

# **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 related to the supply and installation of conduit, junction boxes and pull boxes under this Contract.
- 6.51.1.2 Any specific requirements related to the supply and installation of conduit, junction boxes and pull boxes under this Contract are set out in Section 4 *Special Technical Conditions* and on the drawings.
- 6.51.1.3 The requirements related to the supply and installation of wiring are set out in subsection 6.52 *Electrical Cables*.

### 6.51.2 REFERENCE STANDARDS

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

#### 6.51.2.1.1 (ASTM) ASTM International

- ASTM A167-99(2004) *Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip*;
- ASTM A480/A480M-08b *Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip*;
- ASTM B177-01(2006)e1 *Standard Guide for Engineering Chromium Electroplating*;
- ASTM D2247-02 *Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity*

#### 6.51.2.1.2 (CSA) Canadian Standards Association

- CAN/CSA C22.2 No. 0-M91 (R2006) *General Requirements – Canadian Electrical Code, Part II*;
- CAN/CSA C22.2 No. 18.1-04 *Metallic Outlet Boxes (Tri-National standard, with ANCE NMX-J-023/1 and UL 514A)*;
- CAN/CSA C22.2 No. 18.2-06 *Nonmetallic Outlet Boxes*;
- CAN/CSA C22.2 No. 18.3-04 *Conduit, Tubing, and Cable Fittings (Tri-National standard, with ANCE NMX-J-017 and UL 514B)*;

- CAN/CSA C22.2 No. 18.4-04 *Hardware for the Support of Conduit, Tubing, and Cable (Bi-National standard, with UL 2239)*;
- CAN/CSA C22.2 No. 18.5-02 (R2007) *Positioning Devices (Bi-National standard, with UL 1565)*;
- CAN/CSA C22.2 No. 40-M1989 (R2004) *Cutout, Junction and Pull Boxes*;
- CAN/CSA C22.2 No. 45-M1981 (R2008) *Rigid Metal Conduit*;
- CAN/CSA C22.2 No. 76-M89 (R2007) *Splitters*;
- CAN/CSA C22.2 No. 85-M89 (R2006) *Rigid PVC Boxes and Fittings*;
- CAN/CSA C22.2 No. 211.0-03 (R2008) *General Requirements and Methods of Testing for Nonmetallic Conduit*;
- CAN/CSA C22.2 No. 211.1-06 *Rigid Types EB1 and DB2/ES2 PVC Conduit*;
- CAN/CSA C22.2 No. 211.2-06 *Rigid PVC (Unplasticized) Conduit*;
- CAN/CSA C22.10-07 *Québec Construction Code - Chapter V, Electricity - Canadian Electrical Code, Part I (Twentieth Edition) with Québec Amendments*;
- CAN/CSA-G164-M92 (R2003) *Hot Dip Galvanizing of Irregularly Shaped Articles*.

#### 6.51.2.1.3 (MTQ) Ministère des Transports du Québec

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

### 6.51.3 MATERIALS

#### 6.51.3.1 GENERAL

- 6.51.3.1.1 Conduit, fittings, accessories, junction boxes and pull boxes shall be CSA approved.
- 6.51.3.1.2 All steel or PVC components shall be new and shall not be warped, cracked or otherwise flawed.

#### 6.51.3.2 CONDUIT, FITTINGS AND ACCESSORIES

- 6.51.3.2.1 According to the specifications on the drawings and in the *Special Technical Conditions*, conduit, fittings and accessories shall meet the following requirements:

- 6.51.3.2.1.1 all rigid steel conduit, fittings and accessories shall conform to standards CAN/CSA C22.2 No. 45 and CAN/CSA C22.2 No. 18.1, 18.2, 18.3, 18.4 and 18.5, and shall be hot dip galvanized after cutting and threading and overcoated as follows:
- 6.51.3.2.1.1.1 a coat of urethane at least 0.05 mm thick applied to the inside walls and threads of every conduit and a hot dip coating of polyvinyl chloride (PVC) at least 1 mm thick on the outside surfaces;
- 6.51.3.2.1.1.2 a coat of urethane at least 0.05 mm thick applied to the inside and outside surfaces of fittings and accessories and a hot dip coating of polyvinyl chloride (PVC) at least 1 mm thick on the outside surfaces;
- 6.51.3.2.1.1.3 the colour of the PVC coating shall match the colour of the structure.
- 6.51.3.2.1.2 conduit that is to be buried or set in concrete shall be *DB2/ES2* rigid PVC conduit conforming to standard CAN/CSA C22.2 No. 211.1;
- 6.51.3.2.1.3 all rigid PVC fittings, including flared tips, elbows, reducers and adapters, shall conform to standard CAN/CSA C22.2 No. 85; fittings shall also be opaque, clean and solvent welded;
- 6.51.3.2.1.4 all 22°, 45° and 90° elbows and fittings shall be factory perforated;
- 6.51.3.2.1.5 unless otherwise indicated on the drawings, expansion joints in rigid conduit shall permit linear expansion of 100 to 300 mm as needed and vertical movement of the structure without compromising the continuity of the grounding system; further, the joints shall be weather-resistant Thomas & Betts XTRAFLEX or an approved equivalent;
- 6.51.3.2.1.6 bending joints in rigid conduit shall permit non-linear expansion of the conduit at the box inlet and between conduits; further, the joints shall not compromise the continuity of the grounding system and shall be weather-resistant Thomas & Betts XTRAFLEX or an approved equivalent.
- 6.51.3.3 JUNCTION AND PULL BOXES
- 6.51.3.3.1 All junction and pull boxes shall conform to standards CAN/CSA C22.2 No. 18.1, CAN/CSA C22.2 No. 0 and CAN/CSA C22.10 and shall be CSA 4X certified. In addition to the specifications on the drawings and in the *Special Technical Conditions*, junction and pull boxes shall meet the following requirements:
- 6.51.3.3.1.1 hot dip galvanized steel boxes shall be overcoated as follows:
- 6.51.3.3.1.1.1 a coat of urethane at least 0.05 mm thick applied to the inside and outside surfaces of the boxes and a hot dip coating of polyvinyl chloride (PVC) at least 1 mm thick on the outside surfaces;

