

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.

1.3 FUNCTIONAL
PERFORMANCE TESTING
(FPT)

- .1 Prior to Functional Performance Testing, submit the following documentation:
 - .1 Record drawings.
 - .2 Operations and maintenance manuals.
 - .3 Documentation listed in Section 01 78 00.
 - .4 Written confirmation of System Demonstration and Operating and Maintenance Instructions have been performed in accordance with Section 01 78 00.
- .2 Immediately rectify deficiencies or discrepancies discovered during the FPT process.
- .3 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.
- .2 Comply with relevant CSA standards and all current Inspection Department bulletins.

1.5 REFERENCES

- .1 CSA C22.1-2015, Canadian Electrical Code.
 - .2 CAN3 C235-83(R2015), Preferred Voltage Levels for AC Systems.
 - .3 CSA Z462-15, Workplace Electrical Safety.
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- .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.

1.9 PERMITS, FEES,
AND INSPECTION
(Cont'd)

- .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.

1.10 MATERIALS AND
EQUIPMENT

- .1 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.
- .2 Factory assemble control panels and component assemblies.
- .3 All equipment and materials which serve a similar function must be from a single manufacturer and a single product line.

1.10 MATERIALS AND
EQUIPMENT
(Cont'd)

- .4 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.

1.13 WARNING SIGNS

- .1 Provide warning signs, as specified and/or to meet requirements of the Inspection Department.
- .2 Confirm all 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 indicated otherwise.
- .2 Verify mounting height of equipment before proceeding with rough in.

1.14 MOUNTING
HEIGHTS

(Cont'd)

- .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.

1.15 PROTECTION

- .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.

1.16 CONDUIT AND
CABLE INSTALLATION

- .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.

1.16 CONDUIT AND
CABLE INSTALLATION
(Cont'd)

- .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.

1.17 FIELD QUALITY
CONTROL

- .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.
- .2 Furnish manufacturers' certificates or letters confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .4 Submit test results for the Departmental Representative's review.

1.18 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.

1.18 SHORT CIRCUIT
AND COORDINATION
STUDY

(Cont'd)

- .2 Provide Arc-Flash warning labels for all electrical equipment in accordance with CSA Z462. Obtain arc-flash ratings for each piece of equipment from the Departmental Representative prior to ordering labels.

1.19 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.
- .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.

1.20 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.

1.21 SPRINKLER
PROOF HOODS

- .1 Protect 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.

1.22 INSTALLATION
REQUIREMENTS

- .1 Install 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 equipment and appurtenances to allow free access for adjustment, maintenance and/or replacement.
 - .4 Provide 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. Fabricate equipment supports not supplied by equipment manufacturer using structural grade steel.
 - .5 Exterior supports to be galvanized, unless noted otherwise.
 - .6 Install products and services in accordance with the respective manufacturer's recommendations.
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1.22 INSTALLATION
REQUIREMENTS
(Cont'd)

- .7 Do not use high-velocity explosive-activated tools. Low-velocity system types are permitted.
- .8 Provide caps and seal open ends of installed conduits to prevent the entrance of foreign substances.
- .9 Install services capped for future possible use such that easy access is provided for future connections.
- .10 Schedule modifications to the main electrical entrance and work requiring a facility outage outside the time the arena is in full operation.
- .11 Provide backup power and connection equipment, including switchboards, as required to support all arena operations at the time the main electrical entrance is out of service during replacement or during any work requiring a facility outage.
- .12 Maintain existing communication to the un-renovated areas of the building and co-ordinate with the utilities providing communication services to ensure the continuous connection.
- .13 Maintain the existing fire protection system, security system and other similar systems in the un-renovated areas of the building and to extend the existing system components to the new system control panels.

1.23 FIELD REVIEW

- .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.

1.24 TORQUES FOR
WIRE TERMINATION

- .1 For proper termination of conductors, field connections must be made properly tight.
- .2 Where possible, obtain and comply with Manufacturer's instructions for proper termination torque values for the equipment.
- .3 In the absence of Manufacturer's instructions, make terminations in conformance with the values given in Tables D6 and D7 of the CEC.

1.25 CABLE TIES AND
TYE WRAPS

- .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.

1.26 WORKING SPACE
ABOUT ELECTRICAL
EQUIPMENT

- .1 Arrange installation as required to maintain minimum working space around electrical equipment in conformance with the CEC.

1.27 LOW VOC
MATERIALS

- .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.

1.28 PLYWOOD
BACKBOARDS

- .1 Provide 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.
- .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.

1.29 NETWORK
CONNECTIONS

- .1 All required network connections must be registered with the Owner's facilities management information technology department. Provide technical connection information for each and every device supplied under this contract which may require connection to the Owner's IT network. This includes, but is not limited to: CCTV cameras, access control, intrusion alarm, Ethernet ports, building automation system, lighting control etc.

