

**TS 813****GROUNDING AND BONDING****TABLE OF CONTENTS****1. DRAWINGS**

TTD 813.001	TRAFFIC SIGNAL INSTALLATION AND CONTROLLER CABINET GROUNDING SYSTEM
TTD 813.005	CONTROLLER CABINET GROUNDING

**2. CONSTRUCTION SPECIFICATIONS**

TTS 813.100	CONSTRUCTION SPECIFICATION FOR GROUNDING
-------------	--

**3. MATERIAL SPECIFICATIONS**

NOT USED

**4. RECOMMENDATIONS**

TTR 813.300	DESIGN AND MAINTENANCE RECOMMENDATION FOR TRAFFIC SIGNAL INSTALLATION GROUNDING
-------------	--

## TABLE OF CONTENTS

- 1.0 Scope**
- 2.0 References**
- 3.0 Construction and Materials**
  - 3.1 Ground Wires
    - 3.1.1 Ground Wire in Ducts
    - 3.1.2 Ground Wire on Poles or Open Surfaces
    - 3.1.3 Ground Wire Connections
    - 3.1.4 Earth Excavation and Backfill
    - 3.1.5 Coils of Ground Wire
    - 3.1.6 Removals and Restoration
  - 3.2 Ground Electrodes
    - 3.2.1 Ground Rods
    - 3.2.2 Ground Plates
  - 3.3 Grounding Systems
  - 3.4 Testing Requirements
- 4.0 Measurement for Payment**
  - 4.1 Actual Measurement
    - 4.1.1 Ground Wires
    - 4.1.2 Ground Electrodes
  - 4.2 Plan Quantity Measurement
    - 4.2.1 Ground Wires
    - 4.2.2 Ground Electrodes
- 5.0 Basis of Payment**
  - 5.1 Ground Wires-Item
  - Ground Electrodes-Item
  - Grounding Systems-Lump Sum Item

## 1.0 Scope

This specification covers the requirements for the installation of Electrical grounding equipment and grounding systems.

The requirements of TS 1.00 and TS 801 shall apply to this work

## 2.0 References

This specification refers to the following standards, specifications or publications:

### Toronto Transportation:

TS 1.00	Maintenance of Traffic
TS 2.10	General Excavation
TS 801	Electrical Work
TS 803	Ducts
TS 806	Power Supply Equipment
TS 815	Removals

### Ontario Provincial Standards

TS 1010 Aggregates - Granular A,B,M

### American Standards for Testing and Materials:

ASTM B3-74 (1985) - Soft or Annealed Copper Wire

### Canadian Standards Association:

CSA C22.2 No. 381986 - Thermoset Insulated Wires and Cables

CSA C22.2 No. 411987 - Grounding and Bonding Equipment

CAN/CSA G40.21 - Structural Quality Steels

CSA G1641981 - Hot Dip Galvanizing of Irregularly Shaped Articles

### Others:

Ontario Electrical Safety Code, Current Edition.

## 3.0 Construction and Materials

### 3.1 Ground Wires

The work of ground wires, regardless of type, size or method of installation, shall include ground wire in ducts, ground wire direct buried, ground wire on poles, ground wire in handwells/chambers or enclosures, ground wire connections, vertical

runs of ground wire, earth excavation and backfill, coils of ground wire, and removals and restoration.

Insulated ground wire shall be stranded copper, insulation colour green and shall conform to CSA C22.2 No. 38, type RWU 90-cross link unless otherwise indicated in the contract. Bare ground wires shall be used for the power supply ground grid and handwell grounds whereas insulated ground wires are to be used for the system bonding conductor.

### **3.1.1 Ground Wire in Ducts**

Ground wire shall be pulled through ducts using any necessary cable lubricant, mechanical aids and pulling cables or ropes required. The pulling tension shall conform to the cable manufacturer's specifications.

### **3.1.2 Ground Wire on Poles or Open Surfaces**

Ground wire installed on concrete or metal poles shall be run in rigid duct. Ground wire installed on wood poles shall be run in protective moulding or in rigid duct. In both cases the conduit or moulding shall be aligned in straight runs complementing the taper of the pole.

