

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12 , Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.
 - .2 CAN/CSA-C22.3 No. 1-06, Overhead Systems.
 - .3 CAN3-C235-83, Preferred Voltage Levels for AC Systems, 0 to 50,000 V
- .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
 - .2 Hydro requirements and local applicable codes and regulations.

1.2 DEFINITIONS

- .1 Cable: A solid or stranded, bare or insulated metal conductor (wire) or group of conductors enclosed in a common jacket or twisted to form a group.
- .2 Certificate of Conformance: A document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.
- .3 Down Time: The time during which an electrical system is de-energized or not under full operation.
- .4 Duct: A circular pipe or conduit for the mechanical protection of cables.
- .5 Electrical Chamber: A chamber for placing and maintaining conductors, cables, ducts, or electrical equipment. A general name for electrical maintenance holes and handholes.
- .6 Electrical Work: Any work associated with the installation, modification, removal, inspection, or testing of electrical system components, including work required for all auxiliary concrete, mechanical, metallic, or non-electrical components required for the work.
- .7 Electrician: A person in possession of a certificate of qualification for the trade of Electrician in Canada.
- .8 Emergency Maintenance or Emergency Repairs: An activity required to repair unexpected failure of electrical equipment components that requires immediate action and takes precedence over routine maintenance activities for the duration of the emergency.
- .9 Energized: Electrically live.
- .10 Engineer: A Professional Engineer, registered or licensed in the Provinces of Ontario and Quebec.
- .11 ESA: Electrical Safety Authority.

- .12 Highway Lighting System: A system of luminaires, poles, sign luminaires, underpass illumination, cables, power supply equipment, control system, and all associated materials required to provide illumination on a highway, roadway, or associated appurtenances.
- .13 IMSA: International Municipal Signal Association.
- .14 Luminaire: A complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.
- .15 Nighttime: The time during which the ambient natural horizontal illuminance at ground level is less than 15 lux.
- .16 Non-Routine Maintenance: Any activity, other than routine maintenance activities, required to bring the electrical systems to full functionality according to standards.
- .17 Pad: A concrete footing with a level surface used to mount electrical equipment or for a temporary installation that could be made of wood.
- .18 Power Supply Equipment: Electrical equipment installed to provide a source of power for electrical systems and includes transformation, switching, and control equipment.
- .19 Quality Verification Engineer (QVE): An Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.
- .20 Record Drawings: Drawings illustrating constructed deviations from the original Contract Drawings in hard copy and scanned digital copy. Authorized deviations from the original Contract Drawings are marked up in red on one set of Contract Drawing prints in a neat legible manner.
- .21 Routine Maintenance: Ongoing preventive maintenance activities according to the manufacturer's recommendations and the Departmental Representative's maintenance standards and includes the periodic adjustment of the electrical system components to correct deviations from the system specifications resulting from normal operation of the system.
- .22 Service Manuals: The full literature, drawings, directives, instructions, and procedures issued by the supplier or manufacturer of any system component for the purposes of assembly, installation, operation, preventive maintenance, or emergency maintenance of the system component.
- .23 Signalized Intersection: An intersection or junction of roadways or crosswalks or both where the vehicular and pedestrian traffic is controlled by a traffic signal system.
- .24 Switchover: The act of closing down an electrical system and bringing a new or modified electrical system into operation.
- .25 System Components: All hardware and software components, devices, parts, and materials included in the electrical work supplied and installed under a Contract, including all spare parts supplied by the Contractor.
- .26 Temporary: Work that is done to serve a specific function and removed upon completion of the project for which it was designed.
- .27 Traffic Signal System: A system of traffic signal equipment, poles, traffic signal controllers, traffic signal actuation and interconnection equipment, and all associated materials required to regulate vehicular and pedestrian traffic.

- .28 Departmental Representative: The person representing Public Works and Government Services, Canada for the purposes of the Contract.

1.3 DESIGN REQUIREMENTS

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

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 013300 - Submittal Procedures.
- .2 Shop drawings:
 - .1 Submit four (4) copies of the following electrical equipment:
 - .1 Luminaires
 - .2 Supply Control Cabinet Assemblies
 - .3 Traffic Signal Control Cabinet Assemblies and UPS System
 - .4 Traffic Signal Heads
 - .2 Submit shop drawings for any additional equipment as required by the Departmental Representative. If changes are required, notify Departmental Representative of these changes before they are made.
- .3 Quality Control: in accordance with Section 014500 - Quality Control.
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to electrical inspection authorities for approval before delivery to site.
 - .3 Permits and fees: in accordance with General Conditions of contract.
 - .4 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

1.5 QUALITY CONTROL

- .1 Quality Assurance: in accordance with Section 014500 - Quality Control.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians. Traffic signal equipment installation and testing are to have Level 1 and Level 2 IMSA Traffic Signal Technician Certification.
- .3 Site Meetings:
 - .1 Site Meetings: schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins. Verification of equipment layout.

- .2 Once every 2 weeks.
- .3 Upon completion of Work, Energizing System.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 013529.06 - Health and Safety Requirements.
- .5 Work to be Inspected by Electrical Safety Authority. All electrical work is subject to inspection by the ESA. Perform all work associated with inspection or re-inspection by the ESA. This work includes, but is not limited to the following:
 - .1 Arranging and coordinating all visits to the construction site by the ESA's inspectors.
 - .2 Correcting all defects identified by the ESA.
 - .3 Submitting all applications for inspection.
 - .4 Obtaining all permits.
 - .5 Obtaining all certificates.
 - .6 Obtaining all connection authorizations from the ESA.
 - .7 Payment of fees.
 - .8 Performing any other work that may be required under the Canadian Electrical Code.
- .6 Coordinate the following work with others:
 - .1 Electrical power supply connection and disconnection by the electrical power supply authority.
 - .2 Mounting of any electrical equipment on a pole or any structure owned by or under the jurisdiction of a Utility authority.
 - .3 Mounting of any electrical equipment in close proximity to or requiring modification of any plant owned by a Utility authority, private person, or other company.
 - .4 Utility authority invoices to be paid by the Contractor for all utility costs including monthly utility billings until completion of new structure.
 - .5 Obtain all connection authorizations and layouts. Provide 2 copies of all Utility service layouts to the Departmental Representative.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 1 week after award of Contract.

1.7 SYSTEM START-UP

- .1 The traffic signal system is to be switched on for operation according to the following requirements:
 - .1 For the testing of circuitry and components, operation of the system to take place with signal head covers in place.
 - .2 The Departmental Representative is to be given a minimum of 5 Days notice of when the system is to be ready for operation and 24 hours notice prior to completion of the work. Confirmation is to be given that the work will be done as

- scheduled. Signal system activation is not permitted on Fridays, Saturdays, Sundays or Statutory Holidays.
- .3 Complete all preliminary system testing as specified in the Contract Documents and all repairs or replacement of defective components prior to final energizing.
- .2 A minimum of 48 hours prior to the planned activation of the traffic signals, coordinate and attend an on-site quality control meeting with the Departmental Representative. As a minimum, the following individuals are to be in attendance at the meeting:
 - .1 Contractor's on-site representative
 - .2 Electrical sub-contractor representative
 - .3 Electrical Quality Verification Engineer
 - .4 Departmental Representative
 - .5 Departmental Representative's electrical inspection staff
 - .6 Contractor's person responsible for traffic control and highway work zone safety
 - .7 Departmental Representative's electrical coordinator, traffic representative, and electrical quality assurance representative
 - .8 Pavement marking representative
 - .3 Ensure the following has been completed prior to arranging system start-up meeting:
 - .1 Confirm police presence for traffic control.
 - .2 Coordinate traffic control measures.
 - .3 Confirm all work has been completed in accordance with the Contract documents and is in accordance with the signed legal drawing (PHM-125).
 - .4 Confirm pavement marking are installed in accordance with the PHM-125 drawings and are in place at system start-up.
 - .5 Confirm that the Departmental Representative receives of all Quality Verification Engineer certificates of conformance immediately following the activation of the signals.
 - .6 Confirm that all vehicle detection is positioned as required and functioning correctly.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Material and equipment to be CSA certified. Where CSA certified material and equipment is not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .2 Material and equipment is to meet or exceed provincial standards using materials that are approved for use in Ministry of Transportation Ontario (MTO) or Ministère des Transports du Québec (MTQ) construction projects. Demonstrate in writing that each product meets or exceeds provincial requirements.

2.2 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.3 FINISHES

- .1 Shop finish metal enclosure (except stainless steel) surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical enclosures light gray.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 MOUNTING HEIGHTS

- .1 Ensure traffic signal head and span wire mounting heights are achieved in accordance with the Contract Documents.

3.4 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as over current trips, relays and fuses are installed to required values and settings.

3.5 FIELD QUALITY CONTROL

- .1 Conduct the following tests in accordance with Section 014500 – Quality Control.
- .2 Circuits originating from branch distribution panels.
 - .1 Lighting and its control.
 - .2 Traffic controllers and associated control equipment including sequenced operation of systems where applicable.
 - .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.
- .3 Carry out tests in presence of Quality Verification Engineer and Departmental Representative.

- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Take responsibility for all pre-installation and proof of performance testing and inspections for electrical work. Each time the Contractor is to perform an inspection or test, the Departmental Representative is to be notified 48 hours prior to commencing the inspection or test.

3.6 PRE-INSTALLATION TESTING AND INSPECTION

- .1 Pre-installation testing and inspection of electrical work is to include all testing and inspection of system components, including test of mock-ups, prototype testing, and normal factory production testing undertaken on behalf of the Contractor prior to the installation of such components.

3.7 PROOF OF PERFORMANCE TESTING AND INSPECTION

- .1 Proof of performance testing and inspection of electrical work is to include all testing and inspection of system component installations into the work in order to verify the physical and operational features of each part of the system components and electrical subsystems.
- .2 The Quality Verification Engineer is to witness the inspection, testing, and test results for the following electrical work according to the appropriate specification prior to issuing a Certificate of Conformance:
 - .1 Grounding according to Section 26 05 28
 - .2 Installation of power supply equipment according to Section 26 24 01
 - .3 Installation of roadway luminaires according to Section 26 56 19
 - .4 Traffic signal equipment and electrical traffic control devices according to Section 26 56 20
- .3 When issuing the Certificate of Conformance for the above work, the Quality Verification Engineer is to also certify that he or she has witnessed the inspection, testing, and test results for such electrical work.

3.8 DOCUMENTATION

- .1 Provide documentation, including shop drawings, catalogue sheets, calculations, drawings, diagrams, test print-outs, photographs, manufacturer's instructions, service manuals, and text to a level of detail such that it assures the Departmental Representative that the system components that the Contractor is furnishing are according to the requirements of the Contract Documents. The documentation will also be used to provide records for future operational and maintenance activities.
- .2 Submit, as part of the service manuals, a dated and signed form of inspection of each item of work.

3.9 TEST RESULTS AND INSPECTION REPORTS

- .1 Submit test results and inspection reports, including any required verifications and certifications from the Quality Verification Engineer, to the Departmental Representative. Inspection reports are to include the completed checklist and any material observations made at the time of the inspection.

- .2 Include in the documentation the method of testing and inspecting of each item. The method of testing and inspecting will ensure that the functional, physical, and environmental aspects of the contract specifications are demonstrated.
- .3 Include in the documentation all quantitative information generated as part of the testing and inspecting work, including meter readings, screen displays, charts, and any other numerical or graphical data.

3.10 CLEANING

- .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.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 22 Connectors and Terminations
- .2 Section 26 05 29 Hangers and Supports for Electrical Systems

1.2 REFERENCES

- .1 CSA Standards
 - .1 C22.2 No. 38-10, Thermoset-Insulated Wires and Cables
 - .2 C22.2 No. 65-03 (R2008), Wire Connectors
 - .3 C22.2 No. 197-M1983(R2008) , PVC Insulating Tape
 - .4 C22.2 No. 239-09, Control and Instrumentation Cables
 - .5 C22.3 No. 1-10, Overhead Systems
 - .6 C57-98 (R2011), Electric Power Connectors for Use in Overhead Line Conductors
 - .7 C83-96 (R2011), Communication and Power Line Hardware
 - .8 G12-92 (R2007), Zinc-Coated Steel Wire Strand
 - .9 C83-96 (R2011), Communication and Power Line Hardware
- .2 Insulated Cable Engineers Association (ICEA)
 - .1 S-81-570-2005, 600 Volt Rated Cables of Ruggedized Design for Direct Burial Installations as Single Conductors or Assemblies of Single Conductors
 - .2 S-95-658/NEMA WC70-2009 Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy
- .3 Electrical Safety Authority (ESA)
 - .1 Canadian Electrical Code

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

1.5 QUALITY CONTROL

- .1 General:
 - .1 The Departmental Representative is to be given 24 hours notice of when tests are to be performed. The Departmental Representative may witness all tests and all splice installations.