PART 1 - GENERAL

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| 1.1 RELATED | .1 | Section 01 33 00 - Submittal Procedures.
Disposal |
| | .2 | Section 01 74 21 - Construction Waste Management |
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|------------------|----|---|
| 1.2 PRODUCT DATA | .1 | Submit product data in accordance with Section 01 33 00. |
| | .2 | Product data to include paint colour chips, other products specified in this section. |
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|-------------|----|---|
| 1.3 SAMPLES | .1 | Submit samples in accordance with Section 01 33 00. |
| | .2 | Samples to include nameplates, labels, tags, lists of proposed legends. |

PART 2 - PRODUCTS

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|------------------------------|----|---|
| 2.1 EQUIPMENT IDENTIFICATION | .1 | Identify electrical equipment with nameplates and labels as specified herein. |
| | .2 | Identification:
.1 Provide all panels, disconnect switches, receptacles, transformers, etc. with lamicoid nameplates as further described herein. Take care to affixed plates true and level, and plumb in all instances.
.2 Affix nameplates to all metal surfaces with steel type pop-rivets.
.3 Affix nameplates to other types of surfaces with contact-type cement.
.4 Affix nameplates to building exterior surfaces with nylon inserts and self-tapping screws unless specifically indicated otherwise.
.5 Apply contact type cement to complete rear side of plate, as opposed to several locations or areas on same.
.6 Lamicoid nameplates installed on distribution panelboards, motor control centres, splitter troughs and transformers to indicate the following:
.1 Designated name of equipment. |
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2.1 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.6 (Cont'd)

- .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., shall contain the following information:

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

EXHAUST FAN NO. 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).

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

Example:

MAIN BREAKER 800 AMPS

346/600V, 3PH, 4W

Example:

MAIN SWITCH 200 AMPS

120/208V, 3PH, 4W

2.1 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.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

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.

Example: For computer use only
PANEL H - 24

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

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

.16 All addressable fire alarm devices are to be lamicoid identified.

2.1 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.16 (Cont'd)

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

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

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

.17 Lamicoid 3mm thick plastic engraving sheet, white 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 lamicoid 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 1	10mm x 50mm	1 line	5mm high letters
Size 2	13mm x 70mm	1 line	6mm high letters
Size 3	16mm x 75mm	2 lines	5mm high letters
Size 4	19mm x 90mm	1 line	9mm high letters
Size 5	38mm x 90mm	2 lines	13mm high letters
Size 6	25mm x 100mm	1 line	13mm high letters
Size 7	25mm x 100mm	2 lines	6mm high letters
Size 8	50mm x 150mm	2 lines	13mm high letters
Size 9	75mm 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

2.1 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.17 (Cont'd)

.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.

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

.9 Co-ordinate names of equipment and systems with other trades to ensure that equipment identification is consistent.

.10 In addition to required nameplates and colour coding, junction boxes 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.

2.1 EQUIPMENT
IDENTIFICATION
(Cont'd)

.2 (Cont'd)

.17 (Cont'd)

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

.12 Where a lamicoid identified item is installed above an accessible ceiling, provide two (2) lamicoid plates, one (1) at the item location and one (1) directly below on the underside of the ceiling.

.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.

.3 Identify all conductors with insulation colors 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 c/w yellow strip

.4 Color-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 colored tapes in lieu of insulation coloring may be used to identify conductors that exceed sizes as previously indicated. Labelling is to take place at both ends of all runs at a minimum of 300mm from terminations, in addition to within all boxes between both ends of the run.

.5 Use colour coded wires in communication cables, matched throughout system.

2.2 WIRING
IDENTIFICATION
(Cont'd)

- .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.
- .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 to be coloured on inside only where two colours are required. Metal cover plates to have both colours applied diagonally where two (2) colours are required. Complete plate is to be painted where one colour only is required. All junction boxes must 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 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:

<u>SYSTEM</u>	<u>19mm DISCS</u>	<u>6mm DISCS</u>
0 to 50 Volts	Violet	
51 to 240 Volts	Yellow	
241 to 600 Volts	Orange	
Fire Alarm	Red	
Telephone (voice only)	Black	
P.A. and Intercom	Blue	
Security	Brown	
Ground or Bond	Green	
Cable Television	Yellow	White
Nurse Call	Orange	White
Energy Management	Red	White
Computer (data only)	Black	White
Voice & Data	Blue	White

2.3 CONDUIT AND BOX IDENTIFICATION

(Cont'd)

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.
- .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.

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 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.

PART 1 - GENERAL

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| <u>1.1 REFERENCES</u> | .1 | CSA C22.2 No. 65-13, Wire Connectors, Tri-National Standard, with UL 486A-486B and NMX-J-543-ANCE-03. |
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PART 2 - PRODUCTS

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| <u>2.1 MATERIALS</u> | .1 | Spring-type pressure wire connectors: with current carrying parts of copper and copper alloy sized to fit copper conductors 10AWG or less. Provide connectors 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

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|----------------------|----|---|
| <u>3.1 MATERIALS</u> | .1 | Make connections and terminations electrically and mechanically secure. Sizes of connectors to be as per manufacturer's recommendations for various sizes and combinations of wire sizes. |
| | .2 | Make joints required in branch wiring #10 and smaller utilizing spring-type pressure wire connectors. Plier tighten wire connectors. Cap to completely fit or cover all enclosed conductors as required. |
| | .3 | Joints for all other wiring shall be made 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

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| <u>1.1 REFERENCES</u> | .1 | CSA C22.2 No. 0.3-09(R2014), Test Methods for Electrical Wires and Cables. |
| | .2 | CSA C22.2 No. 208-14, Fire Alarm and Signal Cable. |
| <u>1.2 PRODUCT DATA</u> | .1 | Submit product data in accordance with Section 01 33 00. |
| <u>1.3 OPERATION AND MAINTENANCE DATA</u> | .1 | Submit operation and maintenance data for incorporation into manual specified in Section 01 78 00. |
| <u>1.4 RELATED WORK</u> | .1 | Common Work Results for Electrical: Section 26 05 00. |

