SECTION 404642 - CATHODIC PROCESS CORROSION PROTECTION

Note that this section has only been edited for NYSOGS standardization and has not been technically edited. The designer shall make all technical edits specific to the project for this section.

This Section specifies passive cathodic protection for buried metallic process piping, buried metal structures, and buried metal tanks using sacrificial galvanic anodes.

This Section includes provision for Work performed using unit price payment method if applicable.

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes: Anodes and attachments to buried metallic components [**and buried tanks**].
				2. Related Requirements:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

Section 033000 - Cast-in-Place Concrete: Concrete encasement.

Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Building wire and cable with insulation rated 600 volts and less.

Section 260526 - Grounding and Bonding for Electrical Systems: Grounding grids, loops, and other related grounding components.

Section <**\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_**>: Metal conduit requiring cathodic corrosion protection.

Section <**\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_**>: Buried metal structures requiring cathodic corrosion protection.

Section <**\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_**>: Metal pipe requiring cathodic corrosion protection.

Section <**\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_**>: Metal tanks requiring cathodic corrosion protection.

* + - 1. REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

* + - * 1. ASTM International:

ASTM B418 - Standard Specification for Cast and Wrought Galvanic Zinc Anodes.

* + - * 1. National Electrical Manufacturers Association:

NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

* + - 1. COORDINATION
				1. Coordinate Work of this Section with placement of buried Site metallic components requiring protection.
			2. PREINSTALLATION MEETINGS
				1. Convene minimum [**one week**] [**<\_\_\_\_\_\_\_\_> weeks**] prior to commencing Work of this Section.
			3. SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

* + - * 1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: Submit manufacturer information for anodes and test panels.
				5. Shop Drawings: Indicate system layout and submit wiring diagrams.
				6. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

Include separate Paragraphs for additional certifications.

Include following Paragraph when Contractor is responsible for designing products or assemblies. List affected products when Section specifies more than one product.

* + - * 1. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for cathodic corrosion protection system.
				2. Test and Evaluation Reports: Indicate results of inspections and performance testing.
				3. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
				4. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
				5. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
				6. Qualifications Statements:

Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.

Submit qualifications for manufacturer, installer, and licensed professional.

Submit manufacturer's approval of installer.

* + - 1. CLOSEOUT SUBMITTALS
				1. Project Record Documents: Record actual locations of anodes and test panels.
				2. Operation and Maintenance Data: Submit test procedures for periodic performance evaluation.
			2. QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

In following Paragraph insert "State of New York Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

* + - * 1. Perform Work according to <**\_\_\_\_\_\_\_\_**> standards.

Include following Paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain <**\_\_\_\_\_\_\_\_**> [**copy**] [**copies**] of each standard affecting Work of this Section on Site.
			1. QUALIFICATIONS

Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

* + - * 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience.
				2. Installer: Company specializing in performing Work of this Section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience [**and approved by manufacturer**].
				3. Licensed Professional:

[**Professional engineer**] <**\_\_\_\_\_\_\_\_**> certified by [**National Association of Corrosion Engineers**] <**\_\_\_\_\_\_\_\_**> and licensed in New York State.

[**Submit documentation of designer certification.**]

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
				2. Store materials according to manufacturer instructions.
				3. Protection:

Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

Provide additional protection according to manufacturer instructions.

* + - 1. EXISTING CONDITIONS
				1. Field Measurements:

Verify field measurements prior to fabrication.

Indicate field measurements on Shop Drawings.

* + - 1. WARRANTY

This Article extends warranty period beyond one year. Extended warranties may increase construction costs and State enforcement responsibilities. Specify warranties with caution.

* + - * 1. Furnish [**five**] <**\_\_\_\_\_\_\_\_**>-year manufacturer's warranty for cathodic corrosion protection system.
1. PRODUCTS
	* + 1. PERFORMANCE AND DESIGN CRITERIA
				1. Iron and Steel Components:

Negative voltage of [**0.85**] <**\_\_\_\_\_\_\_\_**> V, measured between component and saturated reference electrode contacting earth near component.

