

PART 1 - GENERAL

- | | | |
|---|----|---|
| <u>1.1 GENERAL</u> | .1 | This Section covers items common to Sections of Division 26, 27, 28 and portions of 33. This section supplements requirements of Division 1. |
| | .2 | Refer to Section 01 91 13 for commissioning requirements. |
| <u>1.2 CODES AND STANDARDS</u> | .1 | Do complete installation in accordance with CSA C22.1-2012, and local regulations, except where specified otherwise. |
| | .2 | Do overhead systems in accordance with CAN/CSA-C22.3 No. 1 and underground systems in accordance with CAN/CSA C22.3 No. 7, except where specified otherwise. |
| | .3 | Abbreviations for electrical terms: to CSA Z85-1983. |
| | .4 | Comply with the requirements of the "Model National Energy Code of Canada for Buildings 2010." |
| | .5 | CAN3 C235-83(R2010). |
| <u>1.3 CARE, OPERATION AND START-UP</u> | .1 | Instruct operating personnel in the operation, care and maintenance of all equipment. |
| | .2 | Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components. |
| | .3 | Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation. |
| <u>1.4 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 operating limits established by above standard. Equipment to operate in extreme |
-

1.4 VOLTAGE
RATINGS
(Cont'd)

- .2 (Cont'd)
operating conditions established in above standard
without damage to equipment.

1.5 PERMITS, FEES
AND INSPECTION

- .1 Submit to the Electrical Inspection Department,
Municipal Authority and supply authority the
necessary number of drawings and specifications, for
examination and approval prior to commencement of
work. This information shall be submitted within
twenty (20) working days of the award of Tender and
the Departmental Representative is to be provided
with written notice at the time this has been
submitted.
- .2 Provide the Departmental Representative with a copy
of the electrical Inspection Department and supply
Authority Plans Review Report, immediately upon
receipt. No shop drawings will be reviewed prior to
receipt of the Plans Review Report from the
Contractor.
- .3 Obtain all necessary permits including an Electrical
Wiring Permit for electrical work and Communications
Cabling Permit for communications cabling work from
the authority having jurisdiction, prior to
commencement of work. Provide a copy of each permit
to the Departmental Representative upon receipt. The
permits are to be properly displayed on the work
site.
- .4 Upon specific request, the Departmental
Representative will provide, to the Contractor, up to
a maximum of three (3) copies of the drawings and
specifications required for submittal to the
Electrical Inspection Department and Supply
Authority. These drawings and specifications will be
provided to the Contractor at no cost, unless
specified otherwise.
- .5 Arrange for all required inspections to be conducted
by the authority having jurisdiction. Provide a copy
of all inspection reports to the Departmental
Representative immediately upon receipt. Notify the
Departmental Representative immediately of changes
required by the authority having jurisdiction.
- .6 Furnish Certificates of Acceptance from authorities
having jurisdiction upon completion of work. Include
a copy in the Operation and Maintenance Manual.

1.5 PERMITS, FEES
AND INSPECTION
(Cont'd)

- .7 Pay all associated fees, including necessary inspections and inspection department representation occurring outside normal working hours.

1.6 MATERIALS
AND EQUIPMENT

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

1.7 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.

1.8 EQUIPMENT
IDENTIFICATION

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

1.8 EQUIPMENT
IDENTIFICATION
(Cont'd)

- .2 Identification:
- .1 All switchboards, panels, disconnect switches, receptacles, voice/data, transformers, control panels, fire alarm devices, magnetic starters, TOL's, etc. are to be provided with "lamicoid" nameplates as further described herein. Care is to be taken to ensure that all plates are affixed true and level, and plumb in all instances.
 - .2 Affix nameplates to all "metal" surfaces with steel type "pop- rivets".
 - .3 Affix nameplates to other types of surfaces with contact type cement.
 - .4 Affix nameplates to building "exterior" surfaces with nylon inserts and self tapping screws unless specifically indicated otherwise.
 - .5 Apply contact type cement to complete rear side of plate, as opposed to several locations or areas on same.
 - .6 Lamicoid nameplates installed on distribution panelboards, motor control centres, splitter troughs and transformers must 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 H - 150 AMPS
120/208V - 3PH - 4W
FED FROM MAIN SWITCHBOARD #QMS-1

- .7 Lamicoid nameplates installed on combination starters, magnetic starters, manual starter and all various systems controls, control panels, disconnect switches, etc., must contain the following information:
- .1 Designated name of equipment.
 - .2 Designated name of power source.
 - .3 Branch circuit breaker number(s) where possible.
 - .4 Voltage(s).

EXHAUST FAN NO. 5	SUPPLY FAN NO. 3
PANEL H - CCT. NO. 17	M.C.C. NO. 1
120V - PH	600V - 3 PH

- .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, designated panel name and electrical characteristics where applicable.

1.8 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 Identification:(Cont'd)

.10 Install lamicoid nameplates 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 800 AMPS
346/600V, 3PH, 4W

Example:

MAIN SWITCH 200 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, etc.), that may contain overcurrent devices (i.e., circuit breakers and/or fuses), that have been designed for, and incorporate interrupting capacity sized "larger" than 10 KAIC.

Example:

Min, interrupting capacity of breakers
installed in this panel to be not less
than 22 KAIC

Example:

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

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

Example: PANEL H - 20

.14 Lamicoid nameplates above 120V receptacles protected by GFCI circuit breakers, or GFCI type receptacles are to be identified as per the following:

.1 1.5mm thick x 19mm wide complete with 6 mm white letters on black face above all

1.8 EQUIPMENT
IDENTIFICATION
(Cont'd)

- .2 Identification:(Cont'd)
- .14 (Cont'd)
- .1 (Cont'd)
- receptacles. Identical width as finish device plate (EXAMPLE: GFCI Protected Panel H-26).
- .15 Apply lamicoid nameplate(s) for power/voice/data outlets above face of finish plate, complete with information as specified in section 27 05 13.
- .1 1.5mm thick x 19mm wide complete with 6mm white letters on black face above all receptacles. Identical width as finish device plate.
- .16 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 wording to match physical location and annunciator display address.
- .17 Lamicoid 3mm thick plastic engraving sheet, white letters on black face, for all electrical systems except fire alarm which shall have red face with white letters.
- .1 1.5mm thick nameplates above receptacles as previously indicated, with top left and right corners to be rounded off.
- .2 Lettering on lamicoid nameplates are not to "start", nor "end" nearer than 13mm from either, or both ends of said plates. Size of lettering, including overall lengths of various plates shall be as indicated in the following chart.

NAMEPLATE SIZES

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

- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for average of forty (40) letters per nameplate and label.
- .5 Identification to be English.

1.8 EQUIPMENT
IDENTIFICATION
(Cont'd)

- .6 Provide lamicoid nameplates installed on, or adjacent to, all various systems' control panels and/or cabinets complete with information as indicated. Nameplates to reflect individual system's assigned name, and where applicable, shall also indicate both designated panel name and associated branch circuit breaker number(s).
 - .1 Fire alarm panels
 - .2 Security (intrusion) panels
 - .3 Energy management panels
 - .4 Communication panels
- .7 Control Transformers:
 - .1 Concealed control transformers located within ceiling spaces are to have lamicoid nameplates installed adjacent to same indicating their identified system, primary power source including designated panel name, complete with associated branch circuit breaker number(s).
 - .2 Install a 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 all 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. Neatly write list using black indelible marker.
- .11 Colour code all electrical junction boxes, pull boxes and conduit fittings as follows:
 - .1 Apply colour coding prior to installation of boxes/equipment.
 - .2 Where primary colour only is indicated:
 - .1 Colour inside and outside of box.
 - .2 Colour all cover plates.
 - .3 Where primary and secondary colours are indicated:
 - .1 Paint inside and outside of box with the primary colour.

