

**Construction Specification for
Cathodic Protection of
Existing Iron Watermains**

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TS 7.20.01 SCOPE

This specification covers the materials required and the work to be undertaken to cathodically protect existing iron watermains in the city of Toronto.

The work shall include the following:

- Obtaining permits and locates for buried and overhead utilities
- Supply all labour, material, tools, equipment, and transportation to complete the works as outlined herein, as shown on the drawings and as necessary by evidence
- Supply and installation of sacrificial anodes, cathodic protection monitoring probes, bond cables and test stations and their associated lead wires
- Backfilling of excavations, surface restoration, and clean-up
- Recording of GPS coordinates of all test stations and submission of data to the City

TS 7.20.01.01 Workmanship

Skilled labour shall only be used for all work.

All work shall be performed according to the instructions and specifications given by the City, using the most suitable equipment

TS 7.20.01.02 Handling and Storage of Materials

Material shall be stored so as to prevent injury to persons and to prevent the delay of work by others.

Sacrificial anodes and other materials which can be damaged by exposure to the environment must be stored in a clean, dry enclosure.

Sacrificial anodes shall not be stored on site.

Sacrificial anodes shall not be handled by their lead wires

TS 7.20.01.03 Units

Units of measurement given in this specification are based on the International System of Units (SI) and the National Standards of Canada Metric Practice Guide.

TS 7.20.02 REFERENCES

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

City of Toronto Standard Drawings

T-1106.07	Test Station for Cathodic Protection of Ductile Iron Watermains
T-1106.08	Test Station with Cathodic Protection Monitoring Probe For New or Existing Iron Watermains

Where a discrepancy exists between the drawings and the specification, the specification shall have priority.

The City shall be permitted to interpret the intent of the drawings and specifications where a discrepancy exists

TS 7.20.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

TS means Toronto Specification

AWG means American Wire Gauge

TS 7.20.04 DESIGN AND SUBMISSION REQUIREMENTS – Not Used

TS 7.20.05 MATERIALS

TS 7.20.05.01 Manufacture of Sacrificial Anodes

Lead wire silver-soldered to steel core.

Soldered connection encapsulated in heat shrinkable tubing.

Magnesium casting centered in anode package and surrounded by a minimum of 25 mm of special backfill.

TS 7.20.05.02 Magnesium Anodes

Packaged magnesium anodes shall have a 14.5 kg magnesium casting having a length of 560 mm ± 20 mm and a high potential alloy composition as per ASTM B-843-93, Type M1C specification or equal.

The magnesium casting shall be contained in a rugged moisture-absorbent cardboard container of the following dimensions: 200 mm diameter x 700 mm long. The core shall be a 3 mm diameter steel core extending a minimum of 75 per cent of the length of the casting.

The magnesium anode shall be no less than 45 per cent efficient for each sample tested as per ASTM G97-89.

The magnesium casting within the container shall be supplied surrounded with a special backfill material having an electrical resistivity of less than 45 ohm-cm when saturated with distilled water and the following composition by volume:

- Gypsum 77% $\pm 2\%$
- Bentonite 15% $\pm 1\%$
- Anhydrous Sodium Sulphate 8% $\pm 1\%$

Packaged magnesium anode shall be supplied with 3000 mm of AWG No 10/7 strand copper with RWU90 blue insulation.

TS 7.20.05.03 Test Stations

Test stations shall be Street Fink manufactured by Cott Industries Ltd. or equivalent with:

- Colour: Blue
- Terminals: 6
- Support Post: 150 mm Ø x 600 mm long
- Bonding Straps: 2

TS 7.20.05.04 Monitoring Probes

Cathodic protection monitoring probes shall be Model N° CPMP-WM as manufactured by Corrosion Service Company Ltd. or equivalent.

TS 7.20.05.05 Conductors

Watermain lead wires shall be AWG N° 10/7 strand copper conductor having RWU90 black insulation.