PART 2 - PRODUCTS

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|---------------------------|----|--|
| <u>2.1 BUILDING WIRES</u> | .1 | Conductors: soft drawn stranded 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 | All phase conductor sizes up to and including #2 AWG will be color coded as below:
.1 Phase A - Red |
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- 2.1 BUILDING WIRES .5 (Cont'd)
- (Cont'd)
- .2 Phase B - Black
 - .3 Phase C - Blue
 - .4 Neutral - White or Grey
 - .5 Bond - Green
 - .6 Ground - Green
 - .7 Isolated Ground Green c/w Yellow Strip
- .6 Insulation Color Coding as per 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 colored tapes in lieu of insulation coloring 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 is 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 TECK 90 CABLE .1 Conductors:
- .1 Grounding conductor: stranded copper.
 - .2 Circuit conductors: stranded copper, size as indicated.
- .2 Insulation:
- .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 1000V.
- .3 Inner jacket: polyvinyl chloride material.
- .4 Armour: interlocking aluminium.
- .5 Overall covering: Polyvinyl chloride (PVC), heat, flame and moisture resistant material,
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|--------------------------------------|----|--|
| <u>2.3 TECK 90 CABLE</u>
(Cont'd) | .6 | Connectors: Thomas & Betts Star TECK aluminum connectors or Crouse-Hinds or Appleton approved equivalent complete with aluminum locknut. |
| | .7 | Teck cable ampacity to be de-rated in accordance with the Canadian Electrical Code for installation in any cable tray. |

PART 3 - EXECUTION

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| <u>3.1 INSTALLATION OF BUILDING WIRES</u> | .1 | Install wiring as follows:
.1 In conduit systems in accordance with Section 26 05 34. |
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|--|----|--|
| <u>3.2 INSTALLATION OF ARMOURED CABLES</u> | .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. |
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3.2 INSTALLATION OF
ARMOURED CABLES
(Cont'd)

- .4 Install concealed, parallel and perpendicular to building lines and adequately secure 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.
 - .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, the box must not be sized 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.
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3.2 INSTALLATION OF .9
ARMoured CABLES
(Cont'd)

(Cont'd)

.2 There must be not more than four (4) drops permitted to be fed from any one box regardless of its size. Secure AC-90 cables used for fixture drops within 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 Use minimum size (4-11/16" square) boxes 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

.10 Provide separate pig-tail type leads in each light fixture junction/outlet box for final connection to fixture drops. These pig-tails are to be only connected to light fixture returns and associated neutral conductors.

.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, use other types of pliable cables, open low voltage or communication wiring, etc. Install neatly and parallel or perpendicular to the building lines unless otherwise noted.

3.3 INSTALLATION OF
CONTROL CABLES

.1 Install control cables in E.M.T. Complete with bonding conductor, minimum 21mm conduit and #14 AWG bonding conductor.

.2 Bond control cable shield where required.

3.4 INSTALLATION OF
CABLES: GENERAL

- .1 Support cables independently of supports used for equipment of other trades; do not support from or secure cables to ductwork, piping and ceiling hanger wires.
 - .2 Do not lay cables on top of suspended ceiling grids and tiles.
 - .3 Install cables in a neat and professional manner, so as to conserve headroom. Correct any unacceptable Work at no cost to the Contract.
 - .4 Install cables parallel and perpendicular to building lines.
 - .5 Secure cables to underside of metal decking.
 - .6 Tye-wrap the neutral conductor with its respective phase conductors at the closest point of entry within all panelboards, pull boxes, junction boxes and outlet boxes, etc.
 - .7 Tye-wrap all branch circuits which do not have neutral conductors at their respective phase conductors together in accordance with Clause 3.5.6 above.
 - .8 Twist stranded conductors 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, test the grounded electrical distribution system to confirm there are no grounds or shorts in the system.
-

3.5 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 shall be #10 AWG. Minimum size of branch circuit neutral where dedicated to its own branch circuit phase conductor to be #12 AWG. Note that minimum size #10 AWG bond conductors to accompany #8 branch circuit conductors.

.2 At a minimum, size conductors in accordance with the following table

<u>Branch Circuit Length of Run</u>	<u>Phase Wire Size</u>	<u>Dedicated Neutral</u>	<u>Shared Neutral</u>	<u>Bond Size</u>
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). Oversized #8 AWG branch circuit wiring conductors to be extended 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.

3.6 INSTALLATION OF SECURITY AND ACCESS CONTROL SYSTEM CABLING

.1 Install access control and security system wiring in conduit in its entirety unless noted otherwise.

.2 The portion of wiring installed in door frames to feed electric strikes or electric latch retraction devices need not be installed in conduit provided that the door frames are suitable for such use. Wiring must be installed in conduit once it exits the door frame.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results for Electrical
- .2 Section 26 05 01 - Electrical Identification
- .3 Section 26 05 21 - Wires and Cables (0 - 1000V)

1.2 REFERENCES

- .1 IEEE 837-2014, Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA C22.2 No. 41-13, Grounding and Bonding Equipment (Bi-National Standard with UL 467).

PART 2 - PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required and suitable for application.
 - .2 Rod electrodes: copper clad steel 19mm dia by 3m long.
 - .3 Direct buried grounding conductors: bare stranded copper of 98% conductivity, soft annealed, size as indicated.
 - .4 Insulated grounding and bonding conductors: soft drawn stranded copper of 98% conductivity, type RW90 for sizes #10 AWG and smaller (green coloured insulation as indicated in Section 26 05 01, item 2.2 - Wiring Identification). Type TW75 green coloured insulation is acceptable for sizes #8 AWG and larger.
 - .5 Ground bus: copper, minimum size 6mm x 75mm x 610mm or as indicated, complete with cone-shaped insulated supports, fastenings, connectors.
 - .6 Provide ground connections taking place on the ground bus are to be as follows:
 - .1 For wire sizes #6 AWG and smaller: copper, one-hole, short barrel (single crimp) lugs.
-

2.1 EQUIPMENT
(Cont'd)

- .6 (Cont'd)
 - .2 Wire larger than #6 AWG to be two-hole, long barrel (dual crimp) lugs.
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.
- .8 Copper compression type, long barrel, two hole type lugs unless specified otherwise.
- .9 Copper compression type connectors (cable to cable, cable to ground rod, etc.).