1.8 EQUIPMENT
IDENTIFICATION
(Cont'd)

- .11 (Cont'd)
 - .2 (Cont'd)
 - .3 (Cont'd)
 - .2 Diagonally apply to each half of the cover plate the primary and secondary colours.
- .12 Where a lamicoid identified item is installed above an accessible ceiling, provide two (2) lamicoid plates, one (1) at the item location and one (1) directly below on the underside of the ceiling.

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

1.10 CONDUIT
AND CABLE
IDENTIFICATION

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

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

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

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

1.10 CONDUIT AND CABLE IDENTIFICATION (Cont'd)	.5	Provide a legend of colour coding, mounted under plexiglass cover. Install in main electrical room.
	.6	Where boxes are not concealed, disks are to be fastened directly to outside of boxes after architectural painting is complete. Coverplates for such boxes are to have each branch circuit number neatly identified inside of the coverplate.
1.11 WIRING TERMINATIONS	.1	Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.
	.2	Label all branch circuit wiring including phase conductors, neutral, ground and/or bonding conductors to be done on both ends of all circuit wires plus in any junction and pull boxes located between ends. Use write-on self laminating labels. Wrap around conductor in a "U" fashion.
1.12 MANUFACTURERS AND CSA LABELS	.1	Visible and legible after equipment is installed.
1.13 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.
1.14 SINGLE LINE ELECTRICAL DIAGRAMS	.1	Provide single line electrical diagrams under plexiglass as follows: .1 Electrical distribution system: locate in main electrical room. .2 Include a legend of colour coding for the various systems indentified in item 10-conduit and cable identification.
	.2	Drawings: Full drawing size in main electrical room and 610mm x 610mm (minimum) size drawing in penthouse.
	.3	Provide 610 x 610mm size drawings indicating riser diagrams for the following systems: .1 Communications .2 Fire Alarm

1.14 SINGLE LINE ELECTRICAL DIAGRAMS (Cont'd)	.3	(Cont'd)
	.3	Security
	.4	Public Address
	.5	Personal Protection Alarm (PPA)
1.15 LOCATION OF EQUIPMENT	.1	Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes. Do not install boxes back to back in the same stud space.
	.2	Change location of equipment at no extra cost or credit, providing distance does not exceed 3m, and information is given before installation.
	.3	Locate light switches on latch side of doors. Locate disconnect devices in mechanical rooms on latch side of doors.
1.16 MOUNTING HEIGHTS	.1	Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
	.2	If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
	.3	Mounting heights for devices to conform with NBCC 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: 450mm
	.2	Above top of continuous baseboard heater: 200mm, minimum 450mm AFF.
	.3	Above top of counters or counter backsplash: 150mm
	.4	In mechanical rooms: 1200mm
	.3	Panelboards: as required by Code or as indicated.
	.4	Wall mounted telephone and data outlets:
	.1	General: 450mm
	.2	Above top of continuous baseboard heater: 200mm, minimum 450mm AFF.
	.3	Above top of counters or counter backsplash: 150mm
	.4	In mechanical rooms: 1200mm
	.5	Fire alarm stations: 1200mm

-
- 1.16 MOUNTING HEIGHTS
(Cont'd)
- .4 (Cont'd)
.6 Fire alarm signals: 2300mm
-
- 1.17 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, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.
- 1.18 CONDUIT AND CABLE INSTALLATION
- .1 Install conduit and sleeves prior to pouring of concrete.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Arrange and pay for holes through exterior walls and roof to be flashed and made weatherproof.
- 1.19 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.
- 1.20 FIELD QUALITY CONTROL
- .1 Conduct and pay for following tests:
.1 Circuits originating from branch distribution panels.
.2 Lighting and its control.
.3 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
.4 Systems: fire alarm system, intrusion alarm system, public address system and personal protection alarm system.
-

-
- 1.20 FIELD QUALITY CONTROL
(Cont'd)
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing.
- .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
- .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- .3 Check resistance to ground before energizing.
- .4 Carry out tests in presence of Departmental Representative.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit typed test results for Departmental Representative's review and inclusion in the Operation and Maintenance Manual.
- 1.21 COORDINATION OF PROTECTIVE DEVICES
- .1 Confirm circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- 1.22 DEMONSTRATION, OPERATING AND MAINTENANCE INSTRUCTIONS
- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, troubleshooting and servicing all systems and equipment, during regular work hours, prior to acceptance.
- .2 Use as-built drawings, operation and maintenance manual, audio visual aids, etc. as part of instruction materials.
- .3 Allow for a minimum of two (2) eight hour working days to provide instruction and demonstration. This is in addition to training specified elsewhere.
- 1.23 WASTE MANAGEMENT AND DISPOSAL
- .1 Collect, separate and recycle all site generated waste materials in accordance with Section 01 74 19 Construction Waste Management.
-

- | | | |
|--|----|--|
| 1.23 WASTE
MANAGEMENT AND
DISPOSAL
(Cont'd) | .2 | Confirm the following forms, included at the end of
Section 01 74 21 Waste Management and Disposal, are
completed and submitted to the Contractor.
.1 Waste Audit (WA) Sheet - Schedule A.
.2 Waste Tracking Form - Schedule B |
|--|----|--|

<u>PART 2 - PRODUCTS</u>	Not applicable.
--------------------------	-----------------

<u>PART 3 - EXECUTION</u>	Not applicable.
---------------------------	-----------------

PART 1 - GENERAL

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

PART 2 - PRODUCTS

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

PART 3 - EXECUTION

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

PART 1 - GENERAL

- | | | |
|---|----|--|
| <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(R2013), Fire Alarm and Signal Cable. |
| <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

- | | | |
|----------------------------|----|--|
| <u>2.1 BUILDING WIRES</u> | .1 | Conductors: to be soft drawn copper of 98% conductivity; stranded for 12 AWG and larger. Minimum size: 12 AWG. |
| | .2 | Copper conductors sized as indicated or as required by C.E.C., with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90-XLPE. |
| | .3 | Grounding and bonding conductors sized up to and including #10 AWG are to have green coloured RW90 cross linked insulation. Type TW75 green coloured insulation is acceptable for sizes #8 AWG and larger. |
| <u>2.2 ARMOURED CABLES</u> | .1 | Conductors: insulated, copper, size as indicated, minimum #12 AWG. |
| | .2 | Type: AC90. |
| | .3 | Armour: interlocking type fabricated from aluminum strip. |
-

- 2.2 ARMOURED CABLES .4 Connectors: designed for cable.
(Cont'd)
- .5 Cable ties to Section 26 05 29 - Fastening and Supports.
.1 6mm dia threaded rods to support suspended channels.

- 2.3 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 with black jacket. FT6 rated.

- 2.4 SECURITY AND AUXILIARY SYSTEM CABLING .1 FT6 rated.
- .2 Insulated copper conductors, size and type as indicated or required by manufacturer.
- .3 Black coloured PVC outer jacket.

PART 3 - EXECUTION

- 3.1 INSTALLATION OF BUILDING WIRES .1 Install wiring as follows:
.1 In conduit systems in accordance with Section 26 05 34.

- 3.2 INSTALLATION OF FIRE ALARM CABLES .1 Install fire alarm cables in RG5.
- .2 Fire alarm cabling will be permitted to be installed in flexible metal conduit for final connection to various fire alarm devices installed upon flush mounted outlet boxes in finished ceiling tiles and to sprinkler devices. Liquid-tight flexible metal conduit is not exceed 5m in total length. Minimum size 12mm.

