

TENDER DOCUMENTS

SUBSECTION 6.51 CONDUIT, JUNCTION BOXES AND PULL BOXES

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SUBSECTION 6.51 CONDUIT, JUNCTION BOXES AND PULL BOXES

6.51.1 GENERAL

- 6.51.1.1 This subsection sets out the requirements relating to the supply and installation of conduit, junction boxes and pull boxes covered by this Contract.
- 6.51.1.2 Any specific requirements pertaining to the supply and installation of conduit, junction boxes and pull boxes covered by this Contract are indicated on the drawings and in Section 4 *Special Technical Conditions*.
- 6.51.1.3 The requirements relating to the supply and installation of wiring are described in subsection 6.52 *Electrical Cables*.
- 6.51.1.4 The electrical conduit include, without being limited to, all elbows, fittings, rigid and flexible conduit, the dugouts and accessories, including all required “standard” expansion joints and all elements required for the installation of the conduit.

6.51.2 MEASUREMENT UNITS

- 6.51.2.1 The measurement units and respective symbols thereof used in this subsection are described as follows:

Measurement Unit	Designation	Symbol
length	meter	m
length	millimeter	mm
angle plan	degree	°
force	kilonewton	kN
temperature	Celsius degree	°C

6.51.3 REFERENCE STANDARDS

- 6.51.3.1 The **Contractor** shall perform all work related to the supply and installation of conduit, junction boxes and pull boxes in accordance with the requirements of the following standards and documents, to which the provisions of this Contract are added:

6.51.3.1.1 (ACNOR(CSA)) Canadian Standards Association:

- CAN/CSA-C22.1 No. 0 *Canadian Electrical Code, Part One, safety standard for electrical installations;*
- CAN/CSA-C22.2 No. 0 *General Requirements – Canadian Code of Conduct electricity, Part Two.*

6.51.3.1.2 CAN/CSA-C22.2 No. 14 Industrial control equipment:

- CAN/CSA-C22.2 No. 18.1 *Metallic outlet boxes (trinational standard with ANCE NMX-J-023/1 and UL 514A);*
- CAN/CSA C22.2 No. 18.2 *Nonmetallic Outlet Boxes;*
- CAN/CSA-C22.2 No. 18.3 *Conduit, tubing and cable fittings (trinational standard with ANCE NMX-J-023/1 and UL 514B);*
- CAN/CSA-C22.2 No. 18.4 *Hardware for the support of conduit, tubing and cable (binational standard with UL 2239);*
- CAN/CSA-C22.2 No. 18.5 *Positioning devices (binational standard with UL 1565);*
- *CAN/CSA C22.2 No. 40 Circuit Breaker, Junction and Pull Boxes;*
- CAN/CSA C22.2 No. 45.1 *Steel rigid metal conduits for electrical conduits (trinational standard with UL-6 and ANCE NMX-J-534-2007);*
- *C22.2 No. 45.2 Electrical rigid metal conduit – Aluminium, red brass and stainless steel (trinational standard with UL-6A and ANCE NMX-J-576);*
- *C22.2 No. 56 Flexible metal conduit and liquid-tight flexible metal conduit;*
- CAN/CSA-C22.2 No. 76 *Splitters;*
- CAN/CSA-C22.2 No. 85 *Rigid PVC Boxes Fitting;*
- CAN/CSA C22.2 No. 211.0 *General Requirements and Methods of Testing for Nonmetallic Conduit;*
- CAN/CSA C22.2 No. 211.1 *Rigid Types EB1 and DB2/ES2 PVC Conduit;*
- CAN/CSA C22.2 No. 211.2 *Rigid PVC (Unplasticized) Conduit;*
- CAN/CSA C22.10 *Code de construction du Québec, Chapitre V - Électricité - Code canadien de l'électricité, première partie et modifications du Québec;*
- CAN/CSA-G164-M *Hot Dip Galvanizing of Irregularly Shaped Articles.*

6.51.3.1.3 (ANSI/SCTE) Society of Cable Telecommunications Engineers ANSI/SCTE 77:

- *ANSI/SCTE 77 Specification for Underground Enclosure Integrity.*

6.51.3.1.4 (ASTM) ASTM International:

- *ASTM A480/A480M-08b Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip;*
- *ASTM B177 Standard Guide for Engineering Chromium Electroplating;*
- *ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity;*

- ASTM D2564-12 *Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems*;
- ASTM F656 *Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings*.

