

PART 1 GENERAL

1.1 GENERAL

- .1 This Section covers items common to Sections of Division 26 and portions of 33. This section supplements requirements of Division 1.

1.2 CODES AND STANDARDS

- .1 Do complete installation in accordance with CSA C22.1-2015, and local regulations, except where specified otherwise.
- .2 Do overhead systems in accordance with CAN/CSA-C22.3 No. 1 and underground systems in accordance with CAN/CSA C22.3 No. 7, except where specified otherwise.
- .3 CAN3 C235-83(R2015).

1.3 CARE, OPERATION AND START-UP

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

1.4 VOLTAGE RATINGS

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

1.5 PERMITS, FEES AND INSPECTION

- .1 Submit to the Electrical Inspection Department, Municipal Authority and supply authority the necessary number of drawings and specifications, for examination and approval prior to commencement of work. Submit this information within twenty (20) working days of the award of Tender and provide the Departmental Representative with written notice at the time this has been submitted.
- .2 Provide the Departmental Representative with a copy of the electrical Inspection Department and supply Authority Plans Review Report, immediately upon receipt. No shop drawings will be reviewed prior to receipt of the Plans

Review Report from the Contractor.

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

1.6 MATERIALS AND EQUIPMENT

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

1.7 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two (2) coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-1.

.2 Paint indoor switchgear and distribution enclosures light grey to EEMAC 2Y-1.

- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.8 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as specified herein.
- .2 Identification:
 - .1 Provide all panels, disconnect switches, receptacles, etc. with "lamicoid" nameplates as further described herein. Take care to affix all 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, and splitter troughs must indicate the following:
 - .1 Designated name of equipment.
 - .2 Amperage of overcurrent protection device.
 - .3 Voltages, number of phases and wires.
 - .4 Designation of power source.

Example
PANEL H - 150 AMPS
120/208V - 3PH - 4W
FED FROM MAIN SWITCHBOARD #QMS-1

.7 Install an additional "lamicoid" nameplate on all, or any piece of electrical equipment, or apparatus (i.e., Panelboards, etc.), that may contain overcurrent devices (i.e., circuit breakers and/or fuses), that have been designed for, and incorporate interrupting capacity sized "larger" than 10 KAIC.

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

.8 Install lamicoid nameplates above all types of receptacles and abutted directly to tops of their respective device plates. Identification is to indicate respective panel source complete with associated circuit breaker number(s) as per the following:

- .1 1.5mm x 13mm high complete with 6 mm white letters on black

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

Example: PANEL H - 20

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

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

.10 Lamicoid 3mm thick plastic engraving sheet, white letters on black face, for all electrical systems.

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

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

NAMEPLATE SIZES

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

.3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.

.4 Allow for average of forty (40) letters per nameplate and label.

.5 Identification to be English.

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

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

.8 In addition to required nameplates and colour coding, junction boxes to have the panel and circuit numbers of all wiring contained within listed on the coverplate. Neatly write list using black indelible marker.

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

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

.2 Where primary colour only is indicated:

.1 Colour inside and outside of box.

- .2 Colour all cover plates.
- .3 Where primary and secondary colours are indicated:
 - .1 Paint inside and outside of box with the primary colour.
 - .2 Diagonally apply to each half of the cover plate the primary and secondary colours.

1.9 WIRING IDENTIFICATION

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

1.10 CONDUIT AND CABLE IDENTIFICATION

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

<u>System</u>	<u>Primary Colour</u>	<u>Secondary Colour</u>
0-50 volts	VIOLET	-
51 to 240 volts	YELLOW	-
241-600volts	ORANGE	-
Ground or Bond	BROWN	-

1.11 WIRING TERMINATIONS

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

1.12 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible after equipment is installed.

1.13 WARNING SIGNS

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

1.14 LOCATION OF EQUIPMENT

- .1 Change location of equipment at no extra cost or credit, providing distance does not exceed 3m, and information is given before installation.

1.15 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished grade/floor to centerline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless otherwise indicated.
 - .1 Panelboards: as required by Code or as indicated.