- 3.3 INSTALLATION OF ARMOURED CABLES .1 A home run is defined as that portion of the branch circuit wiring that runs between the applicable panelboard and the area or room in which it either:
.1 terminates at the applicable branch circuit device, or
-

3.3 INSTALLATION
OF ARMOURED CABLES
(Cont'd)

- .1 (Cont'd)
 - .2 makes a splice for final connection to the applicable branch circuit device.
- .2 AC-90 will only be permitted for branch circuit wiring drops from ceiling junction boxes to light fixtures installed in fully exposed or concealed ceiling spaces, within the same room requiring electrical power. The installation of AC-90 cable for branch circuit wiring home runs or runs between rooms or in areas with linear metal panel ceilings is not acceptable.
- .3 The grouping together of AC-90 cables to form a "bundle" for securing purposes is acceptable provided:
 - .1 In addition to securing AC- 90 cables at 1.5m (60") intervals to structure, multiple or bundled groups of armoured cables shall be tie-wrapped together at mid-point between each structure support and are to be secured to structure at 1.5m (60") intervals, and also secured together between each structure support at 1.5m (60") intervals.
 - .2 Limit grouping of AC-90 cables to a maximum of eight (8) current carrying conductors, including associated oversized neutrals, where phase sharing occurs.
- .4 Install concealed, parallel and perpendicular to building lines and shall be adequately secured to the building structure at not less than 1.5m (60") intervals in such a manner as to ensure they are protected from potential types of mechanical damage occurring. Install independent supports for cabling in ceiling spaces, and do not use those of other trades. Do not secure cables to mechanical piping systems, ducts or suspended ceiling support wires. The laying of un-supported cables directly atop the ceiling grid system is strictly prohibited.
- .5 Always install and secure surface cables directly to the underside of ceiling slabs or metal decking where located in concealed ceiling spaces.
- .6 The following examples incorporate uses of both common and dedicate branch circuit neutral conductors:
 - .1 Maximum of two (2) runs of #12/4 conductor cables including common (oversized) branch circuit neutrals in each.
 - .2 Maximum of two (2) runs of #12/3 conductor cables, including oversized branch circuit neutrals (if net 3 phase 3 wire) plus one (1) run of #12/2 cable.

3.3 INSTALLATION
OF ARMOURED CABLES
(Cont'd)

- .6 (Cont'd)
 - .3 Maximum of four (4) runs of #12/2 conductor cables, each including a separate, dedicated branch circuit neutral conductor.
- .7 Where dedicated or separate branch circuit neutral conductors are non phase sharing they need not be sized larger than phase conductors they are accompanying unless specifically indicated otherwise.
- .8 Originate all 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 4-11/16" square.
- .9 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 concealed or exposed ceiling space and its respective light fixture.
 - .1 Fixture drops are not to exceed 5m (15') in total length unless specifically indicated otherwise.
 - .2 There shall be not more than four (4) drops permitted to be fed from any one box regardless of its size. All AC-90 cables used for fixture drops are to be secured within 300mm (12") of the junction box. Each light fixture is to be complete with its own separate fixture drop originating from junction box located in the same room as the fixture. An exception shall be made for 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 (6") or greater in diameter.
 - .3 Wire each light fixture with a separate "whip" emanating from an overhead junction box.
 - .4 Both #12 AWG and #14 AWG type AC-90 armoured cables may be used where the total fixture drop loads do not exceed the following:
 - .1 5000W @347V, #12AWG
 - .2 3500W @347V, #14AWG
 - .3 1800W @120V, #12AWG
 - .4 1300W @120V, #14AWG
- .10 Separate pig-tail type leads shall be provided in each light fixture junction/outlet box for final connection to fixture drops. These pig-tails are to be only connected to light fixture returns and associated neutral conductors.

- 3.4 INSTALLATION OF CONTROL CABLES
- .1 Install control cables. Complete with bonding conductor, minimum 21mm conduit and #14AWG bonding conductor.
 - .2 Bond control cable shield where required.
 - .3 Building management system controls wiring methods to be installed in accordance with Section 27 05 28 and 27 05 13 (per voice and data structured cabling).
- 3.5 INSTALLATION OF CABLES: GENERAL
- .1 Support cables independently of supports used for equipment of other trades; do not support from or secure cables to ductwork, piping and ceiling hanger wires.
 - .2 Do not lay cables on top of suspended ceiling grids and tiles.
 - .3 Install cables in a neat and professional manner, so as to conserve headroom. Correct any unacceptable work at no additional cost to the Contract.
 - .4 Install cables parallel and perpendicular to building lines.
 - .5 Secure cables to underside of metal decking.
 - .6 Make the tie-wrapping of the neutral conductor with its respective phase conductors at the closest point of entry within all panelboards, pull boxes, junction boxes and outlet boxes, etc.
 - .7 All branch circuits which do not have neutral conductors are to have their respective phase conductors type-wrapped together in accordance with Clause 3.5.6 above.
 - .8 Twist together all stranded conductors prior to any types of terminations taking place, but not necessarily limited to: receptacles, light switches, neutral terminal strips, bonding terminal strips, circuit breakers, disconnect switches, starters, contactors, relays, all types of termination lugs, panelboards, etc.
-

3.6 INSTALLATION OF SECURITY, ACCESS CONTROL AND CCTV SYSTEM CABLING	.1	Install all security, personal protection alarm and public address system wiring in conduit in its entirety unless noted otherwise.
---	----	---

PART 1 - GENERAL

- 1.1 RELATED WORK .1 Wires and Cables 0-1000V: Section 26 05 21
- 1.2 REFERENCES .1 IEEE 837-2002, Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA C22.2 No. 41-2007(R2013), Grounding Equipment.

PART 2 - PRODUCTS

- 2.1 EQUIPMENT .1 Clamps for grounding of conductor: size as required and suitable for application.
- .2 Rod electrodes: copper clad 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 10 - 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 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 Thermit welded type conductor connectors.
- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.

2.1 EQUIPMENT .8 Copper compression type, long barrel, two hole type
(Cont'd) lugs unless specified otherwise.

.9 Copper compression type connectors (cable to cable,
cable to ground rod, etc.).

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

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install complete permanent, continuous grounding
GENERAL system including, electrodes, conductors, connectors,
accessories. Conform to the requirements of the
Departmental Representative, applicable codes and the
local electrical inspection authority having
jurisdiction.

.2 Install connectors in accordance with manufacturer's
instructions.

.3 Protect exposed grounding and bonding conductors
from mechanical injury.

.4 Make buried connections, and connections to
electrodes using inspectable copper crimp type
compression connectors.

.5 Use mechanical connectors for grounding and bonding
connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install insulated bonding conductor in all conduits.

.8 Install separate insulated bonding conductor to
outdoor lighting standards.

.9 Connect building structural steel to ground as
indicated on the drawings.

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

.11 Bond single conductor, metallic armoured cables to
cabinet at supply end, and provide non-metallic entry
plate at load end.

3.1 INSTALLATION
GENERAL

(Cont'd)

- .12 Ground secondary service pedestals.
- .13 The 'feed' bonding conductor shall be secured (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors and/or providing a "pig-tail" lead for device terminations.
- .14 Twist together all ground/bond wires with a screw-on type wire connector, and then placed in the rear of the outlet box.
- .15 Bond all conduits containing insulated ground conductor(s) at both ends.
- .16 Bend radius of all grounding/bonding conductors to a minimum of 200mm diameter.

3.2 ELECTRODES

- .1 Install rod electrodes and make grounding connections.
- .2 Bond separate, multiple electrodes together.
- .3 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.
- .2 The main incoming ground conductor is to run unbroken to the main electrical service entrance overcurrent device ground bus and then to the wall mounted ground bus.

3.4 EQUIPMENT
GROUNDING

- .1 Install grounding/bonding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, duct systems, frames of motors, starters, control panels, building steel work, distribution panels, outdoor lighting, metallic waste water piping systems, metallic rain water leader systems, metallic gas fuel piping systems.