Negative voltage shift of [**300**] <**\_\_\_\_\_\_\_\_**> mV, measured between component and saturated reference electrode contacting earth near component.

Polarization voltage shift of [**100**] <**\_\_\_\_\_\_\_\_**> mV, measured between component and saturated reference electrode contacting earth near component.

* + - * 1. Aluminum Components:

Negative voltage of [**1.2**] <**\_\_\_\_\_\_\_\_**> V, measured between component and saturated reference electrode contacting earth near component.

Negative voltage shift of [**150**] <**\_\_\_\_\_\_\_\_**> mV, measured between component and saturated reference electrode contacting earth near component.

Polarization voltage shift of [**100**] <**\_\_\_\_\_\_\_\_**> mV, measured between component and saturated reference electrode contacting earth near component.

* + - 1. ANODES
				1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=12698&mf=04&src=wd):

designer to provide two manufacturers and approved equivalent for all listed products.

* + - * 1. Magnesium Anode:

Core:

Type: [**Tape**] [**Rod**] <**\_\_\_\_\_\_\_\_**>.

Material: [**Galvanized steel**] <**\_\_\_\_\_\_\_\_**>.

Bare Weight: [**9**] [**17**] [**32**] <**\_\_\_\_\_\_\_\_**> lb

Coating Alloy Content:

Aluminum: [**0.05**] <**\_\_\_\_\_\_\_\_**> percent, maximum.

Manganese: [**0.5 to 1.3**] <**\_\_\_\_\_\_\_\_**> to <**\_\_\_\_\_\_\_\_**> percent, maximum.

Zinc: [**Zero**] <**\_\_\_\_\_\_\_\_**> percent, maximum.

Silicon: [**Zero**] <**\_\_\_\_\_\_\_\_**> percent, maximum.

Copper: [**0.02**] <**\_\_\_\_\_\_\_\_**> percent, maximum.

Nickel: [**0.001**] <**\_\_\_\_\_\_\_\_**> percent, maximum.

Iron: [**0.03**] <**\_\_\_\_\_\_\_\_**> percent, maximum.

Other Impurities: [**0.3**] <**\_\_\_\_\_\_\_\_**> percent, maximum.

* + - * 1. Zinc Anode:

Comply with ASTM B418, Type [**I**] [**II**].

Type: [**Tape**] [**Rod**] <**\_\_\_\_\_\_\_\_**>.

Material: [**Cast**] [**Wrought**] galvanic zinc.

Bare Weight: [**5**] [**30**] <**\_\_\_\_\_\_\_\_**> lb

* + - * 1. Aluminum Anode:

Type: [**Tape**] [**Rod**] <**\_\_\_\_\_\_\_\_**>.

Bare Weight: <**\_\_\_\_\_\_\_\_**> lb

Coating Alloy Content:

Indium: [**0.02**] <**\_\_\_\_\_\_\_\_**> percent, maximum.

Zinc: [**4.5**] <**\_\_\_\_\_\_\_\_**> percent, maximum.

* + - * 1. Conduit and Wiring:

Anode Lead Wire:

Conductor: Solid copper, [**12**] <**\_\_\_\_\_\_\_\_**> AWG.

Insulation: Type [**TW**] [**THW**] [**RHH**] <**\_\_\_\_\_\_\_\_**>.

Field Wiring:

Conductor: Stranded copper, <**\_\_\_\_\_\_\_\_**> AWG.

Insulation: Type [**TW**] [**RHE-USE**] <**\_\_\_\_\_\_\_\_**>.

Conduit:

Type: Rigid [**galvanized steel**] [**nonmetallic**].

As specified in Section [**260519 - Low-Voltage Electrical Power Conductors and Cables**] <**\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_\_\_**>.