1.16 LOAD BALANCE

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

1.17 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Arrange and pay for holes through exterior walls and roof to be flashed and made weatherproof.

1.18 FIELD QUALITY CONTROL

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

1.19 COORDINATION OF PROTECTIVE DEVICES

- .1 Confirm circuit protective devices such as overcurrent trips, relays

and fuses are installed to required values and settings.

1.20 DEMONSTRATION, OPERATING AND MAINTENANCE INSTRUCTIONS

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

1.21 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect, separate and recycle all site generated waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management Disposal.

PART 2 PRODUCTS Not applicable.

PART 3 EXECUTION Not applicable.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

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

PART 2 PRODUCTS

2.1 MATERIALS

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

PART 3 EXECUTION

3.1 MATERIALS

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

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 CSA C22.2 No. 0.3-2009, Test Methods for Electrical Wires and Cables.

1.2 PRODUCT DATA

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

1.3 OPERATION AND MAINTENANCE DATA

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

1.4 RELATED WORK

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

PART 2 PRODUCTS

2.1 BUILDING WIRES

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

PART 3 EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

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

1.2 REFERENCES

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

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required and suitable for application.
- .2 Electrodes: Copper ground plates or copper clad steel rods 19mm dia by 3m long.
- .3 Direct buried grounding conductors: bare stranded copper of 98% conductivity, soft annealed, size as indicated.
- .4 Insulated grounding and bonding conductors: soft drawn stranded copper of 98% conductivity, type RW90 (green coloured insulation as indicated in 26 05 00, item 10 - Wiring Identification).
- .5 Ground bus: copper, minimum size 6mm x 75mm x 600mm size and as indicated, complete with insulated supports, fastenings, connectors.
- .6 Ground connections to take place on the ground bus to be as follows:
 - .1 For wire sizes 6 AWG and smaller: copper, one-hole, short barrel (single crimp) lugs.
 - .2 Wire larger than 6 AWG to be two-hole, long barrel (dual crimp) lugs.
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.
 - .5 Bonding jumpers, straps.
 - .6 Pressure wire connectors.
- .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 inspectable copper crimp type compression connectors.
- .5 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install insulated bonding conductor in all conduits.
- .8 Install separate insulated bonding conductor to outdoor lighting standards.
- .9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- .11 Ground secondary service pedestals.
- .12 The 'feed' bonding conductor shall be secured (wrapped around unbroken) to the grounding screw of each outlet/device box, before connecting to the other grounding conductors and/or providing a "pig-tail" lead for device terminations.
- .13 Twist together all ground/bond wires with a screw-on type wire connector, and then placed in the rear of the outlet box.
- .14 Bond all conduits containing insulated ground conductor(s) at both ends.
- .15 Bend radius of all grounding/bonding conductors to a minimum of 200mm diameter.

3.2 ELECTRODES

- .1 Install electrodes and make grounding connections.

- .2 Bond separate, multiple electrodes together.
- .3 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.3 SYSTEM AND CIRCUIT GROUNDING

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

3.4 EQUIPMENT GROUNDING

- .1 Install grounding/bonding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, duct systems, distribution panels and outdoor lighting.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Where applicable, disconnect ground fault indicator during tests.

END OF SECTION

PART 1 GENERAL Not applicable.

PART 2 PRODUCTS

2.1 SUPPORT CHANNELS

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

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation. Provide additional supports as necessary.
- .5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .6 Fasten exposed conduit or cables within 1m of each outlet box, junction box, pull box, cabinet or conduit fittings with spacing between supports as per CEC to building construction or support system using straps.
 - .1 One-hole zinc plated steel straps to secure surface conduits and cables smaller than 41mm.
 - .2 Two-hole zinc plated steel straps for conduits and cables 41mm and larger.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .7 Suspended support systems.
 - .1 Support individual cable or conduit runs with 9mm dia threaded rods and spring clips.
 - .2 Support two (2) or more cables or conduits on channels supported by 9mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .8 For surface mounting of two or more conduits use channels at 1.5m o.c. spacing.