-
- 3.5 GROUNDING BUS .1 Install copper grounding bus mounted on insulated supports in electrical and telecommunications rooms.
- .2 Ground items of electrical equipment to ground bus as indicated herein and on the Drawings.
- 3.6 COMMUNICATION SYSTEMS .1 Telecommunications: provide grounding and bonding in accordance with BICSI Telecommunications Distribution Methods Manual (TDMM), 12th Edition.
- 3.7 FIELD QUALITY CONTROL .1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Where applicable, disconnect ground fault indicator during tests.

PART 1 - GENERAL

Not applicable.

PART 2 - PRODUCTS

<u>2.1 SUPPORT CHANNELS</u>	.1	U shape, size 40mm x 40mm, galvanized steel, surface mounted, suspended or set in poured concrete walls and ceilings unless otherwise indicated.
-----------------------------	----	--

PART 3 - EXECUTION

<u>3.1 INSTALLATION</u>	.1	Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
	.2	Secure equipment to poured concrete with expandable inserts.
	.3	Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
	.4	Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation. Provide additional supports as necessary.
	.5	Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
	.6	Fasten exposed conduit or cables within 1m of each outlet box, junction box, pull box, cabinet or conduit fittings with spacing between supports as per CEC to building construction or support system using straps. .1 One-hole zinc plated steel straps to secure surface conduits and cables smaller than 41mm. .2 Two-hole zinc plated steel straps for conduits and cables 41mm and larger. .3 Beam clamps to secure conduit to exposed steel work.
	.7	Suspended support systems. .1 Support individual cable or conduit runs with 9mm dia threaded rods and spring clips. .2 Support two (2) or more cables or conduits on channels supported by 9mm dia threaded rod hangers where direct fastening to building construction is impractical.

3.1 INSTALLATION
(Cont'd)

- .8 For surface mounting of two or more conduits use channels at 1.5m oc spacing.
- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Verify there is adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support.
- .13 Install fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Fasten individual and multiple runs of armoured cables to structure and in bundles as permitted in 26 05 21 - Wire and Cables 0-1000 Volts.
- .15 Various suspended types of junction, pull and/or outlet boxes as well as conduits, are to be supported with minimum size 9mm threaded rod, nuts and flat washers. Threaded rods to be secured to boxes with one flat washer and nut installed on both sides of box.
 - .1 One (1) rod required for all type boxes sized 150mm x 150mm and smaller (22,500mm² 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.
- .16 Cut off all excess rod within 13mm of channel bottom. In addition to C.E.C. minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300mm and mid point of "all" 90 bends. Maximum spacings between conduit support channels will be as dictated by smallest size conduit(s) being supported and/or secured to same.
- .17 In addition to the CEC minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one (1) additional support rod installed not greater than

3.1	INSTALLATION	.17	(Cont'd)
	(Cont'd)		300mm from midpoint of all 90 bends. Maximum
			spacings between conduit support channels will be
			dictated by smallest size conduit(s) being supported
			and/or secured to same.

PART 1 - GENERAL

- | | | |
|---|----|---|
| <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. |
|---|----|---|

PART 2 - PRODUCTS

- | | | |
|--|----|---|
| <u>2.1 SPLITTERS</u> | .1 | Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. Interior units shall be CSA Type 1 enclosure. |
| | .2 | Exterior units shall be CSA Type 4X, 304 or 316 stainless steel. |
| | .3 | Main and branch lugs or Connection bars to match required size and number of incoming and outgoing conductors as indicated. |
| | .4 | At least three spare terminals on each set of lugs in splitters. |
| <u>2.2 JUNCTION
AND PULL BOXES</u> | .1 | Type C: welded steel construction, hinged cover, catch with hasp. Provision for locking. Surface mounting. |
| | .2 | Type D: welded steel construction with screw-on flat covers for surface mounting. Surface or flush mounting as indicated. Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes. |
| | .3 | Junction and pull boxes larger than 125mm x 125mm shall be Type "E", complete with continuously hinged door. Junction and pull boxes 125mm x 125mm and smaller to be complete with screw cover. |
| | .4 | Single gang "sectional" type devices boxes being used in steel stud walls for the installation of both metallic and non-metallic type cables, not to be sized smaller than 250cm, complete with wrap around type bracket. |
| | .5 | Two (2) or more flush installed sectional boxes, ganged together on boxes sized 100mm and larger (intended for devices), are to have an additional support bracket installed on opposite side of box, not presently secured to metal stud. |
-

2.2 JUNCTION AND PULL BOXES (Cont'd)

- .6 Where larger sized devices or other types of "flush" outlet or junction boxes may be required, use suitably sized 100mm x 100mm (4x4") deep or 118 mm (4-11/16") square boxes complete with appropriate sized extension tile rings. The use of plaster rings in lieu of tile type extension rings is not acceptable.
- .7 Junction boxes 150mm x 150mm (6"x6") used in branch circuit wiring are to be complete with bonding terminal strips.

2.3 CABINETS

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

PART 3 - EXECUTION

3.1 SPLITTER INSTALLATION

- .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.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2m above finished floor.
- .3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.
- .4 Where located above accessible ceiling systems, locate enclosures within 750mm (30") of ceiling.
- .5 Suspend enclosures on 9mm plated steel threaded rod or rods secured to enclosure with one flat washer and one nut on both sides of box.
- .6 Provide number of threaded rod supports as follows:
 - .1 Boxes up to 120mm square: one (1) rod.
 - .2 Boxes from 120mm to 200mm square: two (2) rods.
 - .3 Boxes with dimensions above 200mm: four (4) rods.

- | | | |
|---|----|---|
| 3.2 JUNCTION,
PULL BOXES AND
CABINETS
INSTALLATION
(Cont'd) | .7 | Concealed junction or outlet boxes feeding a maximum of two fixture drops shall not be sized smaller than 100mm . |
| | .8 | Bond pull boxes and cabinets to ground utilizing a bonding conductor. |
-
- | | | |
|--------------------|----|---|
| 3.3 IDENTIFICATION | .1 | Provide equipment identification in accordance with Section 26 05 00. |
| | .2 | Identify the location of conceded boxes installed above drywall ceilings or behind walls on the room side of access opening frames with properly colour coded identification disks. |

PART 1 - GENERAL

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

PART 2 - PRODUCTS

- 2.1 OUTLET AND CONDUIT BOXES GENERAL .1 Size boxes in accordance with CSA C22.1.
.2 100 mm square or larger outlet boxes as required for all devices.
.3 Gang boxes where wiring devices are grouped.
.4 Blank cover plates for boxes without wiring devices.
- 2.2 SHEET STEEL OUTLET BOXES .1 Electro-galvanized steel flush device boxes for flush installation, minimum size 100mm square and c/w extension and tile rings as required.
.2 Electro-galvanized steel utility boxes for outlets connected to surface- mounted conduit, minimum size 100mm square.
.3 100mm square or octagonal outlet boxes for lighting fixture outlets.
.4 100mm square outlet boxes with extension and tile rings for flush mounting devices in finished walls.
- 2.3 MASONRY BOXES .1 Electro-galvanized steel masonry 100mm square boxes for devices flush mounted in exposed block walls.
- 2.4 CONCRETE BOXES .1 100mm square electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
- 2.5 CONDUIT BOXES .1 Cast FS or FD ferrous alloy boxes with factory-threaded hubs and mounting feet for all surface wiring of devices (switches, receptacle, thermostats and similar devices) installed lower than 2.4m AFF. Matching steel type FS metal device plates

- | | | | |
|-----|--------------|-----|---|
| 3.1 | INSTALLATION | .11 | Do not use sectional type boxes with rigid |
| | (Cont'd) | | galvanized steel conduit, rigid PVC conduit or EMT. |
| | | .12 | In metal drywall partitions, install a short piece |
| | | | of metal stud (same width as wall) on non-supported |
| | | | side of box and secure to box. |

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(R2012), Rigid Metal Conduit - Steel.

