

PART 1 General

1.01 GENERAL

- .1 This Section covers items common to Sections of Division 26. This section supplements requirements of Division 01.

1.02 CODES AND STANDARDS

- .1 Do complete installation in accordance with the current edition of the Canadian Electrical Code, Provincial, Municipal, and other codes, rules and regulations and requirements of local authorities having jurisdiction.

1.03 VOLTAGE RATINGS

- .1 Operating voltages: to the current edition of CAN3-C235.

1.04 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Departmental representative will provide drawings and specifications required by Electrical Inspection Department at no cost.
- .4 Notify Departmental representative of changes required by Electrical Inspection Department prior to making changes.
- .5 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of work to Departmental representative.

1.05 SHOP DRAWINGS

- .1 Submit shop drawings, product data and samples in accordance with Division 01. The submission shall be reviewed, signed and processed as described in Division 01.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .3 Where applicable, include wiring, line and schematic diagrams. Include wiring drawings or diagrams showing interconnection with work of other Sections.
- .4 Content
 - .1 Shop drawings submitted title sheet.
 - .2 Data shall be specific and technical.
 - .3 Identify each piece of equipment.
 - .4 Advertising literature will be rejected.
 - .5 The project and equipment designations shall be identified on each document.
- .5 Coordination
 - .1 Where electrical equipment requires support or backing by other trades or mechanical connections, the shop drawings shall also be circulated through the other "services" contractor(s) prior to submission to the Departmental representatives.

1.06 DRAWINGS AND MEASUREMENTS

- .1 Drawings are generally diagrammatic, are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings.
- .2 Take field measurements, where equipment and material dimensions are dependent upon building dimensions.

1.07 PROJECT COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Departmental representative, without the Departmental representative's review.
- .2 The drawings indicate the general location and route to be followed by the electrical services. Where details are not shown on the drawings or only shown diagrammatically, the services shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All services in the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All electrical services shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .3 Work out jointly all interference problems on the site and coordinate all work before fabricating, or installing any material or equipment. Where necessary, produce interference/coordination drawings showing exact locations of electrical systems or equipment within service areas, shafts and the ceiling space. Distribute copies of the final interference/coordination drawings to the Departmental representative and all affected parties.
- .4 Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Departmental representative of space problems before installing any material or equipment. Demonstrate to the Departmental representative on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required.

1.08 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
- .2 Nameplates:
 - .1 Lamacoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .3 Allow for average of twenty-five (25) letters per nameplate.
- .4 Identification to be English.

- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.

1.09 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

1.10 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green

1.11 WIRING TERMINATIONS

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

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 Minimum size 175 x 250 mm.

1.14 COMMUNICATION DEVICES

- .1 Use of Radio devices must be cleared with the Departmental Representative to ensure system does not interfere with internal security communication systems.

1.15 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the Division 01.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance.

- .4 Promptly investigate any electrical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the warranty.

1.16 TENDER INQUIRIES

- .1 All contractor queries during the tender period shall be made in writing to the Departmental representative. Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be considered valid or issued by the Departmental representative's office during tender. Tender queries may be faxed, mailed or couriered to the Departmental representative's office.

1.17 EXAMINATION

- .1 Visit the site before preparing the tender and examine all existing conditions. No extra cost will be considered for any misunderstanding of work to be done resulting from failure to visit the site.
- .2 Examine the documents for details of work included. Obtain a written clarification in the event of conflict within the specification, between the specification and the drawing, in the drawing, or between drawings and/or specifications of different divisions. Obtain written clarification from the Departmental representative if work affecting the installation is not clear. Where this is not done in advance, allow in the tender sum for providing the most costly alternative.

1.18 RESPONSIBILITIES

- .1 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Departmental representative during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.
- .2 Protect equipment and material from the weather, moisture, dust and physical damage.
- .3 Cover equipment openings and open ends of conduit, piping and pullboxes as work progresses. Failure to do so will result in the Trade being required to adequately clean or replace materials and equipment at no extra cost to the Departmental representative.
- .4 Protect all existing services encountered. Obtain instructions from the Departmental representative when existing services require relocation or modification.
- .5 Restore damaged or marred factory finish to factory quality.
- .6 The specifications and drawings form an integral part of the Contract Documents. Neither the drawings nor the specifications shall be used alone. Work omitted from the drawings but mentioned or reasonably implied in the specifications, or vice versa, shall be considered as properly and sufficiently specified and shall be provided. Misinterpretation of any requirement of either plans or specifications shall not relieve this Contractor of the responsibility of properly completing his/her trade as reviewed by the Departmental representative.

1.19 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into maintenance manual specified in Division 01 and as follows:
- .2 Include in operations and maintenance data:

- .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
- .3 Wiring and schematic diagrams.
- .4 Names and addresses of local suppliers for items included in maintenance manuals.

1.20 PROJECT RECORD DRAWINGS

- .1 Provide project record documents as specified in Division 01 as further called for in this Division.
- .2 During the construction period, keep on Site a clean set of drawings marked up to reflect the "As-Built" state, for examination by the Departmental representative on a regular basis. Include elevations and detailed locations of buried services, empty conduit systems and junction and pull boxes.

