

CATHODIC PROTECTION

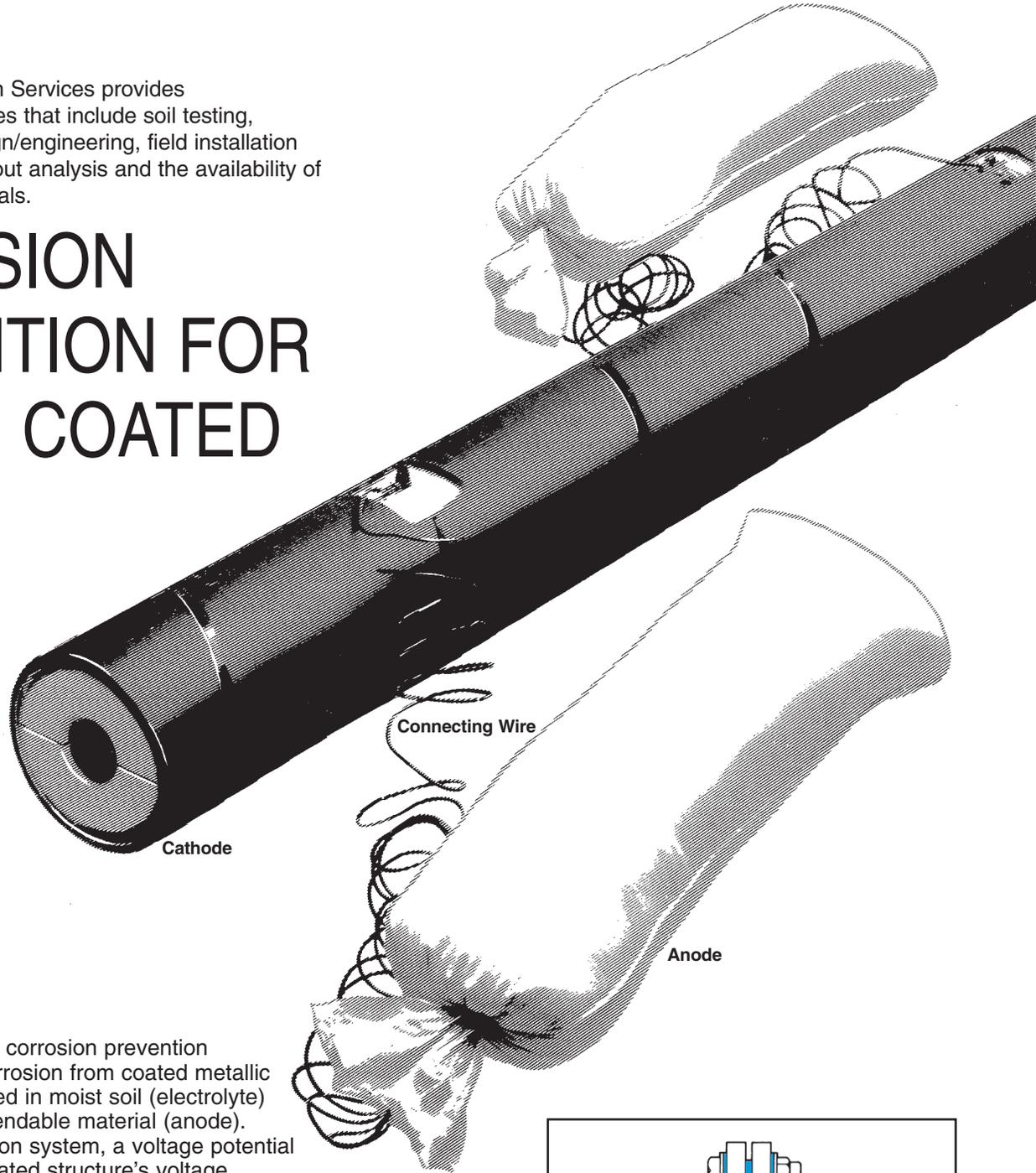


PERMA-PIPE®

Cathodic Protection

PERMA-PIPE® Inspection Services provides cathodic protection services that include soil testing, computer generated design/engineering, field installation instruction, system checkout analysis and the availability of cathodic protection materials.

CORROSION PREVENTION FOR BURIED, COATED METALS



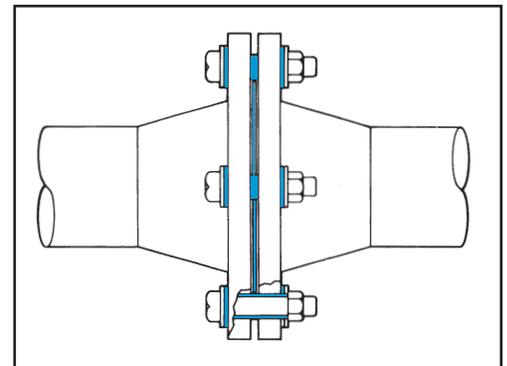
Cathodic Protection

Cathodic protection is a corrosion prevention technology that deters corrosion from coated metallic structures (cathode), buried in moist soil (electrolyte) and redirects it to an expendable material (anode).