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

.3 CSA C22.2 No. 83-1985(R2013), Electrical Metal Tubing.

.4 CSA C22.2 No. 211.2-2006, 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

<u>2.1 OUTLET AND CONDUIT BOXES - GENERAL</u>	.1	Size boxes in accordance with CSA C22.1.
	.2	100 mm square or larger outlet boxes as required for special devices.
	.3	Gang boxes where wiring devices are grouped.
	.4	Blank cover plates for boxes without wiring devices.
<u>2.2 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.
<u>2.3 CONDUIT FASTENINGS</u>	.1	One hole steel straps to secure surface conduits smaller than 41mm. Two hole steel straps for conduits 41mm and larger.
	.2	Beam clamps to secure conduits to exposed steel work.
	.3	Channel type supports for two or more conduits at 1.5m oc.
	.4	9mm dia threaded rods to support suspended channels.
<u>2.4 CONDUIT FITTINGS</u>	.1	Fittings: manufactured for use with conduit specified. Coating: same as conduit.
	.2	Conduit fittings (LB, LL, LR) are to be used for 90 bends. "Ells", or corner pulling "Elbows" are prohibited.
	.3	Waterproof type connectors shall be used on all conduit runs connecting equipment.
	.4	Plastic screw on bushings for conduit ends.

- | | | |
|-----------------------------|----|--|
| <u>2.5 GENERAL FITTINGS</u> | .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. |

- | | | |
|---|----|---|
| <u>2.6 EXPANSION FITTINGS RIGID CONDUIT</u> | .1 | Weatherproof expansion fittings with internal bonding assembly suitable for 200mm linear UIT |
| | .2 | Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19mm deflection in all directions. |
| | .3 | Weatherproof expansion fittings for linear expansion at entry to panel. |

- | | | |
|----------------------|----|--------------------------------------|
| <u>2.7 FISH CORD</u> | .1 | Polypropylene: minimum 3mm diameter. |
|----------------------|----|--------------------------------------|

PART 3 - EXECUTION

- | | | |
|-------------------------|----|--|
| <u>3.1 INSTALLATION</u> | .1 | Install conduits as high as possible to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass. |
| | .2 | Conceal conduits except in mechanical and electrical service rooms and in unfinished areas. Install conduits as high as possible and secured to building structure with approved supports. |
| | .3 | Use rigid galvanised steel threaded conduit except for underground applications. |
| | .4 | Use EMT for all concealed wiring below 300V. |
| | .5 | Use rigid PVC conduit underground: minimum size 21mm dia. |
| | .6 | Use liquid tight flexible metal conduit for connection to motors or vibrating equipment. |
| | .7 | Minimum conduit size for lighting and power circuits: 21mm. |
-

3.1 INSTALLATION
(Cont'd)

- .8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .9 Mechanically bend steel conduit over 21mm dia.
 - .10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
 - .11 Install fish cord in empty conduits.
 - .12 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
 - .13 Dry conduits out before installing wire.
 - .14 Install insulated copper bonding conductor in all conduit runs. Minimum size: #14 AWG or Table 16 of C.E.C. which ever is larger.
 - .15 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. Extend conduits a minimum of 50mm (2") above housekeeping pad or concrete trough.
 - .16 Install plastic bushings in all EMT sized 35mm and larger before pulling in conductors.
 - .17 Use raintight EMT connectors and couplings complete with o-rings on vertical portion of conduit runs where terminating into tops of electrical equipment.
 - .18 Unless indicated otherwise, use liquid tight flexible metal conduit complete with matching connectors for final connection between EMT and applicable control device. Junction or pull boxes may also be used to make this transition.
 - .19 All EMT conduit stubs are to be bonded to ground as required by the CEC.
 - .20 Where construction consists of metal Q-deck and steel joists (roof deck), install conduits as follows:
 - .1 In such a manner that the nearest outside surface of the conduit is not less than 38mm (1.5") from the nearest surface of the metal roof deck. Typically, this would involve the installation of conduits on the underside of the top flange, secured with beam clamps or canstrut.
 - .2 Installation of conduits or raceways between the top flange of a steel support structure and a
-

- 3.1 INSTALLATION (Cont'd)
- .20 (Cont'd)
- .2 (Cont'd)
- steel roof deck is not permitted due to the possible penetration of roof deck mechanical screws or fasteners.
- .21 Where construction consists of metal Q-deck and steel joists (non-roof deck), conduits are to be installed as follows:
- .1 Between the top flange of a steel support structure and the Q-deck.
- .2 Where conduit sizes preclude the above mentioned method, install as high as possible in the space to conserve headroom.
- 3.2 SURFACE CONDUITS
- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 76mm parallel to steam or hot water lines with minimum of 25mm at crossovers.
- 3.3 CONDUITS UNDERGROUND
- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.
- .3 Conduits are only permitted to be installed below floors and are not to be installed in concrete floors unless specifically indicated otherwise.
- .4 Install PVC conduits sized 35mm (1½") and larger in trenches not less than 300mm in depth from underside of concrete floor slab to bottom of trench. Place conduits on a 50mm bed of sand and are to have a second 50mm bed of sand placed on top. Conduits to be completely surrounded by sand prior to backfilling taking place.
-

3.3 CONDUITS
UNDERGROUND
(Cont'd)

- .5 Wiring for all various systems devices and/or outlets installed below ground floor concrete floor slabs may be performed utilizing minimum 21m PVC rigid conduit. Transition from PVC rigid thick wall conduit to rigid steel threaded conduit is to take place below the floor slab.
- .6 All underground conduit to be up sized one (1) trade size above the minimum code requirement.
- .7 Rigid PVC (thick wall) conduit will be permitted to be direct buried.
- .8 Underground and underslab conduits are only permitted to be installed where specifically indicated.
- .9 Install PVC conduits sized 32mm in diameter and larger in trenches not less than 300mm in depth from underside of concrete floor slab to bottom of trench. Place conduits on a 50mm bed of sand and have a second 50mm of sand placed on top. Conduits to be "completely surrounded" by sand prior to backfilling taking place.
- .10 Conduit installation is not to influence the thickness of the floor slab.
- .11 Do not run conduits along concrete walls installed to reinforce wall installations.
- .12 PVC conduits of all sizes prior to turning-up through floor slabs, unless specifically indicated otherwise, are to have transition to rigid steel threaded conduit take place as previously indicated.
- .13 The installation of PVC type conduits above ground is prohibited.
- .14 Up-size all underground conduits at least one trade size above the minimum code requirement for ease of pulling.
- .15 Only use rigid Types EB1 and DB2/ES2 PVC (thinwall) Conduit (CSA C22.2 211.1) where embedded in concrete.
- .16 Rigid PVC (thick wall) Conduit (CSA C22.2 211.2) will be permitted to be direct buried.

PART 1 - GENERAL

1.1 RELATED WORK .1 Electrical general requirements: Section 26 05 00.

PART 2 - PRODUCTS

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

PART 3 - EXECUTION

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.
.3 Check phase rotation and identify each phase conductor of each feeder.
.4 Check each feeder for continuity, short circuits and grounds. Confirm resistance to ground of circuits is not less than 50 megohms.