PART 2 Products

2.01 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 Electrical Inspection Department.
- .2 Factory assemble control panels and component assemblies.

2.02 SPRINKLER PROOF REQUIREMENTS

- .1 All equipment and wiring systems shall be sprinklerproof standard where sprinkler fire protection systems are installed.

2.03 FINISHES

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

PART 3 Execution

3.01 WORKMANSHIP

- .1 Workmanship shall be in accordance with well established practice and standards accepted and recognized by the Departmental representative and the Trade.
- .2 The Departmental representative shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.

3.02 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.03 FIELD QUALITY CONTROL

- .1 All electrical work to be 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 shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this division to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province that the work is being constructed.
- .3 Submit test results for Departmental representative 's review.

3.04 CLEANING

- .1 Do final cleaning in accordance with Division 01.
- .2 At time of final cleaning, clean lighting reflectors, lenses and other lighting surfaces that have been exposed to construction dust and dirt. Remove fingerprints from reflective surfaces.
- .3 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .4 Clean and prime paint exposed non-galvanized hangers, racks, fastenings to prevent rusting. Coordinate finish painting with Division 09.

3.05 CARE, OPERATION AND START-UP

- .1 Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components.

END OF SECTION

Part 1 General

1.01 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE).
 - .1 ANSI/IEEE 837-1988, Qualifying Permanent Connections Used in Substation Grounding.
- .2 Canadian Standards Association (CSA)
 - .1 CSA C22.2No.0.4, Bonding and Grounding of Electrical Equipment.

1.02 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal, and with the Waste Reduction Workplan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

1.03 COORDINATION

- .1 The facility and site shall remain open and in normal operation during the construction period.
- .2 Where existing services such as electrical power, are required to be disrupted and/or shut down, coordinate the shut-downs with the Departmental representative and carry out the work at a time and in a manner acceptable to them. Carefully schedule all disruption and/or shut-downs and ensure that the duration of same is kept to the absolute minimum. Submit for approval a written, concise schedule of each disruption at least 10 days in advance of performing work and obtain Departmental representative's written consent prior to implementing.
- .3 Should any temporary connections be required to maintain services during work in the existing building, supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing system be damaged, make full repairs without extra cost, and to the satisfaction of the Departmental representative and Departmental representative.
- .4 If existing equipment shown on drawings is defective it shall be brought to the Departmental representative and Departmental representative's attention prior to work completion.
- .5 Refer to General Conditions for phasing and staging of work and adhere to that schedule. Comply with instructions regarding working hours necessary to maintain the building in operation.
- .6 Coordinate complete installation of relocated utility services, if required, with Utilities to ensure minimum interruption of service. Coordinate the transfer of the existing hydro service point to the new service point with the Hydro utility in order to keep power interruptions to a minimum.

1.04 EXISTING DEVICES IN NEW CONSTRUCTION

- .1 Where existing devices (receptacles, switches, etc.) presently mounted on a wall which will be covered with a new finish, provide an extension ring, coverplate, etc. or relocate as required to mount the device to the new wall.
- .2 Where existing conduits pass vertically through a floor area, relocate those conduits to be installed concealed in a new wall or surface mounted in a service area. Extend conduit, wiring, etc. as required.
- .3 Existing junction boxes in walls and ceiling spaces required to maintain existing circuits shall remain accessible.
- .4 Where services are concealed within walls, floors or ceilings and cannot be visually identified, Contractor shall provide electronic scanning devices or other approved means to locate and identify concealed services prior to drilling.

1.05 SCHEDULE OF WORK

- .1 Carefully review the drawing project manual and propose a sequence of work for review by the Owner.
- .2 Incorporate Owner's feedback into the sequence of work and update schedule accordingly.

Part 2 Products

2.01 MATERIALS

- .1 Provide all materials required for the complete interface and reconnection installation as herein described and as indicated on the drawings.
- .2 New wiring required to interconnect new devices to existing systems shall be provided to suit the manufacturers requirements and instructions.

Part 3 Execution

3.01 INSTALLATION

- .1 Install boxes, conduit and wiring through existing areas as required for the new installation.
- .2 Add modules, switches, etc. in existing control panels, as required, to extend existing systems to new or renovated areas.
- .3 Patch and repair walls and ceilings in existing areas that have been damaged or cut open due to the new electrical installation.
- .4 Where new cables or conduits have been installed through existing fire rated walls, seal opening around cables and conduit to maintain fire rating.

END OF SECTION

PART 1 General

1.01 SECTION INCLUDES

- .1 Materials and installation for wire and box connectors.

1.02 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2No.65, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
- .3 National Electrical Manufacturers Association (NEMA)

PART 2 Products

2.01 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of suitable material sized to fit conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors as required to: CAN/CSA-C22.2No.18.

PART 3 Execution

3.01 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

PART 1 General

1.01 REFERENCES

- .1 CSA C22.2 No. 0.3, Test Methods for Electrical Wires and Cables.
- .2 CSA C22.2 No. 38 Thermoset Insulated Wires and Cables.
- .3 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

1.02 SUBMITTALS

- .1 Submit product data in accordance with Section 26 05 00 - Common Work Results - For Electrical.