- .9 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .10 Verify there is adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .11 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .12 Do not use supports or equipment installed for other trades for conduit or cable support.
- .13 Install fastenings and supports as required for each type of equipment, cables and conduits, and in accordance with manufacturer's installation recommendations.
- .14 Fasten individual and multiple runs of armoured cables to structure and in bundles as permitted in 26 05 21 - Wire and Cables 0-1000 Volts.
- .15 Various suspended types of junction, pull and/or outlet boxes as well as conduits, are to be supported with minimum size 9mm threaded rod, nuts and flat washers. Threaded rods to be secured to boxes with one flat washer and nut installed on both sides of box.
 - .1 One (1) rod required for all type boxes sized 150mm x 150mm and smaller (22,500mm² and smaller).
 - .2 Two (2) rods required for boxes sized 22,500mm² and larger, up to and including those sized 300mm x 300mm (90,000mm²).
 - .3 Minimum of four (4) rods required for all boxes sized larger than 90,000mm².
- .16 Cut off all excess rod within 13mm of channel bottom. In addition to C.E.C. minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one additional support rod installed not greater than 300mm and mid-point of "all" 90 bends. Maximum spacing's between conduit support channels will be as dictated by smallest size conduit(s) being supported and/or secured to same.
- .17 In addition to the CEC minimum conduit spacing requirements, all suspended conduit runs containing horizontal or vertical elbows are to have one (1) additional support rod installed not greater than 300mm from midpoint of all 90 bends. Maximum spacing between conduit support channels will be dictated by smallest size conduit(s) being supported and/or secured to same.

END OF SECTION

PART 1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

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

PART 2 PRODUCTS

2.1 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. Interior units shall be CSA Type 1 enclosure.
- .2 Exterior units to be CSA Type 4X, 304 or 316 stainless steel.
- .3 Main and branch lugs or connection bars to match required size and number of incoming and outgoing conductors as indicated.
- .4 At least three (3) spare terminals on each set of lugs in splitters.

2.2 JUNCTION AND PULL BOXES

- .1 Type C: welded steel construction, hinged cover, catch with hasp. Provision for locking. Surface mounting.
- .2 Type D: welded steel construction with screw-on flat covers for surface mounting. Surface or flush mounting as indicated. Covers with 25mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Junction and pull boxes larger than 125mm x 125mm shall be Type "E", complete with continuously hinged door. Junction and pull boxes 125mm x 125mm and smaller to be complete with screw cover.
- .4 Single gang "sectional" type devices boxes being used in steel stud walls for the installation of both metallic and non-metallic type cables, not to be sized smaller than 250mm, complete with wrap around type bracket.
- .5 Two (2) or more flush installed sectional boxes, ganged together on boxes sized 100mm² and larger (intended for devices), are to have an additional support bracket installed on opposite side of box, not presently secured to metal stud.
- .6 Where larger sized devices or other types of "flush" outlet or junction boxes may be required, use suitably sized 100mm x 100mm deep or 118 mm square boxes complete with appropriate sized extension tile rings. The use of plaster rings in lieu of tile type extension rings is not acceptable.

- .7 Junction boxes 150mm x 150mm used in branch circuit wiring are to be complete with bonding terminal strips.
- .8 Junction and conduit boxes for the sewage lift station shall be rated for the hazardous area classification noted on the drawings. Boxes to be dye-cast copper-free aluminum with factory threaded hubs. Provide terminal blocks (rated minimum 30A, 600V) in junction boxes used to connect cabling from devices (pumps and floats) located in the wet well.
- .9 High-density polyethylene enclosure and lid complete with hex bolt fastener, flush mounted, grade level open bottom pull boxes sized as required for wire/conduit size and quantity.

2.3 CABINETS

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

PART 3 EXECUTION

3.1 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

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

- .7 Concealed junction or outlet boxes feeding a maximum of two fixture drops shall not be sized smaller than 100mm².
- .8 Bond pull boxes and cabinets to ground utilizing a bonding conductor.