- .2 Tests are to be performed at 500 V for cable insulation rated at less than 600 V and at 1,000 V for cable installation rated 600 V or greater.
- .2 Pre-Installation Testing and Inspection:
 - .1 Cables, splicing, and connection components to be inspected prior to installation to ensure that they meet the requirements of the Contract Documents.
- .3 Proof of Performance Testing and Inspection
 - .1 Ensure that all cables are installed, tested, and spliced as specified in the Contract Documents and that all cables are energized and in working order.
 - .2 The test results are to be submitted to the Departmental Representative.
- .4 Low-Voltage Systems Testing
 - .1 Tests to be limited to approximately 10% of the total cable system and are to be completed at random locations selected by the Departmental Representative. In the event of failure of any test, the Departmental Representative may choose another 10% of the system for further testing.
 - .2 Perform the following tests prior to energizing the system:
 - .1 The continuity of selected cables is to be checked by means of an ohmmeter test. Accumulated resistance is not to exceed the nominal resistance of the cable length, as specified by the cable manufacturer, plus an allowable resistance of 20% per splice or connection.
 - .2 Resistance to ground tests.
- .5 Extra Low-Voltage Systems
 - .1 Continuity of all cables and connections are to be checked by means of an ohmmeter test prior to energizing the system. This test is to be completed with temporary jumpers installed to by-pass any active system elements or any passive DC blocking devices.
 - .2 Cables to be tested for leakage to ground by means of a megger test. Resistance to ground is to be 10 megohm or greater.

Part 2 Products

2.1 LOW VOLTAGE CABLES

- .1 Low-voltage single conductor cables are to be stranded copper type RWU90 cross-linked PE.

2.2 CONTROL CABLES

- .1 Low-voltage multiconductor traffic signal cables to be according to OPSS 2409.

2.3 EXTRA LOW VOLTAGE CABLES

- .1 Extra low-voltage cables for use with video detection equipment to be according to manufacturer's requirements.

2.4 MESSENGER CABLES

- .1 Messenger cables to be 9 mm stranded galvanized steel

2.5 HARDWARE AND FITTINGS

- .1 Hardware and fittings for aerial cable installations to be according to CAN/CSA requirements.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Perform all tests using method appropriate to site conditions and to approval of Department Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Terminate cables in accordance with Section 26 05 22 – Connectors and Terminations.
- .2 Conductor length for parallel feeders to be identical.
- .3 Install conduit systems in accordance with Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .4 Install underground ducts in accordance with Section 33 65 76 – Direct Buried Underground Cable Ducts.

3.3 FISH LINE

- .1 Install fish line in all ducts or conduits when traffic signal cables are installed. A 1.5 m length of fish line is to remain coiled, tied, and accessible in each pole handhole, electrical maintenance hole, junction box, and controller.

3.4 COILS AND SLACK CABLE

- .1 When specified in the Contract Documents, coils of cable and slack cable to remain for future extension by others. Coils are to be neatly taped and remain in a readily accessible location. Cable ends are to be sealed with heat shrink tubing boots.
- .2 A minimum 300 mm length of lighting and power cables are to remain at all accessible pulling points, splicing points, or cable termination points. A coil length of low-voltage, traffic signal, and extra low-voltage cables are to remain at all electrical maintenance holes and underground junction boxes so that a minimum of 1.0 m total length of cable may be pulled out above finished grade.

3.5 LOW TEMPERATURE HANDLING

- .1 Cables are to be warmed to at least -10 °C prior to installation. Cable is not to be installed when the ambient temperature is below -40 °C.

3.6 CABLES IN DUCTS

- .1 Cable is to be pulled through ducts using cable lubricant, mechanical aids, and pulling cables or ropes as required. The pulling tension is not to exceed the safe tension recommended by the cable manufacturer.
- .2 Low-voltage and extra low-voltage splices are to be made only in accessible locations such as junction boxes. Underground splices are not permitted.

3.7 CABLES, AERIAL

- .1 Tension cables to obtain the sag, clearance, and tension values specified in the Contract Documents for the particular installation temperature.
- .2 When specified in the Contract Documents, cables are to be installed on messenger cables. When lashing of cable to a messenger strand is required, a mechanical lashing machine is to be used to install single wound 1.14 mm diameter stainless steel lashing wires. In lieu of lashing wires, and when specified in the Contract Documents, black outdoor nylon cable ties may be used.
- .3 Drip loops and expansion loops to be formed at each pole or conduit entry and held free of the pole or other cables and connections.
- .4 Cables to be re-tensioned, as necessary, to maintain the required cable clearances.
- .5 All work to be according to CSA C22.3 No. 1, and the Canadian Electrical Code.

3.8 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installations is to be the same as for permanent installations of the same type of work, except that the work is to include the removal of the installations when they are no longer required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 33 00 Submittal Procedures.
- .2 Section 26 05 00 Common Work Results for Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.41-M1987 (R1999), Grounding and Bonding Equipment.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by the Departmental Representative.

Part 2 Products

2.1 CONNECTORS AND TERMINATION

- .1 Copper compression connectors to meet CSA C22.2No.41 sized for conductors.
- .2 Electrical insulating tape to meet CSA C22.2No.197 and rated for 600V and -10 °C to 90 °C.

Part 3 Execution

3.1 INSTALLATION

- .1 Bond and ground connections to meet CSA C22.2 No. 41, sized for conductors and wrapped in Electrical Insulating tape. See Section 26 05 28
- .2 Copper compression connectors to meet CSA C22.2 No. 41, sized for conductors, protected with insulating covers and wrapped in Electrical Insulating tape.
- .3 High pressure irreversible compression connectors to be:
 - .1 Made of pure wrought copper extrusion.
 - .2 Made of the same material as the conductors.
 - .3 According to CSA 22.2 No. 41, UL 467, and IEEE 837.
 - .4 Connected according to the manufacturer's recommendations.
 - .5 Connected using a minimum compressive force of 100 kN and a minimum compressive pressure of 70 MPa.

- .4 High pressure irreversible compression connectors to have crimp verification for the inspection and verification of CSA and UL compliance markings.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 00 Common Work Results – Electrical.

1.2 REFERENCES

- .1 CSA Standards
 - .1 C22.2 No. 38-10, Thermoset-Insulated Wires and Cables
 - .2 C22.2 No. 41-07, Grounding and Bonding Equipment
 - .3 G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
 - .4 G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles
- .2 ASTM International
 - .1 B3-01 (2007), Soft or Annealed Copper Wire

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

1.4 QUALITY CONTROL

- .1 Testing Requirements
 - .1 At pad and pole mounted power supply locations, the resistance to ground of the grounding grid is to be tested and measured. In soils of low conductivity, additional ground rods, ground plates, and ground wires are to be added as required by the Departmental Representative or the Electrical Safety Authority. The Departmental Representative is to be notified 48 hours prior to resistance to ground measurements are taken. These measurements are to be undertaken with the Departmental Representative present under dry soil conditions, and when frost penetration has not exceeded 150 mm. Readings are not exceed 25 ohms. The test results are to be documented by the Contractor and a copy of the test results are to be given to the Departmental Representative.
- .2 Pre-Installation Testing and Inspection
 - .1 Grounding cables, bonding jumpers, ground electrodes, and connection components are to be inspected prior to and during installation to ensure that they meet the requirements of the Contract Documents.

- .3 Proof of Performance Testing and Inspection
 - .1 All system and components grounding are to be inspected and tested to ensure that they meet the requirements of the Contract Documents. All electrical grounding connections and splices are to be inspected to ensure they have been properly installed.
 - .2 At pad and pole mounted power supply locations, the resistance to ground of the grounding grid is to be tested and measured. These measurements are to be undertaken when frost penetration does not exceed 150 mm. Readings are not to exceed 25 ohms. In soils of low conductivity, additional ground rods, ground plates, and ground wires are to be added, as required. Copies of all test documentation are to be submitted to the Departmental Representative.
 - .3 A Certificate of Conformance is to be submitted to the Departmental Representative upon completion of the work. The Quality Verification Engineer is to affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:
 - .1 Work
 - .2 Material and installations
 - .3 Inspection, testing, and test results

Part 2 Products

2.1 EQUIPMENT

- .1 Insulated grounding conductors: to Section 26 05 21.
- .2 Ground Rods
 - .1 Ground rods are to be solid steel, 19 mm diameter, 3 m long, copper clad for the full length and to be according to CSA C22.2 No. 41.
- .3 Ground Plates
 - .1 Ground plates are to be hot dip galvanized solid steel, 600 x 600 x 10 mm minimum dimensions. Steel to be according to CAN/CSA G40.20/G40.21, Grade 260W, and is to be galvanized according to CAN/CSA G164.
- .4 Bare Ground Wire
 - .1 Bare ground wire is to be soft drawn stranded copper and be according to ASTM B 3.
- .5 Insulated Ground Wire
 - .1 Insulated ground wire is to be stranded copper, insulation colour green and to be according to CSA C22.2 No. 38, type RWU 90 - cross-link.
- .6 Ground Connectors
 - .1 Moulded connectors to consist of metallic alloys and fusible powder mixtures held in place by suitable moulds and connected using an exothermic type welding process. Physical requirements of the connection to be according to CSA C22.2 No. 41.

- .2 Mechanical connectors to be according to CSA C22.2 No. 41 or UL 467.
- .3 High pressure irreversible compression connectors to be:
 - .1 Made of pure wrought copper extrusion.
 - .2 Made of the same material as the conductors.
 - .3 According to CSA 22.2 No. 41, UL 467, and IEEE 837.
 - .4 Connected according to the manufacturer's recommendations.
 - .5 Connected using a minimum compressive force of 100 kN and a minimum compressive pressure of 70 MPa.
- .4 High pressure irreversible compression connectors to have crimp verification for the inspection and verification of CSA and UL compliance markings.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .5 Soldered joints not permitted.
- .6 Connect all metallic components to the system ground.

3.2 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but no necessarily limited to the following list. Service equipment, duct systems, control panels, traffic control equipment and outdoor lighting.

3.3 GROUNDING WIRE DUCTS

- .1 Pull ground wire through ducts using cable lubricant, mechanical aids, and pulling cables or ropes as required. The pulling tension to be according to the cable manufacturer's specifications.

3.4 GROUND WIRE, DIRECT BURIED

- .1 When ground wire crosses over direct buried cables, a minimum depth of 100 mm of sand bedding material to be placed between the ground wire and the buried cables at the point of crossing.
- .2 Install ground wire at a minimum depth of 600 mm below finished grade when ground wire does not share a common trench with ducts or direct buried cable.

3.5 GROUND WIRE ON POLES OR OPEN SURFACES

- .1 Ground wire installed on concrete or metal poles to be run in rigid duct. Ground wire installed on wooden poles to be run in protective moulding or in rigid duct. In both cases,

the conduit or moulding to be aligned in straight runs complementing the taper of the pole.

- .2 Mechanically fasten conduit to wooden poles using PVC conduit clamps and galvanized lag screws. Moulding to be mechanically fastened to wooden poles using galvanized steel staples. Stainless steel strapping to be installed to secure conduit on concrete or metal poles.
- .3 When ground wire is to be installed on a concrete surface, the concrete is to be drilled to accommodate expandable metal anchors for nylon cable clamps held in place with stainless steel bolts. For installation on wooden surfaces, galvanized steel staples are to be installed. For installation on metal surfaces, nylon cable clamps and stainless steel screws or bolts, nuts, and washers are to be installed. The ground wire is to be installed in straight, neat lines and is to be supported at maximum intervals of 450 mm.

3.6 GROUND WIRE ELECTRICAL CHAMBERS ON ENCLOSURES

- .1 Ground wires in electrical chambers and enclosures are to be trained towards the structure walls with bend radii greater than the minimum recommended by the cable manufacturer. Ground wires are to be fastened with mechanical supports when required.
- .2 Connect ground wire in electrical chambers to ground lugs attached to the frame. For electrical chambers with metallic covers and non-metallic frames, the ground wire is to be connected to the ground lugs attached to the cover. Ground wire in electrical enclosures to be connected to the ground lug provided.