PART 2 Products

2.01 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 and RWU90 when installed below grade.

PART 3 Execution

3.01 GENERAL

- .1 All branch circuit wiring and conduit shall be installed to minimize voltage drop.

3.02 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems.
 - .2 In underground ducts.
 - .3 In trenches.

END OF SECTION

PART 1 General

1.01 REFERENCES

- .1 CSA C22.1, Canadian Electrical Code, Part 1.

PART 2 Products

2.01 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.02 CONDUIT BOXES

- .1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

2.03 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 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 Execution

3.01 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 6 mm of opening.

END OF SECTION

Part 1 General

1.01 REFERENCES

- .1 Canadian Standards Association, (CSA International)
- .2 Insulated Cable Engineers Association, Inc. (ICEA)

1.02 DRAWINGS

- .1 The drawings, which constitute a part of these specifications, indicate the general location of underground pull boxes and duct routing. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.
- .2 Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor shall make field surveys as part of his work.

Part 2 Products

2.01 WIRE

- .1 Wire in conduit to Section 26 05 21.

2.02 UNDERGROUND DUCT

- .1 Heavy wall Rigid PVC duct in trench or encased in reinforced concrete envelope, size and type as indicated.
- .2 High density polyethylene (HDPE) duct in lieu of Rigid PVC where specified, of the same size.

2.03 FITTINGS

- .1 Rigid PVC opaque solvent welded type watertight couplings, bell end fittings, plugs, caps, adaptors, as required to make complete installation.
- .2 Expansion joints as required.

2.04 CABLE PROTECTION

- .1 38 x 140 mm planks pressure treated with naphthenate or 5% pentachlorophenol solution, water repellent preservative.

2.05 UNDERGROUND PULL BOX

- .1 Size(s) as shown on drawings.
- .2 Shall be listed and labeled by a qualified testing agency, and marked for intended location and application.
- .3 Select pull box load rating in accordance with ANSI/SCTE 77 - Specification for Underground Enclosure Integrity.

2.06 CABLE PULLING EQUIPMENT

- .1 19mm (3/4") mule tape shall be pulled continuous throughout each duct run with 3m (10') slack at each end.

Part 3 Execution

3.01 INSTALLATION OF DUCT IN TRENCH

- .1 After specified sand bed is in place, lay ducts maintaining 75 mm clearance from each side of trench to nearest duct/ cable.
- .2 Provide flexible adaptor couplings for thermal action and minor earth movements. Couplings to be provided at each pole based and for each 60 m run, maintaining minimum.
- .3 Underground splices in duct not acceptable.
- .4 duct separation:
 - .1 Maintain 75 mm minimum separation between ducts.
 - .2 Install treated planks on ducts buried less than
- .5 Install sand 150 mm (6") below and 150 mm (6") above cables and conduits.
- .6 Install conduit with watertight couplings. Make transitions, offsets and changes in direction using 5° bend sections. Do not exceed a total of 20° with conduit offset. Clean conduits before laying. Cap ends of conduits during construction and after installation to prevent entrance of foreign materials. Install pull cords in empty conduits.
- .7 Install continuous overlapping cuprinol-treated planking 150 mm (6") above cables and conduits before backfilling. Install continuous yellow marker tapes 150 mm (6") above treated planking.
- .8 Install a separate insulated ground wire in each Rigid PVC duct run.
- .9 Identification of underground installations as per C.E.C. Section 2-100, 4-004 & City of Winnipeg Technical Interpretations.
- .10 Open trench completely along entire length before ducts are laid and ensure that no obstructions will necessitate change in grade.
- .11 Install ducts at elevations as indicated and with minimum slope of 1 to 400.
- .12 Make transitions, offsets and changes in directions using 5° bend sections. Do not exceed a total of 20° with duct offset.
- .13 Use bell ends at duct terminations.
- .14 Cut, trim and taper ends of ducts in field to manufacturer's recommendations.
- .15 Install end caps on empty ducts to prevent entrance of foreign materials.
- .16 After installation of duct in trench, pull through each duct, a wooden mandrel no less than 300mm (12") long and of a diameter 6mm (1/4") less than internal diameter of duct, followed by a stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling in cables. Install pull cords in empty ducts.

3.02 INSTALLATION OF DUCT ENCASED IN CONCRETE

- .1 Build duct bank on undisturbed soil or on well compacted granular fill not less than 6" (150mm) thick compacted to 98% of maximum proctor dry density.

