

SECTION S966 - MAGNESIUM ANODE

S966-1 DESCRIPTION

Work consists of installing prepackaged magnesium anodes, to cathodically protect a portion of new or existing cast or ductile iron water main, service or hydrant branch pipe and new ductile iron fittings and copper water services on new or existing PVC, PVC0 and HDPE water main pipe, as required in the Contract Documents and as directed by the Project Manager.

Work is to be in conformance with the requirements of Section S900 General Water Provisions.

S966-2 MATERIALS

S966-2.01 Magnesium Anode

Anodes shall be high potential magnesium anode ingots with packaged backfill. Anode ingot shall meet or exceed ASTM B843, GRADE M1C for high-potential magnesium anodes, with the following chemical composition:

ELEMENT	PERCENT BY WEIGHT
Aluminum	0.01 maximum
Manganese	0.5 – 1.3
Zinc	0.05 maximum
Copper	0.02 maximum
Silicon	0.05 maximum
Iron	0.03 maximum
Nickel	0.001 maximum
Other metallic elements	0.05 maximum or 0.3 total
Magnesium	Remainder

Laboratory tests of magnesium anodes shall be conducted by a third party, in accordance to ASTM G97 (Laboratory Evaluation of Magnesium Anode Test Specimens for Underground Application) requirements. Test results shall demonstrate a minimum open circuit potential of -1.70 volts with respect to a saturated Calomel electrode (-1.774 volts with respect to a copper/copper sulfate electrode) and a minimum current efficiency of 50% or 500 amp-hours per pound.

Anode shall come furnished with minimum 10 feet of coiled #12 AWG solid copper lead wire with TW, THHN or THWN insulation, firmly attached to the galvanized steel core of the anode. The core cavity shall be filled with electrical sealing compound to assure a fully insulated and protected connection. Magnesium anode and backfill shall be pre-packaged into a single unit in a permeable cloth bag.

Each magnesium anode shall meet or exceed the nominal bare weight as shown in the following table (length, height and width dimensions and packaged weights may vary slightly by manufacturer):

Length	Width	Height	Bare Weight	Packaged Weight
8 inch	3-1/2 inch	3-3/4 inch	5 pound	17 pound
13-3/4 inch	3-1/2 inch	3-3/4 inch	9 pound	24 pound
25-1/4 inch	3-1/2 inch	3-3/4 inch	17 pound	45 pound
19-7/8 inch	5-1/2 inch	5-3/4 inch	32 pound	70 pound
30-1/4 inch	5-1/2 inch	5-3/4 inch	48 pound	96 pound

S966-2.02 Backfill Packaging

Each anode shall be packaged in a permeable cloth bag containing backfill having the following composition, in percent by weight:

- 75 percent Hydrated Gypsum
- 20 percent Bentonite
- 5 percent Sodium Sulfate

S966-2.03 Thermite Weld Equipment

Connection of anode lead wire to cast iron or ductile iron pipe or fittings shall be made by the thermite weld method. Thermite weld materials shall consist of wire sleeves, weld mold and weld cartridges according to the weld manufacturer's recommendations for the specific wire and pipe sizes and materials. Weld materials from different manufacturers shall not be interchanged. Weld molds shall be graphite molds. Ceramic "one-shot" molds will not be acceptable.

S966-3 CONSTRUCTION DETAILS

S966-3.01 General

Spacing and size of magnesium anodes will be as specified in Contract Documents. Each anode shall be placed in a horizontal position parallel with the pipe, with centerline axis of the anode at least 6 inches below the bottom of the water pipe. The centerline axis of the anode shall also be placed at least 2 feet from the exterior wall of the water pipe. Care shall be taken to ensure that the cloth bag is not damaged and no backfill lost during installation. Each anode shall be centered in the cloth bag. It may be necessary to re-center the anode in the cloth bag by rolling it on the ground prior to installation. Each prepackaged anode shall be lowered into the trench using a sling or rope. The anode shall not be lowered, transported, handled or lifted by the lead wire. The anode lead wire shall be long enough to reach from the pipe to the anode without a splice. The anode lead wire shall be attached to the pipe using the thermite weld process.

Anodes that are installed at cathodic protection test stations are not to be directly connected to the water pipe or fitting. When the anode lead wire is not long enough to reach the test station terminal board with sufficient slack, the lead wire may be lengthened by splicing on an additional length of lead wire. Splice shall be made using an approved splice connector suitable for buried applications.

To connect anode lead wire to ductile iron pipes that are encased in a polyethylene tube, the Contractor shall first cut back the polyethylene tubing to expose the pipe. The Contractor shall make an "X" shaped cut in the polyethylene and temporarily fold back the polyethylene at the point where the anode lead wire will be connected to the pipe.

Using a mechanical grinder, remove the minimum area of coating from pipe or fitting surface required for placement of weld mold, creating a bright, shiny surface. Prepare the anode lead wire and pipe surface for thermite welding by assuring that they are dry. Wire and pipe surface shall be free of dirt, grease and other foreign products. Remove insulation at end to be welded in a manner that will avoid damage to wire. Install adapter sleeves for anode lead wire as recommended by thermite weld manufacturer prior to welding. Hold wire at an approximate 30 degree angle to pipe surface when welding.