6.51.3.1.5 (MTQ) Ministère des Transports du Québec:

- MTQ – *Cahier des charges et devis généraux (CCDG)*.

6.51.4 MATERIALS

6.51.4.1 GENERAL

6.51.4.1.1 The conduit, fittings, accessories, junction boxes and pull boxes shall be CSA approved.

6.51.4.1.2 All components shall be new and free of deformations and defects such as cracks.

6.51.4.1.3 All conduit shall be at least 21 mm in diameter.

6.51.4.2 RIGID METAL CONDUIT (RMC)

6.51.4.2.1 Unless otherwise indicated on the drawings, the RMC, the fittings and accessories shall meet the following requirements:

6.51.4.2.1.1 the RMC shall be made of metal and have the same dimensions as those of a standard pipe on which external threads can be made;

6.51.4.2.1.2 the RMC, the fittings and accessories shall be hot dip galvanized and comply with standards CAN/CSA C22.2 N^{os} 45.1 and 45.2 and CAN/CSA C22.2 N^{os} 18.1, 18.2, 18.3, 18.4 and 18.5.

6.51.4.3 PVC-COATED RIGID METAL CONDUIT (PVC- RMC)

6.51.4.3.1 Unless otherwise indicated on the drawings, the polyvinyl chloride- (PVC) coated rigid metal conduit, fittings and accessories shall meet the following requirements:

6.51.4.3.1.1 the PVC-RMC shall be made of metal and have the same dimensions as those of a standard pipe on which external threads can be made;

6.51.4.3.1.2 the PVC-RMC, fittings and accessories shall comply with standard CAN/CSA C22.2 N^o 45.1 and shall be hot dip galvanized after the cutting and threading operations and covered with the following coatings:

6.51.4.3.1.2.1 a coat of urethane of a minimum thickness of 0.05 mm applied to the inner walls and threads of each conduit and hot dip coated with a PVC layer of a minimum thickness of 1 mm at the outer surfaces;

- 6.51.4.3.1.2.2 unless otherwise indicated on the drawings, the colour of the PVC layer shall be similar to that of the structure so that their installation has an appearance that is discrete and indistinct from the structure. The **Contractor** shall have the Engineer approve the colour of the PVC layer.
- 6.51.4.3.1.3 unless otherwise indicated on the drawings, the expansion joints for rigid conduit shall allow a linear expansion ranging from 100 to 300 mm, depending on the needs, as well as the vertical movements of the structure, while ensuring the continuity of the grounding network. In addition, the joints shall be weather-resistant.
- 6.51.4.4 LIQUID-TIGHT FLEXIBLE METAL CONDUIT (LFMC)
- 6.51.4.4.1 The LFMC, fittings and accessories shall comply with standards CAN/CSA C22.2 N° 18.1 and CAN/CSA C22.2 N° 56.
- 6.51.4.4.2 The LFMC shall be manufactured with a flexible galvanized steel or aluminum metal center which shall be covered with a watertight, oil-resistant and UV-resistant outer casing.
- 6.51.4.5 RIGID PVC CONDUIT
- 6.51.4.5.1 The rigid PVC conduit, fittings and accessories shall be Type DB2/ES2 and comply with standard CAN/CSA C22.2 N° 211.1.
- 6.51.4.5.2 The rigid PVC fittings, including the flared tips, the plugs, elbows, reducers and adapters shall comply with standard CAN/CSA C22.2 N° 85. In addition, the fittings shall be opaque, cleaned and solvent welded.
- 6.51.4.5.3 The 22°, 45° and 90° elbows and fittings shall be preformed at the factory.
- 6.51.4.6 SOLVENT CEMENT AND PRIMER FOR PVC CONDUIT AND FITTINGS
- 6.51.4.6.1 The solvent cement used shall comply with standard ASTM D2564-12 and shall be capable of performing resistant and watertight joints.
- 6.51.4.6.2 The primer for PVC conduit and fittings shall comply with standard ASTM F 656 for solvent cementing of PVC conduit.
- 6.51.4.6.3 The IPEX systems solvent cement and primer for PVC conduit shall be labeled and marked in accordance with the standards identified in paragraphs 6.51.4.6.1 and 6.51.4.6.2 and a Material Safety Data Sheet shall be made available to the Engineer and to the personnel that uses or handles these products, according to the applicable Occupational Health and Safety legislation.