6.51.3.3.1.1.2 the colour of the PVC coating shall match the colour of the structure, as indicated in the *Special Technical Conditions*.

6.51.3.3.1.2 boxes made of 304 stainless steel shall be 12 gauge, have a type 2B surface finish conforming to standards ASTM A167 and ASTM A480/A480M and be fitted with flat screw-on covers for surface mounting;

6.51.3.3.1.3 the **Contractor** shall apply electrostatically to exposed surfaces a polyester powder coating at least 100 microns thick conforming to standards ASTM D2247 and ASTM B177 the same colour as the colour of the structure on which the boxes are mounted, as indicated in the *Special Technical Conditions*.

#### 6.51.3.4 POSITIONING SUPPORTS AND ACCESSORIES

6.51.3.4.1 All positioning supports and accessories shall be hot dip galvanized steel. Further, according to the specifications on the drawings and in the *Special Technical Conditions*, the positioning supports and accessories shall have one of the following coatings in the same colour as the structure as indicated in the *Special Technical Conditions*:

6.51.3.4.1.1 an electrostatically applied polyester powder coating at least 100 microns thick conforming to standards ASTM D2247 and ASTM B177;

6.51.3.4.1.2 a coat of urethane at least 0.05 mm thick applied to all surfaces of positioning supports and accessories and a hot dip coating of polyvinyl chloride (PVC) at least 1 mm thick on the outside surfaces.

6.51.3.4.2 All bolts, nuts and washers shall be stainless steel and shall have the same overcoating and be the same colour as the supports.

#### 6.51.3.5 PULL CORDS

6.51.3.5.1 The pull cords to be inserted in the conduit shall be 6 mm twisted nylon with tensile strength of 5 kN.

#### 6.51.3.6 WARNING TAPE

6.51.3.6.1 Warning tape shall be yellow 150 mm tape from Brady bearing the words "*Warning. Buried Electrical Line*": "*Attention ligne électrique enfouie*".

## 6.51.4 EXECUTION OF WORK

### 6.51.4.1 PLANNING

6.51.4.1.1 At least fourteen (14) days before installation of conduit, junction boxes and pull boxes begins, the **Contractor** shall submit to the Engineer for review and comment technical data sheets for the conduit, fittings, accessories and junction and pull boxes.

6.51.4.1.2 At least fourteen (14) days before installation of conduit, junction boxes and pull boxes begins, the **Contractor** shall submit to the Engineer for review and comment shop drawings of the positioning supports for exposed conduit.

### 6.51.4.2 INSTALLATION OF CONDUIT, FITTINGS AND ACCESSORIES

#### 6.51.4.2.1 General

6.51.4.2.1.1 Install conduits, fittings and accessories as indicated on the drawings and in the *Special Technical Conditions* and according to the manufacturer's recommendations. In the event of a discrepancy between the requirements of these documents, the requirements or specifications most favourable to the **Owner** shall take precedence.

6.51.4.2.1.2 When the work is done, every new conduit must be equipped with a one (1) piece pull cord with 3.0 m extra at each end of the conduit attached to the plugs.

#### 6.51.4.2.2 Installation of metal conduit

6.51.4.2.2.1 Where required by the geometry of the installation, rigid metal conduit bigger than 19 mm in diameter shall be cold rolled.

6.51.4.2.2.1.1 Rolling will not be permitted for conduit smaller than 19 mm in diameter.

6.51.4.2.2.1.2 The **Contractor** shall replace at its expense conduit the diameter of which has been reduced by more than 1/10 of the original diameter as a result of crushing or deformation.

6.51.4.2.2.2 The threading on rigid metal conduit, made on site, shall be sufficiently long to permit a tight joint.

6.51.4.2.2.3 Exposed conduit shall be attached to the structure in accordance with the drawings and the *Special Technical Conditions*.

6.51.4.2.2.4 Where piping comprises galvanized metal conduit, the **Contractor** shall install at each end of the expansion joints a collar equipped with a device to ensure continuous grounding manufactured from the same material as the conduit.

