment. |

2.2 BATTERY UNIT - .10 Lamp type: LED Type 4W (MR-16).
 TYPE EM-1
 (Cont'd)

.1 Cabinet: suitable for direct mounting to wall and complete with knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.2 Finish: white.

.3 Auxiliary equipment:

.1 Test switch.

.2 Self Diagnostic circuitry.

2.3 REMOTE HEAD .1 Supply voltage: 12 V dc from the battery pack
 TYPE EM-2 as indicated on the Drawings.

.2 Lamp heads: Lamp heads and stem shall be injection molded, impact resistant, flame retardant thermoplastic. Lampheds shall be fully adjustable for aiming lamps. Lamp type: two (2) LED Type 4W lamps (MR-16).

.3 Mounting: mounts directly onto standard octagon Junction box.

.4 Housing: 125mm round canopy with two (2) lamp heads. Colour is to be white.

2.4 WIRING OF .1 Conduit: As specified in Section 26 05 34 -
 REMOTE HEADS conduits, conduit fastenings and fittings.

.2 Conductors: minimum #12 AWG RW90 in conduit.

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 30 min. battery life upon loss of power.

PART 1 - GENERAL

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| <u>1.1 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| | .2 | Data to include unit specifications and components, mounting method, source of power and special attachments. |

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| <u>1.2 OPERATION AND MAINTENANCE DATA</u> | .1 | Submit operation and maintenance data for incorporation in the Manual specified in Section 01 78 00. |
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| <u>1.3 REFERENCE</u> | .1 | CAN/CSA-C860-2011, Performance of Internally Lighted Exit Signs. |
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PART 2 - PRODUCTS

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| <u>2.1 EXIT LIGHT TYPE EXL-1</u> | .1 | Housing: die cast aluminum, brushed aluminum finish. |
| | .2 | Face and back plates: die cast aluminum. |
| | .3 | Lamps: One LED-2W panel 120VAC, 219,000 h. |
| | .4 | Face plate: number of faces as indicated. Universal faces indicating "running man" pictogram only or "running man" pictogram with directional arrows. |
| | .5 | Face plate pictogram to illustrate image and direction specific to application and installation eg: exist straight form here; progress down to right; progrss left; etc. |
| | .6 | Face plate to remain captive for relamping. |
| | .7 | Finish: white finish. |
| | .8 | Options: Unit complete with integral 30 minute battery backup. |
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- 2.1 EXIT LIGHT TYPE EXL-1
(Cont'd)
- .9 Mounting: Unit to have universal mounting position and single or double face with knock out arrows as indicated.
- .10 Minimum ten (10) year life warranty.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install exit lights.
- .2 Install correct pictogram(s).
- .3 Connect fixtures to exit light circuits as indicated on the drawings.
- .4 Confirm that exit light circuit breaker is locked in on position.

PART 1 - GENERAL

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| <u>1.1 RELATED REQUIREMENTS</u> | .1 | Section 01 33 00 - Submittal Procedures. |
| | .2 | Section 01 74 21 - Construction/Demolition Waste Management and Disposal. |
| | .3 | Section 26 05 00 - Electrical General Requirements. |
| <u>1.2 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Product data to include: <ul style="list-style-type: none">.1 Replacement data for motor element, thermostat and switch..2 Mounting methods..3 kW rating, voltage, phase..4 Cabinet material thicknesses..5 Physical size..6 Finish..7 Thermostat, transformer, controls where integral. |
| <u>1.3 WASTE MANAGEMENT AND DISPOSAL</u> | .1 | Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan. |
| | .2 | Remove from site and dispose of packaging materials at appropriate recycling facilities. |
| | .3 | Collect and separate for disposal paper, plastic. polystyrene. corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan. |
| | .4 | Divert unused metal and wiring materials from landfill to metal recycling facility approved by Department Representative. |
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PART 2 - PRODUCTS

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| <u>2.1 FORCED AIR HEATERS</u> | .1 | Forced air heaters, wall mounted with fully recessed or semi-recessed mounting frame, commercial type as follows:
.1 Enclosure:
.1 Steel, 1.2 mm thick.
.2 Epoxy-polyester powdercoat finish, almond colour.
.3 Knockouts for 21 mm diameter conduit left, right, bottom and rear.
.4 208V, single-phase, complete with built-in thermostat. Wattage as indicated.
.2 Thermostatical controlled blower(s). |
| <u>2.2 COMMERCIAL BASEBOARD HEATERS</u> | .1 | Commercial heavy duty heater, wall mounting as follows:
.1 Enclosure: steel, 1.2 mm thick.
.2 Epoxy-polyester powdercoat finish, almond colour.
.3 Adjustable louvers and protective screen.
.4 208V and 120V as indicated, single-phase, complete with built-in low-voltage relay and thermostat as indicated. Wattage as indicated. |

PART 3 - EXECUTION

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|----------------------------------|----|--|
| <u>3.1 INSTALLATION</u> | .1 | Install heaters in accordance with manufacturer's instructions. |
| | .2 | Coordinate installations in elevator pit with elevator installer. |
| | .3 | Make power and control connections. |
| <u>3.2 FIELD QUALITY CONTROL</u> | .1 | Perform tests in accordance with Section 26 05 00 - Electrical General Requirements. |