- 3.2 FIELD QUALITY CONTROL
(Cont'd)
- .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

- 1.1 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00.
- .2 Indicate:
- .1 Impedance
 - .2 No load losses.
 - .3 Total load losses.
 - .4 Noise level.
 - .5 X/R ratio.
 - .6 Winding configuration and voltages.
 - .7 Taps.
 - .8 Enclosure dimensions.
 - .9 Mounting.
 - .10 Insulation rating.
 - .11 Temperature rise.
 - .12 Rating.
 - .13 Weight.
 - .14 Efficiencies.
- 1.2 OPERATION AND MAINTENANCE DATA .1 Provide operation and maintenance data for dry type transformers for incorporation into Manual specified in Section 01 78 00.
- .2 Include matrix of installed transformers tap settings for each transformer.
- .3 Include matrix of primary and secondary winding megger results.
- 1.3 REFERENCES .1 CSA C802.2-06, Minimum Efficiency Values for Dry-Type Transformers.
- .2 NEMA ST-20, Dry-Type Transformers for General Application.
-

PART 2 - PRODUCTS

- 2.1 TRANSFORMERS
- .1 Use transformers of one manufacturer throughout project.
 - .2 Design 1.
 - .1 Type: dry, epoxy vacuum impregnation.
 - .2 3 phase, kVA as indicated, 600 V input, 120/208 V output, 60 Hz.
 - .3 Voltage taps: -5.0%, -2.5%, 0%, +2.5% and 5.0% of rated voltage.
 - .4 Insulation: Class H (220°C), 150°C temperature rise.
 - .5 Basic Impulse Level (BIL): to NEMA ST-20.
 - .6 Hipot: standard.
 - .7 Average sound level: standard.
 - .8 Impedance at 170 C: standard.
 - .9 Enclosure: EEMAC 2, ventilated removable metal front panel and hood, drip proof.
 - .10 Mounting: Floor mounting only.
 - .11 Finish: in accordance with Section 26 05 00 - Electrical General Requirements.
 - .12 Winding configuration: Delta primary, grounded Y secondary. All windings copper.
 - .13 Options:
 - .1 Vibration isolators.
 - .2 Dual rated spade type transformer lug for ground/bonding of transformers.
 - .14 Electrostatically shielded.
 - .15 Acceptable Manufacturers:
 - .1 Delta
 - .2 Siemens
 - .3 Hammond
- 2.2 EQUIPMENT IDENTIFICATION
- .1 Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements.
 - .2 Label size: 7.
-

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Securely mount dry type transformer on concrete housekeeping pad or steel mounting frame. External vibration isolators to be provided on transformer support channels on each four corners and between transformer enclosure legs and mounting surface.
- .2 Transformers containing electrical termination points located on both front and rear sides of same are not acceptable.
- .3 Confirm adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible on vibration isolators.
- .7 Megger both primary and secondary windings with 1000 V and 500 V megger and report immediately and reading below 100 megohms. Include results in O&M Manual.
- .8 Ensure transformer is on the correct tap, measure voltages on secondary of transformer under normal building loading. Adjust voltage taps to obtain rated secondary voltages. Record tap settings and include in O&M Manual.
- .9 Add lugs for copper conductors when double neutrals are used.
- .10 All dry type transformers are to be complete with a Dual Rated Spade Type Transformer Lug, sized as required to facilitate both grounding and bonding conductor requirements.
 - .1 To be bolted directly to transformer enclosure (chassis) with a minimum of two 3mm (1/2") bolts, flat and lock washers and accompanying nuts etc.
 - .2 To contain number of termination openings as necessary to ensure individual terminations of "each" ground and "each" bond conductor(s) is achieved.
- .11 Connect electrostatic shield and transformer neutral and case solidly to ground.
- .12 Make primary and secondary connections in accordance with wiring diagram.

3.1 INSTALLATION (Cont'd)	.13 Energize transformers after installation end testing is complete.
------------------------------	--

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 IEEE C62.41.1-2008, guide on the Surge Environment in Low-Voltage AC Power Currents.
 - .2 IEEE C62.45-2008, Recommended Practice on Surge Testing for Equipment Connecto to Low-Voltage (1000V or less) AC Power Circuits.
 - .3 UL 1283-2013, Electromagnetic Interference Filters.
- 1.2 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Drawings to include electrical detail of panel, branch breaker type, breaker quantity, ampacity, short circuit rating, bus materials and enclosure dimension.
- 1.3 OPERATION AND MAINTENANCE DATA
- .1 Provide operation and maintenance data for panelboards for incorporation into manual specified in Section 01 78 00.
 - .2 Include panel schedules.

PART 2 - PRODUCTS

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

- | | | |
|------------------------------|-----|--|
| 2.1 PANELBOARDS
(Cont'd) | .7 | Mains: suitable for bolt-on breakers. |
| | .8 | Trim with concealed front bolts and hinges. |
| | .9 | Trim and door finish: baked grey enamel. |
| | .10 | Minimum of one terminal screw on factory installed neutral bar for each circuit breaker position. |
| | .11 | Panel boards rated above 400A shall be 300mm deep and 900mm wide minimum. |
| 2.2 BREAKERS | .1 | Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers. |
| | .2 | Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise. |
| | .3 | Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker. |
| | .4 | Lock-on devices for 10 % of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to the Departmental Representative. |
| 2.3 EQUIPMENT IDENTIFICATION | .1 | Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements. |
| | .2 | Nameplate for each panelboard size 4 engraved as indicated. |
| | .3 | Nameplate for each circuit in distribution panelboards size 2 engraved as indicated. |
| | .4 | Complete circuit directory with typewritten legend showing location and load of each circuit. |
| 2.4 STANDARD OF ACCEPTANCE | .1 | Branch panels: Siemens P2. |
| 2.5 ACCEPTABLE MANUFACTURERS | .1 | Siemens |
| | .2 | Cutler Hammer |
| | .3 | Schneider |
-

PART 3 - EXECUTION

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

PART 1 - GENERAL

- 1.1 REFERENCES .1 CSA C22.2 No. 42-2010, General Use Receptacles, Attachment Plugs and Similar Wiring Devices.
- .2 CSA C22.2 No. 55-M1986(R2012), Special Use Switches.
- .3 CSA C22.2 No. 111-2010, General Snap Switches.
- 1.2 SHOP DRAWINGS .1 Submit shop drawings for each device and coverplate type as per specification Section 01 33 00.
- 1.3 OPERATIONAL AND MAINTENANCE DATA .1 Provide operation and maintenance data for wiring devices for incorporation into manual specified in Section 01 33 00.

PART 2 - PRODUCTS

- 2.1 SWITCHES .1 Design S1:
- .1 20 A, 120 V, specification grade, single pole, two way or three way switches.
- .2 Manually-operated general purpose ac switches with following features:
- .1 Terminal holes approved for No. 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 White 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.
- .5 Standard of Acceptance: Hubbell 1200 Series.
- .6 Approved Manufacturers:
- .1 Hubbell
- .2 Pass & Seymour
- .3 Arrow Hart
- .4 Leviton
- .5 Bryant

2.2 RECEPTACLES

- .1 Design R1:
 - .1 General purpose duplex receptacles, specification grade CSA type 5- 15 R, 125 V, 15 A, U ground, with following features:
 - .1 White urea molded housing for all power receptacles.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Standard of Acceptance: Hubbell 5262-W Series.
 - .7 Approved Manufacturers:
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Arrow Hart
 - .4 Leviton
 - .5 Bryant
 - .2 Design R2:
 - .1 Duplex receptacles, specification grade CSA type 5-20 R(T- Slot), 125 V, 15/20A, U ground, with following features:
 - .1 White urea molded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 White nylon face.
 - .7 Standard of Acceptance: Hubbell 5362-W Series.
 - .8 Acceptable Manufacturers:
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Arrow Hart Leviton
 - .4 Bryant
 - .3 Design R3:
 - .1 GFI duplex receptacles. Specification grade, CSA type 5-15R, 125V, 15A, U-Ground with the following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Eight back wired entrances, four side wiring screws.
-