### 6.51.4.2.3 Installation of buried rigid PVC conduit

6.51.4.2.3.1 When burying rigid PVC conduit, the **Contractor** shall, in addition to meeting the specifications on the drawings and in the *Special Technical Conditions*, carry out the following work:

6.51.4.2.3.1.1 dig a trench the full length indicated;

6.51.4.2.3.1.2 place a layer of granular material at least 150 mm thick compacted to 95% of modified Proctor;

6.51.4.2.3.1.3 thoroughly clean the inside of the conduit before installing it and take the necessary precautions to keep foreign matter out;

6.51.4.2.3.1.4 use flared tips to connect conduit to manholes;

6.51.4.2.3.1.5 use adapters to connect non-metallic conduit where necessary;

6.51.4.2.3.1.6 cut, ream and clean the ends of conduit on site according to the manufacturer's instructions to ensure that it is identical to factory-prepared conduit;

6.51.4.2.3.1.7 clean all elbows, connectors and extensions using a primer recommended by the manufacturer and apply a solvent-based glue;

6.51.4.2.3.1.8 install conduit being buried so as to ensure that it is supported evenly over the entire length of the run based on the slopes and levels indicated on the drawings.

6.51.4.2.3.2 In addition to meeting the above requirements, the **Contractor** shall install conduit to be set in concrete as follows:

6.51.4.2.3.2.1 place the PVC conduit as indicated on the drawings and according to the manufacturer's instructions using spacers;

6.51.4.2.3.2.2 use anchors, fasteners and jacks as needed to hold the conduit in place and prevent it from moving when the concrete is being poured; attach the conduit to the spacers using string or some other non-metallic fastener;

6.51.4.2.3.2.3 embed the conduit in concrete by placing a layer 100 mm thick over top;

6.51.4.2.3.2.4 wait until the concrete has reached 50% of the prescribed strength before backfilling.

6.51.4.2.3.3 Conduit to be buried directly shall be covered with granular material up to 150 mm above the top and compacted the same as the adjacent layers.

6.51.4.2.3.4 Backfilling over the granular material or concrete shall be done in separate layers not more than 300 mm thick using material of the same type, size and compactness as each of the adjacent layers.

6.51.4.2.3.5 The **Contractor** shall install warning tape along the entire length of the trench and at the depth indicated on the drawings, in conformity to standard CAN/CSA C22.10.

#### 6.51.4.3 INSTALLATION OF JUNCTION AND PULL BOXES

6.51.4.3.1 Junction and pull boxes shall be installed as prescribed on the drawings under this Contract.

6.51.4.3.2 The **Contractor** shall have the position of and the methods used to mount junction and pull boxes approved by the Engineer.

6.51.4.3.3 The use of welding to attach boxes to the structure or any other component is strictly prohibited.

6.51.4.3.4 It is strictly forbidden to make holes in any steel structure.

#### 6.51.4.4 IDENTIFICATION OF CONDUIT AND JUNCTION AND PULL BOXES

6.51.4.4.1 An identification plate indicating the circuit and/or voltage characteristics shall be affixed to every junction box and pull box after the wiring is installed.

6.51.4.4.2 The identification plates shall be made of 3 mm plastic laminate with a black surface and a white core and shall be mounted using self-tapping screws.

6.51.4.4.3 The size of the plates and the information to be engraved shall meet the following requirements:

Size No.	Plate Dimensions (mm)	Number of Lines	Height of Engraved Letters (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

6.51.4.4.4 The **Contractor** shall submit the information to be engraved on the identification plates to the Engineer for review and comment before the plates are manufactured in accordance with the following requirements:

6.51.4.4.4.1 the information shall appear in French;

6.51.4.4.4.2 only one plate is to be used per item.

6.51.4.4.5 All conduit and junction and pull boxes shall be identified using a colour code based on the type of circuit.

6.51.4.4.6 The colour code shall comprise stripes of primary colours and, as the case may be, complementary colours. The stripes of primary and complementary colours shall correspond with the following names:

Type	Primary colour	Type	Complementary Colour
Alimentation	Orange	347 V	-
		600 V	Red
Distribution	Yellow	347 V	-
		600 V	Red
		Lighting	Green
		Lane control signals and Camera	Brown
		PMV	Black
Communication	Blue	Lane control signals and Camera	Brown
		PMV	Black
Free	White	-	-

6.51.4.4.6.1 The coloured stripes shall be made using plastic tape or paint compatible with the type of materials and the coating on the component to be identified.

6.51.4.4.6.2 The primary and complementary stripes shall be 25 mm and 20 mm wide respectively.

6.51.4.4.6.3 Conduit shall be identified with a colour code marker every 30 m and wherever it passes through the structure.

### **6.51.5 QUALITY CONTROL**

- 6.51.5.1 Before the issuing of the interim Certificate of completion covering work carried out, the **Contractor** shall ensure that all buried and set-in-concrete conduit is clear of any foreign matter by running a rod through each conduit.
- 6.51.5.2 If any conduit is fully or partially obstructed, the **Contractor** shall take appropriate corrective measures at its expense.
  - 6.51.5.2.1 The use of liquids to clear conduit is prohibited.

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**END OF SUBSECTION**