6.51.4.7 PULL ROPES

6.51.4.7.1 The pull ropes to be inserted into the conduit shall be made of twisted nylon of a minimum of 6 mm in diameter with a minimum tensile strength of 5 kN.

6.51.4.8 MARKING TAPES AND SIGNS

6.51.4.8.1 The marking tapes shall be CSA approved and designed to be buried, shall be red or yellow, with a minimum width of 150 mm, and bear a bilingual mention to the effect that a power line is buried.

6.51.4.8.2 The marking signs shall consist of aluminum small sign panels, mounted on 63.5 mm X 31.8 mm U-shaped cold rolled Type 2 posts treated by hot dip galvanizing according to standard CAN/CSA-G164-M. The posts shall be fitted with 11.1 mm diameter holes distanced from each other by 50.8 mm.

6.51.4.9 JUNCTION AND PULL BOXES

6.51.4.9.1 The junction and pull boxes shall comply with standards CAN/CSA C22.2 N° 18.1 and CAN/CSA C22.2 N° 0.

6.51.4.9.2 The minimum gauge of the sheet metal used to fabricate the boxes shall be 16 for the door and 14 for the body of the box.

6.51.4.9.3 In addition to the indications on the drawings, the junction and pull boxes shall meet the following requirements, without however being limited thereto:

6.51.4.9.3.1 type 4X boxes shall meet the following requirements:

6.51.4.9.3.1.1 be CSA-approved Type 4X and made of Type 304, 316 or 316L stainless steel, with the exception of the boxes exposed to abrasives or salt spray, which shall be of Type 316 or 316L;

6.51.4.9.3.1.2 be equipped with flat lids held with captive screws or piano hinges combined with screwed latches.

6.51.4.9.3.2 type 12 boxes shall meet the following requirements:

6.51.4.9.3.2.1 be CSA-certified Type 12, made of steel and factory-painted;

6.51.4.9.3.2.2 the minimum gauge of the sheet metal shall be 16 for the door and 14 for the body of the box;

6.51.4.9.3.2.3 be equipped with flat lids held with captive screws or piano hinges combined with screwed latches.

6.51.4.9.3.3 the hot dip galvanized steel boxes shall be covered with the following coatings:

6.51.4.9.3.3.1 a coat of urethane of a minimum thickness of 0.05 mm applied at the inner and outer surfaces of the boxes and hot dip coated with a PVC layer of a minimum thickness of 1 mm at the outer surfaces;

6.51.4.9.3.3.2 the colour of the PVC layer shall be the same as that of the structure.

6.51.4.9.3.4 the polymer concrete pull boxes shall comply with standard ANSI/SCTE 77.

6.51.4.10 IDENTIFICATION TAGS

6.51.4.10.1 The identification tags shall be made of lamicoid engraved plastic and shall meet the following requirements, without however being limited thereto:

6.51.4.10.1.1 have a minimum thickness of 3 mm;

6.51.4.10.1.2 have a black surface and white core;

6.51.4.10.1.3 have a chamfered perimeter;

6.51.4.10.1.4 the text shall be in capital letters, bilingual and use the "Arial" font.