* + - 1. ANODE BACKFILL
				1. Material:

Blended granular mixture, 100 percent passing through No. 10 sieve mesh screen.

Composition:

Hydrated Gypsum: 75 percent.

Bentonite Clay: 20 percent.

Sodium Sulfate: 5 percent.

Packaged Weight: 2.5 times unit weight of anode.

* + - 1. ACCESSORIES
				1. Concrete Box:

Precast concrete [**of sulfate-resistant portland cement concrete**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Cast-in-Place Concrete:

As specified in Section 033000 - Cast-in-Place Concrete.

Compressive Strength: 3,000 psi at 28 days.

Dimensions: [**As indicated on Drawings**] [**<\_\_\_\_\_\_\_\_> by <\_\_\_\_\_\_\_\_> by <\_\_\_\_\_\_\_\_> inches**].

Cover: [**Concrete**] [**Cast iron**].

Identification Marking: [**CATHODIC PROTECTION TEST**] <**\_\_\_\_\_\_\_\_**> in letters not less than [**1.5**] <**\_\_\_\_\_\_\_\_**> inches high.

Enclosure types indicated in following Paragraph are as follows:

- Type 3: Constructed for indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection of internal equipment against falling dirt, windblown dust, rain, and ice formation.

- Type 3R: Constructed for indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection of internal equipment against falling dirt, rain, and ice formation.

- Type 4: Constructed for indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection of internal equipment against falling dirt, windblown dust, rain, splashing water, hose-directed water, and ice formation.

- Type 4X: Constructed for indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection of internal equipment against windblown dust, rain, splashing water, hose-directed water, corrosion, and ice formation.

Type 3R is generally least expensive; Types 4 and 4X are most expensive.

* + - * 1. Enclosures: NEMA 250, Type [**3**] [**3R**] [**4**] [**4X**] <**\_\_\_\_\_\_\_\_**>.
				2. Terminal Board:

Type: One piece.

Screw Terminals: Rated [**15**] <**\_\_\_\_\_\_\_\_**> A.

* + - * 1. Shunt:

Rating: [**0.01**] [**0.1**] <**\_\_\_\_\_\_\_\_**> ohm, [**6**] <**\_\_\_\_\_\_\_\_**> A.

Accuracy: Plus or minus [**1**] <**\_\_\_\_\_\_\_\_**> percent.

* + - * 1. Current Control Resistor:

Type: Adjustable slide wire.

Rating: <**\_\_\_\_\_\_\_\_**> ohms, <**\_\_\_\_\_\_\_\_**> W.

* + - * 1. Metering: <**\_\_\_\_\_\_\_\_**>.
1. EXECUTION
	* + 1. EXAMINATION
				1. Verify that buried piping systems have been completed and tested as specified in Section <**\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_\_\_**>
			2. INSTALLATION

Edit first two following Paragraphs accordingly if specifying magnesium anodes.

* + - * 1. Connections:

Fasten anode lead wire to anode [**tape**] [**rod**] <**\_\_\_\_\_\_\_\_**> by silver brazing.

Install wire length of [**10**] [**20**] <**\_\_\_\_\_\_\_\_**> feet.

Insulate connection to [**600**] <**\_\_\_\_\_\_\_\_**> V, overlapping lead wire insulation by minimum [**1/2**] <**\_\_\_\_\_\_\_\_**> inch

Connect system to [**ferrous pipe**] [**copper pipe**] [**, metal tanks**] [**, and**] <**\_\_\_\_\_\_\_\_**> by [**exothermic weld**] [**mechanical**] methods.

* + - * 1. Backfilling:

Pack anode [**cloth**] [**paper**] <**\_\_\_\_\_\_\_\_**> bag.

Center anode and firmly pack backfill with mechanical vibrator.

* + - * 1. Bonding: As specified in Section 260526 - Grounding and Bonding for Electrical Systems.
				2. Test Stations:

Locations:

At each location of protected pipe crossing another metallic pipe.