When weld has cooled, remove weld slag and test weld for strength by striking a sharp blow to the weld with a hammer while pulling firmly on the wire. Re-weld unsound welds and retest weld. Thoroughly clean mold and mold covers after completion of each weld to remove all excess slag. After soundness of weld has been verified, thoroughly clean with a stiff wire brush and brush with an approved bitumastic coating over entire weld area. Lift wire away from pipe and apply bitumastic coating completely around and underneath the wire. Push wire back down on the pipe. Apply a protective bitumastic coating where any original pipe coatings have been disturbed.

After the anode lead wire is connected to the pipe, the Contractor shall repair the polyethylene tubing using polyethylene compatible adhesive tape. The polyethylene tubing shall be folded back against the pipe and the repair tape shall be applied on anode lead wire. The repair tape shall completely cover the area of the polyethylene tubing that was cut and shall completely cover all exposed ductile iron pipe.

Extra anode lead wire for each anode shall be coiled. The wire shall have sufficient slack to allow for pipe and anode movement and to protect against undue stress during backfilling. Prior to backfilling the anode, water shall be applied to the anode to moisten its pre-packed backfill.

The area immediately surrounding the anode shall be backfilled with native soil. Cushion sand shall be backfilled around the water pipe or fitting so that the sand covers the pipe or fitting to a minimum depth of 12 inches on top, and along both sides of the pipe or fitting. The excavation shall be backfilled in stages using select granular backfill (water) material free from stone, rocks, roots, organic material, trash or other debris, and carefully tamped to ensure that no voids exist around the bag and that the bag and wire are not damaged.

S966-3.02 Anodes on Copper Water Services on PVC, PVCO and HDPE Water Mains

One 5 pound anode shall be connected to new copper water services on PVC, PVCO and HDPE water mains, For copper services 1 inch diameter and less, anode lead wire shall be attached to thaw wire type copper tube nut at outlet end of corporation stop. For copper services larger than 1 inch diameter, anode lead wire is to be attached to copper service using bronze ground clamp.

S966-3.03 Anodes on Existing Ductile and Cast Iron Water Mains

Magnesium anodes shall be installed at every pipe joint or every other pipe joint, as designated in the Contract Documents or directed by the Project Manager, on existing cast and ductile iron water main pipe to cathodically protect both pipes on either side of the joint. Two or more anodes will be installed at pipe joint locations, with one or more anodes connected to each pipe on either side of the joint. Pipe joints shall be located by the Contractor utilizing field notes from the original pipe installation records. These notes may be obtained from the Rochester Water Bureau Maps & Records office located at 10 Felix Street, Rochester, New York 14608. A test pit shall be excavated to verify the location of the first pipe joint. The Contractor shall layout the location of remaining joints to be excavated using the record field notes. At each excavated joint, an area shall be excavated that is large enough to expose top and one or both sides of existing water main pipe and safely install both anodes in one operation. Basic general size of the area to be excavated will be as noted in Contract Documents and will be dependent on the depth and location of the water main.

Magnesium anodes are not required to be installed on existing water main fittings or valves encountered in an excavation, unless otherwise required in the Contract Documents or directed by the Project Manager.

S966-3.04 Anodes on Existing Ductile and Cast Iron Hydrant Branches and Water Services

Hydrant branches shall be excavated along the branch pipe with the branch gate valve centered in the trench. One 17 pound anode shall be attached to the branch pipe between the water main and the gate valve and one 17 pound anode on the branch pipe between the gate valve and the hydrant.

Water services 4 inch diameter and larger shall be excavated along the service pipe with the curb shut off valve centered in the excavation. One anode shall be connected to the service pipe between the water main and the curb valve and a second anode shall be connected to the service pipe between the curb valve and the customer's property. For services with no curb valve, one anode shall be connected to the service pipe in the vicinity of the curb. Anode sizes shall be based on the service diameter, with 17 pound anodes installed on 4 and 6 inch diameter services; 32 pound anodes installed on 8 and 10 inch diameter services and 48 pound anodes installed on services 12 inch diameter and larger.

S966-4 METHOD OF MEASUREMENT

The quantity to be measured for payment shall be by the number of prepackaged magnesium anodes installed. Size of magnesium anode is as described by bare weight.

S966-5 BASIS OF PAYMENT

The unit price bid shall include the cost of: furnishing and installing the prepackaged magnesium anode; all thermite weld equipment and materials; attaching the anode lead wire to the pipe or fitting; splicing the lead wire at test stations, bitumastic coating; repairing the polyethylene tubing; locating joints on existing pipe and furnishing all labor, material and equipment necessary to complete the work.

Excavation, rock excavation, furnishing and placing of bedding and select granular backfill, temporary pavement, and final paving and surface restoration will be paid for under separate items.

Payment will be made under:

ITEM NO.	ITEM	PAY UNIT
S966.0305	5 Pound Magnesium Anode	Each
S966.0309	9 Pound Magnesium Anode	Each
S966.0317	17 Pound Magnesium Anode	Each
S966.0332	32 Pound Magnesium Anode	Each
S966.0348	48 Pound Magnesium Anode	Each

REVISED December 9, 2010