- .2 Open trench completely along entire length before ducts are laid and ensure that no obstructions will necessitate change in grade.
- .3 Install ducts at elevations as indicated and with minimum slope of 1 to 400.
- .4 Make transitions, offsets and changes in directions using 5° bend sections. Do not exceed a total of 20° with duct offset.
- .5 Use bell ends at duct terminations.
- .6 Cut, trim and taper ends of ducts in field to manufacturer's recommendations.
- .7 Install a separate insulated ground wire in each PVC duct run.
- .8 Install reinforced concrete encased underground duct banks for depths as follows or where specified on drawings;
 - .1 Less than 600mm below grade in vehicular areas
 - .2 Less than 450mm below grade in non-vehicular areas.
- .9 Install base spacers at maximum intervals of 1.5m (5') leveled to grades indicated, from bottom layer of ducts.
- .10 150mm Lay conduits with configuration and reinforcing as indicated with preformed, interlocking, rigid plastic spacers to maintain spacing between ducts of not less than 75mm (3") horizontally and vertically. Stagger joints in adjacent layers at least 150mm (6") and make joints watertight. Encase duct bank with 75mm (3") thick concrete cover.
- .11 Terminate duct runs with a duct couplings set flush with the end of the concrete envelope when dead ending duct bank for future extension.
- .12 Allow concrete to attain 50% of its specified strength before backfilling.
- .13 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during pouring of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.
- .14 Install end caps on empty ducts to prevent entrance of foreign materials.
- .15 Immediately after pouring of concrete, pull through each duct, a wooden mandrel no less than 300mm (12") long and of a diameter 6mm (1/4") less than internal diameter of duct, followed by a stiff bristle brush to remove sand, earth and other foreign matter. Avoid distributing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling in cables. Install pull cords in empty ducts.

3.03 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
 - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in duct simultaneously.
- .3 Clean and remove any accumulation of water or other liquid residue prior to installing lubricant pulling cable in the duct.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 Before pulling cable into ducts and until cables are properly terminated, seal ends of cables with moisture seal tape.
- .6 After installation of cables, seal duct ends with duct sealing compound.

3.04 UNDERGROUND PULL BOX

- .1 Install in accordance with manufacturer's recommendations.
- .2 Install underground pull boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- .3 Provide 12 to 25mm gravel backfill, at bottom of pull box, leveled and compacted by hand or machine. Top of gravel backfill shall be below duct ends.
- .4 Field-cut openings for cable ducts according to manufacturer's instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used.
- .5 Seal ducts around cables.
- .6 Ensure the top of frames and covers are flush with finished grade.
- .7 As minimum, provide underground pull boxes, when duct length exceeds 183m, when the bends exceed either two 90-degree bends or a total of 180-degree bends.
- .8 Additional pull boxes shall be installed as required for ease of cable installation
- .9 Pull boxes shall be of sufficient size to allow for required bending and routing of cables. Maintain manufacturers recommended cable bending radius
- .10 Do not install pull boxes in areas intended for deliberate vehicular traffic.

3.05 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests.
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing in accordance with manufacturer's recommendations.
 - .4 Leakage Current Testing.
 - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.

- .2 Hold maximum voltage for specified time period by manufacturer.
- .3 Record leakage current at each step.
- .7 Provide Departmental representative with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.
- .9 Advise Departmental Representative when duct installation is ready for review prior to backfilling
- .10 Advise Departmental Representative that he may review duct banks prior to pouring and be present during pour of concrete and clean out.

3.06 RECORD DRAWINGS

- .1 Include on As-constructed Drawings, exact dimensioned position and routing of all underground duct routing, duct banks, pull boxes, etc.

3.07 COORDINATION

- .1 Confirm the locations of all existing underground services, wiring, fiber optic lines, etc., prior to any trenching or installation of new Pole Bases., etc. The Electrical Contractor shall employ a qualified firm to survey and mark out all existing underground services which may be encountered (Electrical, Telephone, Sewer, Gas, Water, etc.). Findings shall be provided to and reviewed with Departmental Representative on site. Upon completion of underground work, service map must be updated to reflect changes.

END OF SECTION

PART 1 General

1.01 OVERVIEW

- .1 Exterior lighting control to include a complete low voltage lighting control system as shown on the plans and specified here in.
- .2 Exterior lighting circuits shall be controlled both on schedule and on the input from an exterior-mounted outdoor rated photo sensor (photocell).
- .3 All relay panel interiors shall be pre-assembled complete with the necessary relays, transformers and devices. Relay panels that are wall mounted shall have interiors separate from enclosure to permit easy mounting, conduit installation and wire pull to enclosures.

1.02 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 26 05 01 – Common Work Results - Electrical.
- .2 Shop drawings shall include, but not be limited to the following information:
 - .1 Relay panel layout
 - .2 Relay panel controller information
 - .3 Photocell
 - .4 Relay
 - .5 Warranty

PART 2 Products

2.01 RELAY PANELS – FACTORY ASSEMBLED

- .1 Where indicated on the drawings, provide a factory pre-assembled relay panel. The panel's enclosure shall be for surface or flush installation, with a screw-on cover or a hinged door assembly as required.
- .2 The panel shall consist of a pre-assembled interior insert; UL/CSA approved with capacities for 8 or 12 relays as required. Panel enclosure must be UL/CSA Approved.
- .3 Panel enclosure shall be sprinkler proof, at minimum NEMA enclosure type 2.
- .4 Panel interior shall have the following pre-assembled and pre-wired:
 - .1 Suitable divider separating class 1 and class 2 compartments.
 - .2 Control transformer, UL/CSA approved for class 2 circuits.
 - .3 Low voltage relays as required by switched circuits shown on plans or schedules.
 - .4 Control devices as required.