With a cathodic protection system, a voltage potential force (greater than the coated structure's voltage potential force) is impressed upon the surface of the coated metallic structure from the anodes. This prevents current discharge into the soil by transferring the corrosion reaction to the anodes.

Electrical isolation is the key to success in cathodic protection systems. Buried coated metallic structures, protected by cathodic protection systems, must be electrically isolated. This prevents the protective current from flowing to other buried structures, such as:

1. adjacent piping,
2. pipe and equipment within a building,
3. pipe passing through steel reinforced concrete and
4. any foreign metallic structure in the area.



Electrically Isolated Flange Detail
Insulating Material

Systems

PERMA-PIPE's engineers are certified by the National Association of Corrosion Engineers (NACE) and are experts in the design of cathodic protection systems. We design, manufacture and service quality piping systems worldwide.

Types of Cathodic Protection

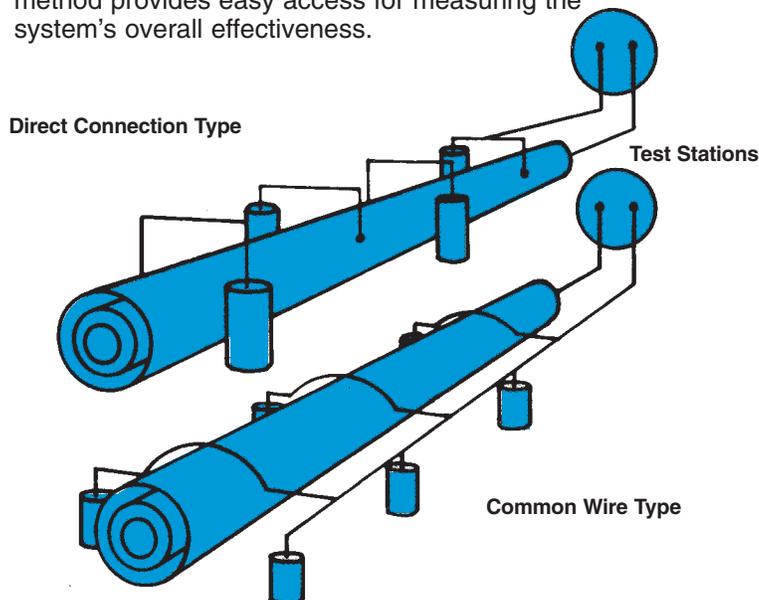
There are two types of cathodic protection systems - sacrificial anode and rectifiers. In a properly designed and maintained system, both are effective in deterring corrosion from the exterior surface of buried metallic structures.

Sacrificial Anode Systems impress a voltage potential force onto the outside surface of the protected structure by use of dissimilar metals. The four basic components of the system are:

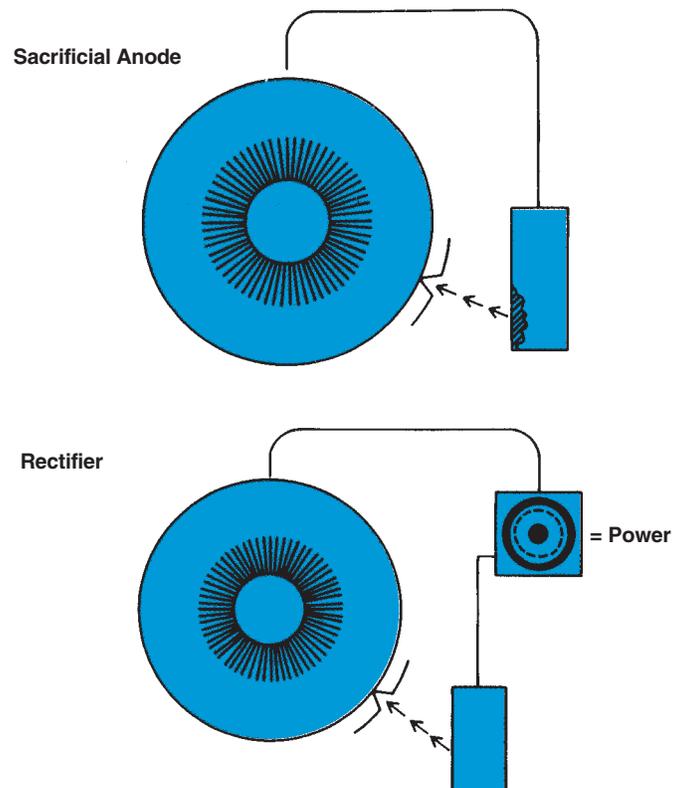
1. Anodes - Negative electrode in the corrosion cell (usually magnesium or zinc).
2. Cathode - Positive electrode in the corrosion cell (the coated structure, usually iron or steel).
3. Electrolyte - Electrically conductive common backfill material (moist soil or water).
4. Connecting Wire - Return path for the corrosion currents that are generated between the anode and the cathode.