2.2 RECEPTACLES
(Cont'd)

- .3 Design R3:(Cont'd)
 - .1 (Cont'd)
 - .4 Triple wipe contacts and riveted grounding contacts.
 - .5 White nylon face.
 - .6 GFI test and reset buttons.
 - .7 Standard of Acceptance:
 - .1 Hubbell GFR5252W Series.
 - .8 Approved Manufacturers:
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Arrow Hart
 - .4 Leviton
 - .5 Bryant
 - .4 Other receptacles with ampacity and voltage as indicated.
 - .5 Receptacles of one manufacturer throughout project.
 - .6 Acceptable materials:
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Arrow Hart
 - .4 Leviton
 - .5 Bryant

2.3 COVER PLATES

- .1 Cover plates for wiring devices.
- .2 Stainless steel, satin finish on flush mounted outlet boxes.
- .3 Galvanized pressed steel surface covers on surface mounted outlet boxes.
- .4 Heavy duty weatherproof while in use cover plates for devices designated as weatherproof.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Mount toggle switches at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
- .2 Receptacles:
 - .1 Mount receptacles at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
 - .2 Mount receptacles with "U" ground up for vertically mounted and neutral slot at top for horizontally mounted receptacle.
 - .3 Install "Pigtail" type leads on conductors in all device or outlet boxes where feeding through to other receptacles. "Daisy-chain" or looping through of conductors from one device to another is not acceptable. Provide separate pigtail conductor leads for final termination to each receptacle for phase, neutral and bond conductors.
 - .4 All receptacles are to be polarity tested.
- .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.
- .4 Device leveller and retainer is an approved accessory for securing devices to flush installed device boxes.

PART 1 - GENERAL

- | | | |
|---------------------------------|----|---|
| <u>1.1 RELATED REQUIREMENTS</u> | .1 | Wiring: Section 26 05 21. |
| | .2 | Conduits: Section 26 05 34. |
| <u>1.2 REFERENCES</u> | .1 | UL-464, Audible Signal Appliances. |
| <u>1.3 SHOP DRAWINGS</u> | .1 | Submit shop drawings in accordance with Section 01 33 00. |
| | .2 | Include: |
| | .1 | Submit manufacturer's descriptive literature and product specifications for each product. |
| | .2 | Manufacturer's product drawings. |

PART 2 - PRODUCTS

- | | | |
|---------------------------------------|----|---|
| <u>2.1 MATERIALS</u> | .1 | Equipment and devices: ULC listed and labelled and supplied by single manufacturer. |
| <u>2.2 AC POWERED CHIME RECEIVERS</u> | .1 | Single stroke chime |
| | .2 | Up to 10 pulses per second. |
| | .3 | Heavy-Duty commercial use. |
| | .4 | Tamper-Proof cover screw. |
| | .5 | Satin aluminum finish. |
| | .6 | 91 dB at 1m. |
| | .7 | 24 VAC operation. |
| | .8 | Standard of Acceptance: Edwards Signals 338 Series. |
-

2.3 120-240VAC
CONTROL TRANSFORMER

- .1 Class 2 signalling transformer.
- .2 20VA rating.
- .3 Non-Regenerative thermal overload protection.
- .4 Suitable for mounting on standard outlet box knockout.
- .5 Standard of Acceptance: Edwards 590 Series.

2.4 PUSH BUTTON

- .1 Suitable for indoor and outdoor use.
- .2 Surface mount.
- .3 Normally open momentary contact.
- .4 Solid brass construction.
- .5 Conduit back plate.
- .6 Standard of Acceptance: Edwards Signals 1780 Series.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install systems in accordance with manufacturer's instruction sheet.
- .2 Locate and install devices and equipment where indicated on the drawings.
- .3 Verify proper operation.

PART 1 - GENERAL

- | | | |
|---|----|--|
| <u>1.1 REFERENCES</u> | .1 | CSA C22.2 No. 248.4-00(R2010), Low Voltage Fuses, Class CC. |
| | .2 | CSA C22.2 No. 248.10-2011, Low Voltage Fuses, Class L. |
| | .3 | CSA C22.2 No. 248.11, Low voltage Fuses, Class J. |
| <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 | Provide six (6) 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

- | | | |
|--------------------------|----|--|
| <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.
.2 Where a time delay characteristic is required, fuses shall carry 500% of their ampere rating for not |

2.2 FUSE TYPES
(Cont'd)

- .2 Class J:(Cont'd)
 - .2 (Cont'd)
less than 10 seconds and shall be clearly labeled "time delay".
- .3 Class L:
 - .1 Fuses rated 601 to 1200 amperes, 600 Vac, shall be CSA certified Class L in accordance with Standard C22.2 No. 248.10.
 - .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".
- .4 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.
- .5 Standard of acceptance:
 - .1 Class J: Ferraz Shawmut type A4J (non-time delay) and AJT (time delay) and HSJ (time delay).
 - .2 Class L: Ferraz Shawmut type A4BY (non-time delay) and A4BQ (time delay) and A4BT (time delay).
 - .3 Class CC: Ferraz Shawmut type ATMR (non-time delay) and ATDR (time delay) and ATQR (time delay).
- .6 Acceptable manufacturers:
 - .1 Ferraz Shawmut.
 - .2 Bussmann.
 - .3 Littlefuse.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Confirm correct fuses fitted to physically matched mounting devices.
- .3 Confirm correct fuses fitted to assigned electrical circuit.
- .4 Confirm fuse size is correctly identified on equipment.
- .5 For feeder circuit fuses, use fast acting Class J and Class L fuses unless otherwise noted.

3.1 INSTALLATION
(Cont'd)

- .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 600Vac control circuits, use Class CC type fuses. Use time delay Class CC fuses upstream of control transformers and solenoids.

PART 1 - GENERAL

- | | | |
|---|----|--|
| <u>1.1 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| <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. |

PART 2 - PRODUCTS

- | | | |
|--|----|---|
| <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 breakers to have single handle. |
| | .3 | Circuit breakers to have interrupting capacity as indicated on the Drawings. |
| <u>2.2 MAGNETIC BREAKERS</u> | .1 | Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection. |
| <u>2.3 OPTIONAL FEATURES</u> | .1 | Include:
.1 On-off locking device for 10% of branch breakers and all breakers supplying exit signs and fire alarm devices. |
| <u>2.4 GROUND FAULT CIRCUIT INTERRUPTER CIRCUIT BREAKERS</u> | .1 | Moulded case thermal magnetic circuit breaker with Class A ground fault protection |
-

PART 3 - EXECUTION

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

PART 1 - GENERAL

- | | | |
|---|----|---|
| <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

- | | | |
|--------------------------------|----|--|
| <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 drip hood) size as indicated. |
| | .2 | Provision for padlocking in off switch position by three locks. |
| | .3 | Mechanically interlocked door to prevent opening when handle in ON position. |
| | .4 | 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 | Acceptable manufacturers: <ul style="list-style-type: none">.1 Siemens..2 Cutler Hammer..3 Schneider. |
| | .9 | Exterior mounted disconnect switches to be complete with NEMA 4X enclosure. |
-

- | | | |
|-------------------------------------|-----|---|
| 2.1 DISCONNECT SWITCHES
(Cont'd) | .10 | 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