TS 7.20.05.06 Electrical Connectors

Electrical connectors shall be manufactured by Thomas & Betts Inc. or equivalent.

Test lead terminals:

- Anode headers and pipe lead wires, Sta-Kon Cat. N° D8-14
- Monitoring probe lead wires, Sta-Kon Cat. N° RA18-14

TS 7.20.05.07 Miscellaneous

Mastic:

- Roskote A-51 Mastic

TS 7.20.06 EQUIPMENT

The Contractor shall use the necessary specialized equipment required for the excavation of the watermain such as augering or vacuum excavation, the connection of lead wires to the watermain (electrical resistance welding or thermite welding), and the compaction of the backfilled excavations.

The City shall inspect and approve the suitability of the Contractor's equipment.

TS 7.20.07 CONSTRUCTION

TS 7.20.07.01 Preliminary Site Work

The location for each anode and test station shall be marked with a white stake or white paint on paved areas and shall be approved by the Contract Administrator prior to installation.

Test station locations:

- Within 10 m of each end of the watermain.
- At minimum intervals of 150 m along the watermain.
- At locations where they shall not interfere with, or present a hazard to pedestrian or vehicular traffic.
- At the nearest property line, whenever possible.

Anode locations:

- Within 3 m of each end of the watermain
- At the following intervals along the watermain, according to watermain diameter

Table 1: Anode spacing interval

Watermain diameter (mm)	Spacing (m)
100	22.0
150	15.0
200	11.5
300	8.0
400	6.0
600	4.5

- Anode locations may be shifted a maximum of 3 m to avoid driveways and other paved areas.

Obtain clearances from buried and overhead facilities as follows:

- Clearances to excavate shall be obtained from all other parties having buried and overhead facilities in the immediate vicinity of the watermain being cathodically protected.
- The locations of all water service piping in the vicinity of the watermain being protected shall be determined.
- The locations of all anodes shall be adjusted such that no anodes are located within 1000 mm of buried facilities specified above.

TS 7.20.07.02 Anode Installation

The excavation at each anode site shall be performed with an auger or vacuum excavator or both, so as to expose the pipe wall and accommodate the anode to be installed.

The size of the excavation at each anode location shall be kept to an absolute minimum.

The pipe surface shall be cleaned to facilitate welding.

The anode lead shall be welded to the pipe surface either by a thermite welding process (i.e. Cadweld) or an electrical resistance welding process (i.e. Nelson Stud Welder).

The integrity of each weld shall be tested by giving a sharp pull on the lead wire.

The cleaned watermain surface, the weld, and the exposed copper wire shall be coated with mastic.

The excavation shall be backfilled with 300 mm of native backfill prior to placement of the anode.

The anode shall be placed in the excavation, no closer than 300 mm to the watermain.

Should the watermain pipe be less than 1.70 m in depth, the anode shall not be placed vertically but diagonally so that the top of the anode is no closer than 300 mm from the bottom of the road subgrade.

Sufficient slack shall be left in the anode wire to prevent any stress on either the anode or pipe connection during backfilling and subsequent soil settlement.

If the excavation is not underneath the pavement, it shall be filled to within 150 mm of the natural grade with excavated natural material, manually compacted and thoroughly watered. Place 150 mm of topsoil and restore sodded area to as good as or better than original condition and watered.

If the excavation is underneath the pavement or any hard surface, it shall be backfilled with compacted Granular B material to the top of the anode. The remaining cut shall be filled to within 100 mm of the surface with unshrinkable fill and then filled to grade with temporary asphalt.

TS 7.20.07.03 Test Station Installation

Install test stations:

- As shown on drawing T-1106.07.
- Within 10 m of each end of the watermain.
- At minimum intervals of 150 m along the watermain.
- At locations which where they will not interfere with, or present a hazard to, pedestrian or vehicular traffic.
- At the nearest property line, whenever possible.
- Flush with the pavement or boulevard.

Install test stations and connect lead wires according to drawing T-1106.07.