3.3 IDENTIFICATION

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

END OF SECTION

PART 1 GENERAL

1.1 LOCATION OF CONDUIT

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

1.2 REFERENCES

- .1 CSA C22.2 No. 45.1-07(R2012), Rigid Metal Conduit - Steel.
- .2 CSA C22.2 No. 56-2004(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .3 CSA C22.2 No. 83-1985(R2013), Electrical Metal Tubing.
- .4 CSA C22.2 No. 211.2-2006, Rigid PVC (Unplasticized) Conduit.

1.3 TRADE SIZE

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

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

1.4 RELATED WORK

- .1 Section 26 05 29: Fastenings and Supports

PART 2 PRODUCTS

2.1 CONDUITS

- .1 Rigid galvanized steel threaded conduit, fittings and connectors: to CSA C22.2 No. 45.1.
- .2 Rigid PVC conduit, fittings; couplings and connectors: to CSA C22.2 No. 211.2.

- .3 Electrical metallic tubing (EMT) with steel set screw couplings to CSA C22.2 No. 83.

2.2 CONDUIT FASTENINGS

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

2.3 CONDUIT FITTINGS

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

2.4 GENERAL FITTINGS

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

2.5 EXPANSION FITTINGS RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200mm linear UIT
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

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 EMT for all concealed wiring unless otherwise indicated, minimum size, 21mm dia.
- .4 Use rigid galvanized steel threaded conduit in areas subject to mechanical damage, minimum size, 21mm dia.
- .5 Use rigid PVC conduit underground: minimum size 21mm dia.
- .6 Minimum conduit size for lighting and power circuits: 21mm dia.
- .7 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .8 Mechanically bend steel conduit over 21mm dia.
- .9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .10 Install fish cord in empty conduits.
- .11 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
- .12 Dry conduits out before installing wire.
- .13 Install insulated copper bonding conductor in all conduit runs. Minimum size: #14 AWG or Table 16 of C.E.C. whichever is larger.
- .14 Non-connected PVC or steel raceways protruding up through open bottoms of free-standing equipment require PVC bell ends and steel type "ground bushings" installed on ends of respective types of conduits. Extend conduits a minimum of 50mm (2") above housekeeping pad or concrete trough.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5m clearance.
- .3 Run conduits in flanged portion of structural steel.

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

3.3 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC accepted) with heavy coat of bituminous paint.
- .3 Conduits are only permitted to be installed below floors and are not to be installed in concrete floors unless specifically indicated otherwise.
- .4 Install PVC conduits sized 35mm (1½") and larger in trenches not less than 300mm in depth from underside of concrete floor slab to bottom of trench. Place conduits on a 50mm bed of sand and are to have a second 50mm bed of sand placed on top. Conduits to be completely surrounded by sand prior to backfilling taking place.
- .5 Wiring for all various systems devices and/or outlets installed below ground floor concrete floor slabs may be performed utilizing minimum 21m PVC rigid conduit. Transition from PVC rigid thick wall conduit to rigid steel threaded conduit is to take place below the floor slab.
- .6 Underground and underslab conduits are only permitted to be installed where specifically indicated.
- .7 Install PVC conduits sized 32mm in diameter and larger in trenches not less than 300mm in depth from underside of concrete floor slab to bottom of trench. Place conduits on a 50mm bed of sand and have a second 50mm of sand placed on top. Completely surround the conduits with sand prior to backfilling taking place.
- .8 Conduit installation is not to influence the thickness of the floor slab.
- .9 Do not run conduits along concrete walls installed to reinforce wall installations.
- .10 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.
- .11 Up-size all underground conduits at least one trade size above the minimum code requirement for ease of pulling.
- .12 Only use rigid Types EB1 and DB2/ES2 PVC (thin wall) Conduit (CSA C22.2 211.1) where embedded in concrete.

- .13 Rigid PVC (thick wall) Conduit (CSA C22.2 211.2) will be permitted to be direct buried.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

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

1.2 SHOP DRAWINGS

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

1.3 OPERATION AND MAINTENANCE DATA

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

PART 2 PRODUCTS

2.1 PANELBOARDS

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

circuit breaker position.

- .11 Panelboards rated above 400A to be 300mm deep and 900mm wide minimum.