6.51.4.10.2 The rectangular identification tags shall meet the following requirements, without however being limited thereto:

6.51.4.10.2.1 have a self-adhesive backside;

6.51.4.10.2.2 the format of the tags and of the information to engrave shall meet the following requirements:

Format N°	Plate Dimension (mm)	Number of Lines	Height of Letters to Engrave (mm)
1	10 x 50	1	3
2	12 x 70	1	5
3	12 x 70	2	3
4	20 x 90	1	8
5	20 x 90	2	5
6	25 x 100	1	12
7	25 x 100	2	6

6.51.4.11 MOUNTING BRACKETS AND ACCESSORIES

- 6.51.4.11.1 All mounting brackets and accessories shall be made of stainless or galvanized steel.
- 6.51.4.11.2 The galvanized steel mounting brackets and accessories shall be hot dip galvanized and be covered with one of the following coatings, of the same colour as that of the conduit:
 - 6.51.4.11.2.1 A coat of urethane of a minimum thickness of 0.05 mm applied to all surfaces of the mounting brackets and accessories and hot dip coated with a PVC layer of a minimum thickness of 1 mm at the outer surfaces.
- 6.51.4.11.3 All bolts, nuts and washers shall be made of stainless steel, covered with the same type of coating and the same colour as the brackets.

6.51.5 EXECUTION OF WORK

6.51.5.1 PLANNING

- 6.51.5.1.1 At least fourteen (14) days before the installation of the conduit, junction boxes and pull boxes begins, the **Contractor** shall submit to the Engineer, for review, the technical data sheets of the conduit, fittings, accessories and junction and pull boxes.
- 6.51.5.1.2 At least fourteen (14) days before the installation of the conduit, junction boxes and pull boxes begins, the **Contractor** shall submit to the Engineer, for review, the shop drawings of the mounting brackets of the exposed conduit.

6.51.5.2 INSTALLATION OF CONDUIT, FITTINGS AND ACCESSORIES

6.51.5.2.1 General

- 6.51.5.2.1.1 The **Contractor** shall proceed with the installation of the conduit, fittings and accessories as indicated on the drawings and according to the manufacturer's recommendations. In case of conflict between the requirements of the aforementioned documents, the most stringent requirements or specifications that are most favourable to the **Owner** shall prevail.
- 6.51.5.2.1.2 The **Contractor** shall seal the conduit openings with a filling material for conduit 'duct seal' to prevent the passage of drafts, dust and moisture.
- 6.51.5.2.1.3 All conduit shall be fixed at regular intervals with appropriate metal fasteners of a width greater than 4 mm.
- 6.51.5.2.1.4 The exposed conduit shall be fixed to the structure according to the indications on the drawings.

- 6.51.5.2.1.5 The fastening components of the conduit shall be securely fastened to the structural components.
- 6.51.5.2.1.6 The **Contractor** shall install the conduit parallel or perpendicular to the structures and implementation lines.
- 6.51.5.2.1.7 Wherever possible, the conduit shall be concealed, except when installed in electrical and mechanical rooms.
- 6.51.5.2.1.8 The bending joints for rigid conduit shall allow for the non-linear expansion of the conduit at the box inlet and between the conduit. In addition, the bending joints shall ensure the continuity of the grounding network and shall be weather-resistant.
- 6.51.5.2.1.9 The **Contractor** shall install a pull rope in each run of conduit, which will be usable once the work is completed.
- 6.51.5.2.2 Installation of rigid metal conduit
 - 6.51.5.2.2.1 Where required by the geometry of the facility, the rigid metal conduit larger than 19 mm in diameter shall be cold bent.
 - 6.51.5.2.2.1.1 Bending will not be permitted for conduit smaller than 19 mm in diameter.
 - 6.51.5.2.2.1.2 The **Contractor** shall replace, at its expense, the conduit whose diameter has been reduced by more than 1/10 from the original diameter following a crush or deformation.
 - 6.51.5.2.2.2 The threading of the rigid metal conduit performed on site shall be long enough to allow the execution of tight joints.
 - 6.51.5.2.2.3 Where a raceway network is composed of galvanized metal conduit, the **Contractor** shall install, at each end of the expansion sleeves, a collar fitted with a continuous ground, fabricated from the same material as that of the conduit.
- 6.51.5.2.3 Installation of the flexible metal conduit
 - 6.51.5.2.3.1 The curve in the flexible metal conduit shall not exceed the radius of curvature limits recommended by the manufacturer, without however being less than seven (7) times the outer diameter of the conduit.
 - 6.51.5.2.3.2 The installation of flexible metal conduit shall ensure protection against mechanical damage.
 - 6.51.5.2.3.3 The flexible metal conduit shall not be installed so as to be exposed to corrosive liquids or to vapors that could damage them.