PART 3 - EXECUTION

3.1 INSTALLATION -
GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Conform to the requirements of the Departmental Representative, applicable codes and the local electrical inspection authority having jurisdiction.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding and bonding conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes using copper welding by thermit process or inspectable copper crimp type compression connectors.
- .5 Soldered joints not permitted.
- .6 Install insulated bonding conductor in all conduits.
- .7 Install separate insulated bonding conductor to outdoor lighting standards.

3.1 INSTALLATION -
GENERAL
(Cont'd)

- .8 Connect building structural steel to ground as indicated on the drawings.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point as indicated. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .11 Ground secondary service pedestals.
- .12 Secure 'feed' bonding conductor (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors and/or providing a "pig-tail" lead for device terminations.
- .13 Twist ground/bond wires together with a screw-on type wire connector, and then placed in the rear of the outlet box.
- .14 Bond EMT wall stubs or sleeves to ground as per the latest CEC requirements.
- .15 Bond conduits containing insulated ground conductor(s) at both ends.
- .16 The bend radius of all grounding/bonding conductors must be a minimum of 200mm diameter.

3.2 SYSTEM AND
CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary systems.
 - .2 The main incoming ground conductor is to run unbroken to the main electrical service entrance overcurrent device ground bus and then to the wall mounted ground bus.
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3.3 EQUIPMENT
GROUNDING

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

3.4 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 Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Where applicable, disconnect ground fault indicator during tests.

PART 1 - GENERAL

1.1 NOT USED .1 Not applicable.

PART 2 - PRODUCTS

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

.2 All threaded hanger rods will be minimum 10mm diameter, larger if required, made from galvanized steel.

2.2 CABLE TIES .1 Use cable solely for the purpose of holding cables in place when installed in cable tray.

.2 Nylon flame retardent, low smoke cable tie. Size as required.

.3 Nylon flame retardant, low smoke cable tie mounting bracket. Mechanical fastening type only; adhesive mounts not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Secure equipment to 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, secure a piece of steel stud 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 equipment in a manner so as not to distort or cause undue stress on any components.

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 a maximum of 1m of each outlet box, junction box, pull box, cabinet or conduit fittings with spacing between supports as per CEC to building construction 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 10mm 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 16mm to 21mm conduit: 1524mm spacing.
 - .2 27mm to 35mm conduit: 1980mm spacing.
 - .3 41mm and larger conduit: 3050mm spacing.
- .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.

3.1 INSTALLATION
(Cont'd)

- .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 Various suspended types of junction, pull and/or outlet boxes as well as conduits, are to be supported with minimum size 9 mm threaded rod, nuts and flat washers. Secure threaded rods to boxes with one flat washer and nut installed on both sides of box.
 - .1 One (1) rod required for all type boxes sized 150mm x 150mm and smaller (23.3cm² and smaller).
 - .2 Two (2) rods required for boxes sized 23.3cm² and larger, up to and including those sized 300mm x 300mm (929cm²).
 - .3 Minimum of four (4) rods required for all boxes sized larger than 29cm²
- .19 Cut-off excess rod within 13mm of channel bottom.
- .20 In addition to C.E.C. minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300mm from mid point of all 90° bends. Maximum spacing between conduit support channels will be dictated by smallest size conduit(s) being supported and/or secured to same.
- .21 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .22 Install fastening and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

PART 1 - GENERAL

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

PART 2 - PRODUCTS

- | | | |
|--|----|---|
| <u>2.1 SPLITTERS</u> | .1 | Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. |
| | .2 | Main and branch lugs or connection bars to match required size and number of incoming and outgoing conductors as indicated. |
| | .3 | Provide at least three (3) spare terminals on each set of lugs in splitters less than 400 A. |
| <u>2.2 JUNCTION AND
PULL BOXES</u> | .1 | Type C: welded steel construction, hinged cover, catch with hasp. Provision for locking. Surface or flush mounting as indicated. |
| | .2 | Type D: welded steel construction with screw-on flat covers for surface mounting. Size cover a minimum of 25mm larger than the actual box dimensions. Surface or flush mounting as indicated. |
| | .3 | Provide junction and pull boxes larger than 125mm x 125mm to be Type "E" complete with continuously hinged door. Provide junction and pull boxes 125mm x 125mm and smaller complete with screw cover. |
| | .4 | Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes. |
| | .5 | Single gang sectional type devices boxes being used in steel stud walls for the installation of both metallic and non-metallic type cables, must not be sized smaller than 250cm ² , complete with wrap around type bracket. |
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<u>2.2 JUNCTION AND PULL BOXES (Cont'd)</u>	.6	Two or more flush installed sectional boxes ganged together, or boxes sized 100mm ² and larger (intended for devices) are to have an additional support bracket installed on opposite side of box not presently secured to metal stud.
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<u>2.3 CABINETS</u>	.1	Type E: sheet steel, hinged screw-to-lock, door and return flange overlapping sides, handle, and catch, for surface mounting.
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<u>2.4 EXTERIOR CABINETS</u>	.1	NEMA 4X, hinged screw-to-lock door for surface mounting.
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PART 3 - EXECUTION

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

<u>3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION</u>	.1	Install pull boxes in inconspicuous but accessible locations.
	.2	Mount cabinets with top not higher than 2m above finished floor.
	.3	Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.
	.4	Where located above accessible ceiling systems, locate enclosures within 760mm of ceiling.
	.5	Suspend enclosures on 9mm plated steel threaded rod or rods secured to enclosure with one flat washer and one nut on both sides of box. Refer to Section 26 05 29 for number of threaded rods.
	.6	Junction or outlet boxes feeding a maximum of two fixture drops must not be sized smaller than 100mm square.