Install test stations flush with the pavement or boulevard.

At each test station location, connect two lead wires to the watermain.

Install the lead wire from the nearest anode into the test station rather than connecting it directly to the watermain.

Connect all lead wires to the appropriate test station terminals using test lead terminal connectors.

Horizontal, underground wiring runs shall be at least 500 mm deep.

Sufficient slack shall be left in the watermain test leads and the anode wires to prevent any stress on either the anode or pipe connections during backfilling and subsequent soil settlement.

Measure and record the GPS coordinates of each test station to within ± 250 mm and submit all data to the City.

TS 7.20.07.04 Installation of Cathodic Protection Monitoring Probes

Install cathodic protection monitoring coupons:

- As shown on drawing T-1106.08.
- At every second test station along the watermain.
- At pipe depth.
- At a distance of between 300 mm and 500 mm from the watermain.

After placement of the monitoring coupon, but prior to backfilling, saturate coupon with water to ensure immediate operation of internal reference electrode.

TS 7.20.07.05 Surface Restoration and Final Clean-Up

The excavated surface shall be restored as specified in the Contract Documents.

The Contractor shall be responsible for removal and disposal of all surplus material.

Surplus materials shall be removed and disposed by the Contractor at the end of each Working Day. No surplus materials are allowed to be left on site for any reason unless authorized by the Contract Administrator.

In no event shall open holes be left on the street unless suitably fenced.

The Contractor shall be responsible for replacing any surrounding pavement or concrete removed or damaged during the installation of the anode.

Surface restoration and final clean-up shall be to the satisfaction of the Contract Administrator.

TS 7.20.07.06 Watermain Breaks

The contractor shall immediately notify the City if a watermain break occurs.

Watermain breaks caused by the Contractor in the process of anode installation shall be the responsibility of the Contractor.

The City shall repair breaks for the Contractor and charge the Contractor for the cost of the repair.

Breaks occurring during the wire welding process, due to decreased pipe structural strength, shall be the responsibility of the City.

The contractor shall be responsible for all damages to other utilities.

TS 7.20.07.07 System Deficiencies

Any system deficiencies as identified by the City's corrosion consultant, shall be corrected at the Contractor's expense. Such deficiencies shall include:

- Missing anodes
- Broken lead wire connections
- Use of improper materials

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- Inadequate restoration and clean-up

Deficiencies shall be corrected within 90 Days of notification by the City.

TS 7.20.08 QUALITY ASSURANCE

TS 7.20.08.01 Quality Assurance

Contractor shall ensure that the anodes supplied conform to this specification.

The Contractor or anode supplier shall forward a copy of the *Certificate of Compliance* acquired from the anode manufacturer to the City for each anode shipment, prior to either their installation or delivery acceptance.

The City may randomly select samples of anodes supplied by the Contractor for testing, by an independent laboratory, with testing costs to be borne by the City.

Any batch of anodes found not to conform to the specification shall be replaced immediately by the Contractor at no extra cost to the City. No additional work shall take place until such time that the anodes are approved and accepted by the Contract Administrator.

Any installed anodes found not to conform to the required specifications shall be replaced by the Contractor at no extra cost to the City.

TS 7.20.09 MEASUREMENT FOR PAYMENT

TS 7.20.09.01 Anode Installation

The Contractor shall invoice the City for work completed on a per anode basis. Invoices shall show the unit(s) installed and unit cost with total cost per item(s).

TS 7.20.09.02 Test Station Installation

The Contractor shall invoice the City for work completed on a per test station basis. Invoices shall show the unit(s) installed and unit cost with total cost per item(s).

TS 7.20.09.03 Monitoring Probe Installation

The Contractor shall invoice the City for work completed on a per monitoring probe basis. Invoices shall show the unit(s) installed and unit cost with total cost per item(s).

TS 7.20.10 BASIS OF PAYMENT

Payment at the Contract Price shall be full compensation for all labour, Equipment, Material, restoration and incidentals to do the work.