



Description

This procedure gives the steps to use when installing cathodic protection systems.

**Regulatory
Applicability**

The following PHMSA regulated pipelines –

- Converted under 49 CFR 192.14 – Must meet the requirements of 49 CFR 192.457 and all other applicable requirements within 1 year of the pipeline being readied for service. However, the requirements of 49 CFR 192.455 apply if the pipeline substantially meets those requirements before it is readied for service or it is a segment that is replaced, relocated or substantially altered.
- Regulated onshore gathering – If the pipeline existed on April 14, 2006, but was not previously subjected to 49 CFR, and any onshore gathering line that becomes a regulated onshore gathering line under 49 CFR 192.9 after April 14, 2006, because of a change in class location or increase in dwelling density:
 - The requirements for corrosion control specifically applicable to pipeline installed before August 1, 1971, apply to the gathering line regardless of the date was actually installed; and
 - The requirements of this subpart specifically applicable to pipelines installed after July 31, 1971, apply only if the pipeline substantially meets those requirements.
- Buried or submerged pipelines installed after July 31, 1971 unless they meet an exception as outlined in 49 CFR 192.455
- Buried or submerged pipelines installed before August 1, 1971 – If the line has an external coating it must be cathodically protected along the entire area that is effectively coated.

Note: Buried piping at compressor, regulator, and measuring stations are exempt from this requirement.

- Except for cast iron or ductile iron pipe, each of the following buried or submerged pipelines installed before August 1, 1971, must be cathodically protected in accordance with 49 CFR Subpart I only in areas where active corrosion is found. (“Active corrosion” is defined as continuing corrosion which, unless controlled, could result in a condition that is detrimental to public safety.)
 - Bare or ineffectively coated transmission lines;
 - Bare or coated pipes at compressor, regulator, and measuring stations;
 - Bare or coated distribution lines.

Note: West Texas Gas will determine the areas of active corrosion, pursuant to P-192.465(e), by electrical survey, or where electrical survey is impractical, by the study of corrosion and leak history records, by leak detection survey, or by other



effective means, documented by data substantiating results and determinations.

Cathodic protection is not required in areas where active corrosion is not found in pipelines installed before August 1, 1971.

- Transmission Pipelines
- Regulated Gathering Pipelines (Type A)
- Regulated Gathering Pipelines (Type B)
- Distribution Pipelines

Frequency As needed after pipe repair, replacement, or to mitigate corrosion

Reference 49 CFR 192.452 *How Does This Subpart Apply to Converted Pipelines and Regulated Onshore Gathering Lines?*

49 CFR 192.453 *General*

49 CFR 192.455 *External Corrosion Control: Buried or Submerged Pipelines Installed After July 31, 1971*

49 CFR 192.457 *External Corrosion Control: Buried or Submerged Pipelines Installed Before August 1, 1971*

49 CFR 192 Appendix D *Criteria for Cathodic Protection & Determination of Measurements*

16, TAC Rule 8.203 **Supplemental Regulations**

LA Title 43 Part XIII 2103 *How Does This Subpart Apply to Converted Pipelines and Regulated Onshore Gathering Lines?*

LA Title 43 Part XIII 2105 *General*

LA Title 43 Part XIII 2107 *External Corrosion Control: Buried or Submerged Pipelines Installed After July 31, 1971*

LA Title 43 Part XIII 2109 *External Corrosion Control: Buried or Submerged Pipelines Installed Before August 1, 1971*

Forms / Record Retention F-192.455 *Installation of Cathodic Protection System / Life of Pipeline System*



**Related
Specifications**

NACE RP-769-2002 *Control of External Corrosion on
Underground or Submerged Metallic
Piping Systems*

**OQ Covered
Task**

0081 *Install Cathodic Protection Electrical Isolation Devices*

(In order to perform the tasks listed above; personnel must be qualified in accordance with West Texas Gas's Operator Qualification program or directly supervised by a qualified individual.)



Procedure Steps

Steel Pipelines:

Each buried or submerged pipeline installed prior to August 1, 1971, that has an effective external coating, must be protected against external corrosion.