2.02 RELAYS

- .1 Lighting control relays shall be mechanically latching and shall come complete with a manual ON/OFF switch. The mechanical switch shall continuously display the true state of the relay's internal contacts.
- .2 Single pole relays shall be rated and UL/CSA listed for 120, 277 and 347 VAC lighting loads at 20 amps and have a general, tungsten, standard and electronic ballast rating.

- .3 Double pole relays shall be rated and UL listed for 208, 240 and 480 VAC and CSA for up to 347 VAC lighting loads at 20 amps and have a general, tungsten, standard and electronic ballast rating.
- .4 The relays shall have a label indicating the short circuit fault current rating as per the NEC 2005. The relays shall have passed UL 508 short circuit tests at 14,000 amperes.
- .5 Each lighting control relay shall be capable of controlling incandescent, fluorescent, electronic ballast and H.I.D. lighting loads and have an inrush capability of 3000 amperes. Relays shall be complete with a 5-year Manufacturer's Limited Warranty.
- .6 Lighting control relays shall include captive screw terminals for both the line voltage and the low voltage connections. Switching the relay shall be accomplished with ONE signal wire and a common return. The signal wire shall be able to signal ON and OFF and shall carry status current that indicates if the relay is ON or OFF.

2.03 RELAY CONTROLLER

- .1 Digital lighting control system to provide automated and manual control over indoor and outdoor lighting.
- .2 Digital lighting controller is to operate on a stand-alone basis.
- .3 Controller to include;
 - .1 A LCD user interface with a keypad.
 - .2 365-day programming with minimum of 60 schedules.
 - .3 Astronomical and real time clock for dusk to dawn operation.
 - .4 Reset to automatic if left in 'manual' for longer than 24 hours.
 - .5 Programmable dry contract inputs: minimum of 2.
 - .6 Programmable inputs to accept low voltage inputs: photocells, switches etc.
 - .7 Pre-defined application for exterior threshold photo control
 - .8 Low voltage dry contact output relays: minimum of 2
 - .9 Listing: ULC or cUL listed.

2.04 PHOTO SENSOR – EXTERIOR

- .1 Photo sensor to be low voltage on/off type designed for fixture mounting box, suitable for outdoor installation.
- .2 Sensor shall be mounted at location of 3.0m AFF unless otherwise specified.
- .3 Photo sensor shall be rated for operation between -40°c and 70°c in high humidity.
- .4 The sensor shall derive both its power and data information from the lighting control panel.

PART 3 Execution

3.01 RELAY PANEL AND CONDUIT

- .1 Ensure that conduit for line voltage wires enters panel in line voltage areas and conduit for low voltage control wires enters panel on low voltage areas. Check manufacturer's drawings for location of line and low voltage areas.

3.02 PHOTOCELL

- .1 Install photocell on building exterior, per manufacture's recommendations.

- .2 Provide wire in conduit back to the relay controller.

3.03 WIRING

- .1 For low voltage wiring, provide wire type as recommended by the manufacturer.
- .2 Adhere to manufacturer's recommendations as to maximum wire length and maximum quantity of relays per switch.

3.04 LINE VOLTAGE WIRING

- .1 Use wire gauges as appropriate for the branch circuit and as noted on the drawings.

END OF SECTION

Part 1 General

1.01 SECTION INCLUDES

- .1 Materials and installation for standard and custom breaker type panelboards.

1.02 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2No.29, Panelboards and enclosed Panelboards.

1.03 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 26 05 01 – Common Work Results - Electrical.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Part 2 Products

2.01 PANELBOARDS

- .1 Approved manufacturers: to match existing panelboard supplier - EATON.
- .2 Panelboards: to CSA C22.2No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .3 250 and 600 V panelboards: bus and breakers rated for 42,000 A (symmetrical) interrupting capacity or as indicated.
- .4 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.
- .5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .6 Lockable c/w two keys for each panelboard and key panelboards alike.
- .7 Copper bus with neutral of same ampere rating as mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Panelboard to be complete with sprinkler proof drip hood, minimum enclosure NEMA rating of 2.
- .11 Trim and door finish: baked grey enamel.

2.02 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 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.
- .4 Lock-on devices for fire alarm, emergency, exit and night light circuits.

2.03 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Nameplate for each panelboard size 4 engraved.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

Part 3 Execution

3.01 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 01 - Common Work Results - Electrical or as indicated.
- .3 Connect loads to circuits.

END OF SECTION

Part 1 General

1.01 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.02 SUBMITTALS

- .1 Submit product data in accordance with Section 26 05 01 – Common Work Results - Electrical.
- .2 Include time-current characteristic curves for breakers.

Part 2 Products

2.01 BREAKERS GENERAL

- .1 Moulded-case circuit breakers: to CSA C22.2 No. 5
- .2 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Circuit breakers to have minimum interrupting capacity rating as indicated.

2.02 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 Series rated breakers to be manufacturer tested and listed. Breakers to be applied following manufacturer's guidelines and accepted best practice.

Part 3 Execution

3.01 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 GENERAL CONDITIONS

- .1 All Sections of General Conditions shall form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.
- .2 Refer to all other Divisions of the Specifications and these Documents to determine their effect upon the work of this Section.
- .3 All sections of all the Divisions of the Specification and all other documents included as part of this document form part of the Contract Documents.