2.2 BREAKERS

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

2.3 EQUIPMENT IDENTIFICATION

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

PART 3 EXECUTION

3.1 INSTALLATION

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

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 CSA C22.2 No. 42-10(R2015), General Use Receptacles, Attachment Plugs and Similar Wiring Devices.
- .2 CSA C22.2 No. 55-15, Special Use Switches.
- .3 CSA C22.2 No. 111-10(R2015), General Snap Switches.

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

1.3 OPERATIONAL AND MAINTENANCE DATA

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

PART 2 PRODUCTS

2.1 SWITCHES

- .1 Design S1:
 - .1 20 A, 120 V, specification grade, single pole, two way or three way switches.
 - .2 Manually-operated general purpose ac switches with following features.
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine molding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White nylon, heavy duty toggle.
 - .6 Integral ground terminal.
 - .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
 - .4 Switches of one (1) manufacturer throughout project.
 - .5 Approved Manufacturers.
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Arrow Hart
 - .4 Leviton
 - .5 Bryant.

2.2 RECEPTACLES

- .1 Design R1:
 - .1 General purpose duplex receptacles, specification grade CSA type 5- 15 R, 125 V, 15 A, U ground, with following features:
 - .1 White urea molded housing for all power receptacles.

- .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
 - .6 Approved Manufacturers:
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Arrow Hart
 - .4 Leviton
 - .5 Bryant
- .2 Design R2:
- .1 Duplex receptacles, specification grade CSA type 5-20 R(T- Slot), 125 V, 15/20A, U ground, with following features:
 - .1 White urea molded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
 - .6 White nylon face.
 - .7 Acceptable Manufacturers.
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Arrow Hart Leviton
 - .4 Bryant
- .3 Design R3:
- .1 GFI duplex receptacles. Specification grade, CSA type 5-15R, 125V, 15A, U-Ground with the following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Eight back wired entrances, four side wiring screws.
 - .4 Triple wipe contacts and riveted grounding contacts.
 - .5 White nylon face.
 - .6 GFI test and reset buttons.
 - .7 Approved Manufacturers.
 - .1 Hubbell
 - .2 Pass & Seymour
 - .3 Arrow Hart
 - .4 Leviton
 - .5 Bryant
- .4 Design R4:
- .1 GFI duplex receptacles. Specification grade, CSA type 5-20R(T- Slot), 125V, 15A, U-Ground with the following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Eight back wired entrances, four side wiring screws.
 - .4 Triple wipe contacts and riveted grounding contacts.
 - .5 White nylon face.
 - .6 GFI test and reset buttons.
 - .7 Approved Manufacturers.
 - .1 Hubbell

- .2 Pass & Seymour
- .3 Arrow Hart
- .4 Leviton
- .5 Bryant

- .5 Other receptacles with ampacity and voltage as indicated.
- .6 Use receptacles of one (1) manufacturer throughout project.

2.3 COVER PLATES

- .1 Cover plates for wiring devices.
- .2 White nylon cover plates on flush mounted outlet boxes unless otherwise indicated.
- .3 Stainless steel cover plates with natural finish on flush mounted outlet boxes in service areas such as mechanical rooms, electrical rooms and telecom rooms.
- .4 Galvanized pressed steel surface covers on surface mounted outlet boxes.
- .5 Heavy duty weatherproof while in use cover plates for devices designated as weatherproof.
- .6 .

2.4 ELECTRIC HAND DRYER

- .1 Automatic Electric Hand Dryer with the following features:
 - .1 Die-cast zinc alloy construction complete with white epoxy paint finish.
 - .2 5/8hp/20,000rpm thermally protected motor.
 - .3 Air velocity of 19,000LFM at the air outlet.
 - .4 970W heating element.
 - .5 Control of unit via infrared optical sensor.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Mount toggle switches at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
- .2 Receptacles:
 - .1 Mount receptacles at height specified in Section 26 05 00 - Electrical General Requirements or as indicated.
 - .2 Mount receptacles with "U" ground up for vertically mounted and neutral slot at top for horizontally mounted receptacle.