- This is not required on the following locations unless areas are found where active corrosion is found the following must be cathodically protected:
 - Bare or ineffectively coated transmission lines
 - Bare or coated distribution lines
 - Bare or coated pipes at compressor, regulator, and measuring stations

Each buried or submerged pipeline installed after July 31, 1971 must be protected against external corrosion, including the following:

- It must have an external protective coating meeting the requirements of §192.461
- It must have a cathodic protection system designed to protect the pipeline in accordance with this subpart, installed and placed in operation within 1 year after completion on construction.

NOTE: If West Texas Gas can demonstrate through tests, investigation or experience in the area of application, including as a minimum, soil resistivity measurements and tests for corrosion accelerating bacteria, that a corrosive environment does not exist; the pipeline is not required to have external corrosion control. Each test, investigation, or experience used when determining cathodic protection systems is not required must be backed by documented proof to substantiate results and determinations. However, within 6 months of this decision, West Texas Gas will conduct tests, including pipe-to-soil potential measurements with respect to either a continuous reference electrode or an electrode using close spacing, not to exceed 20 feet, and soil resistivity measurements at potential profile peal locations, to adequately evaluate the potential profile along the entire pipeline. If the tests made indicate that a corrosive environment exists, the pipeline must be cathodically protected.

When a condition of active external corrosion is found on a pipeline installed before August 1, 1971, positive action will be taken to mitigate and control the effects of the corrosion. Schedules will be established for application of corrosion control. Monitoring effectiveness will be adequate to mitigate and control the effects of the corrosion prior to it becoming a public hazard or endangering public safety. See Procedure P-192.465(a) for cathodic protection monitoring.

The cathodic protection system must be evaluated, designed, installed and maintained by persons qualified through training and experience, and who will utilize the following sources of information to evaluate and design a cathodic protection system:

- Soil resistance studies along the pipeline route.
- Electrical surveys of the unprotected pipeline.
- Areas of electrical interference.



- Areas with foreign pipelines crossing.
- Areas requiring electrical isolation.
- Soil areas along the pipeline route that might contain corrosive elements.¹

Plastic Pipelines

Normal construction and repair practices post January 22, 2019 does not include the installation of metallic fittings below grade. In the rare event of circumstances that the only method of installation or repair of the pipeline would include a metallic fitting below grade, notification to the Compliance Department is required and the following criteria is required:

- An anode of appropriate size must be installed unless the metallic fitting can be:
 - WTG can prove by test, investigation or experience the metallic fitting has adequate corrosion control within the alloy composition and the fitting is designed to prevent leakage caused by localized corrosion pitting. This information must be recorded and placed into the project file.
 - The corrosion control method must be documented in writing and the document placed within the project file.

NOTE: Aluminum may not be installed in a buried or submerged pipeline if exposed to an environment with a natural pH in excess of 8.

Required Level of Cathodic Protection

The amount of protection must be controlled so as to not damage the coating or pipe. Any cathodic protection system required to be installed must meet one of the following criteria:

1. A negative voltage of at least 850 millivolts, with reference to a saturated copper-copper sulfate half cell. Determination of this voltage must be made with the protective current applied.
2. A negative voltage shift of at least 300 millivolts. Determination of this voltage shift must be made with the protective current applied. This applies to structures not in contact with metals of different anodic potentials.
3. A minimum negative polarization voltage shift of 100 millivolts. This polarization voltage shift must be determined by interrupting the protective current and measuring the polarization decay. When the current is initially interrupted, an immediate voltage shift occurs. The voltage reading after the immediate shift must be used as the base reading from which to measure polarization decay.
4. A voltage at least as negative as the originally established voltage at the beginning of the Tafel segment of the E-log-I curve.



5. A net productive current from the electrolyte into the structure surface as measured by an earth current technique applied at predetermined current discharge (anodic) points of the structure.

Interpretation of Voltage Measurement

Voltage (IR) drops other than those across the structure / electrolyte boundary must be considered for valid interpretation of the voltage measurements in #1 and #2 above.

Reference Half Cells

Except as provided below, negative (cathodic) voltage must be measured between the structure surface and a clean saturated copper-copper sulfate half cell contacting the electrolyte.