1.2 SCOPE

- .1 Refer to Section 26 05 00 – Common Work Results – Electrical for project electrical Scope of Work.
- .2 This section covers the supply and installation of all transient voltage surge suppressors.

1.3 STANDARDS

- .1 The specified system shall be designed, manufactured, tested and installed in compliance with the following codes and standards.
- .2 Underwriters Laboratories UL 1283 and UL 1449
- .3 Canadian Standards: cUL, CSA, ETL.
- .4 Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11-2012, C62.41-1991, C62.45-2002)
- .5 Canadian Electrical Code

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 26 05 00 – Common Work Results – Electrical and Section 01 33 00 – Submittal Procedures, including:
 - .1 Unit dimensions, mass, installation instruction details and wiring configuration.
 - .2 Voltage, IEEE let through voltage for each waveform listed, UL 1449 latest revision, latest edition, suppressed voltage ratings, per mode and per phase peak surge current, modes of discrete suppression circuitry, warranty period and replacement terms, conductor size, conductor type and lead length.
 - .3 List and detail all protection systems such as fuses, disconnecting means and protective features.
 - .4 Provide verification that the Surge Suppressor device complies with the required UL 1449, and UL1283, latest editions, latest revisions, and either CSA, or cUL, or ETL approvals.
 - .5 Provide actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41 Categories C, B, and A (as indicated on the drawings), tested in accordance with ANSI/IEEE C62.45.
 - .6 Provide test report from a recognized independent testing laboratory verifying the suppressor components can survive published surge current rating on a per phase mode basis using the IEEE C 62.41, 8x20 microsecond current wave. Test data must be on a complete SPD with internal fusing in place. Test data on an individual module is not acceptable.

1.5 QUALITY ASSURANCE AND WARRANTY

- .1 The SPD and supporting components shall be guaranteed by the manufacturer to be free of defects in material and workmanship for a period of ten (10) years from the date of substantial completion and activation of the system to which the suppressor is attached. Additionally, the warranty shall state that during the applicable warranty period any Surge Suppressor which fails due to any transient surge activity, including lighting, shall be repaired or replaced by the manufacturer without charge. The warranty must specifically provide for unlimited free replacements of the SPD in the event of failure caused by the effects of lightening and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.

1.6 OPERATIONS AND MAINTENANCE INFORMATION

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.

Part 2 Product

2.1 GENERAL PRODUCT

- .1 The transient voltage surge suppressors (SPD) described by this specification are to be installed in the various locations as indicated.
- .2 All SPD devices shall be listed under UL 1449 and certified by either CSA, cUL, or ETL.
- .3 SPD device enclosure shall be rated NEMA 12, unless it is installed into a panel with a minimum NEMA 12 rating.
- .4 The SPD shall protect all modes L-G, L-N, and N-G, have discrete suppression circuitry in L-G, L-N and N-G, and have bi-directional, positive and negative impulse protection. Line-to-neutral-to-ground protection is not acceptable where line-to-ground is specified, and accordingly reduced mode units with suppression circuitry built into only 4 modes are not acceptable.
- .5 The maximum continuous operating voltage (MCOV) of all components shall not be less than 125% for a 120V system and 120% for 220V and 240V systems, and 115% for 277V and 600V systems.
- .6 All SPD's shall be equipped with a comprehensive monitoring system which shall include a visual LCD panel display providing information on unit status and phase loss/protection loss.
- .7 Internal Fusing – Overcurrent Protection:
- .8 Each Metal Oxide Varistor, or other primary suppression component, shall be individually fused for safety and performance to allow the SPD to withstand the full rated single pulse peak surge capacity per mode without the operation or failure of the fuses. Overcurrent fusing that limits the listed peak surge current of the SPD is not acceptable. Replaceable cartridge type per phase or per mode overcurrent fusing is not acceptable where there is more than one MOV per mode.
- .9 For arc quenching capability, minimization of smoke and contaminants in the event of a failure, and to ensure the safest possible design, all surge components, current carrying paths and fusing shall be packed in fuse grade silica sand.
- .10 Fusing shall be present in every mode, including Neutral-to-Ground.
- .11 The fusing shall be capable of interrupting up to a 200kA symmetrical fault current with 600VAC applied
- .12 Each suppressor shall include Form C dry contacts for remote monitoring capability.
- .13 Devices are to be installed as indicated.

- .14 The SPD shall have an audible alarm with mute on front cover.