3.7 GROUND WIRE CONNECTIONS

- .1 Ground connectors to be used on all ground wire connections. All surfaces are to be cleaned to bare metal prior to making ground connections.
- .2 Use moulded connectors or high pressure irreversible compression connectors at pad mounted electrical-electronic equipment, power supply locations, and all locations where the ground connectors are direct buried or inaccessible.
- .3 Messenger cables to be grounded using compression connectors.

3.8 GROUND ELECTRODES GENERAL

- .1 The work for ground electrodes is to include the work to install ground rods, ground plates, and the associated work described in this specification.
- .2 When bedrock, rock fill, or similar materials unsuitable for driving ground rods are encountered at depths of 450 mm to 2.0 m below finished grade, the ground rod is to be replaced with a ground plate.
- .3 When bedrock, rock fill, or similar materials are encountered at less than 450 mm below finished grade, the ground electrode is to be installed at a different location when driving of a ground rod or installation of a ground plate is possible.

3.9 GROUND RODS

- .1 Ground rods are to be driven in a vertical position when soil conditions allow. When rocks, stones, or similar materials are encountered, ground rods may be driven at a maximum angle of 45° to the vertical.

3.10 GROUND PLATES

- .1 Install ground plates on a minimum 150 mm thick compacted bed of suitable native earth material over rock.

3.11 BONDING JUMPERS

- .1 The work for bonding jumpers is to include the work described for ground wire on poles or open surfaces, and ground wire connections.

3.12 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installations is to be the same as for permanent installations of the same type of work, except the work is to include the removal of the installations when they are no longer required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 34 Conduits, Conduit Fastenings, Conduit Fittings

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 SUPPORT STRAPS

- .1 53 mm, 2 hole PVC coated steel pipe straps, surface mounted.

Part 3 Execution

3.1 INSTALLATION

- .1 Secure equipment to concrete surfaces with metal expansion anchors.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Fasten exposed conduit or cables to concrete surfaces using straps.
 - .1 One-hole steel PVC coated straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel PVC coated straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .4 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .5 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .6 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .7 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of the Departmental representative.

- .8 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

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 26 05 00.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.
- .2 Fold up metal banding, flatten and place in designated area for recycling.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Rigid PVC construction with screw-on flat covers for surface mounting.

2.2 ELECTRICAL HANDHOLES

- .1 Concrete composite box and lid ANSI/SCTE TIER 22 RATED

Part 3 Execution

3.1 JUNCTION AND PULL BOXES INSTALLATION

- .1 Install Pull boxes and junction boxes at locations agreed with the Departmental Representative. Secure equipment to solid concrete surfaces with metal expansion anchors.
- .2 Install pull boxes in inconspicuous but accessible locations.

3.2 ELECTRICAL HANDHOLES

- .1 Electrical handholes are to be prefabricated handholes made of concrete composite.
- .2 Electrical handholes are to be installed plumb, true to alignment and grade, and firmly bedded on a 300 mm drainage pocket backfill.
- .3 During installation, the duct entry holes are to be oriented in the required direction. The enlarging of duct entry holes is prohibited.

3.3 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installations is to be the same as for permanent installations of the same type of work, except that the work is to include the removal of the installations when they are no longer required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 29 Hangers and Supports for Electrical Systems
- .2 Section 26 05 31 Splitters, Junction, Pull Boxes and Cabinets
- .3 Section 33 65 76 Direct Buried Underground Cable Ducts

1.2 REFERENCES

- .1 Canadian Standard Association (CSA International)
 - .1 CSA C22.2 No. 211.2-06, Rigid PVC (Unplasticized) Conduit.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Place materials defined as hazardous or toxic waste in designated containers.
- .2 Ensure emptied containers are sealed and stored safely for disposal away from children.

Part 2 Products

2.1 CONDUITS

- .1 Rigid PVC Conduit: to CSA C22.2 No. 211.2.

2.2 CONDUIT FASTENINGS

- .1 One hole steel RPVC coated straps to secure surface conduits 50 mm and smaller. Two hole steel RPVC coated straps for conduits larger than 50 mm.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 211.2 manufactured for use with conduit specified.
Coating: same as conduit.

- .2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 200 mm linear expansion.
- .2 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- .1 Braided nylon or polypropylene cord with a minimum test strength of 400N.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Surface mount conduits.
- .2 Use rigid PVC conduit surface mounted.
- .3 Use rigid PVC conduit underground.
- .4 Minimum conduit size for lighting and power circuits: 50 mm.
- .5 Install fish cord in empty conduits.
- .6 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .7 Dry conduits out before installing wire.

3.3 SURFACE MOUNTED COUDUIT SYSTEMS

- .1 Do not drill through bridge reinforcing steel. Locate reinforcing steel with a cover meter and position anchors accordingly.
- .2 For surface mounted duct systems, when the runs exceed 50 m horizontally:
 - .1 The installation of the support systems and ducts are to be carried out according to the duct manufacturer's installation procedures.
 - .2 Install rigid ducts parallel to the structural surfaces, either horizontally or vertically, using offset bends or fittings where changes in alignment are necessary.
- .3 Appropriate fittings and deflection couplings are to be used for the installation. PVC boxes are to be mounted to provide the least interference with at least two stainless steel bolts and expansion anchors. Duct connection to be cemented to the PVC box adapters.

- .4 Secure conduits at intervals using conduit straps in accordance to the Canadian Electrical Code.
- .5 Conduit straps and junction boxes are to be fastened to concrete surfaces by drilling and inserting concrete anchors and securing the equipment with stainless steel bolts.
- .6 Use stainless steel hardware to fasten conduit straps and junction boxes to steel structural members.

3.4 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.5 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installations is to be the same as for permanent installations of the same type of work, except that the work is to include the removal of the installations when they are no longer required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 56 19 Roadway Lighting.

1.2 REFERENCES

- .1 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package For New Construction and Major Renovations (including Addendum 2007).
 - .2 LEED Canada-CI Version 1.0-2007, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Guide For Commercial Interiors.
- .2 CSA International
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for photoelectric devices and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect photoelectric devices from nicks, scratches, and blemishes.
 - .3 Protect metal accessories and trim from being bent or damaged.
 - .4 Replace defective or damaged materials with new.

Part 2 Products

2.1 PHOTOELECTRIC LIGHTING CONTROL

- .1 Photoelectric Lighting Controls: to CSA C22.1.
 - .1 Pole mounting.
 - .2 Capable of switching 1800 W of lighting at 120 V.
 - .3 Voltage variation: plus or minus 10%.

- .4 Temperature range: minus 40 degrees C to plus 70 degrees C.
- .5 Switching on lights at 16 lx.
- .6 Switching off lights at 50 lx.
- .7 Rated for 5000 operations.
- .8 Options:
 - .1 Lightning arrester.
 - .2 Fail-safe circuit completed when relay de-energized.
 - .3 Twist-lock type receptacle, with three locking type blades according to ANSI C136.10.
 - .4 Sensitivity adjustment.
- .9 Switching time delay of 30 s.
- .10 Wall mounting bracket.
- .11 Colour coded leads: size 12 AWG, 460 mm long.

2.2 CONTACTOR

- .1 Contactor: to CSA C22.1.
 - .1 Cabinet mounting.
 - .2 Capable of switching multiple lamp circuits with total lighting load of 6000 W.
 - .3 Manual override.
 - .4 Mounted in supply control cabinet assembly.

Part 3 Execution

3.1 INSTALLATION

- .1 Install photoelectric controls in accordance with manufacturer's written instructions and to CSA C22.1.

3.2 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by lighting control devices installation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 21 Wires and Cables (O-1000V)
- .2 Section 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings
- .3 Section 26 05 28 Grounding Secondary

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 C22.2 No. 0.12-M1985 (R2007), Wiring Space and Wire Bending Space in Enclosures for Equipment Rated 750 V or Less
 - .2 C22.2 No. 0.4-04, Bonding and Grounding of Electrical Equipment (Protective Grounding)
 - .3 C22.2 No. 5-02 (R2007), Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures
 - .4 C22.2 No. 9-96 (R2006), General Requirements for Luminaires
 - .5 C22.2 No. 14-05, Industrial Control Equipment
 - .6 C22.2 No. 18.1-04, Metallic Outlet Boxes
 - .7 C22.2 No. 29-M1989 (R2004), Panelboards and Enclosed Panelboards
 - .8 C22.2 No. 38-05, Thermoset-Insulated Wires and Cables
 - .9 C22.2 No. 41-07, Grounding and Bonding Equipment
 - .10 C22.2 No. 45-M1981 (R2003), Rigid Metal Conduit
 - .11 C22.2 No. 55-M1986 (R2008), Special Use Switches
 - .12 C22.2 No. 65-03, Wire Connectors
 - .13 C22.2 No. 76-M92 (R2007), Splitters
 - .14 C22.2 No. 83-M1985 (R2003), Electrical Metallic Tubing
 - .15 C22.2 No. 94-M91 (R2006), Special Purpose Enclosures
 - .16 C22.2 No. 144-M91 (R2006), Ground Fault Circuit Interrupters
 - .17 C22.2 No. 227.2.1-04, Liquid-Tight Flexible Nonmetallic Conduit
 - .18 G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
 - .19 G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles
 - .20 W59.2-M1991 (R2008), Welded Aluminum Construction
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-07, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .3 ASTM International
 - .1 A 480/A 480M-08, General Requirements for Flat Rolled Stainless Steel and Heat-Resisting Steel Plate, Sheet and Strip
 - .2 A 666-03, Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
 - .3 B 209-06, Aluminum and Aluminum-Alloy Sheet and Plate

- .4 G 34-01(2007), Test Method for Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)
- .4 IEEE
 - .1 C62.1-1989, Gapped Silicon-Carbide Surge Arresters for AC Power Circuits
- .5 National Equipment Manufacturers Association (NEMA)
 - .1 NEMA 250-2003, Enclosure for Electrical Equipment (1000 Volts Maximum)
- .6 Electrical Safety Authority (ESA)
- .7 Canadian Electrical Safety Code

1.3 DEFINITIONS

- .1 Certificate of Conformance : a document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.
- .2 Engineer : a Professional Engineer, registered or licensed in the Provinces of Ontario and Quebec.
- .3 Quality Verification Engineer (QVE) : an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

1.4 DESIGN REQUIREMENTS

- .1 Power Supply Equipment Requirements
 - .1 Supply control cabinet assemblies to be according to the Contract Documents. Completed assemblies are to be “service entrance ready.” The complete assembly is to pass Electrical Safety Authority (ESA) equipment inspection and have an ESA label of approval. These approvals are to be obtained before the unit is shipped.
 - .2 Completed distribution assemblies are to be approved by the ESA or by an organization that has been accredited by the Standards Council of Canada.

1.5 SUBMISSION REQUIREMENTS

- .1 Shop drawings
 - .1 The Contractor is to submit four sets of Shop drawings to the Departmental Representative at least 14 Days prior to the commencement of fabrication, for information purposes only. A Quality Verification Engineer is to affix his or her seal and signature on the Shop drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.
 - .2 Where multi-discipline engineering work is depicted on the same contract drawing and a single Quality Verification Engineer is unable to seal and sign the drawing for all aspects of the work, the drawing is to be signed and sealed by as many additional engineers as necessary.
 - .3 Shop drawings for supply control cabinet assemblies are to include, as a minimum, the following information:

- .1 Detailed dimensioned layout, including sections and details, to show enclosures, equipment layouts and mounting arrangements, and exact weights.
- .2 Wiring diagrams.
- .3 Details of equipment nameplates.
- .4 Detailed list of Materials
- .4 Once fabrication of the equipment has commenced, materials and dimensions shown on the submitted Shop drawings are not to be changed.