Other standard reference half cells may be substituted for the saturated copper-copper sulfate half cell. Two commonly used reference half cells are listed below along with their voltage equivalent to 850 millivolts as referred to a saturated copper-copper sulfate half cell.

1. Saturated KCL calmel half cell : - 780 millivolts
2. Silver-silver chloride half cell used in sea water: - 800 millivolts.

In addition to the standard reference half cells, an alternate metallic material or structure may be used in place of the saturated copper-copper sulfate half cell if its potential stability is assured and if its voltage equivalent referred to a saturated copper-copper sulfate cell is established.

Ground Beds

Follow these steps to install ground beds for cathodic protection.

1. Excavate line.
2. Surface Beds:
 - a) Remote:
 - i) Install vertically or horizontally between 5 and 15 feet deep on 10- or 15-foot centers between anodes approximately 400 feet away from pipeline.
 - b) Distributed:
 - i) Locate in close proximity to structure. Anodes should be located 5 to 10 feet away from the structure.
3. Deep Beds:
 - a) Shallow well anodes:
 - i) Install in vertical hole.
 - ii) Drill hole depths according to company and manufacturer standards.
 - iii) Install anode singular or multiple stacked according to company needs.
 - iv) Install coated or high-silicon iron anodes.
 - b) Deep well anodes:



- i) Install in vertical drilled holes.
 - ii) Drill hole depths according to company and manufacturer standards.
Drilling and completion procedures must comply with local and state regulations.
4. Backfill with carbonaceous backfill, or backfill with removed soil if prepackaged anodes have been used.
 5. Test for the presence of AC/DC current interference. Potential sources include, but are not limited to, other pipeline cathodic protection facilities, DC Traction systems (subways, light rail systems, trolleys, etc.), high voltage AC transmission lines, welding facilities, stray currents, etc. Install bonds according to the following section as applicable.

Bonds

Follow these steps to install bonds for cathodic protection.

1. Conduct joint cooperative interference tests with personnel representing the affecting structure to determine location of current discharge and magnitude of interference current.
2. Install cathodic wire leads on structure being adversely affected at location of current discharge.
3. Install cathodic wire lead on structure receiving current at a convenient location.
4. Cathodic test wires are to be attached by thermite weld (Cadweld, Thermoweld, etc.), brazing or other method that will yield a permanent, low-resistance connection. This must be done by a qualified individual using a written procedure.
5. Terminate cathodic wires from both structures inside a single test box that is accessible to both structures.
6. Inside of the test box, install shunts for measurement of current flow. Also install resistors as required to limit current interchange between the structures.
7. Install blocking diodes as required.
8. Conduct tests to determine effectiveness of the installed interference bond.
9. Install rectifiers or reverse current switches in unusual situations where a conventional metallic bond is not effective. This installation must be done by a qualified person.

Anodes

Follow these steps to install anodes for cathodic protection.

1. Select the proper size anode according to amount of pipe to be protected and the soil conditions. A pound of magnesium can protect 3860 square inches of bare metal pipe.
 - a) A guide to selecting anodes for coated pipelines is provided below. However, the dielectric strength of the coating, soil resistivity, square feet of pipe being protected and the desired life of the anodes should also be considered.

