Construction Specification for Cathodic Protection of New Watermains

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TS 7.22.01 SCOPE

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

New watermains include:

- Ductile iron watermains
- Metallic components of non-metallic watermains

The work shall include the following:

- 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.

- Recording of GPS coordinates of all test stations and submission of data to the City.

TS 7.22.01.01 Workmanship

Skilled labour shall only be used for all work.

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

TS 7.22.01.02 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 elements, must be stored in a clean, dry enclosure.

Anodes shall not be stored on site.

Sacrificial anodes and cathodic protection monitoring probes shall not be handled by their lead wires.

TS 7.22.01.03 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 7.22.02 REFERENCES

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

City of Toronto Standard Drawings

T-1106.02	Thermite Welding of Metallic Watermains
T-1106.03	Electrical Bonding of Iron Watermains
T-1106.04	Cathodic Protection for Valves Not in Chamber Iron Fittings, Hydrant and Services Connections on Non-Metallic Mains
T-1106.05	Cathodic Protection for New Ductile Iron Watermain Construction
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 Watermains

American Society of Testing and Materials

A418-01	Standard Specification for Cast and Wrought Galvanic Zinc Anodes

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

TS 7.22.03 DEFINITIONS

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

TS means Toronto Specifications

AWG means American Wire Gauge

TS 7.22.04 DESIGN AND SUBMISSION REQUIREMENTS – Not Used

TS 7.22.05 MATERIALS

TS 7.22.05.01 Manufacture of Sacrificial Anodes

Lead wire silver-soldered to steel core.

Soldered connection encapsulated in heat shrinkable tubing.

Zinc casting centred in anode package and surrounded by a minimum of 25 mm of special backfill.

TS 7.22.05.02 Zinc Anodes

Packaged zinc anodes shall have a high potential alloy composition as per ASTM B418-01, Type II specification or equal.

The table below indicates the weight and length for each zinc anode type:

Table 1: Zinc anode type

Anode type	Casting weight (kg) min	Casting length (mm) ± 10	Package diameter (mm) min	Package length (mm) min
Z-24-48	10.9	1220	100	1300
Z-12-24	5.4	610	100	700

The zinc 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 6 mm diameter electro-galvanized steel core extending 100 percent of the length of the casting.

The zinc 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% ±2%
- Bentonite 15% ±1%
- Anhydrous Sodium Sulphate 8% ±1%

Packaged zinc anode shall be supplied with 3000 mm of AWG Nº 10/7 stand copper with RWU90 red insulation.

TS 7.22.05.03 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 7.22.05.04 Monitoring Probes

Cathodic protection monitoring probes shall be Model Nº CPMP-WM as manufactured by Corrosion Service Company Ltd. or equivalent.

TS 7.22.05.05 Thermite Welds

Thermite weld materials to be CADWELD, as manufactured by Erico Products Inc.

Thermite weld metal:

- Anode lead wires: Cat. Nº CA25XF-19
- Bond cables: Cat. Nº CA45XF-19

Thermite weld moulds:

- Anode lead wires: Cat. Nº CAHBA-1G-PD, where PD is pipe Ø in inches
- Bond cables: Cat. Nº CAHBA-1G-PD, where PD is pipe Ø in inches

TS 7.22.05.06 Conductors

Watermain lead wires shall be AWG Nº 10/7 strand copper conductor having RWU90 black insulation.

Bond cables shall be AWG Nº 4/7 strand copper conductor having RWU90 black insulation.

TS 7.22.05.07 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. Nº D8-14.
- Monitoring probe lead wires, Sta-Kon Cat. Nº RA18-14.

Ground clamps:

- Water services up to 25 mm Ø, Blackburn Cat. Nº JD.
- Water services of greater than 25 mm Ø, Blackburn Cat. Nº J2D.

TS 7.22.05.08 Miscellaneous

Bond cables:

- AWG Nº 4/7 strand copper conductor having RWU90 black insulation

Mastic:

- Roskote A-51 Mastic

Ground clamps:

- Water services up to 25 mm Ø, Blackburn Cat. Nº JD.
- Water services of greater than 25 mm Ø, Blackburn Cat. Nº J2D.

TS 7.22.06 EQUIPMENT – Not Used

TS 7.22.07 CONSTRUCTION

TS 7.22.07.01 Anode Installation

The anodes shall be kept dry prior to installation.

The anode shall not be handled or lowered by their lead wires.

Anodes shall be installed complete with their cardboard container and enclosed special backfill.

Anodes shall be installed horizontally at pipe depth a minimum of 600 mm to the side of the pipe, and shall be backfilled with native soil.

The anode lead wire shall be wrapped around the watermain and secured with a knot. Sufficient slack shall be left in the wire to prevent any stress on the anode during backfilling and subsequent soil settlement.

The anode lead wire shall be attached to the water piping by connecting to either:

- A copper service pipe, using a ground clamp, according to the clamp manufacturer's instructions; or
- The iron portions of the watermain, using the thermite weld process.

TS 7.22.07.02 Anode Locations

Install one Z-12-24 anode on each copper water service.

Install one Z-24-48 anode on the lateral piping of each hydrant.

On non-metallic watermains only, install one Z-12-24 anode on each metallic fitting such as a cross, tee, or reducer and on all buried valves.

On ductile iron watermains only, install Z-24-48 anodes at the following maximum intervals along the entire watermain, starting within 2 m from the end of the watermain:

Table 2: Anode spacing interval

Watermain diameter mm	Spacing m
100	22.0
150	8.0
200	6.0
300	4.0
400	3.0
600	2.0

TS 7.22.07.03 Installation of Bond Cables

On ductile iron watermains only, all pipe joints and fittings shall be bonded to ensure electrical continuity throughout the piping system.

Bond cables shall be connected to the watermain using the thermite weld process.

Install one bond cable across each pipe-to-pipe and pipe-to-fitting joint.

Remove and discard any bare copper bond straps that are supplied with the piping.

Bare copper bond straps, conductivity screws, and conductivity wedges shall not be used as a means of providing electrical continuity.

TS 7.22.07.04 Test Station Installation

Test stations shall only be installed on ductile iron watermains.

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.

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 ± 0.25 m, and submit all data to the City.

TS 7.22.07.05 Installation of Cathodic Protection Monitoring Probes

Install cathodic protection monitoring probes:

- On ductile iron watermains only.
- 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 probe, but prior to backfilling, saturate coupon with water to ensure immediate operation of internal reference electrode.

TS 7.22.07.06 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, but not be limited to:

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

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

TS 7.22.08 QUALITY ASSURANCE

TS 7.22.08.01 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 of 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 his own expense.

TS 7.22.09 MEASUREMENT FOR PAYMENT

TS 7.22.09.01 Anode Installation

If the Contract contains separate items for the work required by this specification, payment shall be based on the unit price or lump sum price tendered by the Contractor.

TS 7.22.09.02 Test Station Installation

If the Contract contains separate items for the work required by this specification, payment shall be based on the unit price or lump sum price tendered by the Contractor.

TS 7.22.09.03 Monitoring Probe Installation

If the Contract contains separate items for the work required by this specification, payment shall be based on the unit price or lump sum price tendered by the Contractor.

TS 7.22.10 BASIS OF PAYMENT

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