1.6 QUALITY CONTROL

- .1 Pre-Installation Testing and Inspection
 - .1 Power supply equipment is to be inspected prior to installation to ensure that it meets the requirements of the Contract Documents. A visual inspection of all the power supply equipment is to be performed prior to its delivery. The following components are to be inspected to ensure that they meet the requirements of the Contract Documents:

a) Barriers and raceways	k) Grounding connections
b) Breakers	l) Labels
c) Cabinet materials	m) Lightning arrestors
d) Conduits and tubings	n) Panelboards
e) Contactors	o) Photoelectric controllers
f) Disconnect switches	p) Switches
g) Doors and latching mechanisms	q) Wires and connectors
h) Enclosure materials	i) Cabinet general appearance
j) Grounding and bonding materials	
 - .2 Proof of Performance Testing and Inspection
 - .1 The installed power supply equipment is to be inspected and tested. All components listed under the Pre-Installation Testing and Inspection clause are to be inspected. Low voltage system tests are to be performed on wiring of the equipment according to 26 05 21. Grounding of equipment to be tested according to 26 05 28.
 - .2 A Certification of Conformance is to be submitted to the Departmental Representative upon completion of the work. The Quality Verification Engineer is to affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:
 - .1 Work
 - .2 Material and installations
 - .3 Inspection, testing, and test results
 - .3 As Constructed Drawings
 - .1 In the event changes to the accepted Shop drawings are necessary, as constructed drawings bearing the stamp and signature of an Engineer are to be submitted to the Departmental Representative.

1.7 QUALITY ASSURANCE

- .1 Inspection
 - .1 The Departmental Representative is to be notified a minimum of 3 Business Days prior to the installation of the power supply equipment.
 - .2 The Departmental Representative and ESA are to be notified when the power supply equipment is ready for inspection.
 - .3 All power supply equipment may be subject to an inspection by the Departmental Representative prior to shipment.

Part 2 Products

2.1 SUPPLY CONTROL CABINET ASSEMBLIES

- .1 Enclosures are to be welded 14 gauge stainless steel type 304 and are to have a No. 2B finish outside according to ASTM A 666 and ASTM A 480.
- .2 The panelboard cover for the supply control cabinet assembly is to be manufactured to accommodate a minimum of 10 standard-sized single-pole branch circuit breakers. Unused openings are to be covered with removable blank covers or inserts.
- .3 The removable internal equipment panel consisting of a combination backboard and drip shield are to be fabricated from 14-gauge galvanized steel or phosphate-prepared cold-rolled steel coated with a minimum of 1.5 mil white polyester powder.
- .4 Barriers and dead-front panels are to be fabricated from 14-gauge galvanized steel or phosphate-prepared cold-rolled steel coated with a minimum of 1.5 mil white polyester powder.

2.2 BREAKERS

- .1 Breakers to be according to CAN/CSA C22.2 No. 5 for use with copper bus.

2.3 CONTACTORS

- .1 Contactors to be according to CAN/CSA C22.2 No. 14.

2.4 LIGHTING ARRESTORS

- .1 Lightning arrestors to be according to IEEE C62.1.

2.5 OUTLET BOXES AND FITTINGS

- .1 Outlet boxes and fittings to be according to CSA C22.2 No. 18.1.

2.6 THERMOSET INSULATED WIRES AND CABLES

- .1 All interconnecting wires and cables are to be copper with type RWU90 insulation and according to CAN/CSA C22.2 No. 38.

2.7 PANELBOARDS AND ENCLOSED PANELBOARDS

- .1 Panelboards and enclosed panelboards to be according to CSA C22.2 No. 29. Buses are to be copper.

- .2 Panelboards to accept bus bar bolt-on breakers and all bus work is to be of copper construction. All interconnecting wire and cables are to be of copper construction and bending radius according to CSA C22.2 No. 0.12.

2.8 GROUNDING AND BONDING MATERIALS

- .1 All equipment used for grounding and bonding to be according to CAN/CSA C22.2 No. 0.4 and C22.2 No. 41.

2.9 RIGID METAL CONDUITS

- .1 Rigid metal conduits to be according to CSA C22.2 No. 45.

2.10 SWITCHES

- .1 Switches to be according to CSA C22.2 No. 55.

2.11 GROUND FAULT CIRCUIT INTERRUPTER RECEPTACLES

- .1 Ground fault circuit interrupter (GFCI) receptacles to be according to CAN/CSA C22.2 No. 144.

2.12 NON-METALLIC LIQUID TIGHT CONDUITS AND CONNECTORS

- .1 Non-metallic liquid tight conduits and connectors to be according to CSA/CAN C22.2 No. 227.2.1.

2.13 ELECTRICAL METALLIC TUBING

- .1 Electrical metallic tubing (EMT) to be according to CSA C22.2 No. 83.

2.14 WIRE CONNECTORS

- .1 Wire connectors to be according to CAN/CSA C22.2 No. 65.

2.15 NEUTRAL BUS BARS

- .1 Neutral bus bars are to be copper.

2.16 SUPPLY CONTROL CABINET ASSEMBLY ENCLOSURES

- .1 The enclosure for the supply control cabinet assembly is to be constructed such that exposure to weather, moisture, or external splashing do not impair the effectiveness of the enclosed electrical equipment. The enclosure is to be manufactured to meet the requirements of NEMA 250, Type 4X.
- .2 The enclosure is to consist of the following:
 - .1 Pole mounting brackets according to the Contract Documents.
 - .2 Doors with:
 - .1 An inside mounted, continuous, piano-type stainless steel hinge.
 - .2 A latching mechanism to hold the door open at 90° and 150-180°.
 - .3 A copper or stainless steel flexible flat braid jumper connected between the door and the cabinet by means of welded studs.
 - .4 A stainless steel padlocking provision.

- .5 A stainless steel three-point padlocking handle with a nylon roller wheel complete with bearing.
- .6 Tamperproof stainless steel mounting hardware accessible from the inside.
- .7 A door handle that travels and stops below the keyhole with minimum 25 mm clearance and rotates 90° pointing straight down for the closed position and pointing horizontally for the open position.
- .3 Removable internal equipment panel with a combination backboard and drip shield. The drip shield is to be formed such that the electrical components mounted on the backboard are not affected by moisture forming on the interior at the top of the enclosure.
- .4 Barriers formed according to CSA C22.2 No. 29 separating the service cables from the branch circuits and the photoelectric controller cables.
- .5 Internal dead-front panels for the main breaker and circuit breaker sections that prevent unsafe contact by service personnel with the live circuits from all sides.
- .6 A printed schedule for the supply control cabinet identifying circuits mounted on cardboard, inserted in a clear plastic bag, and permanently attached to the inside of the door.
- .3 Dead-front panels are to be formed such that the circuit breaker panel has to be removed before the main breaker panel can be removed. Both panels are to be supplied with quarter-turn screw latches welded to the dead-front panels.

2.17 PANELBOARD SCHEDULES

- .1 A printed schedule for each panelboard is to be provided indicating equipment served and a description of circuit breaker sizes for each panel as specified in the Contract Documents. The schedule is to be mounted on cardboard, inserted in a clear plastic bag, and hung on the inside of the main door panel.

2.18 MARKINGS

- .1 Markings is to be engraved on a stainless steel plate permanently attached with stainless steel or aluminum pop rivets to the outside of the door and located in a highly visible location. Each power supply is to have identification markings showing the following:
 - .1 Assembly manufacturer's name or trademark.
 - .2 Enclosure manufacturer's name or trademark.
 - .3 Date of manufacture (i.e., yyyy-mm-dd).
- .2 The manufacturer is to attach the label SERVICE ENTRANCE READY on the dead front panel of the supply control cabinet assembly.

2.19 SUPPLY CONTROL CABINET ASSEMBLY MATERIAL REQUIREMENTS

- .1 Supply control cabinet assembly:
 - .1 type 1, 120/240 volt
 - .2 100 amp 1 -phase, complete with:
 - .3 100 amp Main circuit breaker
 - .4 50 amp Traffic signal circuit breaker
 - .5 30 amp Circuit breakers, Pole
 - .6 60 amp Circuit breakers, 2 Pole (for Contractor)

- .7 15 amp Circuit breakers (replamping)
- .8 15 amp Circuit breakers (photozell)
- .9 240, 60 Amp, 3 Pole Lighting Contractor Secondary Lighting Arrester, 650V, 2-Pole
- .10 100 amp Meter socket (as per local power supply authority standards)

Part 3 Execution

3.1 GENERAL

- .1 General requirements for electrical work to be as specified in the Contract Documents.

3.2 SUPPLY CONTROL CABINET ASSEMBLIES

- .1 Supply control cabinet assemblies are to be mounted securely on poles using stainless steel strapping. Rigid ducts and fittings are to be installed on wooden poles using two-hole galvanized pipe straps one trade size larger with galvanized lag screws and on metal or concrete poles using stainless steel strapping, at intervals specified in the Canadian Electrical Code. The conduit system is to be installed in straight lengths to follow the taper of the pole. Offset bends, meter hubs, terminal adapters, and fittings are to be used when required to avoid pole attachments and be kept free of kinks or scorch marks.
- .2 A meter socket, acceptable to the power supply authority, is to be installed.

3.3 CABLES AND FUSES

- .1 Cables, terminations, and connections are to be installed according to Section 26 05 21. Service cables from the point of service connection to the main disconnecting means are to be installed according to the Canadian Electrical Code and the requirements of the power supply authority.

3.4 GROUNDING

- .1 All grounding work to be according to Section 26 05 28.
- .2 Lightning arrestors are to have the ground cable connected securely to the equipment ground bus. The neutral bus of the main disconnecting means or the secondary neutral terminal of the transformer is to be grounded.
- .3 The system ground wire and the service ground wire are to be connected to the neutral bus in supply control cabinet assemblies.

3.5 PHOTOELECTRIC CONTROLLERS

- .1 Photo-conductive cell windows are to be set to face in a northerly direction and away from any nearby light sources.
- .2 Photoelectric controllers are to be installed on poles with twist lock mounting sockets and brackets. Brackets are to be mounted on metal or concrete poles with stainless steel strapping or on wooden poles with galvanized lag screws.

3.6 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installations is to be the same as for permanent installations of the same type of work, except the work is to include the removal of the installations when they are no longer required.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-O15-90 (R1999], Wood Utility Poles and Reinforcing Stubs.
 - .2 CSA O80 Series-97, Wood Preservation.
 - .3 C22.2 No. 9.0-96 (R2006), General Requirements for Luminaires
 - .4 C22.2 No. 65-03 (R2008), Wire Connectors
 - .5 C22.2 No. 211.2-06 (R2011), Rigid PVC (Unplasticized) Conduit
 - .6 C22.2 No. 248.8-11, Low-Voltage Fuses – Part 8: Class J Fuses
 - .7 C83-96 (R2011), Communication and Power Line Hardware
- .2 American National Standards Institute (ANSI)
 - .1 C78.380-2007 High-Intensity Discharge Lamps, Method of Designation
- .3 Illuminating Engineering Society of North America (IESNA)
 - .1 IES-LM-63-02 ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information
- .4 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 617, Construction Specification for Installation of Roadway Luminaires

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .4 Fold up metal banding, flatten and place in designated area for recycling.
- .5 Do not dispose of preservative treated wood through incineration.
- .6 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.
- .7 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Departmental Representative.
- .8 Dispose of unused wood preservative material at official hazardous material collections site approved by Departmental Representative.

- .9 Do not dispose of unused preservative material into sewer system, into streams, lakes, onto ground or in any other location where they will pose health or environmental hazard.
- .10 Divert unused concrete materials from landfill to local quarry or facility approved by Departmental Representative.

1.4 QUALITY CONTROL

- .1 Pre-Installation Testing and Inspection
 - .1 Luminaires, brackets, socket setting, refractor type and ballast type are to be tested and inspected to ensure that they are according to the Contract Documents.
- .2 Proof of Performance Testing and Inspection
 - .1 Luminaires are to be tested and inspected to ensure that they are levelled correctly and according to the Contract Documents. All lamps installed in luminaires are to have a minimum burning-in period of 100 night time hours prior to acceptance of the work by the Departmental Representative.
 - .2 A Certificate of Conformance is to be submitted to the Departmental Representative upon completion of the work. The Quality Verification Engineer is to affix his or her seal and signature to the completed Certificate of Conformance confirming that the following are in general conformance with the requirements of the Contract Documents:
 - .1 Work
 - .2 Material and installations
 - .3 Inspection, testing, and test results

Part 2 Products

2.1 WOOD POLES

- .1 Wood poles: to CAN/CSA-O15, class 4 Western Red Colour, Red Pine, Jack Pine, Lodgepole Pine, and Southern Yellow Pine:
 - .1 Length: 12.2 m
 - .2 Pressure treated: to CSA O80.

2.2 LUMINAIRE MOUNTING BRACKETS

- .1 Mounting brackets aluminum for specified luminaires:
 - .1 Single brackets as indicated.
 - .2 Arm extension length: 2.4 m aluminum elliptical with 1.2 m rise.