- 3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION
(Cont'd)
- .7 Do not install concealed boxes located in the ceiling spaces above suspended type ceilings greater than 762mm above the finished ceiling elevation.
- .8 Provide junction boxes larger than 150mm x 150mm used in branch circuit wiring complete with bonding terminal stripes.
- .9 Bond all metallic pull boxes with bonding conductor.
- 3.3 IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00.

PART 1 - GENERAL

- 1.1 REFERENCES .1 CSA C22.1-2015, Canadian Electrical Code, Part 1.

PART 2 - PRODUCTS

- 2.1 OUTLET AND CONDUIT BOXES GENERAL
- .1 Size boxes in accordance with CSA C22.1.
- .2 100mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

- 2.2 SHEET STEEL OUTLET BOXES
- .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.

- 2.3 MASONRY BOXES .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.
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2.4 CONCRETE BOXES .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES .1 PVC type Thomas & Betts 640P series double gang. Accessories to be provided include brass activation kit for carpet floor and brass flip-up cover plate and all fittings to make a complete installation.

2.6 CONDUIT BOXES .1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for all surface wiring of switches, receptacle, thermostats and similar devices mounted.

2.7 FITTINGS-
GENERAL .1 Bushing and connectors with nylon insulated throats.
.2 Knock-out fillers to prevent entry of debris.
.3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
.4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Support boxes independently of connecting conduits.
.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of Work.
.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.
.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.

3.1 INSTALLATION
(Cont'd)

- .6 Install surface mounted boxes in service rooms and above ceilings unless otherwise indicated.
- .7 Install flush mounted boxes in outside of exterior walls unless otherwise indicated.
- .8 Install type FS or FD boxes for all outlets (regardless of system type involved) to be surfaced mounted.
- .9 Install concealed boxes in accessible locations.
- .10 Flush installed 100mm or 120mm square box being used as a pull box or junction box to have installed a single or double gange tile ring and blank cover installed on the box.
- .11 Do not use sectional type boxes with rigid galvanized steel conduit, rigid PVC conduit or EMT.
- .12 Boxes connected to AC-90 cables must be specifically made for only AC-90 cables.
- .13 In metal drywall partitions, install a short piece of metal stud (same width as wall) on non-supported side of box and secure to box.

PART 1 - GENERAL

1.1 LOCATION OF CONDUIT .1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

1.2 REFERENCES .1 CSA C22.2 No. 45.1-07(R2012), Electrical Rigid Metal Conduit - Steel (Tri-National Standard, with UL 6 and NMX-J-534-ANCE-2007).

.2 CSA C22.2 No. 56-2013, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

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

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

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

1.4 RELATED WORK .1 Section 26 05 29: Fastenings and Supports.

PART 2 - PRODUCTS

- | | | |
|-------------------------------|----|---|
| <u>2.1 CONDUITS</u> | .1 | Rigid galvanized steel threaded conduit, fittings and connectors: to CSA C22.2 No. 45.1. |
| | .2 | Electrical metallic tubing (EMT) with steel set screw couplings: to CSA C22.2 No. 83. |
| | .3 | Rigid PVC conduit, fittings; couplings and connectors: to CSA C22.2 No. 211.2. |
| | .4 | Flexible aluminum conduit and liquid-tight flexible metal conduit: to CSA C22.2 No. 56. |
| | .5 | ENT conduit is not permitted. |
| <u>2.2 CONDUIT FASTENINGS</u> | .1 | One hole 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 (2) or more conduits at 1.5m oc. |
| | .4 | 10mm dia threaded rods to support suspended channels. |
| <u>2.3 CONDUIT FITTINGS</u> | .1 | Fittings: manufactured for use with conduit specified. Coating: same as conduit. |
| | .2 | Conduit fittings (LB, LL and LR) are to be used for 90° bends. "Ells" or corner pulling "Elbows" are prohibited. |
| | .3 | Connectors and couplings for EMT: galvanized steel set-screws type complete with case hardened steel locknuts. Insulated throats are to be provided on connectors sized 35mm or larger. |
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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. Plastic thread-on bushings to be installed on all flexible metal conduit connectors sized 35mm 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 ~~Knockouts to be filled and capped with bushings and sheet metal boxes.~~

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 205mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

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.
- .11 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .12 Install fish cord in empty conduits.

3.1 INSTALLATION
(Cont'd)

- .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.
 - .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:

3.1 INSTALLATION
(Cont'd)

- .19 (Cont'd)
- .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 1.0m. 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.
- .26 Show in-slab or underground conduits will be clearly shown 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.