6.51.5.2.4 Outdoor installation of above-ground conduit

6.51.5.2.4.1 For outdoor installation of above-ground conduit, the **Contractor** shall, in addition to the indications on the drawings, proceed with the following:

6.51.5.2.4.1.1 use PVC-coated rigid metal conduit;

6.51.5.2.4.1.2 introduce the conduit into the housings through the bottom or the side of the boxes;

6.51.5.2.4.1.3 use a minimum length of 300 mm of liquid-tight flexible metal conduit for the connection to devices that require flexibility, to motors, transformers, instruments and to junctions with boxes.

6.51.5.2.5 Installation of conduit to be buried directly and cast in concrete

6.51.5.2.5.1 For the installation of conduit to be buried directly and cast in concrete, the **Contractor** shall, in addition to the indications on the drawings, proceed with the following:

6.51.5.2.5.1.1 use PVC rigid conduit;

6.51.5.2.5.1.2 excavate a trench over the entire length indicated on the drawings;

6.51.5.2.5.1.3 place a layer of granular material of a minimum thickness of 150 mm and compacted to 95% of the modified Proctor;

6.51.5.2.5.1.4 thoroughly clean the inside of the conduit prior to installation thereof and take the necessary precautions to avoid the insertion of foreign matter;

6.51.5.2.5.1.5 use flared fittings to connect the conduit to the manholes;

6.51.5.2.5.1.6 where required, use adapters to connect non-metallic conduit;

6.51.5.2.5.1.7 use expansion joints where sections of conduit leave the ground;

6.51.5.2.5.1.8 cut, ream and shape the ends of the conduit on site, following the manufacturer's recommendations, so that they are identical to those shaped at the factory;

6.51.5.2.5.1.9 clean all elbows, fittings and extensions with a primer recommended by the manufacturer and glued using a solvent cement;

6.51.5.2.5.1.10 install the conduit to be buried so that they are evenly supported over the entire length of the conduit, according to the slopes and levels indicated on the drawings.

- 6.51.5.2.5.2 In addition to the aforementioned requirements, the **Contractor** shall install the conduit to be cast in concrete according to the following requirements:
- 6.51.5.2.5.2.1 place the conduit as indicated on the drawings and according to the manufacturer's recommendations, using spacers provided for that purpose;
 - 6.51.5.2.5.2.2 use the anchors, brackets and trench jacks needed to hold the conduit in place and prevent them from shifting during concreting. The **Contractor** shall fasten the conduit to the spacers with string or another type of non-metallic bracket;
 - 6.51.5.2.5.2.3 cast the conduit in the concrete, covering them with a 100 mm thick layer;
 - 6.51.5.2.5.2.4 wait until the concrete has reached 50% of the required strength before backfilling.
 - 6.51.5.2.5.3 The conduit to be buried directly shall be surrounded with granular material up to 150 mm above the upper line thereof and compacted to the same degree of compaction as that of the adjacent layers.
 - 6.51.5.2.5.4 The backfilling above the granular material or concrete coating shall be carried out in separate layers, each of a maximum thickness of 300 mm, using a material of the same type, size and compactness as that of each of the adjacent layers.
- 6.51.5.3 SOLVENT CEMENTING AND APPLICATION OF PRIMER FOR PVC CONDUIT AND FITTINGS
- 6.51.5.3.1 Preparation to cementing
 - 6.51.5.3.1.1 When cutting is required, the **Contractor** shall cut the conduit at right angles, remove the burrs with a knife, a file or a reamer and remove the dirt, grease and moisture with a clean dry rag.
 - 6.51.5.3.2 Use of the primer
 - 6.51.5.3.2.1 When the ambient installation temperature is below -26°C, the use of a primer is required.
 - 6.51.5.3.3 Use of the solvent cement:
 - 6.51.5.3.3.1 During the cementing, the **Contractor** shall maintain the conduit and the fitting one inside the other tightly, for a minimum period of thirty (30) seconds, to avoid any dislocation.