2.3 LUMINAIRES

- .1 Luminaire with cast aluminum weatherproof housing and:
 - .1 Lamp type: HPS, wattage: 250.
 - .2 Ballast: 120 V, one lamp.
 - .3 Optical assembly:

- .1 For high pressure sodium lamps:
 - .1 Reflector: sheet aluminum with a diffused anodized finish.
 - .2 Flat glass.
 - .3 Gasket: neoprene seal between refractor and housing.
- .4 Light Distribution:
 - .1 IES distribution Type III by adjusting position of lamp socket.
- .5 Self-locking latches of stainless steel and aluminum.
- .6 Factory wired including integral CWA ballast terminated at terminal block.

2.4 FUSE HOLDERS AND FUSES

- .1 Fuse holders are to be of the in-line type suitable for use with #12 AWG conductors, rated 600 V, and are to be complete with protective boots. Fuses are to be according to CSA C22.2 No. 248.8, 600 V with a current rating as specified in the Contract Documents.

Part 3 Execution

3.1 BRACKETS

- .1 Install brackets at right angles to the centreline of the roadway being served. Bracket clamping assemblies are to be securely tightened. Brackets are to be mounted on wooden poles using 16 mm diameter galvanized steel square head through bolts, nuts, and 50 x 50 mm washers.

3.2 LUMINAIRES

- .1 Luminaires are to be stored in conditions free of moisture, dirt, and other factors that could damage the ballasts or reflecting surfaces of the optical system.
- .2 Mount luminaires on brackets and level along both the longitudinal and transverse axis.
- .3 Securely tighten luminaire clamping assemblies upon completion of leveling.
- .4 Orient and aim luminaires using the horizontal and vertical angles specified in the Contract Documents. When instructed by the Departmental Representative, each luminaire or luminaire component is to be readjusted once under nighttime operating conditions.
- .5 Install glass refractors complete with gaskets. Securely tighten mounting hardware. The luminaire reflector and refractor is to be thoroughly cleaned prior to installing lamps. Lamps are to be installed with the installation date marked on the lamp base.
- .6 If required, the refractor and the lamp holder is to be reset or replaced according to manufacturer's instructions to give the proper type of light distribution specified in the Contract Documents.

3.3 WIRING AND CONNECTIONS

- .1 Riser wires in metal and concrete poles is to be terminated at the luminaire terminal block and installed through the bracket and pole to the pole handhole.

- .2 Riser wires on wooden poles are to enter the bracket with a drip loop and be installed in conduit when the distance from the bracket to the low voltage bus exceeds 450 mm.
- .3 Connections or riser wires to the assigned feeder conductors are to be made with compression connectors insulated with insulating covers.
- .4 Install in-line fuse holders and fuses in the pole handhole and placed in an accessible location. For wooden poles, in-line fuse holder and fuses are to be installed at the point of connection.

3.4 GROUNDING

- .1 Install a #12 AWG insulated (green) stranded copper ground wire between the luminaire housing ground terminal and the system ground, for wooden pole mounting,

3.5 RELAMPING

- .1 When required, existing lamps are to be removed. The existing luminaires cleaned thoroughly and new lamps installed according to the Contract Documents.

3.6 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installations is to be the same as for permanent installations of the same type of work, except the work is to include the removal of the installations when they are no longer required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 21 Wires and Cables (0-100V)
- .2 Section 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings
- .3 Section 26 05 28 Grounding Secondary

1.2 REFERENCES

- .1 CSA Standards
 - .1 C22.2 No. 41-07, Grounding and Bonding Equipment
 - .2 C22.2 No. 45.2-08, Electrical Rigid Metal Conduit – Aluminum, Red Brass, and Stainless Steel
 - .3 C22.2 No. 65-03 (R2008), Wire Connectors
 - .4 C22.2 No. 85-M89 (R2010), Rigid PVC Boxes and Fittings
 - .5 C22.2 No. 197-M19383 (R2008), PVC Insulating Tape
 - .6 C22.2 No. 211.2-06 (R2011), Rigid PVC (Unplasticized) Conduit
 - .7 C57-98 (R2011), Electric Power Connectors for Use in Overhead Line Conductors
- .2 Electrical Safety Authority (ESA)
 - .1 Canadian Electrical Code

1.3 DEFINITIONS

For the purpose of this specification, the definitions in the OTM Book 12 and the following definitions apply:

- .1 Auxiliary Signal Head: A traffic signal head installed as supplementary to the primary and secondary signal heads and that may be necessary due to local conditions.
- .2 Certificate of Conformance: A document issued by the Quality Verification Engineer confirming that the specified components of the Work are in general conformance with the requirements of the Contract Documents.
- .3 Detection: The operation of a detector sensor unit in registering the presence or passage of a vehicle or pedestrian.
- .4 Engineer: A Professional Engineer, registered or licensed in the Provinces of Ontario and Quebec.
- .5 General Conformance: Means that in the opinion of an Engineer, the standard of construction work fulfills the essential requirements of the Contract Documents and has been done in accordance with normally accepted industry standards and will perform its intended function.
- .6 Highway Signal Head: A traffic signal head with a 300 mm diameter red lens, amber and green lenses.

- .7 Interconnection: The system of cables and devices that operate traffic signal controllers at consecutive intersections in a fixed or pre-programmed timing sequence.
- .8 Pedestrian Signal Head: A traffic signal head comprising of a Walk and Don't Walk symbol mounted at a crosswalk.
- .9 Primary Signal Head: A traffic signal head mounted on the far right side of an intersection approach.
- .10 Quality Verification Engineer (QVE): An Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.
- .11 Secondary Signal Head: A traffic signal head mounted on the far left side or in the median of an intersection approach.
- .12 Signal Head: An assembly containing one or more signal displays.
- .13 Special Signal Head: A traffic signal head comprised of a combination of sections with red, amber and green or green/amber arrow displays.
- .14 Uninterruptible Power Supply: A backup power supply that supplies temporary power without an interruption in system operation in the event of a short-term loss of power from the local supply authority.
- .15 Vehicle Extension: The time, in seconds, added to the green interval to permit additional green time upon actuation by a vehicle approaching the intersection.

1.4 QUALITY CONTROL

- .1 General:
 - .1 The Departmental Representative is to be notified of the time and location of all inspection and testing 3 business days prior to the start of the work and confirm that the work will be performed as scheduled 24 hours prior to the start of work.
 - .2 The work is to be inspected and tested 3 days prior to the actual turn on of the signals to ensure that it is according to the requirements of the Contract Documents.
 - .3 A minimum of 72 hours prior to the scheduled activation of each traffic signal, the Contractor is to coordinate and attend an on-site quality control meeting with the Departmental Representative.
 - .4 Upon completion of installations and testing, a visual check is to be made of the controller cabinet to ensure proper operation of the equipment.
 - .5 All test results are to be submitted to the Departmental Representative.
- .2 Test Plans:
 - .1 A test plan is to be submitted to the Departmental Representative documenting how the traffic signals and electrical traffic control devices will be tested. The test plan is to be submitted to the Departmental Representative prior to any installation work and a minimum of 10 business days prior to the start of any testing.
 - .2 Make additions or modifications to the test plan as specified by the Departmental Representative. Testing is not to commence until the test plan has been accepted by the Departmental Representative. Once accepted, the traffic

- signals and traffic control devices are to be tested according to the accepted test plan and the Contract Documents.
- .3 As a minimum, the test plan is to include a pre-installation test plan and a proof of performance test plan.
 - .4 Once accepted by the Departmental Representative, the accepted test plan will form part of the Contract Documents.
- .3 Pre-Installation Testing and Inspection:
- .1 General:
 - .1 Actuation devices and connection components to be inspected prior to installation to ensure that they meet the requirements of the Contract Documents.
 - .2 Traffic signal controllers and components to be inspected prior to installation to ensure that they meet the requirements of the Contract Documents.
 - .3 Ensure that all controller and conflict monitor programming are installed and that all timing controls, switches, and programming controls are properly set.
 - .4 Signal heads, traffic signal head supports, and connection components to be inspected prior to installation to ensure that they meet the requirements of the Contract Documents.
 - .2 Traffic Signal Control Equipment:
 - .1 Test and inspect traffic signal control cabinets complete with traffic signal control equipment. Test functionality and performance of each component and confirm operation according to the manufacturer's specifications and the Contract Documents.
 - .2 Test entire traffic control equipment with the traffic signal control equipment installed within the cabinet and all programming, timing, switched, and controls installed and set. Test functionality and performance of the traffic signal control equipment as a complete system and confirm operation according to the traffic signal timing plan, the manufacturer's specifications and the Contract Documents.
 - .3 If the traffic signal control equipment or any part thereof fails to operate correctly, the deficiency is to be corrected and the testing and inspection repeated in full.
 - .3 Traffic Signal Equipment
 - .1 Test and inspect functionality and performance of each piece of traffic signal equipment and confirm operation according to the manufacturer's specifications and the Contract Documents.
 - .2 If the traffic signal equipment or any part thereof fails to operate correctly, the deficiency is to be corrected and the testing and inspection repeated in full.
 - .4 Electrical Traffic Control
 - .1 Test and inspect functionality and performance of each electrical traffic control device and confirm operation according to the manufacturer's specifications and the Contract Documents.

- .2 If the electrical traffic control device or any part thereof fails to operate correctly, the deficiency is to be corrected and the testing and inspection repeated in full.
- .5 **Controllers**
 - .1 Pre-shipping shop tests are required to transporting the controller to the Working Area.
 - .2 The following pre-installation tests are required:
 - .1 Cabinet Assembly and Components – A visual check is to be made to ensure that all components necessary to the complete controller are present and that all pre-assembled equipment is securely mounted and connected.
 - .2 Circuit Output – The output terminal board voltage is to be tested for 108 V minimum output from load switches and for proper terminal assignment according to the manufacturer’s wiring diagram.
 - .3 Programming – With the actual phase timing for the intended intersection in operation, the controller programming is to be tested to ensure that the intended operation is accomplished. This test is to include all required combinations of actuation and recall settings together with any special features such as advance green, phase skip, pre-emption, or coordination.
 - .4 Interval Sequence –With the proper programming for the intended intersection in operation, but with modified timing values suitable to test conditions, the controller unit is to be cycled through all phases for a minimum of 24 hours. Controller output is to be tested using a test board with indicator lights to ensure that the proper phases and phase intervals appear in the correct sequence. The testing is to be conducted using either a 120 V test board wired to the output side of the load switched or by a 24 V test board wired to the input side of the load switched. Test results are to be confirmed a minimum of six times.
 - .5 Actuation – With an appropriate test board, the effect of detection devices by entering a call to the controller unit is to be tested. All modes of detector sensor unit program and vehicle extension calls are to be tested. Tests are to confirm that all calls are registered, activated, and are associated with the correct traffic phase.
 - .6 Conflict Monitors – Conflict monitors are to be tested according to the manufacturer’s recommendations. All flash and reset functions are to be tested.
 - .7 Flashers – the output of flasher units and flash transfer relays are to be tested for proper functioning over a two hour period.
 - .8 Recall – Recall switch functions for each phase are to be tested to ensure that the controller recalls to the phase selected and remains on hold in the absence of a call on an opposing phase.