- 1.1 REFERENCES .1 UL 508-2013, Industrial Control Equipment.
- 1.2 SHOP DRAWINGS AND PRODUCT DATA .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate:
- .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Wiring diagram for each type of starter.
 - .6 Interconnection diagrams.
- 1.3 OPERATION AND MAINTENANCE DATA .1 Provide operation and maintenance data for motor starters for incorporation into manual specified in Section 01 78 00.
- .2 Include operation and maintenance data for each type and style of starter.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 Starters: EEMAC E14-1
- .1 Half size starters are not acceptable.
 - .2 IEC equipment not acceptable.
- .2 Acceptable manufacturers:
- .1 Cutler Hammer
 - .2 Schneider
 - .3 Siemens
- 2.2 MANUAL MOTOR STARTERS .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
- .1 Switching mechanism, quick make and break.
 - .2 All phase conductors to have overload heaters, manual reset, trip indicating handle.
-

2.2 MANUAL MOTOR
STARTERS
(Cont'd)

- .2 Accessories:
 - .1 Toggle switch: heavy duty labelled as indicated.
 - .2 Indicating light: LED and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE
MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
 - .5 Hand-off-auto selection switch in cover.
 - .6 LED pilot light indicating coil is energized.
 - .7 LED pilot light indicating unit is powered.
- .2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:
 - .1 Locking in "OFF" position with up to three (3) padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
- .3 Accessories:
 - .1 Selector switches: heavy duty labelled as indicated.
 - .2 Indicating lights: L.E.D. type and color as indicated.
 - .3 One (1) N/O and one (1) N/C spare auxiliary contacts unless otherwise indicated.
 - .4 Provide solid state protection complete with single phasing protection.
 - .5 Provide one (1) 24 VAC interposing relay complete with two (2) normally open and two (2) normally closed contacts mounted in starter enclosure. Connect relay as indicated.

- | | | |
|-------------------------------------|----|---|
| <u>2.4 CONTROL TRANSFORMER</u> | .1 | Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed in with starter as indicated. |
| | .2 | Size control transformer for control circuit load plus 20% spare capacity. |
| | | |
| <u>2.5 FINISHES</u> | .1 | Apply finishes to enclosure in accordance with Section 26 05 00 - Electrical General Requirements. |
| | | |
| <u>2.6 EQUIPMENT IDENTIFICATION</u> | .1 | Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements. |

PART 3 - EXECUTION

- | | | |
|----------------------------------|----|--|
| <u>3.1 INSTALLATION</u> | .1 | Install starters, connect power and control as indicated. |
| | .2 | Confirm fuses and overload elements are correct for the actual loads. Obtain correct information from Divisions 21, 22 and 23 prior to ordering and setting overloads. |
| | .3 | Coordinate with Controls contractor. |
| | | |
| <u>3.2 FIELD QUALITY CONTROL</u> | .1 | Perform tests in accordance with Section 26 05 00 - Electrical General Requirements and manufacturer's instructions. |
| | .2 | Operate switches, contactors to verify correct functioning. |
| | .3 | Perform starting and stopping sequences of contactors and relays. |
| | .4 | Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as required. |
| | .5 | Provide test forms to Commissioning Agent for each motor starter confirming operation and settings. |

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 ANSI C82.1-2004, Specifications for Fluorescent Lamp Ballasts.
 - .2 ANSI C62.41-2008, IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - .3 ANSI C62.45-2008, IEEE Guide on Surge Testing for Equipment Connected to Low- Voltage AC Power Circuits.
 - .4 CAN/CSA C654-2010, Fluorescent Lamp Ballast Efficiency Measurements.
 - .5 NECA/ESNA 500-1998, Recommended Practice for installing indoor commercial lighting systems.
 - .6 ANSI/IESNA RP1-2004; American national Standard practice for office lighting.
 - .7 ASTM F1137-2011e1, American Society for Testing and Materials Specification for phosphate/oil and phosphate/organic corrosion protective coatings for fasteners.
 - .8 FCC CFR47; USA Federal Communications Commission Frequency allocations and radio treaty matters; general rules and regulations.
 - .9 IESNA LM-79, Electrical and photometric Measurements of Solid State Lighting.
 - .10 IESNA LM-80, Measuring Lumen Maintenance of LED Light Sources.
- 1.2 RELATED WORK
- .1 Submittal Procedures: Section 01 33 00
- 1.3 SHOP DRAWINGS AND PRODUCT DATA
- .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Submit shop drawings for the following:
 - .1 Luminaire.
 - .2 Lamp/engine for each luminaire type.
 - .3 Ballast/driver for each luminaire type.

1.3 SHOP DRAWINGS
AND PRODUCT DATA
(Cont'd)

- .3 Shop Drawings:
 - .1 Shop drawings shall clearly indicate the following:
 - .1 Luminaire ID number as identified in contract documents.
 - .2 Fixture specification as identified in Part 2 and on the drawings.
 - .3 Lamp specification as identified in Part 2 and on the drawings.
 - .4 Ballast specification as identified in Part 2 and on the drawings.
 - .5 Photometric data for each luminaire type.
 - .6 Energy data for lamps and ballasts.
 - .4 Catalogue cuts lacking sufficient detail to indicate compliance with Contract documents will not be acceptable.
 - .5 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental Representative. Photometric data to include:
 - .1 VCP Table, spacing criterion;
 - .2 Total input watts;
 - .3 Candlepower summary, candela distribution, zonal lumen summary;
 - .4 Luminaire efficiency, C.I.E. type, coefficient of utilization;
 - .5 Lamp type;
 - .6 Lumen ratings
 - .7 Summary in accordance with IES procedures.
 - .8 Electronic IES file (provide on CD).

1.4 OPERATION
AND MAINTENANCE

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

1.5 WASTE AND
DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal.
- .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 Conserve Nova Scotia's "Smart Lighting Choices" program.

PART 2 - PRODUCTS

2.1 LAMPS .1 Linear Fluorescent Lamps:

Lamp Type	Wattage	Base	Initial Lumens	Rated Life h	Colour Temp. (25C)	CRI	Additional Information
T8	32W	Med Bipin	2,900	36,000	4,100 K	85	
T5HO	17W	Med Bipin	1,450	36,000	4,100 K	85	

2.2 BALLASTS .1 Fluorescent Electronic Programmed Rapid Start Ballast:

- .1 Performance requirements:
- .1 Electronic programmed rapid start.
 - .2 Independent Lamp Operation (IOL) for instant start ballasts allowing remaining lamps 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 50/60 Hz input source of 120V, 277V or 347V as applicable with sustained variations of +/- 10% voltage and frequency with no damage to the ballast.
 - .5 High frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.
 - .6 Power Factor greater than 0.98 primary lamp.
 - .7 Minimum ballast factor of 1.0 for primary lamp.
 - .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.
 - .11 Minimum starting temperature of -18°C (0°F).
 - .12 End of life (EOL) protection circuit.
 - .13 Polychlorinated Biphenyl (PCB) free.

- 2.2 BALLASTS
(Cont'd)
- .1 (Cont'd)
 - .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 shall meet or exceed the requirements of CSA Standard 654 for ballast efficiency.
 - .6 Provide ballast with integral leads colour 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 for operation at a maximum case temperature of 75 .

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

- 2.4 LUMINAIRES
- .1 Luminaires are specified on the drawings.

PART 3 - EXECUTION

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

3.2 WIRING

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

3.3 LUMINAIRE
SUPPORTS

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

3.4 LUMINAIRE
ALIGNMENT

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

PART 1 - GENERAL

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

PART 2 - PRODUCTS

- 2.1 BATTERY UNIT .1 Refer to drawings for specifications.

PART 3 - EXECUTION

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

PART 1 - GENERAL

- 1.1 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00.
- 1.2 OPERATION AND MAINTENANCE DATA .1 Submit operation and maintenance data for incorporation in the Manual specified in Section 01 78 00.
- 1.3 REFERENCE .1 CAN/CSA-C860-2011, Performance of Internally Lighted Exit Signs.

PART 2 - PRODUCTS

- 2.1 STANDARD UNITS .1 Refer to drawings for specifications.

PART 3 - EXECUTION

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