At each end of casing under [**roadway**] <**\_\_\_\_\_\_\_\_**>.

At each inaccessible insulating pipe joint.

At intervals not to exceed [**1,000**] <**\_\_\_\_\_\_\_\_**> feet.

Mounting: Install test stations on pipe stanchion <**\_\_\_\_\_\_\_\_**> inches above grade.

* + - * 1. Restore protective coatings and wraps damaged during installation.
			1. FIELD QUALITY CONTROL
				1. Nondestructive Testing of Anodes:

Select one anode of each type at random.

Submerge in container of fresh water for 30 minutes.

Measure anode-to-water potential difference between a calibrated copper-copper sulfate reference electrode; potential differences should be within following ranges:

High-Potential Magnesium: Minus 1.65 V to minus 1.75 V.

Standard Magnesium: Minus 1.4 V to minus 1.5 V.

Zinc: Minus 1.0 V to minus 1.15 V.

* + - * 1. Destructive Testing of Anodes:

Select one anode of each type with lead wires for static pull test.

Minimum Connection Tensile Load: [**300**] <**\_\_\_\_\_\_\_\_**> lbf

* + - * 1. Base Potential Testing:

After [**backfilling of pipe**] [**installation of structure to be protected**] [**initial operation of structures containing liquids**] and installation of anodes, but before connection of anodes, measure base structure-to-electrolyte potentials of [**pipe**] [**pipe and casings**] [**structures**].

Perform measurements at anode junction boxes and test stations, at intervals not exceeding [**100**] [**400**] <**\_\_\_\_\_\_\_\_**> feet.

* + - * 1. Insulation Joint Testing:

Perform test at each insulating joint or fitting before and after connection of anodes to [**pipe**] [**structure**] at [**anode junction boxes**] [**test stations**].

Before Connection: Test using insulation checker.

After Connection: Test by measuring potential shift on both sides of insulating joint.

Demonstrate that no metallic contact or short circuit exists between two insulated sections of pipe.

* + - * 1. Electrical Continuity Testing:

Testing joint-bonded pipe prior to backfilling.

Circulate current through pipe and compare measured resistance to theoretical resistance of pipe and bond cables.

Measured Resistance: Not greater than 150 percent of theoretical resistance.

* + - * 1. Pipe Casing Testing: Test electrical insulation of carrier pipe from casings and correct short circuits if they occur.
				2. Anode-to-Soil Potential and Anode Output Testing:

Measure anode-to-soil potential of each anode with anode disconnected.

After reconnection, measure current output of each anode.

* + - * 1. Protected Potential Measurement Testing:

After one [**day**] [**week**] <**\_\_\_\_\_\_\_\_**> of operation, measure potentials along [**pipe**] [**pipe and casings**] [**structures**] using reference electrodes and voltmeter.

Locations: As used for base potential measurements.

* + - * 1. Interference Testing:

Locations: Pipe crossings and nearby existing pipes.

Verify that cathodic protection system does not affect existing pipes, and that existing pipes do not interfere with pipe Work.

* + - * 1. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than <**\_\_\_\_\_\_\_\_**> [**days**] [**hours**] on Site for installation, inspection, startup, field testing, and instructing Director’s Representative in operation and maintenance of equipment.
				2. Equipment Acceptance:

Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

Make final adjustments to equipment under direction of manufacturer's representative.

* + - * 1. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.
			1. MAINTENANCE

Evaluate need for maintenance and emergency service based on Project requirements. If desired, retain following Paragraphs.

* + - * 1. Provide service and maintenance of corrosion protection system for one year from date of Substantial Completion.
				2. Inspect, test, and adjust cathodic protection system [**quarterly**] [**semi-annually**] <**\_\_\_\_\_\_\_\_**> to ensure its continued conformance with criteria as specified in this Section.

END OF SECTION 404642