- .9 Manual Override Controls – Manual override controls are to be tested for proper operation under all possible switching combinations.
 - .10 Environmental Controls – The heater element and circuitry are to be tested for continuity and proper resistance. The ventilation fan is to be checked for proper operation in conjunction with the thermostat control system. If the average temperature during the installation period is below 5°C, the cover plate is to be installed over the louvers and the heater circuit will be prepared for operation.
- .4 Proof of Performance Testing and Inspection
- .1 General
 - .1 Inspect and test work a minimum of 3 business days prior to the actual turn on of the signals to ensure that it is according to the requirements of the Contract Documents. In particular, and without limiting the foregoing, ensure all components are installed, tested, and proven to perform as specified in the Contract Documents and that all cables are energized and in working order and that the signal timing is consistent and complete, without activating the traffic signals for public display.
 - .2 All proof of performance testing and inspection is to be performed on site with all signal heads covered with an opaque covering.
 - .3 All traffic signal cable circuits to be tested according to Section 26 05 21.
 - .4 Each signal display is to be inspected and tested for correct phase connection and operation according to the Contract Documents.
 - .5 Detection and actuation devices are to be tested and inspected for correct operation according to the manufacturer's specifications and the Contract Documents. This testing is to include observation of all calls generated to verify that they are registered and activated.
 - .6 Traffic signal timing is to be verified to be consistent and complete. With the proper programming and signal timing in operation and with all system components and circuits connected, the traffic signal system is to be cycled through all of its phases and operations.
 - .2 Video Detection Systems
 - .1 Video detection systems are to be tested to confirm that the video detection equipment is accurately detecting vehicles and transmitting calls to the controller. Video detection systems are to be tested according to the manufacturer's specifications and the Contract Documents.
 - .3 Controller
 - .1 Field tests are required upon completion of the installation of the controller. The controller will be allowed to operate functionally only after all testing has been completed and all components are operational.
 - .4 Signal Cable
 - .1 All traffic signal cable circuits is to be tested according to Section 26 05 21.
 - .5 Interval Sequence

- .1 With the proper programming and timing functions in operation, the controller is to be cycled through all phases with all signal circuits connected and with signal heads covered.
- .6 Actuation
 - .1 All calls are to be observed to be registered and activated. Actuation equipment is to be tested.
- .7 Uninterruptible Power Supply Systems
 - .1 Uninterruptible power supply systems are to be tested to confirm that the system operation continues without interruption when there is an interruption of power from the local supply authority. The duration of operation on the uninterruptible power supply system will be confirmed to be according to the manufacturer's specifications and the Contract Documents.
- .8 System Proof of Performance Testing and Inspection
 - .1 The work is to be inspected and tested to ensure that the work is according to the requirements of the Contract Documents. In particular, and without limiting to the foregoing, all components are installed, tested, and proven as specified in the Contract Documents and that all cables are energized and in working order without activating the traffic signals for public display.
 - .2 The complete traffic signal system, including the traffic signal control system, is to be inspected and tested to verify that the complete integrated system operates correctly, safely, and according to the Contract Documents.
 - .3 The inspection testing and test results are to be certified by a Quality Verification Engineer. The Quality Verification Engineer is to issue a Certificate of Conformance that the work has been inspected and tested and that the material and installation are in general conformance with the requirements of the Contract Documents.

1.5 QUALITY ASSURANCE

- .1 Equipment and Materials, as supplied by the Contractor, are subject to inspection by the Departmental Representative prior to installation.
- .2 Equipment requiring the submission of Shop drawings and service manuals as specified in the Contract Documents may be inspected by the Departmental Representative prior to shipping from the manufacturer's factory or at the supplier's place of business. The Contractor is to inform the Departmental Representative when the equipment fabrication is complete and is to make suitable arrangements for any required inspection.
- .3 All electrical installation work is subject to random inspection by the Departmental Representative. The Departmental Representative may witness any testing performed by the Contractor during installation.

Part 2 Products

2.1 TRAFFIC SIGNAL HEADS

- .1 Traffic signal heads to be according to MTO and MTQ approved materials, TAC, and the Highway Traffic Act. The LED signal module is to conform to the mandatory specifications of: ITE Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) 2005.

2.2 MAST ARMS, BRACKETS, AND SIGNAL HANGERS

- .1 Mast arms, brackets, and signal hangers to be according to the Contract Documents, MTO and MTQ approved materials.

2.3 TRAFFIC SIGNAL CABLES

- .1 Traffic signal cables to be according to MTO and MTQ approved cable.

2.4 LED MODULES

- .1 LED modules to be according to MTO and MTQ approved LED modules.

2.5 ELECTRICAL CONNECTORS FOR TRAFFIC SIGNAL CABLE

- .1 Wire connectors are to be of the insulated wing nut, vibration proof spring type and to be according to CAN/CSA C22.2 No. 65.
- .2 Cable connectors to be according to CAN/CSA C22.2 No. 65 and CSA C57.

2.6 STRAPPING

- .1 Stainless steel strapping and buckles to have a minimum ultimate strength of 4.5 kN.

2.7 TRAFFIC SIGNAL MOUNTING EQUIPMENT

- .1 Fittings, accessories, and hardware to be according to the Contract Documents.

2.8 GROMMETS

- .1 Grommets to be rubber or neoprene sized to suit the aperture, metal thickness, and cable diameter.

2.9 GROUNDING MATERIALS

- .1 Grounding materials to be according to Section 26 05 28.

2.10 CONTROLLERS

- .1 Controllers to be according to the MTO and MTQ approved traffic controllers. A used traffic signal controller may be used for a temporary installation provided that it is in good condition and it complies with the requirements of the Contract.

2.11 AERIAL MOUNTING EQUIPMENT

- .1 Fittings, accessories, and hardware to be according to the Contract Documents.

2.12 VIDEO DETECTORS

- .1 Microwave detectors to be according to the manufacturer's specifications and the Contract Documents.

2.13 ADVANCED WARNING SIGNS

- .1 Advance warning signs to be according to the manufacturer's specifications and the Contract Documents.

2.14 UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

- .1 Uninterruptible power supply systems to be according to the manufacturer's specifications and the Contract Documents. A used UPS System may be used for a temporary installation provided that it is in good condition and it complies with the requirements of the Contract.

Part 3 Execution

3.1 GENERAL

- .1 General electrical work requirements are as specified in the Contract Documents.
 - .1 The work is to include the supply, installation, modification, and testing of all materials and systems required to provide traffic signal systems, traffic control devices, and other devices that are fully functional and perform their intended function according to the Contract Documents.

3.2 TRAFFIC SIGNALS

- .1 Signal Heads:
 - .1 Install signal heads facing the direction of approaching traffic. Install LED modules of the size and type specified in the Contract Documents.
 - .2 Cover signal heads with opaque covers and leave securely in place until all tests have been completed and the signal heads are put into operation.
 - .3 Adjust signal heads for maximum visibility and focusing prior to final tightening or sealing of hardware. Unused top and bottom hubs in signal heads are to be plugged with bird stops and the top hub gasketed.
- .2 Pole Mounted Conduit Systems:
 - .1 Pole mounted conduit systems including rigid PVC junction boxes and all necessary fittings and hardware are to be installed when traffic signal equipment is installed on concrete or wooden poles. Install conduit in straight lengths to follow the taper of the pole using stainless steel strapping or galvanized steel two-hole clips secured by galvanized lag screws at 1.5 m maximum spacing. Offset bends are to be used when required to avoid pole attachments and other equipment. Conduits are to be kept free of kinks or scorch marks.
- .3 Wiring:

- .1 Install aerial cable from the PVC junction box to the signal head according to Section 26 05 21.
 - .2 Connect riser cables to LED module leads via terminal blocks or with insulated wing nut vibration proof spring connectors. Termination of spare conductors in junction boxes is to be made with insulated spring connectors. All insulated wire connectors are to be held in place with three half laps of electrical vinyl tape. Upon completion of connection, all conductors are to be neatly bundled together and secured with four laps of electrical vinyl tape.
 - .3 Signal heads are to be bonded according to 26 05 28 and the Canadian Electrical Code using the designated bonding conductor in the cable, connected securely to the signal head and the pole ground stud or the system ground wire in PVC junction boxes.
 - .4 Cables are to be identified at all access points and labeled as specified in the Contract Documents. Cables are to be identified using tags with permanent waterproof markings.
- .4 Aerial Mounted Equipment:
- .1 Install aerial mounted equipment using all fitting, hardware, PVC junction boxes, and accessories necessary for the mounting of equipment on aerial messenger cable systems. All compression nuts, lock nuts, and fitting hardware are to be securely tightened to prevent shifting of equipment by wind.

3.3 TRAFFIC CONTROL DEVICES

- .1 Flasher Beacons
 - .1 Flasher beacons for post top mounting are to be aligned facing the direction of approaching traffic.

3.4 CONTROLLERS

- .1 Pole Mounted Controller Cabinets
 - .1 Install pole mounted control cabinets complete with mounting brackets, hardware and stainless steel strapping. Pole mounted conduits and fittings and are to be located and oriented as specified in the Contract Documents.
- .2 Equipment Bonding
 - .1 Equipment bonding to be according to Section 26 05 28 and Canadian Electrical Code.
- .3 Shelf-Mounted and Rack Mounted Controller Equipment
 - .1 Shelf-mounted and rack-mounted controller equipment are to be neatly and suitably arranged on the shelves or racks so that all preformed wiring harnesses are of adequate length to allow connections and may be trained to out-of-the-way locations. Similar items of equipment are to be grouped together. All equipment is to be installed with the front facing outward so that the main operational controls and switches are readily accessible.
- .4 Cabinet-Wall Mounted Controller Equipment

- .1 Cabinet-wall mounted equipment is to be installed level and clear of nearby components. The equipment is to be bolted in place with minimum 5 mm diameter stainless steel machine bolts, nuts, and lock washers.
- .5 Identification of Equipment
 - .1 All equipment is to be identified with permanent markings.
- .6 Security
 - .1 Lock controller cabinets at all times, except when work is being performed on the controller cabinet equipment. Upon completion of the work, all keys to the controller cabinet are to be given to the Departmental Representative.
- .7 Traffic Signal Control Programming and Timing
 - .1 All controller and conflict monitor programming is to be installed and all timing controls, switches, and programming controls to be set.
 - .2 The Departmental Representative is to provide the traffic signal interval timing to the Contractor. The Contractor is to install the traffic signal timing into the traffic signal controller. The Contractor is to verify that the traffic signal timing is consistent and complete prior to installing it.

3.5 ACTIVATION DEVICES

- .1 Video Detectors
 - .1 Install video detectors at locations and mounting heights specified in the Contract Documents. Video detectors are to be oriented and configured for operation according to the manufacturer's specifications and the Contract Documents.
 - .2 All cabling and equipment required to transmit, receive, and process video and video detection signals are to be installed according to the manufacturer's specifications and the Contract Documents.

3.6 UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

- .1 Uninterruptible power supply equipment is to be installed and adjusted according to the manufacturer's instruction and the Contract Documents.

3.7 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installation is to be the same as for permanent installations of the same type of work, except the work is to include the removal of the installations when they are no longer required.

3.8 SIGNAL TIMING SHEET
GENERIC SIGNAL TIMING SHEET

ACTUATED PRE-TIMED SIGNAL TO BE MAINTAINED BY: Contractor

LOCATION: Des Allumettes Bridge SIGNAL TO BE OPERATED BY: Contractor

MAINSTRE ET (HWY): Hwy 148 TIMING DEVELOPED BY: Delcan

DATE TIMING DEVELOPED : .Aug 8, 2013

GENERIC TIMING IDENTIFIED HERE WILL BE TRANSCRIBED ONTO "OFFICIAL" TIMING SHEETS FOR THE TRAFFIC SIGNAL CONTROLLER BEING USED AT THIS SIGNALIZED INTERSECTION. A COPY OF THE "OFFICIAL" LOCAL TIMING SHEETS AND COORDINATION SHEETS IF USED, ARE TO BE ATTACHED TO THIS FORM.

OPERATIONAL NOTES:

- 1 Phase 2 is Eastbound, Phase 4 is Westbound

FUNCTION/OPERATION	MOVEMENT (FAZE)						
		EB THRU		WB THRU			
PERMITTED MOVEMENTS		2		4			
RED LOCK							
AMBER LOCK							
VEHICLE RECALL							
PEDESTRIAN RECALL							
VEHICLE MAX RECALL							
OVERLAP A							
OVERLAP B							
PROT/PERM LEFT TURN ARROW							
PROT/PERM FAST FLASH ADVANCE GREEN							
FULLY PROTECTED LEFT TURN							
DISPLAY AMBER ON STARTUP		Y					
PLACE PED CALLS ON STARTUP							

2ND EMERG. PRE-EMPT CLEARANCE TIME								
RR PRE-EMPT TRACK CLEARANCE MOVEMENTS								
RR PRE-EMPT CLEARANCE TIME								
RR PRE-EMPT DELAY TIME								
RR PRE-EMPT LIMITED SERVICE MOVEMENTS								

TIME OF DAY OPERATIONS	TIME OF DAY		DAY OF WEEK							MOVEMENT (FAZE)								
	START	END	S	M	T	W	T	F	S	WB LEFT	EB THRU	NB LEFT	SB THRU	EB LEFT	WB THRU	SB LEFT	NB THRU	
PHASE OMIT																		
MAX RECALL																		
PED RECALL																		
MIN RECALL																		
MAX GREEN 2																		
REST IN WALK																		
AMBER LOCK																		
RED LOCK																		

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 21 Wires and Cables (0-1000 v)
- .2 Section 26 05 28 Grounding Secondary
- .3 Section 26 05 34 Conduits, Conduit Fastening and Conduit Fittings
- .4 Section 26 56 20 Traffic Signal Equipment and Electrical Traffic Control Devices

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 C22.1-06, Canadian Electrical Code
 - .2 C22.2 No. 94-M91 (R2001), Special Purpose Enclosures
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 TS 2-2003, Traffic Controller Assemblies with NTCIP Requirements
- .3 Electrical Safety Authority
 - .1 Canadian Electrical Safety Code

1.3 DEFINITIONS

- .1 CSA Enclosure Type 3: An enclosure for either indoor or outdoor use, constructed so as to provide a degree of protection against rain, snow, and windblown dust, undamaged by the external formation of ice on the enclosure.
- .2 UPS: Uninterruptible Power Supply.
- .3 AGM VRLA Battery: A sealed battery using Absorbed Glass Mat & Valve Regulated Lead Acid technology.
- .4 Gel Cell Battery: A sealed battery that contains acid in a gel form so it does not leak.