Sacrificial anodes are normally installed one of two ways:

1. Each anode wire is welded directly to the protected structure or
2. anodes are spliced to a common gathering wire that is laid parallel to the protected structure, terminating at the test station where it is connected to the protected structure by a lead wire. This method provides easy access for measuring the system's overall effectiveness.



Rectifier Systems convert A.C. current to D.C. current and impress a voltage potential force upon the exterior surface of the protected structure through inert anodes (usually carbon or high silicon cast iron). This system differs from the sacrificial anode system only in the manner that current is generated.



Cost Effective Cathodic Protection Systems

The use of properly designed, properly maintained cathodic protection systems can extend the life of buried, coated metallic structures 15 years or longer. The cost of corrosion control is minimal when compared to the expense of maintaining or replacing a deteriorated system and the disruption of service. Normally, the cost is only 5 to 10% of the total installed price of a buried pipe distribution system.

Cathodic Protection Systems:

- Extend the Life of Buried Metallic Structures
- Increase Return on Investment
- Reduce Repair Costs
- Meet Requirements of DOT and EPA for Hazardous Materials Containment Vessels and Piping

Typical Applications/Users

Typical Applications
Buried Piping Systems
Buried Storage Tanks
Walkthrough Tunnels
Steel Manholes

Typical Users
Military Bases
Government Installations
Colleges/Universities
Public Utilities
Hospitals
Private Industrial Plants

GENERAL

Cathodic protection against galvanic corrosion shall be provided for the underground piping furnished under these specifications. The cathodic protection system shall be designed and furnished by the piping system manufacturer. Cathodic protection materials, including anodes, wire and test stations shall be supplied by the cathodic protection system supplier. Testing of the system as outlined in the NACE Recommended Practice RP-01-69 (Latest Revision) shall be made under the direction of a NACE Accredited Corrosion Specialist. The cathodic protection system shall be tested within six months of completion of backfilling.

The cathodic protection system shall be designed for a minimum anode life of twenty years, upon an earth resistivity test performed by the manufacturer. A soil survey shall be conducted along the route of the proposed piping system to determine the corrosivity of the soil. The firm conducting the survey shall be regularly engaged in corrosion related work and shall be under the direction of a Corrosion Specialist accredited by the National Association of Corrosion Engineers.

MATERIALS

ANODES-17# Magnesium anodes shall be used having the following chemical compositions.

Aluminum	5.3 - 6.7%
Manganese	0.15% Minimum
Zinc	2.5 - 3.5%
Silicon	0.3% Maximum
Copper	0.05% Maximum
Nickel	0.003% Maximum
Iron	0.003% Maximum
Other	0.3% Maximum
Magnesium	Remainder

All anodes shall be cast with a perforated galvanized steel strap core. The anode lead wire shall be #12 type THWN solid copper wire. The anode lead wire shall be connected to the strap core with silver solder. The anode shall be packaged in a permeable cloth bag containing backfill of the following composition:

Hydrated Gypsum	75%
Powdered Bentonite	20%
Sodium Sulfate	5%

Provide granular backfill with 100 percent passing through a 100 mesh screen. Provide prepackaged anode in a bag containing the anode and backfill. Center the anode in the firmly packaged backfill. anodes should be buried in natural earth.

ELECTRICAL ISOLATION

Piping must be electrically isolated from internal building piping at the point of connection inside the building and at manhole entries. Dielectric flanges must be installed on each pipe and the pipe must be isolated from the building wall with

wall sleeves and link seals. It shall be the responsibility of the contractor to install the underground piping to prevent shorting of the system to building steel, reinforcing steel in buildings, manhole walls, foundations and other buried metallic structures. Electrical isolation flanges or dielectric unions shall be installed on all piping at all building entries and wherever else required to electrically isolate the piping system. Electrical isolation materials must be suitable for the temperatures and pressures of the piping system.

TEST STATIONS

Test stations shall be located at maximum 300 foot intervals for the purpose of testing the performance of the cathodic protection system. Test leads shall be housed in electrical conduit and terminate in waterproof junction boxes.

INSTALLATION

The installing contractor shall handle the materials in accordance with the directions furnished by the cathodic protection supplier and as approved by the engineer.

TESTING

After complete backfill of the site by the installing contractor, the cathodic protection system shall be tested to provide conformance to NACE criteria. Criteria for determining the adequacy of protection shall be per NACE Standards.

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