

December 12, 2019

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal
- .2 Section 01 78 00 - Closeout Submittals
- .3 Section 26 05 01 - Electrical Identification

1.2 GENERAL

- .1 This section covers items common to all Sections of Division 26 and 27.
- .2 The General Conditions of the contract as well as provisions of Division 01 are part of and to be read in conjunction with this Section.
- .3 Refer to Division 01 for commissioning requirements.

1.3 FUNCTIONAL
PERFORMANCE
TESTING (FPT)

- .1 Refer to Division 01 91 13 - General Commissioning Requirements.
- .2 Prior to Functional Performance Testing, submit the following documentation:
 - .1 Record drawings.
 - .2 Operations and maintenance manuals.
 - .3 Documentations listed in Section 01 78 00 - Closeout Submittals.
 - .4 Written confirmation of System Demonstration and Operating and Maintenance Instructions have been performed in accordance with Section 01 78 00 - Closeout Submittals.
- .3 Immediately rectify deficiencies or discrepancies discovered during the FPT process.
- .4 Return copies of deficiency lists to the Departmental Representative with all corrected items signed off.

1.4 CODES AND
STANDARDS

- .1 Do complete installation in accordance with CSA C22.1 and local regulations, except where specified otherwise.

December 12, 2019

1.4 CODES AND
STANDARDS
(Cont'd)

- .2 Comply with relevant CSA standards and all current Inspection Department bulletins.

1.5 REFERENCES

- .1 CSA C22.1-2018, Canadian Electrical Code.
- .2 CAN3 C235-83(R2015), Preferred Voltage Levels for AC Systems
- .3 CSA Z462-2018, Workplace Electrical Safety.
- .4 CSA 080 Series-2017, Wood Preservation.

1.6 CARE, OPERATION
AND START-UP

- .1 Instruct the Departmental Representative and operating personnel in the operation, care, and maintenance of all equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.7 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

December 12, 2019

1.8 INTERFERENCE
DRAWINGS

- .1 Refer to Division 01 for the requirement to provide interference drawings. Coordinate and cooperate with the production of these interference drawings and note that the installation of electrical systems must not commence until these interference drawings have been reviewed by the Departmental Representative.

1.9 PERMITS, FEES,
AND INSPECTION

- .1 Submit to the Electrical Inspection Department, Municipal Authority, and supply authority the necessary number of drawings and specifications for examination and approval prior to commencement of work. Submit this information within twenty (20) working days of the award of Tender and provide the Departmental Representative with written notice at the time this has been submitted.
- .2 Provide the Departmental Representative with a copy of the electrical inspection department and supply authority plans review report immediately upon receipt. No shop drawings will be reviewed prior to receipt of the plans review report from the Contractor.
- .3 Obtain all necessary permits including an Electrical Wiring Permit for electrical work and Communications Cabling Permit for communications cabling work from the authority having jurisdiction, prior to commencement of work. Provide a copy of each permit to the Departmental Representative upon receipt. Properly display the permits on the work site.
- .4 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.
- .5 Furnish Certificates of Acceptance from authorities having jurisdiction upon completion of work. Include a copy in the Operation and Maintenance Manual.
- .6 Pay all associated fees.

December 12, 2019

1.10 MATERIALS AND
EQUIPMENT

- .1 Provide materials and equipment in accordance with Section 01 61 00 - Common Product Requirements.
- .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. Pay all fees associated with special approval and/or field certification.
- .3 Factory assemble control panels and component assemblies.
- .4 All equipment and materials which serve a similar function must be from a single manufacturer and a single product line.
- .5 The equipment listed on the project equipment schedules and shown on the drawings is the "basis of design equipment"; the Contractor may utilize the alternates listed in the project documents or submit alternates for approval to this equipment that meet the technical and quality requirements of the project specifications. If there are necessary changes to any building system to accommodate these alternates, coordinate the changes and provide at no additional cost to the Contract.

1.11 FINISHES

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

1.12 EQUIPMENT
IDENTIFICATION

- .1 Identify electrical equipment in accordance with Section 26 05 01.

December 12, 2019

1.13 WARNING SIGNS

- .1 Provide warning signs, as specified and/or to meet requirements of the Inspection Department.
- .2 Confirm electrical equipment is field marked to warn persons of the potential electric shock and arc flash hazards, as per CSA C22.1, Rule 2-306. Provide hazard labels in accordance with CSA Z462.

1.14 MOUNTING
HEIGHTS

- .1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or
- .2 Verify mounting height of equipment before proceeding with rough in.
- .3 Coordinate with architectural elevations prior to mounting exterior electrical devices.
- .4 Install electrical equipment at the following heights unless indicated otherwise. Refer to device mounting height details on drawings.
 - .1 Local switches: 1200mm A.F.F. unless otherwise indicated
 - .2 Wall receptacles:
 - .1 General: 460 mm A.F.F. unless otherwise indicated
 - .2 Above top of counters or backsplash: 152 mm.
 - .3 In mechanical/boiler rooms: 1370 mm A.F.F.
 - .3 Panelboards: 1980 mm A.F.F. to top of panel.
 - .4 Communications system outlets:
 - .1 General: 460mm A.F.F. unless otherwise indicated.
 - .2 Above top of counters or backsplash: 152 mm.
 - .3 In mechanical/boiler rooms: 1370 mm A.F.F.
- .5 Exit signs: 2286 mm A.F.F. or 152 mm above door frame.
- .6 Emergency lights and remote heads: 2286 mm A.F.F.
- .7 Fire alarm manual stations: 1200mm A.F.F.
- .8 Fire alarm signaling devices: 305 mm below finished ceiling.

December 12, 2019

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| <u>1.15 PROTECTION</u> | <ul style="list-style-type: none">.1 Protect exposed live equipment during construction for personnel safety..2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage..3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of an electrician. |
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| <u>1.16 CONDUIT AND CABLE INSTALLATION</u> | <ul style="list-style-type: none">.1 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum..2 Conceal all wiring and conduit unless noted otherwise. Where this is not possible due to existing construction, use metal surface mounted raceways. Refer to the contract documents for more detail..3 Where conduits cross building expansion joints, provide conduit expansion joints with telescoping sleeve and insulated bushings. |
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| <u>1.17 FIRESTOPPING</u> | <ul style="list-style-type: none">.1 Where conduits, cables, and cable troughs pass through fire-rated assemblies, provide firestopping in accordance with Section 07 84 00 - Firestopping..2 Refer to architectural drawings for location of fire-rated assemblies. |
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| <u>1.18 FIELD QUALITY CONTROL</u> | <ul style="list-style-type: none">.1 Have all electrical work carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program will be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted will be determined based on the level of training attained and the demonstration of ability to perform specific duties. |
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December 12, 2019

1.18 FIELD QUALITY
CONTROL
(Cont'd)

- .2 Conduct and pay for tests of the following:
 - .1 Fire alarm system.
- .3 Furnish manufacturers' certificates or letters confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .4 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results for review by the Departmental Representative
- .6 Have installation, termination, and testing of the Access Control system carried out by a Certified Alarm and Security Technician licenced in the province of Nova Scotia.

1.19 SHORT-CIRCUIT
AND COORDINATION
STUDY

- .1 At a minimum, provide the following:
 - .1 Manufacturer's trip curves for all breakers and fuses.
 - .2 Available trip settings for all breakers with adjustable settings.
 - .3 Conductor and conduit sizes for all feeders, including branch panel and relay panel feeders.
 - .4 Length of all feeders, including branch panel and relay panel feeders, to the nearest metre.
 - .5 Transformer impedances.

1.20 DRAWINGS

- .1 Electrical drawings are not intended to show structural details or architectural features.
- .2 The electrical drawings are not to be scaled.
- .3 Electrical drawings, except where dimensioned, indicate general layouts only. Investigate structural and finish conditions and the work of all other trades affecting this work and arrange work accordingly.
- .4 Coordinate the elevation of all outlet boxes with architectural drawings and report any conflicts to the Departmental Representative prior to installation.

December 12, 2019

1.20 DRAWINGS
(Cont'd)

- .5 All electrical junction boxes must be accessible at the completion of the project. Coordinate the location of each junction box with the proposed location of mechanical services prior to installation.
- .6 Layouts on the electrical drawings are based on the specified equipment including electrical power connections, number of conductors and conduit sizes, and physical dimensions. Alternate equipment and systems proposed for use on this project which necessitate changes in service connections, numbers of conductors and conduit sizes to perform the specified functions may be considered by the Departmental Representative, however, any required modifications or additions to the electrical contract or the work of other trade contractors must be done at no additional cost to the Contract. Furthermore, if it is found that the provisions made regarding space conditions and code required clearances are not met, the right is reserved by the Departmental Representative to require installation of the equipment specified.

1.21 ACCESS DOORS

- .1 Where junction boxes, pull boxes, and miscellaneous electrical equipment are concealed, provide access doors for operating, inspecting, adjusting, and servicing. Provide access doors which meet or exceed the fire resistance rating of the partition or ceiling in which they are being installed.

1.22 CONNECTION OF
EQUIPMENT

- .1 Provide all connections required by the equipment supplied by this Division.
- .2 Provide all connections required by equipment supplied by the Departmental Representative or by other Divisions. Examine all drawings and specifications and identify all requirements.
- .3 Provide all necessary accessories to make connections, including flexible connectors, etc.

December 12, 2019

1.23 SPRINKLER-
PROOF HOODS

- .1 Protect all distribution equipment within ventilated enclosures located in the building from the direct spray from sprinkler heads to the satisfaction of the Inspection Authority by the use of non-combustible hoods.
- .2 Install distribution conduits exiting or entering equipment enclosures equipped with sprinkler hoods with rain-tight EMT connectors equipped with rubber O-rings.

1.24 INSTALLATION
REQUIREMENTS

- .1 Install all products and services to follow building planes. Installation must permit free use of space and maximum headroom to the satisfaction of the Departmental Representative.
- .2 Confirm the exact location of fixtures, outlets and connections.
- .3 Install all equipment and appurtenances to allow free access for adjustment, maintenance and/or replacement.
- .4 Provide all hangers, supports and fasteners such that no undue stresses are imposed on the structure and systems. Confirm the load onto structures does not exceed the maximum loading. Equipment supports not supplied by equipment manufacturer are to be fabricated using structural grade steel.
- .5 Exterior supports to be galvanized, unless noted otherwise.
- .6 Install all products and services in accordance with the respective manufacturer's recommendations.
- .7 Do not use high-velocity explosive-activated tools. Low-velocity system types are permitted.
- .8 Provide caps and seal all open ends of installed conduits to prevent the entrance of foreign substances.
- .9 Install all services capped for future possible use such that easy access is provided for future connections.

December 12, 2019

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| <u>1.25 FIELD REVIEW</u> | .1 | The Departmental Representative must have access to the site at all times for review of the work. |
| | .2 | Correct any deficiencies as they are reported during the performance of the Work. |
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| <u>1.26 TORQUES FOR WIRE TERMINATION</u> | .1 | For proper termination of conductors, field connections must be made properly tight. |
| | .2 | Where possible, obtain and comply with Manufacturer |
| | .3 | In the absence of Manufacturer's instructions, make terminations in conformance with the values given in Tables D6 and D7 of the Canadian Electrical Code. |
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| <u>1.27 CABLE TIES AND TYE WRAPS</u> | .1 | Cable ties and tye wraps are only permitted to be used to provide limited support for bundling purposes only. These devices are not intended to provide the primary support for conduits or cables as required by the Canadian Electrical Code. |
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| <u>1.28 WORKING SPACE ABOUT ELECTRICAL EQUIPMENT</u> | .1 | Arrange installation as required to maintain minimum working space around electrical equipment in conformance with the CEC. |
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| <u>1.29 LOW V.O.C. MATERIALS</u> | .1 | All site applied coatings, adhesives & sealants must be low volatile organic compound (VOC) content. |
| | .2 | Provide Material Safety Data Sheets for all products and materials of these types incorporated into the work. |
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| <u>1.30 PLYWOOD BACKBOARDS</u> | .1 | Provide all plywood backboards for mounting of all wall-mounted electrical and communications equipment located inside electrical rooms, communications rooms, and other services rooms, including but not limited to panelboards, control panels, contactors, etc. |
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GC Co-Working Site
Pilot Program at
BIO Facility
1 Challenger Drive
Project No. R.101402.002

COMMON WORK RESULTS
FOR ELECTRICAL

Section 26 05 00
Page 11

December 12, 2019

1.30 PLYWOOD
BACKBOARDS
(Cont'd)

- .2 Plywood used for backboards must be marked indicating that it is Fire Retardant Treated Wood (FRTW) in accordance with the CAN/CSA-080 standard, and meets Underwriters Laboratories FR-S rating, or equivalent. Materials must be free of formaldehyde and VOCs.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Submittal Procedures: Section 01 33 00
- .2 Common Product Requirements: Section 01 61 00
- .3 Construction Waste Management Disposal: Section 01 74 21
- .4 Painting: Section 09 91 00

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include paint colour chips, other products specified in this section.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples to include nameplates, labels, tags, lists of proposed legends.

PART 2 - PRODUCTS

2.1 EQUIPMENT
IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as specified herein.
- .2 Identification:
 - .1 Provide all switchboards, panels, disconnect switches, receptacles, voice/data/CATV/Multimedia outlets, MCC's, transformers, control panels, fire alarm devices, magnetic starters, TOL's, etc. with lamicoid nameplates as further described herein. Affix plates true, 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.

December 12, 2019

2.1 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.4 Affix nameplates to building exterior surfaces with nylon inserts and self-tapping screws unless specifically indicated otherwise.

.5 Apply contact type cement to complete rear side of plate, as opposed to several locations or areas on same.

.6 Lamicoid nameplates installed on distribution panelboards, motor control centres, splitter troughs and transformers to indicate the following:

- .1 Designated name of equipment.
- .2 Amperage of overcurrent protection device.
- .3 Voltages, number of phases and wires.
- .4 Designation of power source.

Example:

PANEL 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., to contain the following information:

- .1 Designated name of equipment.
- .2 Designated name of power source.
- .3 Branch circuit breaker number(s) where possible.
- .4 Voltage(s).

EXHAUST FAN NO. 5

PANEL H - CCT. NO. 17

120V - 1 PH

SUPPLY FAN NO. 3

M.C.C. NO. 1

600V - 3 PH

.8 Lamicoid nameplates installed on fusible-type disconnect switches 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.

.10 Install lamicoid nameplates adjacent to each overcurrent devices located in switchboards, MCCs, CDP panels, etc. They need only indicate designated name and/or number of equipment they feed. Identify unused O.C. devices as spare(s).

December 12, 2019

2.1 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.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 (2) lines of 13 mm high lettering (Size #8 nameplate).

Example:

MAIN BREAKER 800 AMPS
346/600V, 3 PH, 4W

Example:

MAIN SWITCH 200 AMPS
120/208V, 3 PH, 4W

.12 Install an additional lamicoid nameplate on all, or any piece of electrical equipment, or apparatus (i.e., Main Switchboard, CDP panels, panelboards, Motor Control Centres. etc.), that 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 black letters on white core, directly above all receptacles. Plate to be identical width as finish device plate.

Example: PANEL H - 20

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

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

December 12, 2019

2.1 EQUIPMENT IDENTIFICATION
(Cont'd)

.2 (Cont'd)

Example: For computer use only
PANEL H - 24

.15 Identify lamicaid nameplates above 120V receptacles protected by GFCI circuit breakers, or GFCI type receptacles as per the following:

.1 1.5mm thick x 19mm wide complete with 6 mm black letters on white core above all receptacles. Identical width as finish device plate (EXAMPLE: GFCI Protected Panel H-26).

.16 Apply lamicaid nameplate(s) for power/voice/data/multimedia outlets above face of finish plate, complete with information as specified in Section 27 05 28.

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

.17 Addressable fire alarm devices to be lamicaid identified.

.1 Lamicaid identification to be chain hung on mechanical items (pressure switches, supervisory switches, etc.).

.2 Manual pull station lamicaid plate to be similar to typical receptacle lamicaid plate.

.3 Lamicaid wording to match physical location and annunciator display address.

.18 Lamicaid 3mm thick plastic engraving sheet, white face, black core, for all electrical systems except fire alarm and emergency power which shall have red face with white core.

.1 1.5mm thick nameplates above receptacles as previously indicated, with top left and right corners to be rounded off.

.2 Lettering on lamicaid nameplates must not start, nor end nearer than 13mm from either, or both ends of said plates. Size of lettering, including overall lengths of various plates to be as indicated in the following chart:

NAMEPLATE SIZES

Size 110mm x 50mm	1 line 5mm high letters
Size 213mm x 70mm	1 line 6mm high letters
Size 316mm x 75mm	2 lines 5 mm high letters
Size 419mm x 90mm	1 line 9mm high letters
Size 538mm x 90mm	2 lines 13mm high letters

December 12, 2019

2.1 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.18 (Cont'd)

Size 625mm x 100mm 1 line 13mm high letters
Size 725mm x 100mm 2 lines 6mm high letters
Size 850mm x 150mm 2 lines 13mm high letters
Size 975mm x 150mm 3 lines 13mm high letters

.3 Have wording on nameplates and labels approved by the Departmental Representative prior to manufacture.

.4 Allow for average of fifty (50) letters per nameplate and label.

.5 Identification to be English.

.6 Provide lamicoid nameplates and install 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, 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 Television panels.

.5 Communication panels.

.6 Lockdown system panels.

.7 Low voltage lighting relay panels
(EXAMPLE: LIGHTING RELAY PANEL #1 - LPA - 36).

.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 A second plate with identical information is to be installed 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 All control transformers installed in either control cabinets or on walls adjacent to same, are to be identified with lamicoid nameplates containing information as previously indicated.

December 12, 2019

2.1 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.18 (Cont'd)

.8 Junction and pull boxes: indicate system and voltage.

.9 Coordinate 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 and pull boxes to have the panel and circuit numbers of all wiring contained within listed on the cover plate. Write circuit list neatly using a black indelible marker.

.11 Colour code electrical junction boxes, pull boxes, and conduit fittings as follows:

.1 Apply colour coding prior to installation of boxes/equipment.

.2 Where primary colour only is indicated:

.1 Colour inside and outside of box.

.2 Colour all cover plates.

.3 Where primary and secondary colours are indicated:

.1 Paint inside and outside of box with the primary colour.

.2 Diagonally apply to each half of the cover plate the primary and secondary colours.

.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.

.13 Paint boxes and conduits outside of the building in an area that will not cause vapours to enter the building ventilation system.

2.2 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.

December 12, 2019

2.2 WIRING
IDENTIFICATION
(Cont'd)

- .3 Identify all conductors with insulation colours as follows:
 - .1 Phase A - Red.
 - .2 Phase B - Black.
 - .3 Phase C - Blue.
 - .4 Neutral - White.
 - .5 Bond - Green.
 - .6 Ground - Green.
 - .7 Isolated Ground - Green complete with yellow strip.
- .4 Colour coded conductor insulation as per the following:
 - .1 All sizes of phase conductors up to and including #2 AWG.
 - .2 All sizes of neutral, bond and/or ground conductors up to and including #3/0 AWG.
 - .3 Approved coloured tapes in lieu of insulation colouring 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.

2.3 CONDUIT AND BOX
IDENTIFICATION

- .1 Colour code conduits and metallic sheathed cables as per the schedule below.
- .2 Code with paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m intervals.

December 12, 2019

2.3 CONDUIT AND BOX
IDENTIFICATION
(Cont'd)

- .3 Colour code junction and/or pull boxes, conduit fittings (and respective covers), complete with their respective cover plates as per the following: Boxes are to be coloured both inside and outside, where one colour only is required. Boxes are to be coloured on inside only where two colours are required. Metal cover plates are to have both colours applied diagonally where two colours are required. Complete plate is to be painted where one colour only is required. All junction boxes are to be colour identified prior to installation and not within the building.
- .4 All various systems concealed junction and/or pull boxes located within ceiling spaces are to have their locations identified on room side of T-Bar grid spline or access cover frames with appropriate colour coded, circular shaped, self-adhering discs. Discs are to be both 19mm and 6mm in diameter as indicated in the following legend, with 6mm discs always being centered in middle of 19mm discs:

SYSTEM	19mm DISCS	6mm DISCS
0 to 50 Volts	Violet	
51 to 240 Volts	Yellow	
241 to 600 Volts	Orange	
Fire Alarm	Red	
Telephone (voice only)	Black	
Security	Brown	
Ground or Bond	Green	
Computer (data only)	Black	White
Voice & Data	Blue	White
Emergency Lighting (DC)	Yellow	Black
Other	Brown	White

- .5 Where boxes are not concealed, such as in an open ceiling concept, fasten discs directly to the outside of the boxes after architectural painting is complete. Cover plates for boxes containing branch circuits, are to have each branch circuit number neatly identified on the inside of the cover plate. Felt marker-pen may be used for this purpose.
- .6 Provide a legend of colour coding, mounted under plexiglass cover. Install in main electrical room. Minimum size: 610mm x 610mm.

December 12, 2019

2.3 CONDUIT AND BOX
IDENTIFICATION
(Cont'd)

- .7 Where boxes are not concealed, fasten disks directly to outside of boxes after architectural painting is complete. Cover plates for such boxes are to have each branch circuit number neatly identified inside of the cover plate.

2.4
TELECOMMUNICATION
IDENTIFICATION

- .1 Telecommunication Spaces:
.1 Uniquely identify telecommunications spaces within a building as part of a complete administration system.
.2 Use the room designation number within the administration system identifier as follows and provide a lamicoid type nameplate (minimum 50mm X 300mmL).
- Example: TR-110
Where TR denotes Telecommunication Room
110 denotes architectural room number
- .3 For the Main Telecommunications room, use 'MTR' as the abbreviation for the room type.
.4 Secure the lamicoid nameplate to the exterior of the door entering that space.
.5 All telecommunications equipment racks within each telecommunications space require a unique component identifier as part of the administration system by a lamicoid type nameplate, minimum (50mm H) X (600mm L) shown and secured to the upper horizontal rail of the equipment rack.

Example: TR-110-Rack 1
Where Rack 1 denotes rack position in bay
110 denotes architectural room number
TR denotes Telecommunication Room

- .6 All telecommunications termination hardware within the telecommunications space requires a unique component identifier as part of the administration system. Identifiers are to be self-adhesive thermal transfer type (minimum 300mm long x 50mm high) and placed appropriately to indicate all ports.
- .2 Horizontal Distribution System:
.1 Uniquely identify horizontal cabling with a wrap type self-laminating adhesive label with mechanically generated (not hand written) identifier.

December 12, 2019

2.4
TELECOMMUNICATION
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.2 Horizontal cable identifiers must denote basic telecommunications system application and the originating telecommunications space termination equipment port:

Example: D-024

Where 'D' denotes 'data',

'024' denotes Termination Equipment Port Number

.3 For other telecommunications cabling system other than data, use the following abbreviations:

- .1 V=Voice
- .2 DB=Data Backbone
- .3 VB=Voice Backbone
- .4 DMR=Demarcation Backbone
- .5 TV=Internal Multimedia Broadcast System
- .6 CA=Video Surveillance

.3 Work Area:

.1 For the purposes of system administration, the work area includes the telecommunications outlet faceplate and all outlet termination hardware.

.2 All telecommunications outlet faceplates will be standard four port configuration with port assignments as shown.

.3 All Telecommunications Outlet (TO) locations require a unique component identifier as part of the administration system by a lamicoid type etched vinyl nameplate, minimum 120mm H X 70mm L and secured to the wall-space centered and above min. 12mm the telecommunications outlet faceplate.

.4 Telecommunications work area outlet identifiers must denote basic telecommunications system application, originating telecommunications space and termination equipment port:

Example: TR-118 D-012

Where: TR denotes telecommunication room

118 denotes architectural room number

D denotes data

012 denotes termination equipment port number

.4 Backbone System:

.1 For the purposes of system administration, backbone system to include all backbone system cabling only.

December 12, 2019

- 2.4
TELECOMMUNICATION IDENTIFICATION
(Cont'd)
- .4 (Cont'd)
- .2 Uniquely identify all backbone system cabling with a wrap type self-laminating adhesive label with mechanically generated (not hand written) identifier.
- .3 Backbone cable identifiers to denote basic telecommunications system application and originating telecommunications space.
- .5 Telecommunications Demarcation Facilities:
- .1 For the purposes of system administration, the telecommunications demarcation facilities includes three basic components:
- .1 Building cross-connect hardware.
- .2 Building demarcation backbone cable.
- .3 Building demarcation termination hardware.
- .2 All Building cross-connect hardware within the telecommunications space requires a unique component identifier as part of the administration system. Identifiers must be self-adhesive thermal transfer type and placed appropriately to indicate applicable pair assignments as shown.
- .3 All administration system requirements for associated termination hardware located within the telecommunications spaces are addressed in clause 2.4.1.
- .4 Uniquely identify all telecommunications demarcation backbone cabling with a wrap type self-laminating adhesive label with mechanically generated (not hand written) identifier.
- .5 All telecommunications demarcation backbone cable identifiers must denote basic telecommunications system application and originating telecommunications space.

PART 3 - EXECUTION

- 3.1 PAINTING OF
BOXES
- .1 Do not paint junction boxes, pull boxes, cabinets, etc. inside the building at any time during construction.
- 3.2 TIMING
- .1 Provide identification only after all painting specified in Section 09 91 00 has been completed.

- 3.3 NAMEPLATES
- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
 - .2 Protection:
 - .1 Do not paint, insulate or cover in any way.

December 12, 2019

PART 1 - GENERAL

- 1.1 REFERENCES .1 CSA C22.2 No. 65-2018, Wire Connectors.

PART 2 - PRODUCTS

- 2.1 MATERIALS .1 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.
- .2 Clamps or connectors for armoured cable, liquid tight flexible metal conduit.
- .3 Bushing stud connectors are not acceptable.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Make connections and terminations electrically and mechanically secure. Sizes of connectors to be as per manufacturer's recommendations for various sizes and combinations of wire sizes.
- .2 Make joints required in branch wiring #10 and smaller utilizing spring-type pressure wire connectors. Plier tighten wire connectors. Cap to completely fit or cover all enclosed conductors as required.
- .3 Make joints for all other wiring utilizing colour keyed compression type connectors complete with compression tools. Apply an initial layer of compound type tape followed by an additional layer of vinyl tape.

PART 1 - GENERAL

- | | | |
|---|----|--|
| <u>1.1 REFERENCES</u> | .1 | CSA C22.2 No. 0.3-09(R2019), Test Methods for Electrical Wires and Cables. |
| | .2 | CSA C22.2 No. 208-18, Fire Alarm and Signal Cable. |
| <u>1.2 RELATED WORK</u> | .1 | Section 26 05 00 - Common Work Results for Electrical. |
| <u>1.3 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00 - Submittal Procedures. |
| <u>1.4 OPERATION AND MAINTENANCE DATA</u> | .1 | Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals. |

PART 2 - PRODUCTS

- | | | |
|---------------------------|----|--|
| <u>2.1 BUILDING WIRES</u> | .1 | Conductors: 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. |
| | .4 | Provide phase colour-coding of conductors as per CEC rule 4-036, unless noted otherwise. |
| | .5 | Colour code phase conductor sizes up to and including #2 AWG as follows: |
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December 12, 2019

2.1 BUILDING WIRES
(Cont'd)

Phase A	Red
Phase B	Black
Phase C	Blue
Neutral	White or Grey
Bond	Green
Ground	Green
Isolated Ground	Green c/w Yellow Strip

- .6 Insulation colour coding as per the following:
- .1 Phase conductors up to and including #2 AWG.
 - .2 Neutrals, bonds and ground conductors up to and including #3/0 AWG.
 - .3 Approved coloured tapes in lieu of insulation colouring may be used to identify conductors that "exceed" sizes as noted on both ends of runs.

2.2 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated, minimum #12 AWG.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Termination of AC90 cable to utilize steel connections with accompanying lock nuts similar to or equal to T&B 3301 series.
- .5 Supports to be as per Section 26 05 29 - Hangers and Supports for Electrical Systems.

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 6A with yellow jacket.
- .3 Cables to be FT6 rated.

December 12, 2019

2.4 FIRE ALARM
CABLES

- .1 Type FAS 105 to CSA C22.2 No. 208, PVC insulation, size and quantity of conductors as indicated, Red PVC outer jacket.

2.5 SECURITY AND
ACCESS CONTROL
SYSTEM CABLING

- .1 Minimum FT4 rated.
- .2 Insulated copper conductors, size as indicated or required by manufacturer.
- .3 White coloured PVC outer jacket.

2.6 OVERHEAD
SECONDARY
CONDUCTORS

- .1 Neutral Supported (NS90) quadraplex 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.
- .2 100% rated insulated neutral support conductor, complete with white finish.
- .3 Low-temperature rating of -40°C.

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 - Conduits, Conduit Fittings and Fastenings.

3.2 INSTALLATION OF
FIRE ALARM CABLES

- .1 Install fire alarm cables in E.M.T.
- .2 Install fire alarm cabling 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. Flexible metal conduit must not exceed 5m in total length. Minimum size: 16mm.

December 12, 2019

3.3 INSTALLATION OF
ARMOURED CABLES

- .1 AC-90 will only be permitted for branch circuit wiring drops from ceiling junction boxes to light fixtures within the same room. The installation of AC-90 cable for branch circuit wiring home runs or runs between rooms is not acceptable.
- .2 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
 - .2 Makes a splice for final connection to the applicable branch circuit device.
- .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 intervals to structure, multiple or bundled groups of armoured cables shall be tye-wrapped together at mid-point between each structure support and are to be secured to structure at 1.5m intervals, and also secured together between each structure support at 1.5m intervals.
 - .2 Limit the 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 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 upon 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.

December 12, 2019

3.3 INSTALLATION OF .6
ARMOURED CABLES
(Cont'd)

(Cont'd)

.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 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 AC-90 fixture feeds to originate 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, do not use a box smaller than 119 mm 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 ceiling space and its respective light fixture.
- .1 Fixture drops are not to exceed 3 m in total length unless specifically indicated otherwise.
- .2 There must not be more than four (4) drops permitted to be fed from any one box regardless of its size. Secure AC-90 cables used for fixture drops within 300 mm of the junction box. Provide each light fixture complete with its own separate fixture drop originating from junction box located in the same room as the fixture. An exception will 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 150 mm or greater in diameter.
- .3 Wire each light fixture with a separate whip emanating from an overhead junction box.
- .4 Minimum size 119mm square box will be used when extending three (3) or four (4) drops.
- .5 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 at 347V, #12AWG
- .2 3500W at 347V, #14AWG
- .3 1800W at 120V, #12AWG
- .4 1300W at 120V, #14AWG

December 12, 2019

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- 3.3 INSTALLATION OF .9 (Cont'd)
ARMOURED CABLES .5 (Cont'd)
(Cont'd) .10 Provide separate pig-tail type leads in each light
fixture junction/outlet box for final connection to
fixture drops. Only connect these pig-tails to light
fixture returns and associated neutral conductors.
- .11 Support and securing of type AC90 cables, low
voltage wiring etc., will not be derived from either
suspended ceiling support wires and/or by directly
laying atop of the ceiling grid system.
- .12 Where application of AC90 cables, other types of
pliable cables, open low voltage or communication
wiring, etc. are to be used; install neatly and
parallel or perpendicular to the building lines
unless otherwise noted.
- 3.4 INSTALLATION OF .1 Install control cables in E.M.T. complete with
CONTROL CABLES bonding conductor, minimum 21mm conduit and #14 AWG
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
- Pathways for Communications Systems (per voice and
data structured cabling).
- 3.5 INSTALLATION OF .1 Support cables independently of supports used for
CABLES: GENERAL 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.
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December 12, 2019

3.5 INSTALLATION OF
CABLES: GENERAL
(Cont'd)

- .6 The tye-wrapping of the neutral conductor with its respective phase conductors is to be made 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 tye-wrapped together in accordance with Clause 3.5.6 above.
- .8 All stranded conductors are to be twisted together 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.
- .9 All CDP's panelboards, MCC's (pull boxes, junction boxes, etc.) will have their respective feeder phase and neutral conductors tye-wrapped together and with enough slack conductor length to enable the ability to clamp the ground detector around each set of feeders. This wiring method is such that ease of clamping the ground detector can be accomplished without excessive exposure to live bus.
- .10 After all electrical wiring has been completed by the Electrical Subcontractor, test the grounded electrical distribution system to confirm there are no grounds or shorts in the system.

3.6 VOLTAGE DROP

- .1 Run all branch circuits so that the voltage drop in no instance exceeds 3% of the line voltage. The following table is to include both vertical and horizontal lengths of conductor runs. Minimum size of branch circuit neutral where phase sharing occurs must be #10 AWG. Minimum size of branch circuit neutral where dedicated to its own branch circuit phase conductor must be #12 AWG. Note that minimum size #10 AWG bond conductors to accompany #8 branch circuit conductors.
- .2 At a minimum, provide size conductors in accordance with the following table:

GC Co-Working Site
Pilot Program at
BIO Facility
1 Challenger Drive
Project No. R.101402.002

WIRES AND CABLES
(0-1000V)

Section 26 05 21
Page 8

December 12, 2019

3.6 VOLTAGE DROP
(Cont'd)

Branch Circuit Length of Run	Phase Wire Size	Dedicated Neutral	Shared Neutral	Bond Size
Up to 24.3m	#12	#12	#10	#12
Up to 38.1m	#10	#10	#8	#12
Up to 56.3m	#8	#8	#6	#10

- .3 Oversized #10 AWG branch circuit wiring conductors to be extended to outlet box of device they feed (including switch legs). Extend oversized #8 AWG branch circuit wiring conductors from panelboard to junction box located on wall or ceiling directly above wall light switches and/or receptacles. Reduce #8 AWG wire to #10 AWG for vertical portion of drop only.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

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

1.2 REFERENCES

- .1 IEEE 837-2014, Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA C22.2 No. 41-13(R2017), Grounding and Bonding Equipment.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required and suitable for application.
- .2 Insulated grounding and bonding conductors: soft drawn stranded copper of 98% conductivity, type RW90 (green coloured insulation as indicated in 26 05 00, item 10 - Wiring Identification).
- .3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
- .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Bonding jumpers, straps.
 - .5 Pressure wire connectors.

PART 3 - EXECUTION

3.1 INSTALLATION
GENERAL

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

December 12, 2019

3.1 INSTALLATION
GENERAL

(Cont'd)

- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding and bonding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs except grounding terminations in 600V switchboards, 600V CDP panels, 600V MCC's to be copper, compression type, long barrel, two hole connectors.
- .5 Soldered joints not permitted.
- .6 Install insulated bonding conductor in all conduits.
- .7 Secure the feed bonding conductor (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors and/or provide a pig-tail lead for device terminations.
- .8 Twist ground/bond wires together with a screw-on type wire connector, and place in the rear of the outlet box.
- .9 Bond EMT "wall stubs" or sleeves to ground as per CEC requirements.
- .10 Bond all conduits containing insulated ground conductor(s) at both ends.
- .11 Bend radius of all grounding/bonding conductors must be a minimum of 200mm in diameter.

3.2 SYSTEM AND
CIRCUIT GROUNDING

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

December 12, 2019

3.3 EQUIPMENT
GROUNDING

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

3.4 FIELD QUALITY
CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the 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.

December 12, 2019

PART 1 - GENERAL

1.1 NOT USED .1 Not applicable.

PART 2 - PRODUCTS

2.1 SUPPORT CHANNELS .1 U shape, size 40 mm x 40 mm, galvanized steel, surface mounted, suspended or set in poured concrete walls and ceilings unless otherwise indicated.
.2 All threaded hanger rods to be minimum of 10mm diameter. Where they are larger as required, they must be made from galvanized steel.

2.2 CABLE TIES .1 Use cable ties solely for the purpose of holding cables in place when installed in cable tray.
.2 Nylon flame retardant, low smoke cable tie. Size as required.
.3 Nylon flame retardant, low smoke cable tie mounting bracket. Mechanical fastening type only; adhesive mounts not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Secure equipment to hollow and solid masonry, tile and plaster surfaces with expanding anchors.
.2 Secure equipment to poured concrete with expandable inserts.
.3 Where outlet boxes are set in drywall construction, a piece of steel stud will be secured to either side of the outlet box or use caddy quick-mount box supports, or caddy J-1-A for side box supports.
.4 Secure all equipment in a manner so as not to distort or cause undue stress on any components.

December 12, 2019

3.1 INSTALLATION
(Cont'd)

- .5 Secure equipment to masonry, tile or plaster surfaces with lead anchors or nylon shields.
- .6 The use of toggle bolts for securing equipment to hollow masonry walls, suspended ceilings, or drywall is strictly prohibited.
- .7 Support equipment, conduit or cables using clips, spring-loaded bolts, cable clamps designed as accessories to basic channel members.
- .8 Secure surface mounted equipment with twist clip fasteners to inverted T-bar ceilings.
- .9 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.
- .10 Suspended support systems:
 - .1 Support single or multiple cables or conduits on a common steel support channel system supported by 10 mm-diameter threaded rod hangers, washers and nuts where direct fastening to building construction is impractical. Channel to be sandwiched between nuts and washers located on both upper and underside portions of channels.
 - .2 Do not support a single conduit using a threaded rod and a conduit clip.
- .11 For surface mounting of two (2) or more conduits use steel channels. Securely attach channels to hangers with the maximum spacing not greater than:
 - .1 Conduits of one size only:
 - .1 16 mm to 21 mm conduit: 1524 mm spacing
 - .2 27 mm to 35 mm conduit: 1980 mm spacing
 - .3 41 mm and larger conduit: 3050 mm spacing
 - .2 Conduits of mixed size:
 - .1 Arrange supports so that maximum spacing of supports conforms to above, based on smallest conduit diameter.

December 12, 2019

3.1 INSTALLATION
(Cont'd)

- .11 (Cont'd)
- .12 (Cont'd)
- .12 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .13 Provide adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .14 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .15 Do not use supports or equipment installed for other trades for conduit or cable support.
- .16 Install fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.
- .17 Fasten individual and multiple runs of armoured cables to structure and in bundles as permitted in Section 26 05 21 - Wire and Cables (0 - 1000V).
- .18 Support various suspended types of junction, pull and/or outlet boxes as well as conduits, with minimum size 9 mm threaded rod, nuts and flat washers. Secure threaded rods to boxes with one (1) flat washer and nut installed on both sides of box.
 - .1 One (1) rod is required for all type boxes sized 150 mm x 150 mm and smaller (23.3 cm² and smaller).
 - .2 Two (2) rods are required for boxes sized 23.3 cm² and larger, up to and including those sized 300 mm x 300 mm (929 cm²).
 - .3 Minimum of four (4) rods are required for all boxes sized larger than 929 cm².
- .19 Cut-off excess rod within 13 mm of channel bottom.
- .20 In addition to the CEC minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300 mm from midpoint of all 90° bends. Maximum spacing between conduit support channels shall be dictated by smallest size conduit(s) being supported and/or secured to same.

GC Co-Working Site
Pilot Program at
BIO Facility
1 Challenger Drive
Project No. R.101402.002

HANGERS AND SUPPORTS
FOR ELECTRICAL SYSTEMS

Section 26 05 29
Page 4

December 12, 2019

3.1 INSTALLATION
(Cont'd)

- .21 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .22 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

PART 1 - GENERAL

1.1 SHOP DRAWINGS
AND PRODUCT DATA

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

PART 2 - PRODUCTS

2.1 PRODUCTS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. Interior units to be CSA Type 1 enclosure.
- .2 Exterior units to 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 Provide at least three (3) spare terminals on each set of lugs in splitters.

2.2 JUNCTION AND
PULL BOXES

- .1 Type C: welded steel construction, hinged cover, catch with hasp. Provision for locking. Surface mounting.
- .2 Type D: welded steel construction with screw-on flat covers for surface mounting. Surface or flush mounting as indicated. Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Junction and pull boxes larger than 125mm x 125mm to be Type "E", complete with continuously hinged door. Junction and pull boxes 125mm x 125mm and smaller shall 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, must not be sized smaller than 250 cm², complete with wrap around type bracket.

December 12, 2019

2.2 JUNCTION AND
PULL BOXES
(Cont'd)

- .5 Two or more flush installed sectional boxes, ganged together or boxes sized 100 mm-square and larger (intended for devices), are to have an additional support bracket installed on opposite side of box, not presently secured to metal stud.
- .6 Where larger sized devices or other types of flush outlet or junction boxes may be required, suitably sized 100 mm x 100 mm deep or 119 mm square boxes complete with appropriate sized extension tile rings are to be utilized. The use of plaster rings in lieu of tile type extension rings is not acceptable.
- .7 Provide junction boxes 150mm x 150mm used in branch circuit wiring 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. Finish ASA-61 grey enamel. Complete with bonding terminal strip.
- .2 Type T: 1.6 mm steel cabinet, 1.9 mm cover, latch lock, two (2) keys. Finish - ASA - 61 grey enamel. Provide complete with bonding terminal strip.

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. Install with hinges at side or bottom of enclosure; do not install with hinge on top.
- .2 Mount cabinets with top not higher than 2m above finished floor.

December 12, 2019

3.2 JUNCTION, PULL
BOXES AND CABINETS
INSTALLATION
(Cont'd)

- .3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30m of conduit run between pull boxes. Each run of raceway must not have more than the equivalent of four (4) 90-degree bends installed, including the bends located at an outlet or fitting.
- .4 Where located above accessible ceiling systems, locate enclosures within 750mm of ceiling. Where radiant heating panels are installed, junction boxes are to be in-board of same for easy access.
- .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 Support all suspended types of junction and pull boxes using a minimum of 10 mm threaded rod complete with nuts and flat washers. Secure threaded rods to boxes using one flat washer and nut installed on both sides of box. Provide as follows:
 - .1 Boxes up to 120 mm-square: 1 rod.
 - .2 Boxes from 120 mm- to 250 mm-square: 2 rods.
 - .3 Boxes with dimensions above 300 mm: 4 rods.
- .7 Concealed junction or outlet boxes feeding a maximum of two (2) fixture drops must not be sized smaller than 100mm².
- .8 Bond pull boxes and cabinets to ground utilizing a bonding conductor.
- .9 Use type T cabinets when equipment is required to be housed in a lockable enclosure.
- .10 Place pull boxes in straight sections of conduit run and shall not be used in lieu of a bend.
- .11 In no case will a pull or junction box be installed in a ceiling space that is not considered accessible.
- .12 All junction and or pull boxes 150mm x 150mm in size or larger where surface installed will be either type "C" or "E", complete with hinged cover plate.
- .13 All type "D" junction and / or pull boxes where flush mounted, will have the finish cover plate sized a minimum of 25mm larger than the box.

December 12, 2019

3.2 JUNCTION, PULL
BOXES AND CABINETS
INSTALLATION
(Cont'd)

- .14 All concealed type junction and / or pull boxes larger than 120mm square boxes will be type "C" or "E", complete with hinged cover plates.
- .15 Do not use sectional boxes with PVC. Rigid/thin wall conduit installation section boxes are intended for flexible conduit, AC-90, and/or other types of "pliable" cables.

3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Electrical Identification.
- .2 Provide a legend of colour coding used under plexiglass and located in the Main Electrical Room.
- .3 All various system "concealed" junction and /or pull boxes located in ceiling spaces will have locations identified on room side of T-bar grid spline or access cover frames with appropriate colour coded, circular shaped, self-adhering discs.
- .4 Discs will be both 18mm and 6mm in diameter as described in following legend, with 6mm discs being centered in middle of 18mm discs. Concealed junction, pull and outlet boxes, conduit fittings, etc. in ceiling spaces complete with their respective metal cover plates, and all location discs, will be colour coded as follows:

Various Systems	18mm Disc.	6mm Disc.
51 to 240 Volts	Yellow	
241 to 600 Volts	Orange	
Fire Alarm	Red	
Telephone	Black	
P.A. Intercom, Panic Alarm		Blue
Security	Brown	
Ground or Bond	Green	
Cable Television	Yellow	
Computer / Data	Black	White
Energy Management	Red	White
Others (As Noted)		

- .5 Cover plates for junction and or pull boxes located above finish ceilings housing branch circuits will have each branch circuit number neatly identified on plate. Use felt marker for this purpose.

December 12, 2019

3.3 IDENTIFICATION
(Cont'd)

- .6 All various systems junction and/or pull boxes etc., where located above grid system, will have location identified on underside or room side of T-Bar spline, with 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 disc on ceiling or wall access cover plates.
- .7 Concealed boxes installed above drywall ceilings or behind walls are to have their locations identified on the room side of access opening frames with properly colour coded identification disks.

PART 1 - GENERAL

- | | | |
|-----------------------------|----|---|
| <u>1.1 REFERENCES</u> | .1 | CSA C22.1-2018, Canadian Electrical Code, Part 1. |
| <u>1.2 RELATED SECTIONS</u> | .1 | Section 26 05 01 - Electrical Identification. |
| | .2 | Section 26 05 29 - Hangars and Supports for Electrical Systems. |
| | .3 | Section 26 05 34 - Conduits, Conduit Fittings, and Fastenings. |

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 | Provide multi-gang boxes where wiring devices are grouped. |
| | .4 | Blank cover plates for boxes without wiring devices. |
| | .5 | Boxes for 347 V devices shall be rated as such. |
| <u>2.2 SHEET STEEL OUTLET BOXES</u> | .1 | Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76mm x 50mm x 38mm or as indicated. 100mm square outlet boxes when more than one conduit enters one side with extension and tile rings as required. |
| | .2 | Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 100mm x 54mm x 47mm. |
| | .3 | 100mm square or octagonal outlet boxes for lighting fixture outlets. |
| | .4 | 100mm square outlet boxes with extension and tile rings for flush mounting devices in finished walls. |

December 12, 2019

<u>2.2 SHEET STEEL OUTLET BOXES (Cont'd)</u>	.5	Tile rings to have square corners. Select appropriate depth of tile ring to suit application.
	.6	Provide the following for each multi-media outlet: .1 A 119 mm x 119 mm x 53mm deep box with 38 mm extension ring and a single gang, square, welded tile ring, located where indicated.
<u>2.3 MASONRY BOXES</u>	.1	Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.
<u>2.4 CONCRETE BOXES</u>	.1	Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.
<u>2.5 CONDUIT BOXES</u>	.1	Cast FS aluminum boxes with factory-threaded hubs and mounting feet for all surface wiring of devices (switches, receptacle, thermostats and similar devices) installed lower than 2440 mm AFF. Matching steel type FS metal device plates specifically made for FS boxes are to utilize 4-point fastening.
	.2	Surface type boxes larger in size than 119 mm-square where installed on or within ceiling spaces to be type "E" complete with hinged-type cover plates. Hinged covers are not required for pull boxes.
<u>2.6 FITTINGS- GENERAL</u>	.1	Bushing and connectors with nylon insulated throats.
	.2	Knock-out fillers to prevent entry of debris.
	.3	Double locknuts and insulated bushings on sheet metal boxes.
<u>2.7 COLOUR CODING</u>	.1	Colour coding of system to be as per Section 26 05 01.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Install flush mounted boxes in all finished areas unless otherwise indicated.
- .6 Install surface mounted boxes in service rooms and above ceilings unless otherwise indicated.
- .7 Install flush mounted boxes in outside of exterior walls unless otherwise indicated.
- .8 Install type FS boxes for all surface-mounted devices (regardless of system type involved).
- .9 Install concealed boxes in accessible locations.
- .10 For flush installed 100mm or 120mm square box being used as a pull box or junction box, install a single or double gauge tile ring and blank cover installed on the box.
- .11 Do not use sectional type boxes with rigid galvanized steel conduit, rigid PVC conduit, or EMT.
- .12 Connect boxes to AC-90 cables specifically made for only AC-90 cables.
- .13 When installing flush boxes in metal drywall partitions where the grouping of multiple device boxes is required, support the box between the studs with a box mounting bracket. Where a single flush box is installed, this box may be supported by the wall stud without any additional support required.

GC Co-Working Site	OUTLET BOXES, CONDUIT	Section 26 05 32
Pilot Program at	BOXES AND FITTINGS	Page 4
BIO Facility		
1 Challenger Drive		December 12, 2019
Project No. R.101402.002		

3.1 INSTALLATION	.14	Identify all boxes in accordance with Section 26 05
(Cont'd)		01.

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 CAN/CSA C22.2 No. 45.1-07(R2017), Electrical Rigid Metal Conduit - Steel.
- .2 CSA C22.2 No. 56-2017, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .3 CSA C22.2 No. 83-1985(R2017), Electrical Metal Tubing.
- .4 CSA C22.2 No. 211.2-06 (R2016), 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.

Metric (mm)	Imperial (inch)
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 - Hangers and Supports for Electrical Systems.

PART 2 - PRODUCTS

2.1 CONDUITS

- .1 Rigid galvanized steel threaded conduit, fittings and connectors: to CSA C22.2 No. 45.1.
- .2 Electrical metallic tubing (EMT) with steel set screw couplings: to CSA C22.2 No. 83.
- .3 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.
- .5 ENT conduit is not permitted.

2.2 CONDUIT
FASTENINGS

- .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 10mm dia. threaded rods to support suspended channels.

2.3 CONDUIT
FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Use conduit fittings (LB, LL, LR) for 90° bends. "Ells", or corner pulling elbows are prohibited.
- .3 Connectors and couplings for EMT: galvanized steel set-screws type complete with case hardened steel locknuts. Provide insulated throats on connectors up to and including 27 mm. Install metal thread-on bushings on all EMT connectors sized 35 mm or larger.

December 12, 2019

2.3 CONDUIT
FITTINGS
(Cont'd)

- .4 Use waterproof type connectors on all vertical conduit runs connecting equipment. Equip connectors with a rubber "O" Ring gasket. In addition, any conduit couplings in the vertical portion of the conduit run over equipment enclosures equipped with sprinkler hoods must be rain tight.
- .5 Flexible metal conduit connectors to be nylon insulated, steel or malleable iron type similar to T & B Tite-Bite #3115 thru 3124. Provide insulating bushings (anti-shorts) for flexible metal conduit connectors. Install plastic thread-on bushings on all flexible metal conduit connectors sized 35 mm or larger.
- .6 Liquid-tight flexible metal conduit fittings:
 - .1 Specifically listed for liquid tight flexible metal conduit.
 - .2 Steel type, to match conduit size.
 - .3 Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening.
 - .4 Safe edge ground type.
 - .5 Connectors to have insulated throats.
- .7 Plastic screw-on bushings for conduit ends up to 35mm diameter; metal bushings for larger sizes.

2.4 GENERAL
FITTINGS

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Double locknuts and insulated bushings on sheet metal boxes.

2.5 EXPANSION
FITTINGS FOR RIGID
CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 205 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 21 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

December 12, 2019

2.6 FISH CORD .1 Polypropylene: minimum 3mm diameter.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install conduits as high as possible to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
 - .2 Conceal conduits except in 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 electrical metallic tubing (EMT) except in cast concrete.
 - .4 Install EMT as a complete system and securely fasten in place within 300 mm of each outlet box, junction box, cabinet, couplings, fittings and changes in direction and the spacing between supports as follows:
 - .1 Not greater than 1500 mm for 16 mm and 21 mm trade size EMT.
 - .2 Not greater than 1800 mm for 27 mm and 35 mm trade size EMT.
 - .3 Not greater than 3000 mm for 41 mm trade size EMT or larger.
 - .5 Use rigid galvanized steel threaded conduit through poured concrete floor slabs and where otherwise specified.
 - .6 Use rigid PVC conduit underground: minimum size 21mm dia.
 - .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.
 - .8 Minimum conduit size for lighting and power circuits: 21mm.
 - .9 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .10 Mechanically bend steel conduit over 21mm dia.

December 12, 2019

3.1 INSTALLATION
(Cont'd)

- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.
- .13 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .14 Dry conduits out before installing wire.
- .15 Install insulated copper bonding conductor in all conduit runs. Minimum size: #12 AWG or Table 16 of C.E.C. whichever is larger.
- .16 Non-connected PVC or steel raceways protruding up through open bottoms of free-standing equipment require PVC bell ends and steel type ground bushings installed on ends of respective types of conduits. Extend conduits a minimum of 50mm above housekeeping pad or concrete trough.
- .17 Install plastic bushings in all EMT sized 35mm and larger before pulling in conductors.
- .18 Installation of conduit for control circuit wiring and structured cabling.
 - .1 Install surface wiring in EMT.
 - .2 Conduit to extend 750mm of all various control devices associated with the operation of any given piece of mechanical equipment or device they may feed.
 - .3 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.
 - .4 Locate EMT type conduit wall stub complete with flush installed device box in all partitions to accommodate wiring between device and accessible ceiling.
 - .5 Install EMT connectors complete with nylon insulated throat or threaded type bushing on end of EMT stub where it protrudes through the wall above the accessible ceiling. EMT plastic end cap bushings that are CSA approved may also be used.
 - .6 Bond EMT conduit stubs to ground as required by the CEC.

December 12, 2019

3.1 INSTALLATION
(Cont'd)

- .18 (Cont'd)
 - .7 Turn out EMT conduit stubs installed in walls into the accessible ceiling space in the room where the associated wall box is located. Provide separate stubs for each room.
- .19 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 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 steel roof deck is not permitted due to the possible penetration of roof deck mechanical screws or fasteners.
- .20 Where construction consists of metal Q-deck and steel joists (non-roof deck), install conduits 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.
- .21 Provide expansion joints for rigid conduit systems to the requirements of the CEC.
- .22 Code approved conduits will be used for underground or below slab installations.
- .23 Liquid tight flexible metal conduit will be used for equipment such as cameras or motors. Limit length to 1.2m. Confirm feeds to camera are secure and inaccessible.
- .24 Provide two (2) 20mm spare conduits to accommodate future power or data etc., into any areas that may become inaccessible after construction; or, installation at a later time would cause a major disruption to the operation.
- .25 Install spare conduits in a concealed secure manner but allowing for future access.

December 12, 2019

3.1 INSTALLATION
(Cont'd)

- .26 Clearly show in slab or underground conduits on the record drawings.
- .27 Do not install conduits (indoors and outdoors) in a manner in which they may be used as a climbing aide to gain access to rooftops or non-secured areas.
- .28 All distribution panel boards, motor control centers, splitter troughs, various other systems control panels, etc., which are fed underground to utilize code approved, rigid type, thick wall and PVC conduit.
- .29 PVC conduits of "all" sizes prior to turning-up through floor slabs, are to have transition to threaded steel take place.
- .30 Provide fire barrier material equivalent to 3M for all penetrations of conduits between walls, floors or ceilings.

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. Slope conduits entering/exiting the building away from the building.
- .2 Waterproof joints (PVC accepted) with heavy coat of bituminous paint.

December 12, 2019

3.3 CONDUITS
UNDERGROUND
(Cont'd)

- .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 and larger in trenches not less than 305mm in depth from underside of concrete floor slab to bottom of trench. Place conduits on a 50mm bed of sand and place a second 50mm bed of sand on top. Completely surround conduits with sand prior to backfilling.
- .5 Wiring for all various systems devices and/or outlets installed below ground floor concrete floor slabs may be performed utilizing minimum 21mm PVC rigid conduit. Transition from PVC rigid thick wall conduit to rigid steel threaded conduit is to take place below the floor slab. Transition from rigid steel to EMT above concrete floor slab.
- .6 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.
- .7 Rigid PVC (thick wall) conduit shall be permitted to be direct buried.
- .8 Conduit installation is not to influence the thickness of the floor slab.
- .9 Do not run conduits along concrete walls installed to reinforce wall installations.
- .10 The installation of PVC type conduits above ground is prohibited.
- .11 Up-size underground conduits at least one (1) trade size above the minimum code requirement for ease of pulling.
- .12 Only use rigid Types EB1 and DB2/ES2 PVC (thin wall) Conduit (CSA C22.2 211.1) where embedded in concrete.
- .13 Direct bury rigid PVC (thick wall) Conduit (CSA C22.2 No. 211.2).

PART 1 - GENERAL

- 1.1 REFERENCES
- .1 CSA C22.2 No. 111-2018, General-use Snap Switches.
 - .2 CSA C22.2 No. 55-15, Special Use Switches.
 - .3 CSA C22.2 No. 42-10(R2019), General use Receptacles, Attachment Plugs, and Similar Wiring Devices.
- 1.2 SHOP DRAWINGS
- .1 Submit shop drawings for each device and cover plate type as per specification Section 01 33 00 - Submittal Procedures.
- 1.3 OPERATIONAL AND MAINTENANCE DATA
- .1 Provide operation and maintenance data for wiring devices for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

PART 2 - PRODUCTS

- 2.1 RECEPTACLES
- .1 Type 1:
 - .1 General purpose duplex receptacles, specification grade CSA type 5-15R, 125 V, 15 A, U ground, with following features:
 - .1 Ivory urea molded housing for all power receptacles.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
 - .2 Type 2:
 - .1 Duplex receptacles, specification grade CSA type 5-20R (T-Slot), 125 V, 15/20A, U ground, with following features:
 - .1 Ivory urea molded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.

2.1 RECEPTACLES
(Cont'd)

.2 (Cont'd)

.1 (Cont'd)

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and riveted grounding contacts.

.3 Type 3:

.1 GFI duplex receptacles, specification grade CSA type 5- 15R, 125 V, 15 A, U ground, with following features:

.1 Ivory urea molded housing for all power receptacles.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and riveted grounding contacts.

.6 GFI test and reset buttons.

.4 Type 4:

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

.1 Ivory urea molded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and riveted grounding contacts.

.6 GFI test and reset buttons.

.5 Type 5:

.1 General purpose duplex receptacles, specification grade CSA type 6-15R, 250 V, 15 A, U ground, with following features:

.1 Ivory urea molded housing for all power receptacles.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

December 12, 2019

-
- 2.1 RECEPTACLES .5 (Cont'd)
- (Cont'd) .1 (Cont'd)
- .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
- .6 Type 6:
- .1 Duplex receptacles, specification grade CSA type 6-20R (T-Slot), 250 V, 15/20A, U ground, with following features:
 - .1 Ivory urea molded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
 - .7 Provide other receptacles with ampacity and voltage as indicated.
 - .8 Provide the receptacles of a single manufacturer throughout project.
- 2.2 COVER PLATES .1 Cover plates for wiring devices.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
 - .3 Brushed stainless steel plates for wiring devices mounted in flush-mounted outlet box.
 - .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

PART 3 - EXECUTION

- 3.1 INSTALLATION .1 Receptacles:
- .1 Install receptacles in gang type outlet box when more than one (1) receptacle is required in one (1) location.
 - .2 Mount receptacles at height as indicated.
-

December 12, 2019

3.1 INSTALLATION
(Cont'd)

- .1 (Cont'd)
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Mount receptacles with "U" ground up for vertically mounted and neutral slot at top for horizontally mounted receptacle.
 - .5 Install pigtail type leads on conductors in all device or outlet boxes where feeding through to other receptacles. Daisy-chaining or looping through of conductors from one device to another is not acceptable. Provide separate pigtail conductor leads for final termination to each receptacle for phase, neutral and bond conductors.
 - .6 Test all receptacles for polarity.
- .2 Cover plates:
 - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .3 Device leveller and retainer is an approved accessory for securing devices to flush installed device boxes.
- .4 Single gang adjustable box extension is an approved accessory for extending single gang box openings a maximum of 22mm. Their use is acceptable in non-combustible type walls where front edges of boxes have not been installed greater than 28mm from wall surface.

3.2 COMMISSIONING

- .1 Refer to Section 01 91 13 - General Commissioning Requirements.

PART 1 - GENERAL

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

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 | Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating. |
| | .4 | Circuit breakers with interchangeable trips as indicated. |
| | .5 | Circuit breakers to have interrupting capacity as indicated on the drawings. Circuit breakers are not to utilize series rating in determining their interrupting capacity. |
| | .6 | Circuit breakers rated 225 A and above are to be complete with adjustable magnetic trip units. |

December 12, 2019

2.2 THERMAL
MAGNETIC BREAKERS

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

2.3 MAGNETIC
BREAKERS

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

2.4 SOLID STATE
TRIP BREAKERS

- .1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self- powered shunt trip to provide inverse time current trip under overload condition, and long-time short time instantaneous tripping for phase ground fault short circuit protection. Settings to be individually adjustable.

2.5 OPTIONAL
FEATURES

- .1 Include:
 - .1 On-off locking device for 10% of branch breakers and all breakers supplying emergency lighting battery units and fire alarm devices.

2.6 GROUND FAULT
CIRCUIT INTERRUPTER
CIRCUIT BREAKERS

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

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install circuit breakers as required, factory install breakers in all panelboards, switchboards MCC's and distribution panels.
- .2 Adjust circuit breaker settings to the values indicated on the manufacturer's supplied Coordination Study.

GC Co-Working Site	MOULDED CASE CIRCUIT	Section 26 28 21
Pilot Program at	BREAKERS	Page 3
BIO Facility		
1 Challenger Drive		December 12, 2019
Project No. R.101402.002		

3.1 INSTALLATION	.3	Install individual circuit breakers in CSA Type 1
(Cont'd)		enclosures complete with bonding and neutral
		connections.

PART 1 - GENERAL

1.1 REFERENCES

- .1 IEEE C62.41.1-02(R2008), IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 IEEE C62.45-2002(R2008), Guide on Surge Testing for Equipment Connected to Low- Voltage AC Power Circuits.
- .3 CSA C22.2 No. 250.13-17, Light Emitting Diode (LED) Equipment for Lighting Applications.
- .4 NECA/NEIS 500-2006, Recommended Practice for Installing Indoor Commercial Lighting Systems.
- .5 ASTM F 1137/F1137M-19, American Society for Testing and Materials Specification for phosphate/oil and phosphate/organic corrosion protective coatings for fasteners.
- .6 FCC CFR47, USA Federal Communications Commission Frequency allocations and radio treaty matters; general rules and regulations.
- .7 IES LM-79-19, Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
- .8 IES LM-80-2015, Approved Method: Measuring Lumen Maintenance of LED Light Sources.
- .9 NEMA SSL 1-2016, Electronic Drivers for LED Devices, Arrays, or Systems.

1.2 RELATED
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 78 00 - Closeout Submittals
- .3 Section 01 91 13 - Commissioning General Requirements

1.3 SHOP DRAWINGS
AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

December 12, 2019

1.3 SHOP DRAWINGS
AND PRODUCT DATA
(Cont'd)

- .2 Submit shop drawings for the following:
 - .1 Luminaire.
 - .2 Driver for each luminaire type.
- .3 Shop Drawings:
 - .1 Shop drawings to clearly indicate the following:
 - .1 Luminaire ID number as identified in contract documents.
 - .2 Fixture specification as identified in Part 2 and on the drawings.
 - .3 Driver specification as identified in Part 2 and on the drawings.
 - .4 Photometric data for each luminaire type.
 - .5 Energy data for luminaires.
- .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 the 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 - Closeout Submittals.

PART 2 - PRODUCTS

2.1 LED DRIVERS

- .1 Electronic LED drivers:
 - .1 Performance requirements:
 - .1 Voltage: 120 V, 60 Hz.
 - .2 Power factor: greater than 0.90.

-
- 2.1 LED DRIVERS .1 (Cont'd)
- (Cont'd) .1 (Cont'd)
- .3 Total harmonic distortion: less than 20%.
 - .4 Efficiency: 85% or greater.
 - .2 Regulatory requirements:
 - .1 Underwriters Laboratories (UL) listed and Canadian Standards Association (CSA) approved.
 - .2 Meet or exceed ANSI C62.41 Category A for transient protection.
 - .3 Meet or exceed NEMA SSL 1 where applicable.
 - .4 Meet or exceed the requirements of the Federal Communications commission (FCC) rules and regulations, Title 47 CFR part 15, non-consumer (Class A) for EMI/RFI (conducted and radiated).
- 2.2 SPARES .1 For LED fixtures, provide 10% spare LED lamp modules for each type and 5% spare drives for each type.
- 2.3 LUMINAIRES .1 Luminaires are specified on the drawings.
- .2 Paint interior troffers after fabrication.
- .3 Recessed troffers, in order to eliminate raw edges and corrosion and to maximize efficiency, paint the fixture housing and driver cover with a baked white polyester enamel powder coat with 90% minimum reflectivity after fabrication using an electrostatic process. This need not include the lens frame.
- 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.
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|-------------------------------------|----|---|
| <u>3.1 INSTALLATION</u>
(Cont'd) | .3 | For open ceilings where there are pipes running through the ceiling, mount luminaires to accommodate pipes and be flush for maximum illumination performance. |
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 | | |
| <u>3.2 WIRING</u> | .1 | Connect luminaires to lighting circuits as indicated. |
| | .2 | Provide separate neutrals for all lighting circuits. |
| | .3 | Each light fixture must have a separate fixture power drop installed and connected to hard wired junction box or outlet box in ceiling space. |
| | .4 | Do not wire recessed and/or surface type light fixtures in a daisy-chain manner or loop their power sources between fixtures, unless the fixtures are installed end-to-end or are housed in an integral junction box. |
| | .5 | Provide suspended fixtures mounted in continuous rows with a separate #12 AWG bonding conductor in the fixture raceway. |
|
 | | |
| <u>3.3 LUMINAIRE</u> | .1 | For suspended ceiling installations support luminaires independently of ceiling using an approved supporting method. Supporting luminaires from any part of the ceiling system is strictly prohibited. |
| | .2 | Recessed Down Lights: |
| | .1 | Non-accessible Ceilings: |
| | | .1 If the luminaire opening is less than 150mm in diameter, a separate fixture drop shall be provided. |
| | | .2 Fixture drops shall be run to an accessible junction box above an accessible ceiling or an access panel. |
| | .2 | Fixture drops must not exceed 5m in length. |
| | .3 | Accessible T-bar Ceilings: |
| | | .1 Notwithstanding item 3.3.1 above, securely fasten fixtures to the T-bar ceiling grid. No part of the fixture is to derive support from the T-bar ceiling tiles. |
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GC Co-Working Site
Pilot Program at
BIO Facility
1 Challenger Drive
Project No. R.101402.002

LIGHTING EQUIPMENT

Section 26 50 00
Page 5

December 12, 2019

3.3 LUMINAIRE
(Cont'd)

- .2 (Cont'd)
- .3 (Cont'd)
- .3 Refer to drawings for support details for other fixtures. Provide all required mounting hardware.

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.

3.5 COMMISSIONING

- .1 Refer to Section 01 91 13 - General Commissioning Requirements.

PART 1 - GENERAL

1.1 SUMMARY

- .1 Related Sections:
 - .1 Section 26 27 26 - Wiring Devices.
 - .2 Section 26 50 00 - Lighting Equipment

1.2 DESCRIPTION OF
WORK

- .1 Supply and install a complete system for the control of lighting and other equipment as indicated on the drawings and as further defined herein. All drivers, must be compatible and fully function with the LCS.
- .2 Verify quantity of specific devices and equipment required for this project. Provide all components and accessories necessary to install a fully functional lighting control system.
- .3 The lighting control system may only utilize wired components to achieve the functionality required. Wireless components are not permitted.
- .4 Review luminaire data and provide devices and accessories compatible with luminaires as required to affect control.

1.3 REFERENCES

- .1 IEEE C62.41-2002, IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Currents.
- .2 UL 20-2018, General Use Snap Switches.
- .3 UL 94-2013, Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
- .4 UL 508-2018, Industrial Control Equipment.
- .5 UL 1472-2015, Solid State Dimming Controls
- .6 ASTM D4674-19, Standard Practice for Accelerated Testing of Color Stability of Plastics Exposed to Indoor Office Environments.

December 12, 2019

1.4 CONSTRUCTION
SUBMITTALS

- .1 Shop Drawings: submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, control stations, occupancy sensors and other interfaces. Shop drawings to indicate locations of each device.

1.5 QUALITY
ASSURANCE

- .1 Products to be manufactured by a firm regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in successfully used in similar service for not less than five (5) years.

1.6 WARRANTY

- .1 Provide a minimum of one (1) year warranty on the lighting control system components. The warranty will begin on the date of Substantial Completion as agreed by the Departmental Representative.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Provide system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.

2.2 MATERIAL AND
COMPONENTS

- .1 Power Interfaces:
 - .1 Provide power interfaces as required.
 - .2 Electrical: Phase independent of control input.
 - .3 On/off and dimming control power packs as required.
- .2 Occupancy/Vacancy Sensors:
 - .1 Wall, ceiling, or corner mounted as indicated on drawings.
 - .2 Provide all necessary mounting hardware.
 - .3 Dual or single technology as indicated on drawings:
 - .1 Dual technology shall consist of passive infrared (PIR) and acoustic sensing technologies.
 - .2 Single technology to consist of passive infrared (PIR) only.

December 12, 2019

2.2 MATERIAL AND
COMPONENTS
(Cont'd)

- .2 (Cont'd)
 - .4 Minimum coverage of 186m² while mounted at 2.7m above finished floor.
 - .5 Suitable for high humidity locations.
 - .6 Wall mounted units with integral on/off switch.
 - .7 Complete with power packs as necessary:
 - .1 Single 20A relay.
 - .2 120V operation.
 - .3 Suitable for high humidity locations.
 - .4 Plenum rated.
- .3 Dimming controls:
 - .1 Stand-alone units or combined with occupancy sensors as required.
 - .2 Occupancy/vacancy features for combined units to 2.2.2.
 - .3 Automatic dimming control with self-calibration for set-point.
 - .4 Stepped dimming not acceptable.
 - .5 12-24 VAC low voltage control of luminaires using dimming power pack.

PART 3 - EXECUTION

3.1 EQUIPMENT
INSTALLATION

- .1 Install equipment in accordance with manufacturer's installation instructions.
- .2 Provide complete installation of system in accordance with Contract Documents.
- .3 Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- .4 Wiring:
 - .1 Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
 - .2 Confirm low voltage conduits or control wires do not run parallel to current carrying conduits.
 - .3 Install lighting control system and make all necessary wiring connections to external devices and equipment.
 - .4 Wire per manufacturer instructions.
- .5 Demonstrate successful operation of lighting controls.

PART 1 - GENERAL

1.1 RELATED
SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 78 00 - Closeout Submittals
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Fittings

1.2 PRODUCT DATA

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

1.3 OPERATION AND
MAINTENANCE DATA

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

1.4 REFERENCES

- .1 CAN/CSA C22.2 No. 141-15, Emergency Lighting Equipment

PART 2 - PRODUCTS

2.1 BATTERY UNIT

- .1 Supply voltage: 120 VAC.
- .2 Output voltage: 12 VDC.
- .3 Operating time: 60 min. based on actual DC load plus.
- .4 Battery: sealed, maintenance free, ten (10) year life warranty.
- .5 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.

December 12, 2019

2.1 BATTERY UNIT
(Cont'd)

- .6 Solid state transfer circuit.
- .7 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .8 Signal lights: LED solid state, for 'AC Power ON' and 'High Charge'.
- .9 Lamp heads: integral on unit, 345 horizontal and 180 vertical adjustment. Lamp type: LED.
- .10 Suitable for t-bar ceiling mounting.
- .11 Finish: white.
- .12 Auxiliary equipment:
 - .1 Test switch.
 - .2 Self-Diagnostic circuitry.

2.2 REMOTE UNIT

- .1 12Vdc double head remote units, suitable for wall or ceiling mounting.
- .2 Lamp heads: integral on unit, 345° horizontal and 180° vertical adjustment. Lamp type: LED MR16.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install equipment and fixtures as indicated.
- .2 Make connections.
- .3 Test and verify operation of units upon loss and restoration of normal ac power. Verify 60 minute battery life upon loss of power.
- .4 Feed the emergency lighting system from the same circuit which feeds the normal lights in that area or as indicated on the drawings.

PART 1 - GENERAL

- 1.1 PRODUCT DATA .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- 1.2 OPERATION AND MAINTENANCE DATA .1 Submit operation and maintenance data for incorporation in the Manual specified in Section 01 78 00 - Closeout Submittals
- 1.3 REFERENCE .1 CSA C860-11 (R2016), Performance of Internally Lighted Exit Signs.
- .2 CAN/CSA C22.2 No. 141-2015, Emergency Lighting Equipment.

PART 2 - PRODUCTS

- 2.1 STANDARD UNITS .1 Housing: extruded, one-piece aluminum housing and face plates.
- .2 Lamps: One (1) LED-2W panel 120Vac, 219,000 h.
- .3 Operation: designed for 219,000 h, LED panel only, 120Vac/12 V dc, self-powered for 2 hours operation upon power failure.
- .4 Housing finish: white.
- .5 Unit to operate on 12 V DC under emergency conditions.
- .6 Mounting: unit to have universal mounting position and single or double face with arrows as indicated.
- .7 Ten (10) year life warranty.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 COMMISSIONING

- .1 Refer to Section 01 91 13 - General Commissioning Requirements.