Conduit shall be mechanically fastened to wood poles using PVC conduit clamps and galvanized lag screws. Moulding shall be mechanically fastened to wood poles using galvanized steel staples. Stainless steel strapping shall be installed to secure conduit on concrete or metal poles.

The ground wire shall be installed in straight and neat lines and shall be supported at a maximum spacing of every 450 mm.

### **3.1.3 Ground Wire Connections**

Ground connectors shall be used on all ground wire connections. All surfaces shall be cleaned to bare metal prior to making ground connections.

Moulded type ground connectors shall also be used on all ground wire-to-ground rod connections. Moulded connectors shall consist of metallic alloys and fusible powder mixtures held in place by suitable moulds and connected using an exothermic type welding process. The physical requirements of the connection shall conform to CSA C22.2 No. 41.

Mechanical connectors shall conform to CSA C22.2 No. 41.

### **3.1.4 Earth Excavation and Backfill**

Where ground plates or rods are to be installed in asphalt boulevards, the dry cutting of the asphalt shall include all applicable measures and procedures as per the City of Toronto Measures and Procedures for Roadwork with Asphalt Containing Asbestos Fibres.

Earth excavation and backfill shall conform to TS 2.10 and TS 1010.

### **3.1.5 Coils of Ground Wire**

Where indicated in the contract, the Contractor shall leave ground wire coiled. Coils shall be neatly taped and left in a safe readily accessible location.

### **3.1.6 Removals and Restoration**

Remove and restoration work shall conform to TS 815.

## **3.2 Ground Electrodes**

The work for ground electrodes, regardless of type, size or method of installation, shall include ground rods, ground plates, ground connection, the work described in sub-section 3.1 for earth excavation and backfill, and removals and restoration.

### **3.2.1 Ground Rods**

Copper clad ground rods shall be driven in a vertical position where soil conditions allow. Where rocks, stones or similar materials are encountered, ground rods may be driven at a maximum angle of 45 degrees to the vertical.

Ground rods shall be driven so that the top of the ground rod is a minimum of 300 mm below finished grade.

### **3.2.2 Ground Plates**

The Contractor shall excavate a minimum depth of 2.0 m at ground plate locations.

Ground plates shall be installed vertically (not flat) and shall be installed on a minimum 150 mm thick compacted bed of suitable native earth materials.

Native earth backfill or a minimum depth of 300 mm of the same materials shall be placed and compacted over the ground plate.

All compacting shall conform to TS 1010.

## **3.3 Grounding Systems**

The work included shall be as described in sub-section 3.1 for ground wires and 3.2 for ground electrodes where indicated in the contract.

## **3.4 Testing Requirements**

At pole mounted power supply locations, the Contractor shall test the resistance to ground between the equipment enclosures and the grounding grid. In soils of low conductivity, additional ground rods, ground plates and ground wires shall be added as required by the authority.

#### **4.0 Measurement for Payment**

##### **4.1 Actual Measurement**

###### **4.1.1 Ground Wires**

Measurement for ground wire will be made horizontally in metres, along the longitudinal axis of the duct, trench, on open surfaces and shall be from centre to centre of poles, pole footings, electrical chambers or enclosures, sign footings, controller cabinet pads and ground electrodes.

###### **4.1.2 Ground Electrodes**

The unit of measurement is each.

##### **4.2 Plan Quantity Measurement**

###### **4.2.1 Ground Wires**

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity. Measurement for ground wire will be made horizontally in metres, along the longitudinal axis of the duct or trench, on open surfaces, and shall be from centre to centre of poles, pole footings, handwells or enclosures, sign footings, controller cabinet pads and ground electrodes.

###### **4.2.2 Ground Electrodes**

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity. The unit of measurement is each.

#### **5.0 Basis of Payment**

##### **5.1 Ground Wires-Item Ground Electrodes-Item Grounding Systems-Lump Sum-Item**

Payment at the contract price for the above tender item shall be full compensation for all labour, equipment and materials required to do the work.