2.2 SERVICE ENTRANCE (PANELBOARD) PROTECTION

- .1 The manufacturer shall provide written specifications showing let-through voltage of the unit with six inches of lead length pursuant to the latest ANSI/IEEE C62.41 and C62.45,, categories C1 and C3 bi-wave, 90 degree phase angle, positive polarity, measurements in peak voltage from the zero reference, all dynamic test except N-G and UL suppressed voltage ratings, all of which shall be no higher than:

ANSI/IEEE C62.41 Measured Limiting Voltage B3/C1 Impulse (6kV, 3kA) Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	725V	726V	1098V	728V
120/240 (1S240)	725V	726V	1098V	728V
347/600 (3Y600)	1273V	1281V	2161V	1295V
600 delta (600NN)	-	2095V	2098V	-
C3 Impulse (20kV, 10kA) Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	907V	1173V	1267V	1090V
120/240 (1S240)	907V	1173V	1267V	1090V
347/600 (3Y600)	1537V	1707V	2470V	1800V
600 delta (600NN)	-	2160V	2470V	-
UL 1449 Voltage Protection Ratings Voltage (Voltage Code)	L-N	L-G	L-L	N-G
120/208 (3Y208)	800V	800V	1200V	800V
120/240 (1S240)	800V	800V	2500V	800V
347/600 (3Y600)	1500V	1500V	2500V	1500V
600 delta (600NN)	-	2500V	2500V	-

2.3 CONTROL VOLTAGE CIRCUITS

- .1 Each suppressor shall incorporate enhanced tracking filtering technology to attenuate transients that fall within the sine wave normal voltage envelope.
- .2 The manufacturer shall provide written specifications showing let-through voltage of the unit pursuant to the latest ANSI/IEEE C62.41 and C62.45, categories A1 and A3 ringwave and category B3/C1 impulse, 90 or 180 degree phase angle as listed below, positive polarity, dynamic or static test, which shall be no higher than:

A1 (2kV, 67A) (180 degrees)	A3 (6kV, 200A) (90 degrees)	B3/C1 (6kV, 3kA) (90 degrees)
L-N 28	L-N 108	L-N 444
L-G 28	L-G 104	L-G 440
N-G 28	N-G 100	N-G 456

2.4 ACCEPTABLE MANUFACTURER

- .1 All SPD devices shall be from the same manufacturer
- .2 Acceptable manufacturer for the SPD devices shall demonstrate that they meet or exceed the above requirements and include Total Protection Solutions, Leviton, Eaton.

Part 3 Execution

3.1 INSTALLATION

- .1 Install the SPD devices with the conductors under 1m in length (under 3m if Low Impedance Conductors are used) and straight as practicably possible.
- .2 Follow the SPD manufacturer's recommended installation practice as outlined in the equipment installation manual. The electrical contractor shall ensure that all neutral conductors are bonded to the system ground at the service entrance or the serving isolation transformer prior to installation of the associated SPD.
- .3 Main service entrance units shall be installed on a 60A breaker or, where indicated, shall be installed on a non-fused disconnect switch that meets or exceeds the fault current rating of the switchgear.
- .4 Distribution branch panel units shall be installed on 30A dedicated circuit breaker or, where indicated, shall be wired directly to the main lugs or feed through lugs, or wired directly to the bus bars.
- .5 The installing contractor shall comply with all applicable codes

END OF SECTION

PART 1 General

1.01 REFERENCES

- .1 Technical Criteria for Correctional Institutions – 2015 (Available upon request)
- .2 American National Standards Institute (ANSI)
 - .1 ANSI C82.1, Electric Lamp Ballasts-Line Frequency LED Lamp Ballast.
 - .2 ANSI C82.4, Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps.
- .3 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.

1.02 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 26 05 01 – Common Work Results - Electrical.
- .2 Light fixtures shop drawings shall include, but not be limited to the following information:
 - .1 Luminaire voltage
 - .2 Luminaire lumens
 - .3 Luminaire dimensions
 - .4 Construction materials
 - .5 Mounting methods
 - .6 Fixture dimensions
 - .7 Luminaire power consumption (in watts, including driver / ballast losses)
 - .8 Luminaire photometry
 - .9 Luminaire warranty
- .3 In addition to Section 1.2.4 of this specification, LED light fixture shop drawing shall include, but not be limited to the following information:
 - .1 LED color temperature
 - .2 Anticipated fixture lifespan based on L80
- .4 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Departmental representative.
- .5 Photometric data to include: spacing criterion.

1.03 MANITOBA HYDRO POWER SMART

- .1 Submit Manitoba Hydro Power Smart Commercial Lighting Program application on behalf of owner.
- .2 Coordinate with MB Hydro for pre-approval prior to purchase of any lighting products.
- .3 Advise Departmental representative if any lighting is deemed by MB Hydro to be ineligible.

PART 2 Products

2.01 LAMPS AND LIGHT SOURCES

- .1 All new luminaires shall be complete with lamps where applicable.
- .2 All LED lamps and light sources shall be 4000K and minimum 80 CRI unless noted otherwise.
- .3 Correlated Color Temperature of LEDs in LED fixtures shall be in compliance with ANSI C78.377-2015.