1.4 QUALITY CONTROL

- .1 General:
 - .1 Inspect the traffic signal controller(s), UPS system(s), and other components prior to installation to ensure that they are according to the Contract Documents.
 - .2 Notify the Departmental Representative of the time and location of all testing 3 Working Days prior to the start of each test.
 - .3 Inspect and test the work to ensure that it is in accordance with the requirements of the contract, 3 Working Days prior to the actual “switch on” of the signals. In particular, and without limiting the foregoing, ensure that all components are installed, tested and proven as indicated in the Contract Documents; that all systems are energized and in working order and that the signal timing is consistent and complete, without activating the traffic signals for public display.

- .4 The inspection, testing, and test results are to be witnessed by the Quality Verification Engineer. The Quality Verification Engineer is to issue a Certificate of Conformance that the work has been inspected and tested, and that the material and installation are in General Conformance with the requirements of the contract. The Certificate of Conformance is to be submitted to the Departmental Representative prior to the signals being switched on for operation.
- .2 Testing of UPS System
 - .1 Activate the UPS system according to the manufacturer's recommendations. The Contractor is responsible for all testing and documentation required to establish acceptance of the installation and operation of material supplied.
- .3 Pre-installation Testing and Inspection
 - .1 Prior to the installation of the UPS system, the UPS system is to be tested and inspected to verify that it performs according to the manufacturer's specifications and the Contract Documents. In particular, and without limiting the foregoing, the UPS system is to be operated and tested to verify the following:
 - .1 Transfer time in case of power failure is less than 60 milliseconds.
 - .2 Voltage regulation at 120 VAC is ± 3 percent.
 - .3 Frequency regulation at 60 Hz is ± 3 Hz.
 - .4 Thermostat controlled battery heating mats operate according to the manufacturer's specifications.
 - .5 When powered by the batteries alone, the UPS system provides full signal operation at full load for a minimum of 4 hours, and then switches over to flashing operation and provides flashing operation for a further 6 hours.
- .4 Proof of Performance Testing and Inspection
 - .1 The UPS system is to be tested and inspected to verify that it performs according to the manufacturer's specifications and the Contract Documents. The Proof of Performance testing and inspection to include all testing and inspection identified under Pre-installation Testing and Inspection. In particular, and without limiting the foregoing, ensure that all components are installed, tested and proven as indicated in the contract Documents. In addition, perform visual inspection on the installed UPS system and perform all tests on grounding of equipment according to Section 26 05 28.
 - .2 The inspection, testing and test results are to be witnessed by the Quality Verification Engineer. The Quality Verification Engineer is to issue a Certificate of Conformance that the work has been inspected and tested, and that the material and installation are in General Conformance with the requirements of the contract.

1.5 QUALITY ASSURANCE

- .1 The testing of the traffic signal controller and UPS system performed by the Contractor to be witnessed by the Departmental Representative and Quality Verification Engineer. The Departmental Representative to also be in attendance during the "turn-on" of the traffic signal.

Part 2 Products

2.1 GENERAL

- .1 The UPS system is to provide uninterruptible power and conditioning of the utility power required for the operation of all electronic equipment used to operate the traffic control signals in the event of main utility power supply failure or voltage or frequency fluctuations.
- .2 The UPS system to be supplied complete with UPS automatic switch.
- .3 The UPS control unit is to be a line interactive or double conversion type with automatic voltage regulation for 120V, 60Hz, single phase.
- .4 The UPS system to include all wiring necessary to interconnect the UPS control unit to the power source and to the traffic signal control components.
- .5 The UPS control unit must latch from line to battery and from battery to line (transfer time) in less than 60 milliseconds.
- .6 When installed at a traffic signal using LED signal lamps, the UPS system to be capable of maintaining full signal display operation for a minimum of 4 hours after which it to be capable of maintaining a flashing signal display for a further 6 hours minimum.
- .7 Switching from full operation to a flashing operation may be determined by a timer circuit or based on battery capacity.
- .8 If the UPS control unit or the batteries fail, the system to automatically switch back to utility line power.
- .9 The UPS cabinet to be supplied complete with pole mounting hardware as indicated in the Contract Documents.
- .10 The battery installation and wiring to the batteries to be according to the Canadian Electrical Code.
- .11 The UPS system components to operate properly for the time periods specified above under the following conditions:
 - .1 Ambient temperature -37°C to $+74^{\circ}\text{C}$
 - .2 Humidity: 5 percent to 95 percent
 - .3 The UPS system components to withstand shock and vibration according to NEMA TS 2-2003

2.2 UPS CABINET

- .1 The UPS cabinet to be a CSA-Type 3 cabinet constructed of aluminum and is to be painted grey. The cabinet to be fabricated using sheet aluminum 3.17 mm thick and adequately reinforced by welded aluminum members.
- .2 The dimensions and details of the UPS cabinet to be according to the Contract Documents.
- .3 The cabinet to have one door hinged on one side with a continuous stainless steel piano hinge.

- .4 The door to use a latch and lock mechanism. The door handle to be zinc coated and painted the same colour as the cabinet.
- .5 The opening in the UPS cabinet to allow full access to UPS components housed in the cabinet.
- .6 The cabinet to be vented according to the Canadian Electrical Code.
- .7 The cabinet is to be approved by the Electrical Safety Authority or by a certification organization accredited by the Standards Council of Canada.
- .8 The circuit providing power to the battery heating mats to be thermostat controlled and the thermostat is to be located in the UPS cabinet.

2.3 BATTERIES

- .1 Batteries to be AGM VRLA or Gel Cell technology.
- .2 Battery leads to UPS control unit to be of suitable length and not less than 2.5 metres.
- .3 Each battery to be placed on its own heater mat with all heater mats being supplied with AC power by the UPS control unit.
- .4 Battery mats to become inoperable with loss of line voltage.
- .5 The batteries to be protected by a circuit breaker or a fuse.
- .6 Each battery to be labeled with the date of manufacture. The label to be at a visible location on the top of the battery.

2.4 UPS CONTROL UNIT

- .1 The UPS control unit to be rack mountable with the following maximum dimensions: Width of 483 mm (19 inch), depth of 254 mm (10 inch), and height of 153 mm (6 inches) for an M-170, 332 cabinet. Make all necessary modifications should a NEMA cabinet be used.
- .2 The front face of the control unit to have indicators capable of displaying the following:
 - .1 Number of times the system was on battery supply
 - .2 Total time on battery supply
 - .3 Battery charge status to indicate the battery capacity
- .3 Each of the battery supply indicators listed above to have a manual reset switch.
- .4 The UPS control unit to have a minimum of one standard 120V grounded socket located on either the back or the front panel.
- .5 The UPS control unit to contain over-current protection located on the front panel to switch power On/Off from the batteries and to switch AC input and output power On/Off.
- .6 The UPS control unit to have a self-test feature to test the UPS Automatic Switch and the control circuitry.
- .7 The UPS control unit to have an open collector output or and AC or DC contact closure to indicate when the traffic signal is operating on a battery supply.

- .8 The UPS control unit to have an open collector output or an AC or DC contact closure to indicate low battery alarm.
- .9 The UPS control unit to have a minimum of 1 switched AC output that is to switch on when the traffic signal has been on battery supply continuously for 4 hours.
- .10 A 9 pin male serial port to be located on the front panel to allow for communication to a laptop computer for changing software setting.
- .11 A set of battery voltage test points, or a readout indicating battery voltage condition to be located on the front panel.

2.5 UPS AUTOMATIC SWITCH

- .1 The UPS automatic switch to allow the UPS control unit to be removed for replacement or maintenance without turning off the traffic signal system.
- .2 The utility line power to be connected to the input of the automatic switch. Under normal operating conditions the automatic switch to connect the utility line power to the UPS control unit. In the event that the UPS control unit is not present or does not function, the automatic switch to automatically connect the utility line power directly to the traffic signal system, bypassing the UPS control unit.

2.6 POWER CONDITIONING AND THE USE OF BATTERIES BY THE UPS

- .1 Under normal operating conditions the utility line power to flow through the UPS control unit to the traffic signal system and any other connected loads.
- .2 When the utility line power is within the operating parameters specified by the UPS manufacturer and the Contract Documents the UPS control unit to condition and deliver the power to the loads without drawing power from the batteries.
- .3 When the utility line power is not within the operating parameters specified by the UPS manufacturer and the Contract Documents the UPS control unit to condition and deliver the power to the loads without drawing power from the batteries as required.

2.7 ELECTRICAL

- .1 The UPS system to accept an AC voltage input range of 85 to 135 VAC, single phase, 2 wire plus ground without drawing on battery power.
- .2 The UPS system to provide voltage regulation at 120 VAC ± 3 percent under any line, load or battery conditions other than "low battery", and a frequency regulation of 60 Hz \pm 3Hz synchronized to the utility line power.
- .3 Power rating to be a minimum of 1000 VA (700W). The UPS system to provide pure sine wave output, computer grade power compatible with all equipment loads, with power factor correction.
- .4 The UPS system to include full time protection from sudden voltage increase with inrush protection and AC line filtering.
- .5 The UPS system to provide complete isolation from the line operating as a separately derived power source in accordance with section 10-Grounding and bonding, CSA C22.1.
- .6 The forced flash relay to be 10 Amp, 60 Hz, Double Pole Double Throw (DPDT) relay.

- .7 The heating fan breaker to be 15 Amp breaker mounted on the service panel.

2.8 PRODUCTION

- .1 All wires and leads are to be tied and secured within the UPS cabinet prior to delivery.

Part 3 Execution

3.1 CONTROLLER SUPPLIED BY THE CONTRACTOR

- .1 All temporary traffic signal controllers to be equipped with an uninterruptible power supply system.

3.2 POLE MOUNTED UPS CABINET

- .1 Install the pole mounted UPS cabinet, including batteries and heating pads, complete with all mounting brackets, hardware, stainless steel strapping and pole mounting conduits and fittings. The edges of the cabinet are not to protrude over a sidewalk or roadway pavement. The cabinet not to obstruct access to the pole handhole and pedestrian pushbuttons. The UPS control unit and the UPS automatic switch to be installed in the signal controller cabinet according to the Contract Documents. A 10 Amp DPDT 60 Hz relay to be installed in the traffic signal controller cabinet to allow flash operation when initiated by the UPS control unit. All wiring to be according to the Contract Documents.

3.3 UPS AUTOMATIC SWITCH, FORCED FLASH RELAY AND HEATER/FAN BREAKER

- .1 Install the UPS automatic switch, forced flash relay, heater/fan breaker and terminal block in the signal controller cabinet according to the Contract Documents.

3.4 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installation is to be the same as for permanent installations of the same type of work, except the work is to include the removal of the installations when they are no longer required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 21 Wires and Cables (0-1000V)
- .2 Section 26 56 20 Traffic Signal Equipment and Electrical Traffic Control Devices
- .3 Section 26 56 20.01 Uninterrupted Power Supply (UPS) System

1.2 REFERENCES

- .1 CSA Standards
 - .1 C22.2 No. 0.4-04, Bonding of Electrical Equipment
 - .2 C22.2 No. 45 - M1981 (R1999), Rigid Metal Conduit
 - .3 C22.2 No. 65-03, Wire Connectors (Tri-National standard, with UL 486A-486B and NMX J 543 ANCE 03)
 - .4 C22.2 No. 127-99 (R2004), Equipment and Lead Wires
 - .5 C22.2 No. 197-M1983 (R2003), PVC Insulating Tape
 - .6 C22.2 No. 211.2-M1984 (R2003), Rigid PVC, Unplasticized Conduit
 - .7 CAN3-S157-M83 (R2002), Strength Design in Aluminum
- .2 Others
 - .1 Canadian Electrical Safety Code

1.3 DEFINITIONS

- .1 Load Switch means device used to switch 120-volt power to the traffic control signal heads. Load switches are normally semi-conductor devices which are switched by low voltage signal from the controller unit.
- .2 Quality Verification Engineer (QVE) means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents.