3.1 INSTALLATION
(Cont'd)

- .28 All distribution panel boards, motor control centers, splitter troughs, various other systems control panels, etc., which are fed underground will utilize code approved, rigid type, thick wall and PVC conduit.
- .29 Install PVC conduits sized 25mm diameter and larger in trenches not less than 300mm in depth from underside of concrete floor slab to bottom of trench. Conduits will be placed on a 50mm bed of sand and have a second 50mm of sand placed on top (completely around) of conduits prior to backfilling taking place.
- .30 PVC conduits of "all" sizes prior to turning-up through floor slabs, are to have transition to threaded steel take place.
- .31 Provide fire barrier material 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.

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 are in trenches not less than 305mm in depth from underside of concrete floor slab to bottom of trench. Conduits are to be placed on a 50mm bed of sand and are to have a second 50mm bed of sand placed 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 All underground conduit must be upsized one (1) trade size above the minimum code requirement.
- .8 Rigid PVC (thick wall) conduit will be permitted to be direct buried.
- .9 Conduit installation is not to influence the thickness of the floor slab.
- .10 Do not run conduits along concrete walls installed to reinforce wall installations.
- .11 The installation of PVC type conduits above ground is prohibited.
- .12 All underground conduits are to be up-sized at least one trade size above the minimum code requirement for ease of pulling.
- .13 Only use rigid Types EB1 and DB2/ES2 PVC (thin wall) Conduit (CSA C22.2 211.1) where embedded in concrete.
- .14 Rigid PVC (thick wall) Conduit (CSA C22.2 211.2) will be permitted to be direct buried.

PART 1 - GENERAL

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|--|----|--|
| <u>1.1 REFERENCES</u> | .1 | CAN/CSA-C802.2-2012, Minimum Efficiency Values for Dry-Type Transformers. |
| <u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawings and product data in accordance with Section 01 33 00. |
| | .2 | Indicate: <ul style="list-style-type: none">.1 Impedance.2 No load losses.3 Total load losses.4 Noise level.5 X/R ratio.6 Winding configuration.7 Taps.8 Enclosure dimensions.9 Mounting.10 Insulation rating.11 Temperature rise.12 Rating.13 Weight.14 Efficiencies |
| <u>1.3 OPERATIONS & MAINTENANCE DATA</u> | .1 | Provide operations and maintenance data for transformers for incorporation into manual. |
| | .2 | Include matrix of installed transformer tap settings for each transformer. |
| | .3 | Include matrix of primary and secondary winding Megger results. |

PART 2 - PRODUCTS

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|-------------------------|----|---|
| <u>2.1 TRANSFORMERS</u> | .1 | Use transformers of one (1) manufacturer throughout project. |
| | .2 | Transformers must meet or exceed energy efficiencies as outlined in CAN/CSA-C802.2. |
| | .3 | Design: |
-

- 2.1 TRANSFORMERS .3 (Cont'd)
- (Cont'd)
- .1 Type: dry, epoxy vacuum impregnated.
 - .2 3 phase, kVA as indicated, 600 V input, 120/208 V output, 60 Hz.
 - .3 Transformers to be a rated K13 (minimum).
 - .4 Voltage taps: -5.0%, -2.5%, 0%, +2.5% and 5.0 of rated voltage.
 - .5 Insulation: Class H, 115°C temperature rise.
 - .6 Basic Impulse Level (BIL): standard.
 - .7 Hipot: standard.
 - .8 Average sound level: to NEMA ST-20.
 - .9 Impedance at 170°C: standard.
 - .10 Enclosure: NEMA Type 2, ventilated removable metal front panel and hood, drip proof.
 - .11 Mounting: wall mount.
 - .12 Transformers to accomodate 200% upsized neutrals.
 - .13 Finish: in accordance with Section 26 05 00.
 - .14 Winding configuration: Delta primary, grounded Y secondary. All windings copper. T-connected transformers are not acceptable.
 - .15 Connections:
 - .1 Locate all secondary, primary and system ground connections at the front of the transformer and readily accessible when the front cover is removed,
 - .2 Rear connection types are not acceptable.
 - .16 Terminate primary and secondary conductors in factory-installed multi-barrel lugs (each conductor is to be provided with an individual, suitably sized connection point), with a single connection point at the transformer feed.
 - .17 Provide the following accessories:
 - .1 Wall Mounting brackets.
 - .2 Dual rated spade type transformer lug for ground/bonding of transformers.
 - .18 Elctronstatically shielded.
 - .19 All dry type transformers are to be complete with a Dual Rated Spade Type Transformer Lug, sized as required to facilitate both grounding and bonding conductor requirements.
 - .20 Standard of Acceptance: Delta.
- 2.2 EQUIPMENT IDENTIFICATION .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Label size: 9.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Securely mount dry type transformer on wall.
- .2 Provide adequate clearance around transformer for ventilation.
- .3 Install transformers in level upright position.
- .4 Remove shipping supports only after transformer is installed and just before putting into service.
- .5 Loosen isolation pad bolts until no compression is visible.
- .6 Megger both primary and secondary windings with 1000 V and 500 V megger as recommended by the manufacturer and report immediately any reading below 100 megohms. Include results in O&M Manual.
- .7 Confirm the transformer is on the correct tap. Measure voltages on secondary transformer under normal loading. Adjust voltage taps to obtain ratsecondary voltages. Record tap settings and include in O&M Manual.
- .8 Provide factory-installed lugs for copper conductors when double neutrals are used.
- .9 Make primary and secondary connections in accordance with wiring diagram.
- .10 Make connections flexible metal conduit. If "liquid tight" flexiblemetal conduit is used, then the associated "liquid tight" connectors must also be used.
- .11 Energize transformers after installation and testing is complete.