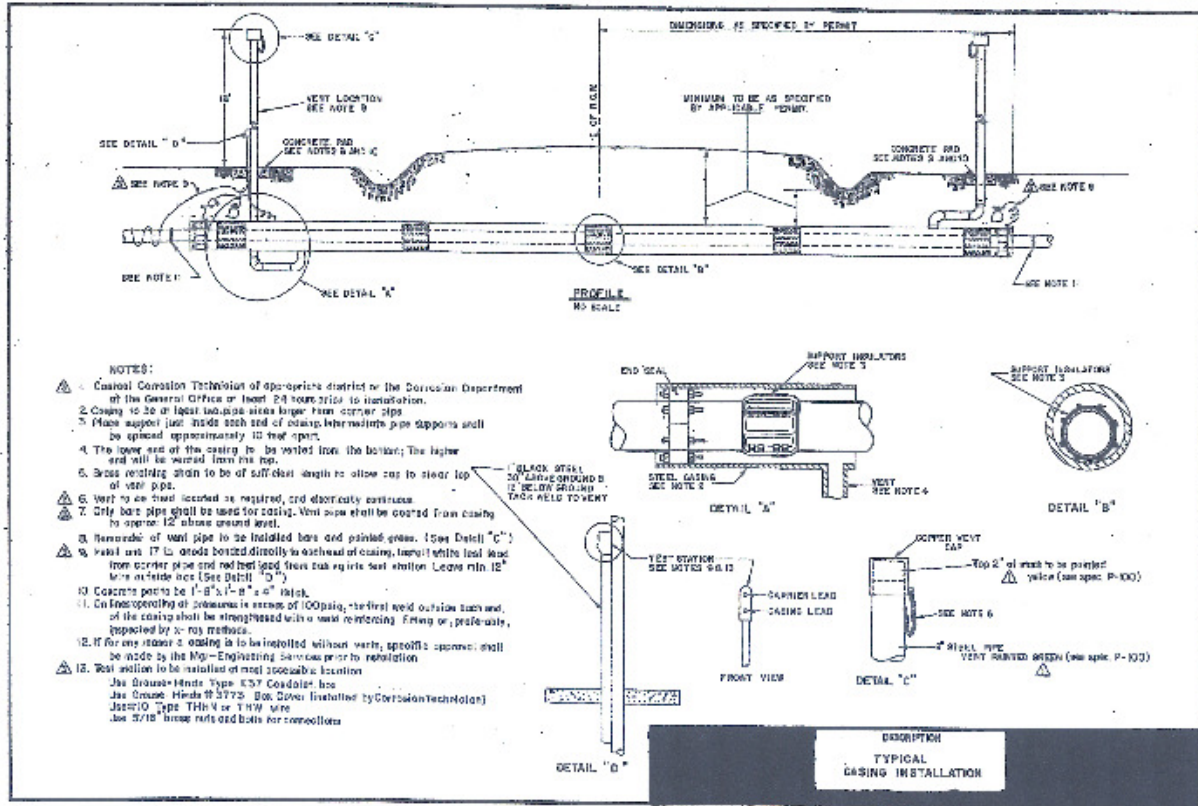


Service Rises and etc.	1 lb.
Short, small diameter service lines and etc.	5 lbs. to 9 lbs.
Sections of mains, space for adequate coverage	17 lbs.
Sections of Mains in low resistance soils spaced for adequate coverage	32 lbs.

- b) Pipe-to-soil readings should be taken before and after anode installation, so that the pipeline meets the criteria for protection as described above.
- 2. Galvanic Anodes – Determine the most suitable location for anode installation.
 - a) Excavate anode hole at least four feet from the pipeline and at the same or greater depth of the pipeline to be protected.
 - b) Install anode by placing in horizontal position and perpendicular to the pipe.
- NOTE: Do not lift or lower the anode by its lead wire.
 - c) Use care to protect the connection of the lead to the anode as even a small crack in the coating can allow moisture penetration leading to failure.
 - d) Bury at sufficient depth to protect against accidental damage.
 - e) Wet down anode prior to backfilling.
 - f) Uncoil anode pigtail and extend fully, being careful not to damage or kink wire.
 - g) Backfill carefully with native soil backfill. Use rock-free backfill to pad anode and the anode lead wire.
 - h) Use care not to damage the coating of the lead wire.
- 3. Impressed Current Anodes
 - a) Determine location of anode installation.
 - b) Excavate vertical hole or horizontal ditch for anode installation.
 - c) Carefully install anode(s) in excavated hole. Do not lift or lower an anode by its lead wire.
 - d) Use care to protect the connection of the lead to the anode as even a small crack in the coating can allow moisture penetration leading to failure.
 - e) Bury at sufficient depth to protect against accidental damage.
 - f) Surround anode with coke breeze. For vertically augured holes, bring coke breeze level up to just under ground surface level if a vent pipe is not installed, to make a porous path for off-gassing to occur.

- g) Backfill with native soil. Use rock-free soil to pad the anode and the lead wire, being careful not to damage either.
- h) Use care not to damage the coating of the lead wire.

Figure 1. Typical Casing Installation





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