1.4 QUALITY CONTROL

- .1 Pre-installation Testing and Inspection:
 - .1 Camera equipment, cables, brackets, interface card or panel, and connection components are to be tested and inspected prior to installation to ensure they conform to the general requirements of the Contract Documents.
- .2 Proof of Performance Testing and Inspection:
 - .1 Inspect and test the work to ensure it is in accordance with the requirements of the Contract. Ensure that all components are installed, tested and proven as indicated in the Contract Documents and that all cables are energized and in working order prior to or at the time of the traffic signals turn on. The inspection, testing, and test results to be witnessed by a QVE. The QVE is to certify that the work has been inspected and tested, and that the material and installation are in general conformance with the requirements of the Contract Documents.

1.5 QUALITY ASSURANCE

- .1 The Departmental Representative may provide direction for the aiming of the vehicle video cameras. At any time, the Departmental Representative may test-drive the controlled traffic lanes and notify the Contractor of any adjustments required.

Part 2 Products

2.1 VIDEO CAMERA COMPLETE SYSTEM

2.2 TYPE II CMOS (LOOP EMULATOR) CAMERA

- .1 The Type II CMOS (loop emulator) grey image camera is not to have real time monitoring by a central control monitoring system.

2.3 COMMUNICATION SOFTWARE

- .1 Communication software to be able to communicate locally to the loop emulator camera system.

2.4 VIDEO SETUP EQUIPMENT

- .1 Video setup equipment for the loop emulator camera to be according to the manufacturer's specifications.

2.5 VIDEO CONNECTING CABLE

- .1 All cable is to have no splices and to be according to the video camera manufacturer's specifications, and other relevant specifications referred to in this Special Provision that may apply.

2.6 CAMERA MOUNTING BRACKET

- .1 The camera mounting bracket to be according to the video camera manufacturer's specifications.
- .2 All mounting hardware to be treated with an anti-seize compound.

2.7 VIDEO CAMERA TRAFFIC CONTROL EQUIPMENT CABINET INPUT FILE INTERFACE UNIT

- .1 Video camera traffic control equipment input file interface unit to be according to the video camera manufacturer's specifications.

2.8 TRAFFIC CONTROL CABINET VIDEO I/O WIRING HARNESS OR CABLE

- .1 All necessary video cabinet wiring harness or cable to be according to the video camera manufacturer's specifications.

2.9 VIDEO SETUP COMMUNICATION CABLE

- .1 Video setup communication cable to be according to the video camera manufacturer's specifications.

2.10 APPROVED SUPPLIERS FOR VEHICLE DETECTION SYSTEM

- .1 The vehicle video detection system to be selected from the MTO and MTQ approved materials for video detectors.

2.11 VIDEO EQUIPMENT SUPPLIED BY THE CONTRACTOR

- .1 Supply and install the video detection equipment at locations shown on the Contract Drawings.
- .2 Used video detection equipment may be used for a temporary installation provided that it is in good condition and it conforms with the requirements of the Contract Documents.

Part 3 Execution

3.1 GENERAL

- .1 Install all components of the video detection equipment according to the manufacturer's specifications and according to the Contract Documents. Electrical work to be according to the Contract Documents.

3.2 CAMERA MOUNTING BRACKET

- .1 Install the camera mounting bracket, hardware, PVC junction boxes, and accessories necessary for mounting of the bracket on a traffic signal pole. All compression nuts, locknuts and fitting hardware are to be securely tightened to prevent shifting of equipment by natural elements (i.e. wind, rain, ice or snow, etc.).

3.3 VIDEO CAMERA

- .1 Install video camera facing the direction of approaching traffic and angled downwards, to reduce interference from the sun. The video camera is to be placed to avoid occlusion problems.
- .2 Adjust video camera for focus prior to final tightening or sealing of hardware.
- .3 The video camera to be installed in accordance with the manufacturer's specifications. The video camera is to be adjusted to focus along the designated roadways or traffic lanes.

3.4 VIDEO CONNECTING CABLE

- .1 Install the cable between the video camera and the traffic signal control cabinet. The cable to run continuous with no splices.
- .2 Drip loops to be left on all external cable. Cable is to be protected with rigid PVC conduit where slack lengths of more than 450 mm are externally exposed. Aerial cable from the PVC junction box to the signal head to be according to Section 26 05 21 Wires and Cables (0-1000V).
- .3 Connect cables to the video camera according to the manufacturer's specifications. Termination of spare conductors and junction box connections to be made with insulated spring connectors. All insulated spring connectors to be held in place with three half laps of electrical vinyl tape. Upon completion of connections, all conductors are to be neatly bundled together and secured with four wraps of electrical vinyl tape.

- .4 Metal video camera covers to be grounded in accordance with the requirements of Section 26 05 28 by use of the designated spare green conductor, connected securely to the ground terminal in the traffic signal pole and either the pole ground stud or the system ground wire in PVC junction boxes.

3.5 POLE MOUNTED CONDUIT SYSTEMS

- .1 Install the video cameras on minimum 10.5 m wood poles. Install pole mounted conduit systems including rigid PVC junction boxes and all necessary fittings and hardware. Conduit to be installed in straight lengths to follow the taper of the pole using stainless steel strapping or galvanized lag screws at 1.5 m maximum spacing. Offset bends are to be used where required to avoid pole attachments and conduits are to be kept free of kinks and scorch marks.

3.6 VIDEO CAMERA INPUT FILE INTERFACE CARD OR PANEL

- .1 Install the video camera input file interface card or panel unit according to the manufacturer's recommendations.

3.7 TRAFFIC CONTROL CABINET VIDEO I/O WIRING HARNESS OR CABLE

- .1 Install the traffic control cabinet video I/O wiring harness or cable according to the manufacturer's recommendations.

3.8 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installations to be the same as for permanent installations of the same type of work, except the work is to include the removal of the installations when they are no longer required.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 56 20 Traffic Signal Equipment on Electrical Traffic Control Devices

1.2 REFERENCES

- .1 CSA Approved
 - .1 IEC 61215 Photovoltaic Modules
 - .2 ITE VTCSH CHAP.2 Traffic Signal Housing
 - .3 IEC 60529 IP67 Enclosures

1.3 QUALITY ASSURANCE

- .1 The product must be FCC certified to comply with all 47 CFR FCC Part 15 Subpart B Emission requirements.
- .2 The system, including battery pack, solar panel, LED module and all components, is to be guaranteed for a minimum of three years.
- .3 Manufacturer must be ISO 9001 certified.

Part 2 Products

2.1 SOLAR ENGINE

- .1 The solar engine is to be constructed from powder coated aluminum, and is to be no greater in size than 121 mm x 381 mm x 381 mm. The solar panel is to be integrated to the solar engine. All batteries and electronics to be mounted in the solar engine, with no external control cabinet or battery cabinet required. The solar engine is to be vented to provide cooling of the battery and electronic system. Venting is to be covered by wire mesh to prevent intrusion of insects.
- .2 The solar engine is to have the provision to mount an external device for remote activation. System must have capability to power such device. Solar engine must contain sufficient space to house third party device inside a sealed enclosure located inside the solar engine.
- .3 The overall weight of the assembly, including mounting hardware, signal housing, LED module and solar engine is not exceed 19.5 kg.
- .4 The entire system must be delivered as a complete unit ready to install and requiring no assembly.
- .5 Top of solar engine must be completely flat to the ground such that mounting in any orientation will keep the solar engine level.

2.2 SOLAR/BATTERY SYSTEM

- .1 The solar engine to include one 10-watt solar panel no larger than the footprint of the housing. The solar engine is to house a single, field replaceable, sealed, lead, acid battery

no greater than 24 Ah. Solar panel and battery system is to be 12 Volt DC. When mounted, the solar panel is not to be visible from ground level.

- .2 The solar panel is to meet the design qualification and type approval of photovoltaic modules in accordance with IEC 61215. This specification includes radiation testing, thermal testing and mechanical testing for environmental conditions such as UV-exposure, thermal cycling, as well as degradation of maximum power output.
- .3 The solar panel to consist of one single solar panel, mounted to the solar engine with an aluminum flashing.
- .4 Battery is to be mechanically secured into the housing. Battery bracket to enclose the battery in a manner to restrict the thermal expansion of the battery.
- .5 System to have an auxiliary 12 VDC power output to power third party devices, such as wireless radio or sensing equipment.

2.3 SIGNAL HOUSING

- .1 The signal housing to meet the equipment standard of the Institute of Transportation Engineers (ITE) Vehicle Traffic Control Signal Heads (VTCSH) Chapter 2 and to be a 300 mm diameter amber LED head.
- .2 The signal head to be mounted directly below the solar engine. The solar engine is not overhang the signal head, so as not to restrict mounting a signal head back plate. The signal head is to be easily removable from the assembly. The bracket assembly is to be constructed such that the signal head can be removed easily in the field without removing the solar engine. The bracket assembly is to be designed to take the torsion and bending load of the solar engine. The signal head is not to be subjected to the torsional or bending load of the solar engine.
- .3 The signal housing must be able to rotate independent from the bracket for lens alignment.

2.4 LED SIGNAL MODULE

- .1 The LED signal module is to conform to the mandatory specifications of: ITE Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) 2005.

2.5 OPERATIONAL SPECIFICATIONS

- .1 The system is to conform to all standards for flashing beacons as required in the Manual of Uniform Traffic Control Devices 2003 Edition Revision 1 or current version.
- .2 The beacon is to flash at a rate of not less than 50 or more than 60 times per minute. The illuminated period of each flash is not to be less than one-half and not more than two-thirds of the total cycle.
- .3 The beacon is to have a night dimming feature. The beacon is to have a minimum operating autonomy of 30 days at 24 hours per day. The beacon is to automatically reduce light output in case of low battery situations, reducing risk that the beacons will fail entirely under conditions of poor solar insulation.

2.6 ENVIRONMENTAL SPECIFICATIONS

- .1 The system is to be able to withstand and operate at temperature extremes of -40 deg C to +50 deg C.
- .2 The system is to be designed and constructed to withstand 178 km/h wind loads in conformance with the requirements of the AASHTO publication "Standard Specifications for Structural Supports of Highway Signs, Luminaires and Traffic Signals", 4th Edition 2001.
- .3 The electronic circuit board housing, wire harnessing and connectors are to be designed and tested in accordance to IEC International Standard 60529, Ingress Protection IP67 requiring that the enclosure be dust tight and remain completely sealed when immersed in water to a depth of one metre for one hour.
- .4 The LED Module is to meet the following environmental tests as specified in the ITE Vehicle Traffic Control Signal Heads, Light Emitting Diode (LED) Circular Signal Supplement:
 - .1 Mechanical vibration MIL-STD-883
 - .2 Temperature cycling: MIL-STD-883
 - .3 Moisture resistance: MIL-STD-810F
- .5 Each unit to consist of a self-contained solar engine, LED signal module and signal housing, and mounting hardware such that the entire assembly mounts to the top of the pole. The solar engine is to contain all electronic, batteries and solar panels. No additional cabinet is required. The system is to conform to all provisions of the OTM Book 12, Flashing Beacons.

Part 3 Execution

3.1 MOUNTING

- .1 The entire assembly, including solar engine, signal housing and LED module, and bracket is to be provided with hardware for mounting on to the top of 50 mm square perforated tubing. The entire assembly is to mount at one point. Separate mounting for the signal head or any other component is not required.
- .2 Lag a 750 mm section of 50 mm square perforated tubing to the 150 mm x 150 mm wood sign post extending 150 mm above the top of the post for the installation of the flashing beacon assembly.
- .3 Attach appropriate sign on wood sign post with galvanized lag bolts below flashing beacon assembly, sign mounting height as per OTM Book 12.
- .4 Install solar powered LED flashing beacon at the location shown on the Contract Drawings.

3.2 ACTIVATION

- .1 The beacon is to operate continuously when the battery is connected. The beacons is to have the option to be turned on by a third party switch or third party device with a compatible contact closure output.

3.3 TEMPORARY ELECTRICAL WORK

- .1 The work for temporary electrical installations is to be the same as for permanent installations of the same type of work, except the work is to include the removal of the installations when they are no longer required.

END OF SECTION