PART 1 - GENERAL

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|---|----|---|
| <u>1.1 SOURCE QUALITY CONTROL</u> | .1 | Provide manufacturer's factory test certificates. |
| | .2 | Submit written test results to Departmental Representative. |
| <u>1.2 SHOP DRAWINGS AND PRODUCT DATA</u> | .1 | Submit shop drawings in accordance with Section 01 33 00. |
| | .2 | Drawings to include electrical detail of panel, branch breaker type, breaker quantity, ampacity, short circuit rating, bus materials and enclosure dimension. |
| | .3 | Submit shop drawings for surge protection device and digital metering. |
| <u>1.3 OPERATION AND MAINTENANCE DATA</u> | .1 | Provide operation and maintenance data for panelboards, surge protection device and digital metering for incorporation into manual specified in Section 01 78 00. |
| | .2 | Include panel schedules. |

PART 2 - PRODUCTS

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|------------------------|----|--|
| <u>2.1 PANELBOARDS</u> | .1 | Panelboards: use the product of a single manufacturer throughout. |
| | .2 | 250 and 600 V panelboards: bus and breakers rated as indicated, short circuit current rating (RMS momentary symmetrical) as indicated. |
| | .3 | Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase. |
| | .4 | Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated. |
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|-------------------------------------|-----|--|
| <u>2.1 PANELBOARDS
(Cont'd)</u> | .5 | Two (2) keys for each panelboard and key panelboards alike. |
| | .6 | Tin-plated copper bus. Neutral to be 200% rated of mains. |
| | .7 | Mains: suitable for bolt-on breakers. |
| | .8 | Trim with concealed front bolts and hinges. |
| | .9 | Trim and door finish: baked grey enamel. |
| | .10 | Minimum of one terminal screw on factory installed neutral bar for each circuit breaker position. |
| | .11 | Panelboards rated 225A and less will not be less than 508mm in width. Panelboards rated more than 225A shall not be less than 914mm wide x 280mm deep. |
| <u>2.2 BREAKERS</u> | .1 | Breakers: to Section 26 28 21 - Moulded Case Circuit Breakers. |
| | .2 | Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise. |
| | .3 | Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker. |
| | .4 | Lock-on devices for 10 % of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to the Owner. |
| <u>2.3 EQUIPMENT IDENTIFICATION</u> | .1 | Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements. |
| | .2 | Nameplate for each panelboard size 4 engraved as indicated. |
| | .3 | Nameplate for each circuit in distribution panelboards size 2 engraved as indicated. |
| | .4 | Complete circuit directory with typewritten legend showing location and load of each circuit. |
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PART 3 - EXECUTION

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

PART 1 - GENERAL

- | | | |
|---|----|--|
| <u>1.1 REFERENCES</u> | .1 | CAN/CSA C22.2 No. 42-10(R2015), General Use Receptacles, Attachment Plugs and Similar Wiring Devices. |
| | .2 | CAN/CSA C22.2 No. 55-15, Special Use Switches. |
| | .3 | CAN/CSA C22.2 No. 111-10(R2015), Standard-use Snap Switches (Bi-National Standard with UL 20). |
| <u>1.2 SHOP DRAWINGS</u> | .1 | Submit shop drawings for each device and coverplate type as per specification Section 01 33 00. |
| <u>1.3 OPERATIONAL AND MAINTENANCE DATA</u> | .1 | Provide operation and maintenance data for wiring devices for incorporation into manual specified in Section 01 78 00. |

PART 2 - PRODUCTS

- | | | |
|---------------------|----|--|
| <u>2.1 SWITCHES</u> | .1 | Design S1: <ul style="list-style-type: none">.1 20A, 120V, specification grade single pole or two way switches as indicated..2 Manually-operated general purpose AC switches with following features:<ul style="list-style-type: none">.1 Terminal holes approved for #10 AWG wire..2 Silver alloy contacts..3 Urea or melamine molding for parts subject to carbon tracking..4 Suitable for back and side wiring..5 Ivory nylon, heavy duty toggle..6 Integral ground terminal..3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads..4 Switches of one manufacturer throughout project. |
| | .2 | Design S2: Motor rated manual control switch with the following features: <ul style="list-style-type: none">.1 Nominal 30A, 250 V rating;.2 Single or three phase as indicated; |
-

.2 (Cont'd)

.3 Surface mounting CSA 3R enclosure;

.4 Lockable in open position.

- .1 Design R1:
 - .1 General purpose duplex receptacles, specification grade CSA type 5-15R, 125V, 15A, U-ground, with following features:
 - .1 Ivory urea molded housing.
 - .2 Suitable for #10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight (8) back wired entrances, four (4) side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Isolated ground receptacles where indicated.
 - .7 Grey nylon face for all technical power receptacles, white for all others.
- .2 Design R2:
 - .1 Duplex receptacles, specification grade CSA type 5-20 R(T-Slot), 125 V, 15/20A, U ground, with following features:
 - .1 Ivory urea molded housing.
 - .2 Suitable for #10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight (8) back wired entrances, four (4) side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 Isolated ground receptacles where indicated.
 - .7 White nylon face.
- .3 Design R3:
 - .1 GFI duplex receptacles. Specification grade, CSA type 5-15R, 125V, 15A, U-Ground with the following features:
 - .1 Ivory urea moulded housing.
 - .2 Suitable for #10 AWG for back and side wiring.
 - .3 Eight (8) back wired entrances, four (4) side wiring screws.