6.51.5.3.3.2 The **Contractor** shall wait for the initial set duration before carefully handling the joint, according to the following table:

Temperature Range	Conduit with a Diameter of 35 mm and Less	Conduit with a Diameter of 41 mm and More
Greater than 15°C	2 minutes	5 minutes
From 4°C to 15°C	5 minutes	10 minutes
Less than 4°C	10 minutes	15 minutes

6.51.5.4 INSTALLATION OF PULL ROPES

6.51.5.4.1.1 Upon completion of the work, every new conduit shall be equipped with a single-length pull rope having an excess 3.0 m at each end of the conduit and fastened to the plugs.

6.51.5.5 INSTALLATION OF MARKING TAPES AND SIGNAGE

6.51.5.5.1 The **Contractor** shall install a marking tape over the entire length of the trench and to the depth indicated on the drawings, according to standard CAN/CSA C22.10.

6.51.5.5.2 If the depth is not indicated on the drawings, the tape shall be installed halfway between the finished ground and the top of the conduit or duct banks.

6.51.5.5.3 When installing buried conduit by means of the push-pipe technique, the **Contractor** shall install, in a conspicuous place, adequate marking signage that indicates the location and depth of the underground facility, in accordance with standard CAN/CSA C22.10.

6.51.5.6 INSTALLATION OF JUNCTION AND PULL BOXES

6.51.5.6.1 The junction and pull boxes shall be installed as indicated on the drawings.

6.51.5.6.2 The **Contractor** shall have the positioning of and the method used to fix the junction and pull boxes approved by the Engineer.

6.51.5.6.3 The use of welding to fix the boxes to the structure or to any other component is prohibited.

6.51.5.6.4 Drillings in any steel structure are prohibited.

6.51.5.7 IDENTIFICATION OF CONDUIT

6.51.5.7.1 All conduit shall be identified using a locator colour code based on the nature of the network.

6.51.5.7.2 The locator colour code shall consist of primary colours strips and, as appropriate, complementary colours strips. The primary and complementary colour strips shall comply with the following nomenclature:

Type	Primary Colours	Type	Complementary Colours
Power Supply	Orange	347 V	-
		600 V	Red
Distribution	Yellow	347 V	-
		600 V	Red
		Lighting	Green
		Lane Control Signals and Camera	Brown
		VMS	Black
Communication	Blue	Lane Control Signals and Camera	Brown
		VMS	Black
Free	White	-	-

6.51.5.7.2.1 The colour strips shall be made using plastic tape or paint compatible with the type of materials and coating of the component to identify;

6.51.5.7.2.2 The basic and complementary colour strips shall have respective widths of 25 mm and 20 mm;

6.51.5.7.2.3 The conduit shall be identified with a locator colour code every 30 m and at every point where they cross walls, floors or components of the structure.

6.51.5.8 IDENTIFICATION OF JUNCTION AND PULL BOXES

6.51.5.8.1 Before fabrication of the identification plates, the **Contractor** shall submit to the Engineer, for review, the text to be engraved thereon.

6.51.5.8.2 A rectangular identification tag indicating the function, the network and the voltage characteristics shall be affixed to every junction box and pull box.

6.51.5.8.3 The identification tag shall be installed at the center of the box cover, in the upper portion, and shall be fixed mechanically by means of a minimum of two (2) stainless steel rivets.

6.51.5.8.4 The installation of the tags shall allow for the certification, integrity and seal of boxes to be maintained.

6.51.5.8.5 For high-density polymer concrete pull boxes to be directly buried, the information indicating the network and the voltage characteristics shall be indicated on the box cover by the manufacturer.

6.51.6 QUALITY CONTROL

6.51.6.1 Before the issuance of the Interim Certificate of Completion of the work, the **Contractor** shall ensure that all buried and cast-in-concrete conduit are clear of any foreign matter by running a mandrel through every conduit.

6.51.6.2 If a conduit is blocked, in whole or in part, the **Contractor** shall take the appropriate corrective measures, at its expense.

6.51.6.2.1 The use of liquids to unclog the conduit is prohibited.

END OF SUBSECTION