2.02 DRIVERS

- .1 Shall be CSA certified.
- .2 Rated case temperature shall be suitable for operation in the Luminaire operating in the ambient temperature range of -40° to +40° C.
- .3 Shall be rated for voltage specified in the Luminaire schedule at 60Hz, and shall operate normally for input voltage fluctuations of $\pm 10\%$. Efficient at full load $>80\%$.
- .4 Shall have a minimum Power Factor (PF) of 0.90 at full input power and across specified voltage range.
- .5 Shall have a maximum 600mA driver operating current for interior lighting and maximum of 700mA for exterior lighting. Unless specified on the luminaire schedule.
- .6 Shall be cUL listed.
- .7 Thermal management:
 - .1 The thermal management (of the heat generated by the LEDs) shall be of one sufficient capacity to assure proper operation of the Luminaire over the expected useful life.
 - .2 Heat sinks on area/site lighting luminaire shall facilitate hose-down cleaning and discourage debris accumulation.
 - .3 The driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating ambient. Thermal management shall be passive by design (mechanical or protruding external surface (heat sink fins)). The use of fans other mechanical devices shall not be allowed.
- .8 Surge Suppression: The Luminaire shall include a surge protection to withstand high repetition noise and other interference. The surge protection which resides within the driver shall protect the Luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C62.41 for location Category A, where failure does not mean a momentary loss of light during the transient event.
 - .1 Total Harmonic distortion (THD): induced into an AAC power line by a luminaire shall not exceed 20% at any standard input voltage.

2.03 LUMINAIRES

- .1 Provide luminaires in accordance with the Luminaire Schedule.
- .2 Coordinate luminaire mounting methods with site plan. Include all necessary hardware to mount luminaire at locations indicated on the drawings. Refer to electrical drawings for exact luminaire locations.

2.04 LUMINAIRE WARRENTY

- .1 The manufacturer shall provide a warranty against loss of performance and defects in materials and workmanship for the Luminaires for a period of Five-year (5-year) after acceptance of the luminaires.
- .2 Warranty shall cover all components including parts and labour.
- .3 All warranty documentation shall be provided to customer prior to the first shipment.

2.05 MOUNTING – STEEL POLE

- .1 Steel poles: to CSA C22.2 No.206 designed for underground wiring and:
 - .1 Pole type finish: to match existing poles on site, at minimum, hot dipped galvanized on interior and exterior surfaces as per STM A123-09.
 - .2 Mounting on concrete anchor base.
 - .3 Style: monotube, tapered octagonal type.
 - .4 Height as indicated on design drawings and reviewed during shop drawings.
 - .5 Anchor bolts and cage assembly supplied by pole manufacturer.
 - .6 Access handhole (min) 450 mm above pole base for wiring connections, with welded-on reinforcing frame and bolted-on cover (gasketed, with stainless steel bolts).
 - .7 Pole hand hole: Sized for access to wiring, breakers and/or terminals inside of pole base, with ground lug gasket cover, stainless steel bolts, located approximately 450mm above base of pole. Access doors to included tamperproof hardware for securing doors in place.
 - .8 Maximum wind loading resistance for pole and attached luminaires to CSA-S6-00, wind velocity of 160 km/h and ice loading characteristics of the project location. Coordinate with light fixture manufacturer for effective projected area (EPA) and weight for light fixtures as indicated on drawings.
 - .9 Provide ground lug welded to pole.
 - .10 Non-shrink grout.
 - .11 Aluminium name plate located 300mm (1') above base to include manufacture's name/ identification mark, year of manufacture, pole length and ordering reference number.
 - .12 Provide a stencil-based painting of pole tag number. Tag name character length and size as noted on design drawings.

PART 3 Execution

3.01 INSTALLATION

- .1 Install poles true and plumb, complete with brackets in accordance with manufacturer's instructions.
- .2 Install luminaires at locations indicated, c/w lamps, all wiring, connections, fittings, aligners, box covers and accessories, as required.
- .3 Install luminaires as indicated.
- .4 Install luminaires parallel with curb lines.
- .5 Connect luminaire to lighting circuit.

- .6 Review all mounting types, construction details and mounting arrangements before placing luminaire orders and ensure that all mounting assemblies, frames, and similar features are included for and match the required installation.
- .7 All luminaires and assemblies shall be properly secured and supported.
- .8 Co-ordinate the installation of luminaires with the work of other trades.
- .9 Ensure all fixtures are CSA/ULC certified as a complete installation. Where field certification is required, arrange and pay for certification by the Office of the Fire Commissioner.
- .10 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.

3.02 WIRING

- .1 Connect luminaires and light controls to lighting circuits.

3.03 STARTUP SERVICE AND SUPPORT

- .1 Engage a factory-authorized service representative to perform startup service.
 - .1 Complete installation and startup checks according to manufacturer's written instructions.
 - .2 Activate light fixtures and verify that all lamps are operating at 100%.
- .2 Startup service shall include the following on-site activities as part of deployment requirements.
 - .1 Wiring and Hardware Review: All wiring connections and electrical equipment included in the scope shall be assessed.
 - .2 Field Testing: Connections, terminations and sensor connections shall be verified in accordance to a specified testing procedure.
 - .3 Final Inspection: All of the connections relating to the lighting shall be tested and verified.

3.04 STARTUP AND PROGRAMMING

- .1 Provide factory certified field service engineer to make minimum of two site visits for each major construction area, according to the Contractor's schedule to ensure proper system installation and operation under following parameters:
 - .1 Qualifications for factory certified field service engineer.
 - .1 Certified by the equipment manufacturer on the system installed.
 - .2 Visit duration shall be suitable to accomplish required tasks.

3.05 CLEANING

- .1 Prior to Substantial Performance of the project, clean the lenses and reflectors of all luminaires with a damp cloth to remove dust, smudges and fingerprints.

END OF SECTION