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

END OF SECTION

PART 1 GENERAL

1.1 PRODUCT DATA

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

1.2 OPERATION AND MAINTENANCE DATA

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

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

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

2.2 MAGNETIC BREAKERS

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

2.3 OPTIONAL FEATURES

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

2.4 GROUND FAULT CIRCUIT INTERRUPTER CIRCUIT BREAKERS

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

PART 3 EXECUTION

3.1 INSTALLATION

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

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00

1.2 SHOP DRAWINGS AND PRODUCT DATA

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

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Heavy duty, fusible and non-fusible horsepower rated, disconnect switch in size and voltage as indicated.
- .2 Provision for padlocking in the off switch position by three (3) pad locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size and type as indicated.
- .5 Fuse holders: suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.
- .8 Provide equipment identification in accordance with Section 26 05 00.
- .9 Switches to be NEMA enclosure type 12 unless noted otherwise. Switches located in electrical rooms and other dry non-process areas to be NEMA 1 construction. Switches located outdoors, in wet/damp process areas, in chemical rooms and in chlorine rooms to be NEMA 4X (stainless steel) construction.
- .10 Provide switches complete with window to view open/close status of disconnect switch blades.

2.2 MANUAL TOGGLE TYPE SWITCHES

- .1 Manual "on-off" switch, horsepower rated, of size, type, rating as indicated, with components as follows:
 - .1 Toggle type switch with quick-make, quick-break switching mechanism.
 - .2 Terminals: screw type, suitable for #10AWG (or smaller) copper conductors.
 - .3 Enclosure:

- .1 NEMA Type 1 (painted steel) in electrical rooms.
- .2 NEMA Type 12 (painted steel) unless noted otherwise.
- .3 NEMA Type 4X (stainless steel) in wet/damp process areas,
in chemical rooms and in chlorine rooms.
- .4 Provide unit complete with locking tab to permit padlocking in
the off position.

PART 3 EXECUTION

3.1 DISCONNECT SWITCH INSTALLATION

- .1 Install disconnect switches complete with fuses, type, rating as
indicated on drawings.
- .2 Install true, plumb and square to building lines.
- .3 Confirm disconnect switch has proper clearance for operation of
handle.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for the supply and installation of motor starters.

1.2 RELATED WORK

- .1 Electrical General Requirements: Section 26 05 00

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 00 00.
- .2 Indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout of identified internal and front panel components.
 - .4 Enclosure types.
 - .5 Schematic and wiring diagrams for each type of starter.
 - .6 Circuit breaker type.
 - .7 Overload relay type.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for motor control center for incorporation into manual.
- .2 Include data for each type and style of starter.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Starters: EEMAC E14-1.
 - .1 Half size starters not acceptable.
 - .2 IEC equipment not acceptable.
 - .3 Minimum starter size 1. Overloads shall be sized for actual motor horsepower ratings.

2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
 - .1 Switching mechanism, toggle type quick make and break.
 - .2 Overload heater(s), manual reset, trip indicating handle.
 - .3 Terminals: screw type, suitable for #10AWG (or smaller) copper conductors.
 - .4 Enclosure:
 - .1 NEMA Type 1 (painted steel) in electrical rooms.
 - .2 NEMA Type 12 (painted steel) unless noted otherwise.

.3 NEMA Type 4X (stainless steel) in wet/damp process areas, in chemical rooms and in chlorine rooms.

.2 Accessories:

- .1 Toggle switch labelled as indicated.
- .2 Indicating light: standard, heavy duty, oil tight LED type and colour as follows: Green = Run/On.
- .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Single phase and 3 phase magnetic or combination magnetic starters of size, type (non-reversing, reversing or multi-speed type), rating as indicated on the Drawings with components as follows:
 - .1 Enclosure:
 - .1 NEMA Type 1 (painted steel) in electrical rooms.
 - .2 NEMA Type 12 (painted steel) unless noted otherwise.
 - .3 NEMA Type 4X (stainless steel) in wet/damp process areas, in chemical rooms and in chlorine rooms.
 - .2 120 V operating coil with primary and secondary fused control transformer where indicated. Provide control fuses for 120 V power supply circuit from panelboards.
 - .3 For three-phase magnetic starters, provide solid state motor overload protective device in each phase, with single phasing and ground fault protection, manually reset from outside enclosure.
 - .4 For single-phase magnetic starters, provide standard overload relay (ambient compensated, bimetallic type) with interchangeable heaters. Overload protective device shall be manually reset from outside of the enclosure.
 - .5 Power and control terminals.
 - .6 Wiring and schematic diagram inside starter enclosure in visible location.
 - .7 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter or fused disconnect switch as noted on the Drawings and with operating lever on outside of enclosure to control disconnecting device and provision for:
 - .1 Locking in "OFF" position with up to three (3) padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door is open.
- .3 Accessories:
 - .1 Selector switches: industrial heavy duty, NEMA style, 30mm, watertight, corrosion resistant (NEMA 4X enclosure only), oil and dust tight, labeled as indicated.
 - .2 Indicating lights: industrial, heavy duty, NEMA style, 30 mm, watertight, corrosion resistant (NEMA 4X enclosure only), oil and dust tight, LED type, color as indicated.
 - .3 Auxiliary contacts as indicated.
 - .4 Provide motor current transducers for starter units indicated on the drawings.

.5 Provide door mounted devices, terminal blocks, and auxiliary contacts as detailed on the Drawings.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.
- .2 Magnetic starter designation label, white plate, black letters, size 9, engraved as indicated.
- .3 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install starters, connect power and control as indicated.
- .2 Confirm correct breakers, fuses and overload devices elements are installed and set per manufacturer's recommendation for motor size.

3.2 TESTS

- .1 Perform tests in accordance with Sections 01 00 00 and 26 05 00 and manufacturer's instructions.
- .2 Operate switches, contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Confirm sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- .5 Confirm monitoring equipment is connected and properly working upon completion of installation. Simulate I/O from each unit and verify status and alarms.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 ANSI C62.41-2008, IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 ANSI C62.45-2008, IEEE Guide on Surge Testing for Equipment Connected to Low- Voltage AC Power Circuits.
- .3 NECA/ESNA 500-1998, Recommended Practice for installing indoor commercial lighting systems.
- .4 ANSI/IESNA RP1-2004; American national Standard practice for office lighting.
- .5 ASTM F1137-2011e1, American Society for Testing and Materials Specification for phosphate/oil and phosphate/organic corrosion protective coatings for fasteners.
- .6 FCC CFR47; USA Federal Communications Commission Frequency allocations and radio treaty matters; general rules and regulations.
- .7 IESNA LM-79, Electrical and photometric Measurements of Solid State Lighting.
- .8 IESNA LM-80, Measuring Lumen Maintenance of LED Light Sources.
- .9 IESNA TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.

1.2 RELATED WORK

- .1 Submittal Procedures: Section 01 33 00.

1.3 SHOP DRAWINGS AND PRODUCT DATA

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

- .6 Energy data for lamps and ballasts.
- .7 IESNA TM-21 Data for each luminaire
- .4 Catalogue cuts lacking sufficient detail to indicate compliance with Contract documents will not be acceptable.
- .5 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by the Departmental Representative. Photometric data to include:
 - .1 VCP Table, spacing criterion;
 - .2 Total input watts;
 - .3 Candlepower summary, candela distribution, zonal lumen summary;
 - .4 Luminaire efficiency, C.I.E. type, coefficient of utilization;
 - .5 Lamp type;
 - .6 Lumen ratings
 - .7 Summary in accordance with IES procedures.

1.4 OPERATION AND MAINTENANCE

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

1.5 WASTE AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal.

PART 2 PRODUCTS

2.1 LUMINAIRES

- .1 Luminaires are specified on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

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

3.2 WIRING

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

3.3 LUMINAIRE SUPPORTS

- .1 Support luminaires independently of all other systems using chain, aircraft cable or threaded rod. Supporting luminaires from any part of the ceiling system or using ceiling tiles as fixture supports is not permitted.

3.4 LUMINAIRE ALIGNMENT

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

END OF SECTION