- 2.2 RECEPTACLES
(Cont'd)
- .3 (Cont'd)
- .1 (Cont'd)
- .4 Triple wipe contacts and riveted grounding contacts.
- .5 Ivory nylon face.
- .6 GFI test and reset buttons.
- .7 Leakage current: Class A, 5mA.
- .4 Design R4:
- .1 GFI duplex receptacles: Specification grade, CSA type 5-20R(T-Slot), 125V, 15/20A, U-ground with the following features:
- .1 Ivory urea moulded housing.
- .2 Suitable for #10 AWG for back and side wiring.
- .3 Eight (8) back wired entrances, four side wiring screws.
- .4 Triple wipe contacts and riveted grounding contacts.
- .5 Ivory nylon face.
- .6 GFI test and reset buttons.
- .7 Leakage current: Class A, 5mA.
- .5 Other receptacles with ampacity and voltage as indicated.
- .6 Use the receptacles of one (1) manufacturer throughout project.
- 2.3 COVER PLATES
- .1 Cover plates for wiring devices.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Brushed stainless steel plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Cast aluminum "in use" weather-proof cover plates.
- 2.4 LIGHT CONTROL DEVICES
- .1 Provide lighting control devices including dimmers, occupancy/vacancy sensors, day light sensor and power packs to control lighting fixtures as indicated.
-

2.4 LIGHT CONTROL
DEVICES
(Cont'd)

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

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one (1) switch is required in one location.
 - .3 Mount toggle switches at height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
 - .4 Recess switches in finished areas.
 - .5 Install Type S2 manual motor controls switch at each air conditioning outdoor unit; located switch within 1500 mm of AC unit.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Mount receptacles with "U" ground up for vertically mounted and neutral slot at top for horizontally mounted receptacle.
 - .5 "Pigtail" type leads are to be installed on conductors in all device or outlet boxes where feeding through to other receptacles. "Daisy-chain" or looping through of conductors from one device to another is not acceptable. Provide separate pigtail conductor leads for final termination to each receptacle for phase, neutral and bond conductors.
 - .6 Recess receptacles in finished areas.
- .3 Cover plates:
 - .1 Protect cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .4 Demonstrate successful operation of all devices and record results and set points at time of completion.

PART 1 - GENERAL

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

PART 2 - PRODUCTS

- | | | |
|---------------------------------|----|---|
| <u>2.1 BREAKERS
GENERAL</u> | .1 | Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient. |
| | .2 | Multiple pole breakers shall have single handle. |
| | .3 | Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating. |
| | .4 | Circuit breakers with interchangeable trips as indicated. |
| | .5 | Circuit breakers to have interrupting capacity as indicated on the Drawings. |
-

- 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 solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, long time, short time, and instantaneous tripping for phase and ground fault short circuit protection. Settings to be individually adjustable.
- 2.5 OPTIONAL
FEATURES
- .1 Include:
.1 On-off locking device for 10% of branch breakers and for all breakers supplying emergency lighting battery units and fire alarm devices.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install circuit breakers as required, factory install breakers in all panelboards.
- .2 Adjust circuit breaker settings to the values indicated on the manufacturer's supplied Coordination Study.
- .3 Install individual circuit breakers in CSA Type 1 enclosures complete with bonding and neutral connections.

PART 1 - GENERAL

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

PART 2 - PRODUCTS

- | | | |
|-------------------------------------|----|---|
| <u>2.1 DISCONNECT SWITCHES</u> | .1 | Heavy duty, fusible and non-fusible, horsepower rated disconnect switch in CSA enclosure type as indicated (minimum CSA type 1 with driphood) as indicated. |
| | .2 | Provision for padlocking in off switch position by three locks. |
| | .3 | Mechanically interlocked door to prevent opening when handle in ON position. |
| | .4 | Quick-make, quick-break action. |
| | .5 | ON-OFF switch position indication on switch enclosure cover. |
| <u>2.2 EQUIPMENT IDENTIFICATION</u> | .1 | Provide equipment identification in accordance with Section 26 05 01 - Electrical Identification. |
| | .2 | Indicate name of load controlled voltage panel designation and circuit numbers on size 4 nameplate. |
-

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install disconnect switches complete with fuses
where required.

PART 1 - GENERAL

1.1 RELATED
REQUIREMENTS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 26 05 00 - Electrical General Requirements.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data to include:
 - .1 Replacement data for motor element, thermostat and switch.
 - .2 Mounting methods.
 - .3 kW rating, voltage, phase.
 - .4 Cabinet material thicknesses.
 - .5 Physical size.
 - .6 Finish.
 - .7 Thermostat, transformer, controls where integral.

1.3 WASTE
MANAGEMENT AND
DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic. polystyrene. corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
 - .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by the Departmental Representative.
-

PART 2 - PRODUCTS

2.1 VERTICAL HEATERS

- .1 Vertical unit heater (down flow), ceiling mounted commercial type as follows:
 - .1 Enclosure:
 - .1 Steel, 1.02 mm thick.
 - .2 Epoxy-polyester powdercoat finish, almond colour.
 - .3 Knockouts for 21 mm diameter conduit left, right, bottom and rear.
 - .4 208V, three-phase, complete with built-in thermostat. Wattage as indicated.
 - .2 Thermostatical controlled blower(s).
 - .3 Ceiling mounting brackets.
 - .4 Low voltage thermostat.
 - .5 Control: 24V relay with transformer.
 - .6 Wattage: 5 kW.
 - .7 Thermally protected motor.
 - .8 Motor and heating element to be protected against overheating by automatic thermal high-limits.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install heaters in accordance with manufacturer's instructions.
- .2 Coordinate installations in elevator pit with elevator installer.
- .3 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements.