

Technical Seminar for Cathodic Protection to GOGC Design Unit Specialists

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WITHIN THE JURISDICTION OF THE MINISTRY OF ENVIRONMENT, ENERGY & CLIMATE CHANGE



Source of Development, Supplier of Energy



Cathodic Protection

Statistics on gas Pipeline accidents

- **EGIG. 8th Report of the European Gas Pipeline Incident Data Group. 2011**
- **U.S. Dept. of Transportation, Pipeline & Hazardous Materials Safety Administration (PHMSA)**
http://primis.phmsa.dot.gov/comm/reports/safety/SigPSIDet_1993_2012_US.html?nocache=4940#_ngtrans.



Protection System against Corrosion

- **Impressed Current Cathodic protection**
- **Coating**
- **AC mitigation**
- **Surge/Lightning Protection System**



Cathodic Protection Inspection Objectives

- Protecting pipelines and piping accessories against corrosion
- Acting as a diagnostic tool for infrastructure integrity
- Operation and testing of the earthing equipment that mitigates the electric interference detriments
- Operation and testing of isolating piping accessories (e.g. insulating flanges/joints, casing spacers etc.)



Cathodic Protection

- ◆ **Cathodic Protection (CP) is the main method of protecting buried low alloy carbon steel pipelines against corrosion**

Principle:

Supply of dc cathodic current to the under protection structure

Application methods:

- ***Galvanic (Sacrificial) Anodes***
- ***Impressed Current (ICCP)***



Cathodic Protection

WORKING GALVANIC ANODE OF ZINC OR MAGNESIUM BURIED IN EARTH AND CONNECTED TO PIPELINE WITH WIRE WILL DISCHARGE CURRENT AND PROTECT PIPELINE AS SHOWN.

DRIVING VOLTAGE CAN BE DEMONSTRATED BY CONNECTING ANODE AND UNPROTECTED PIPELINE TO VOLTMETER AS SHOWN. TYPICALLY, PIPELINE COULD BE APPROXIMATELY 1.0 VOLT POSITIVE TO MAGNESIUM ANODE AND 0.5 VOLT POSITIVE TO ZINC ANODE.

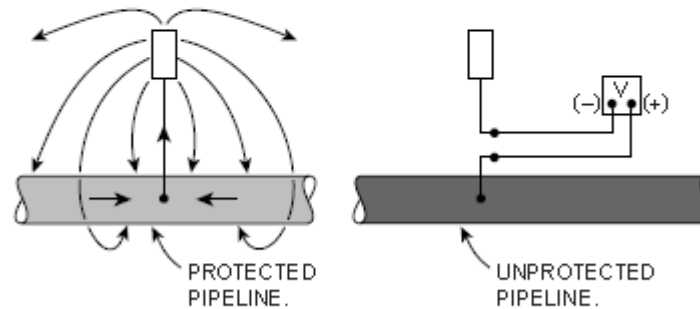
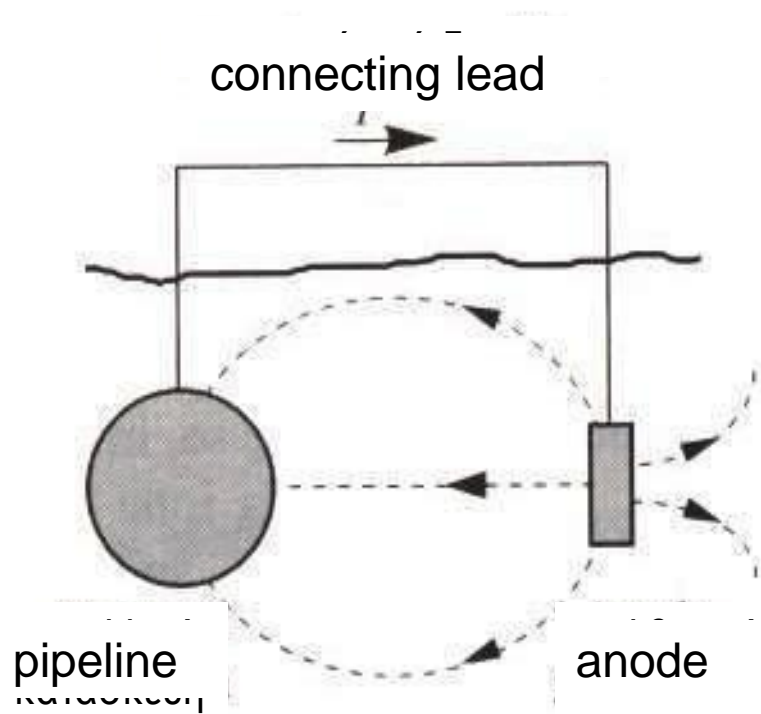


Figure 3.2 Cathodic protection with galvanic anodes.



Cathodic Protection

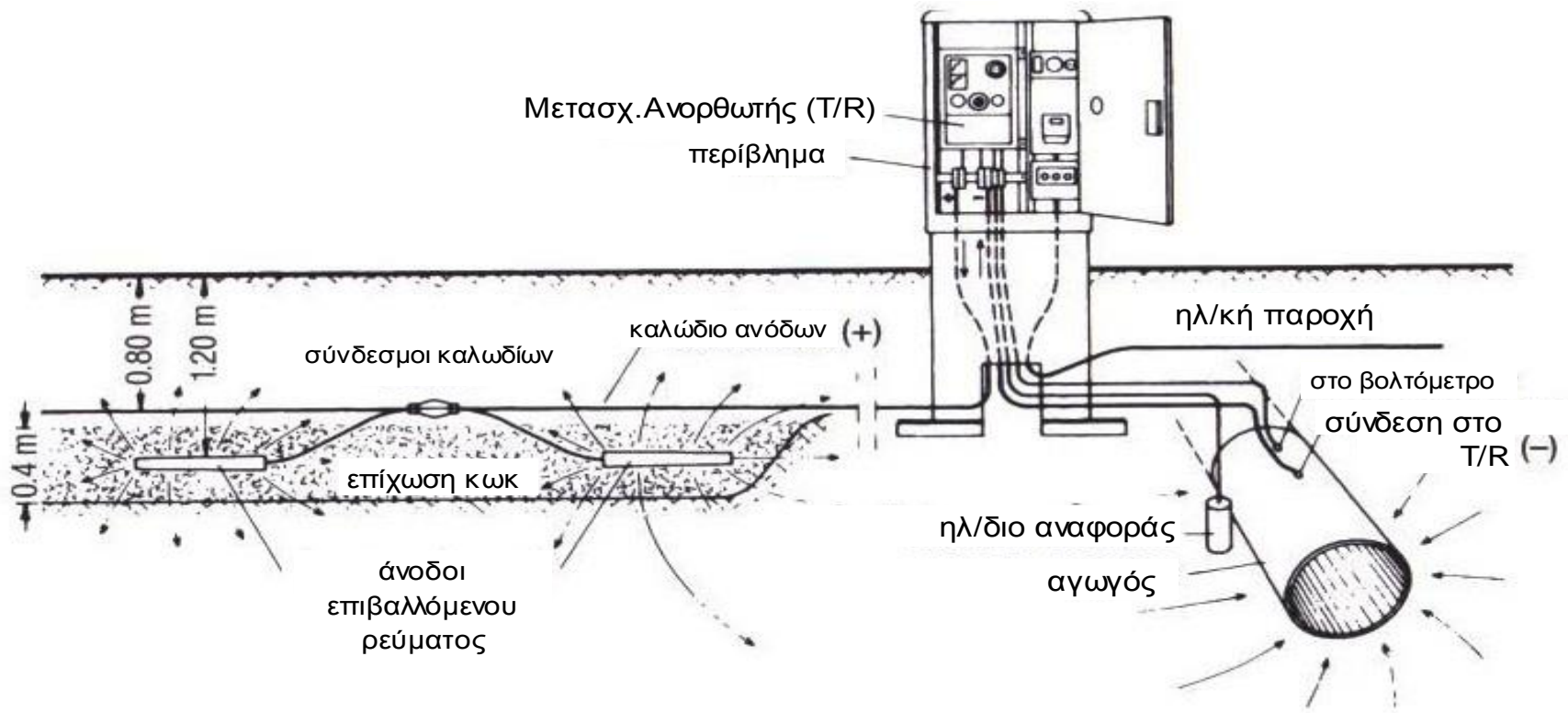
Direct connection with galvanic anode

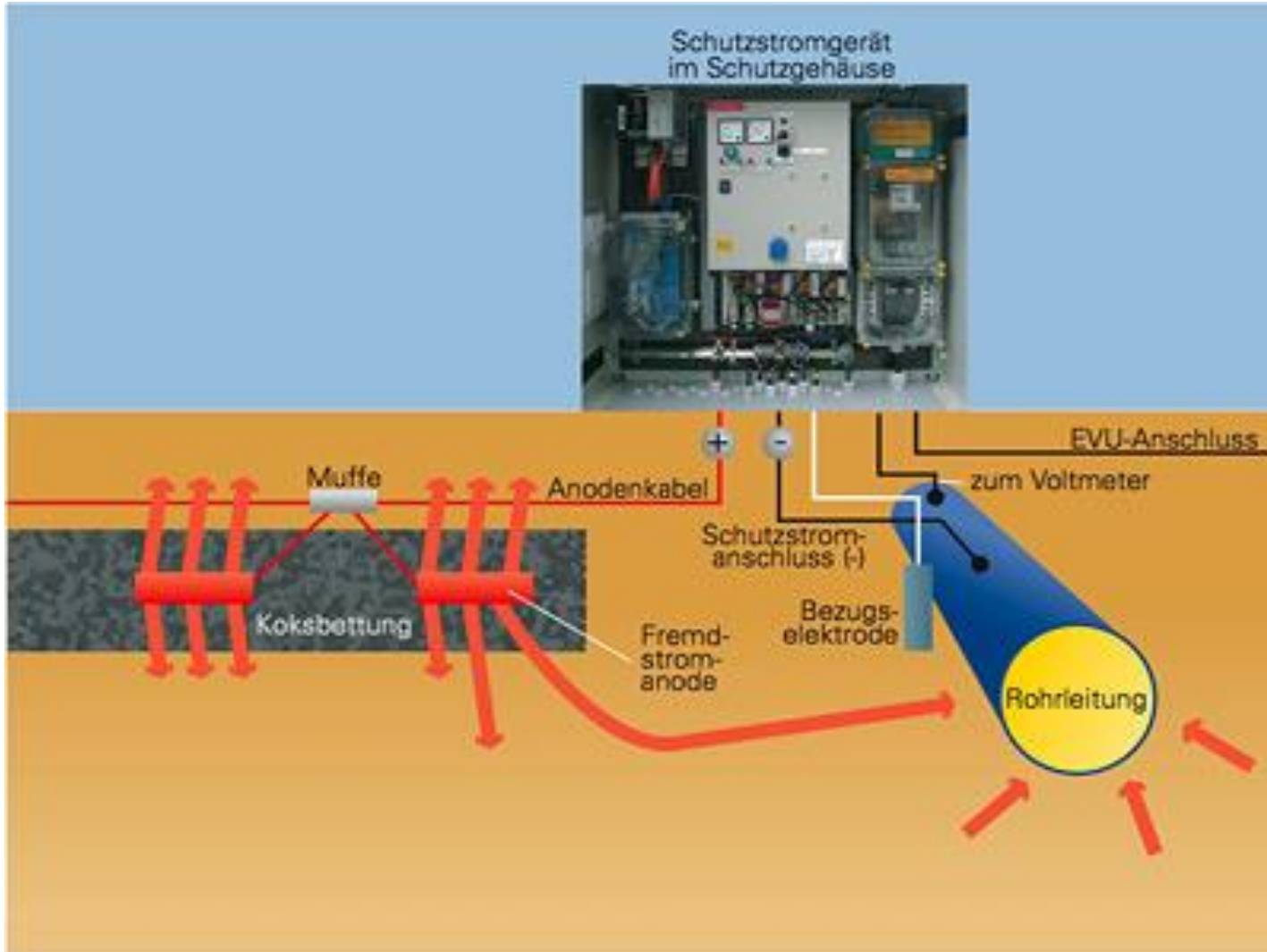




Cathodic Protection

Impressed Current Cathodic Protection System







Transformer/Rectifier

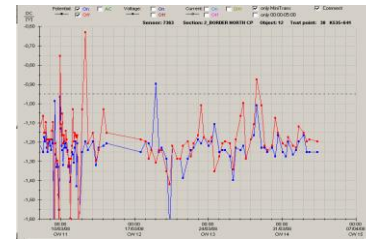
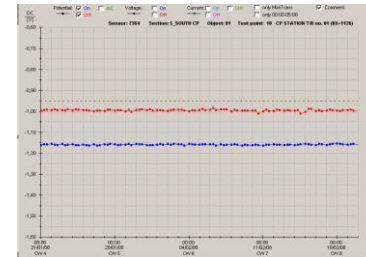
(specifically designed for pipelines with highly isolating coatings)



- Galvanostatic (constant current output) or Potentiostatic operating mode
- Low pass AC filter
- Lightning Protection
 - ❖ mains(230Vac)
 - ❖ Against overvoltages coming from circuit of
 - ✓ Anodes
 - ✓ Reference Electrode
- Remote monitoring (telmeasurement & control of on/off switch relay)
- on/off switching relay



- **Modern equipment for CP maintenance and monitoring.**
 - Remote monitoring at Rectifiers
 - Modern CP data management system





**Basic CP
Installation
(fig. courtesy of
Peabody's book)**

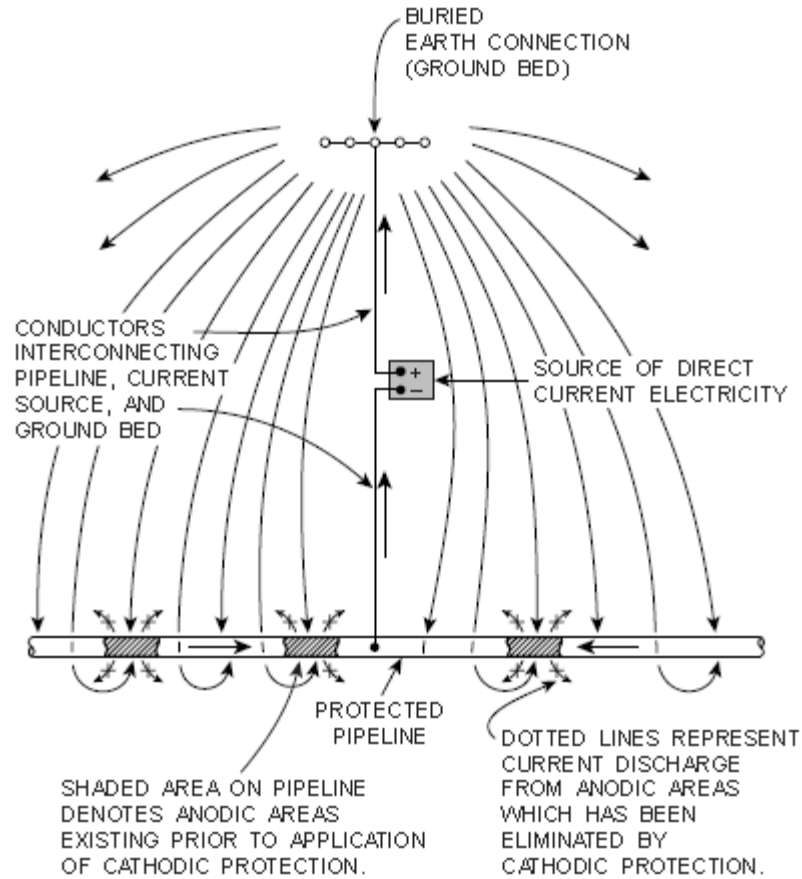


Figure 3.1 Basic CP installation.



Cathodic protection of a coated pipeline

(fig. Courtesy of Peabody's book)

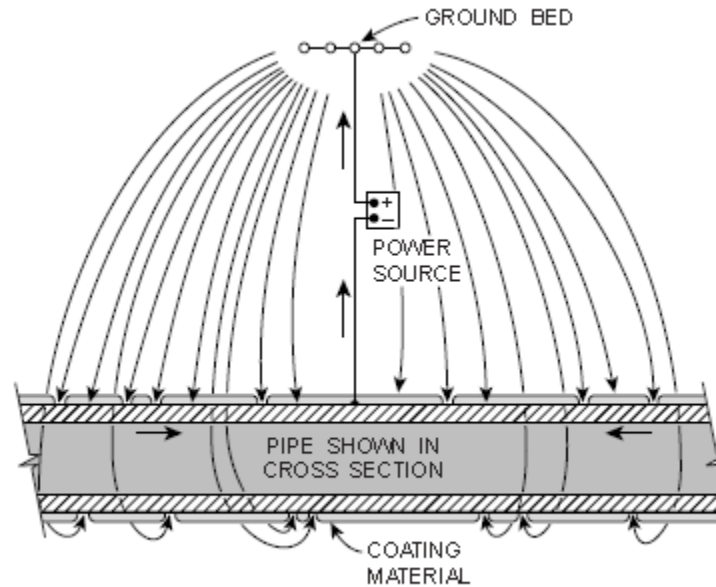


Figure 3.3 Cathodic protection of a coated pipeline.



Range of current required for protection of 10 miles of 36-in diameter pipeline (courtesy of Peabody's book)

Table 3.1 Range of Current Required for Protection of 10 Miles of 36-in Diameter Pipe (under conditions stated in text)

Effective coating resistance in ohms for one average square foot	Current required in amperes
Bare Pipe ^a	500
10,000	14.91
25,000	5.964
50,000	2.982
100,000	1.491
500,000	0.2982
1,000,000	0.1491
5,000,000	0.0298
Perfect coating	0.000058

^aBare pipe assumed to require a minimum of 1 mA/ft².



Simplified equivalent circuit of a pipeline with a remote groundbed (fig. courtesy of Peabody's book)

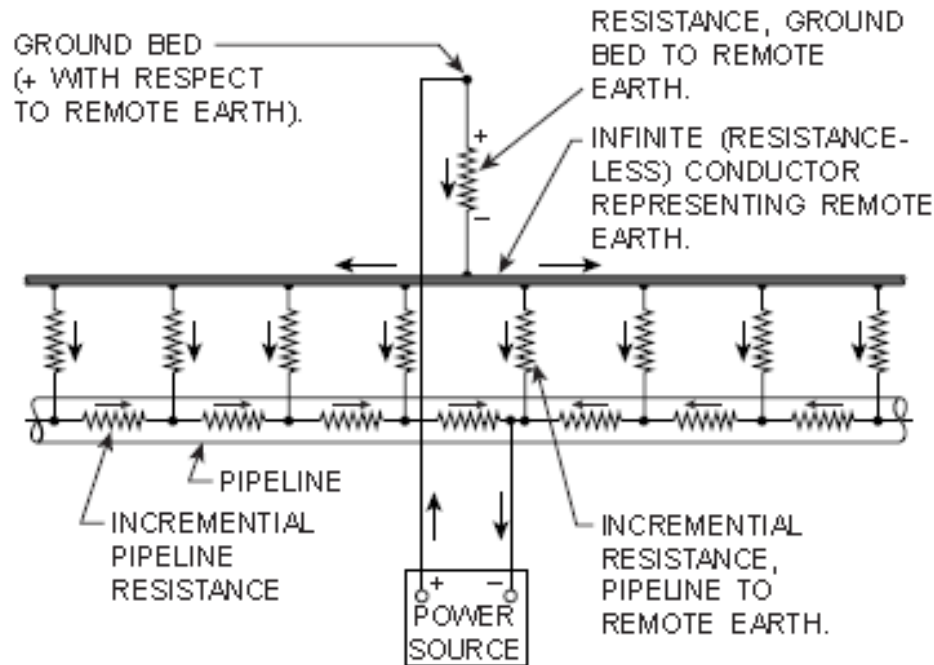


Figure 3.4 Simple equivalent circuit of a pipeline with a remote ground bed.

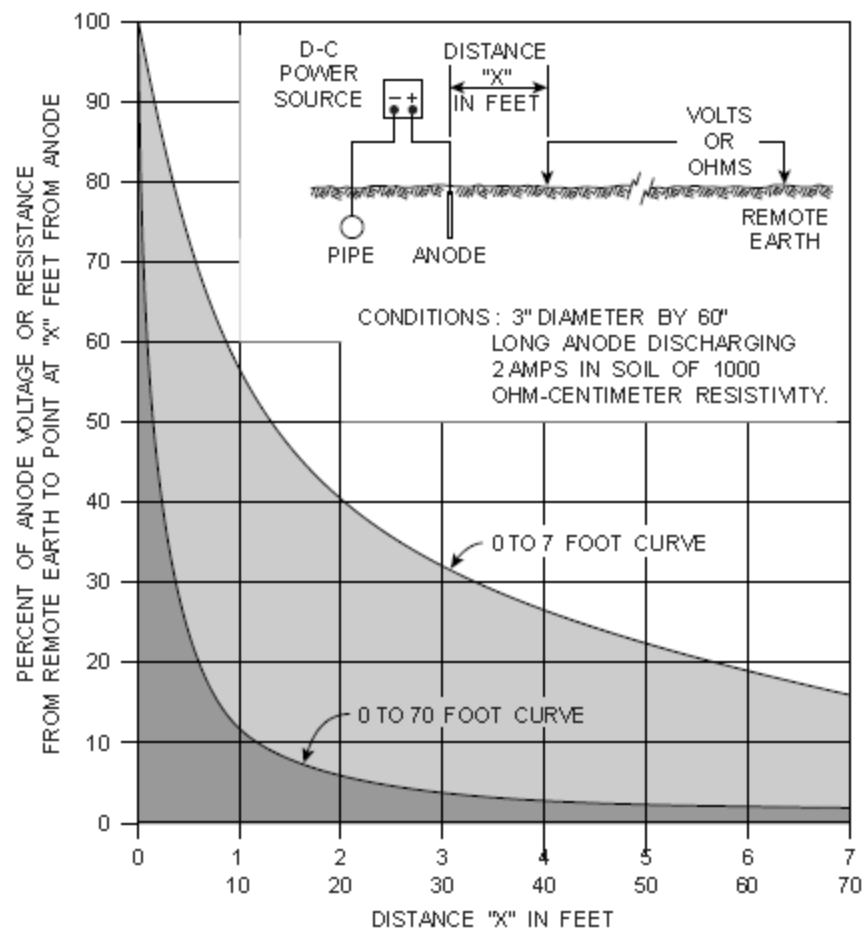


Figure 3.5 Gradients at a ground bed anode.



Close groundbed case

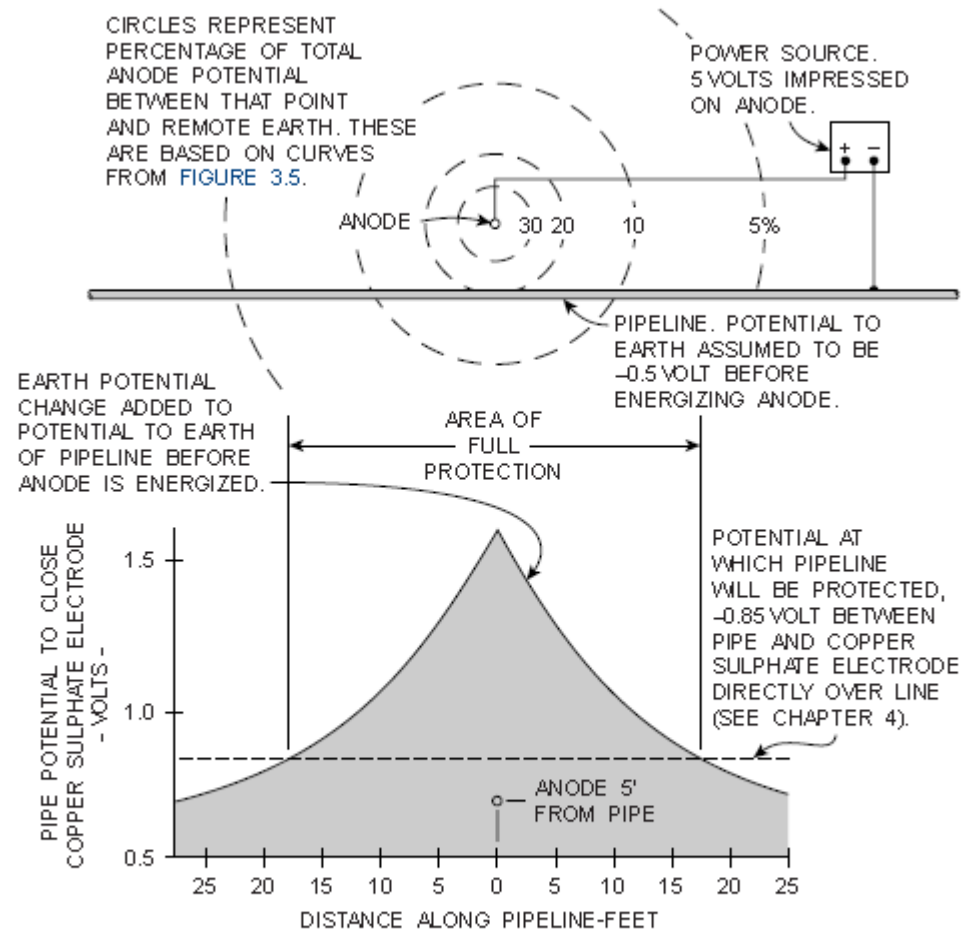


Figure 3.6 Protective potentials impressed on a pipeline by a close ground bed anode.



Electrical Shielding and Cathodic Protection

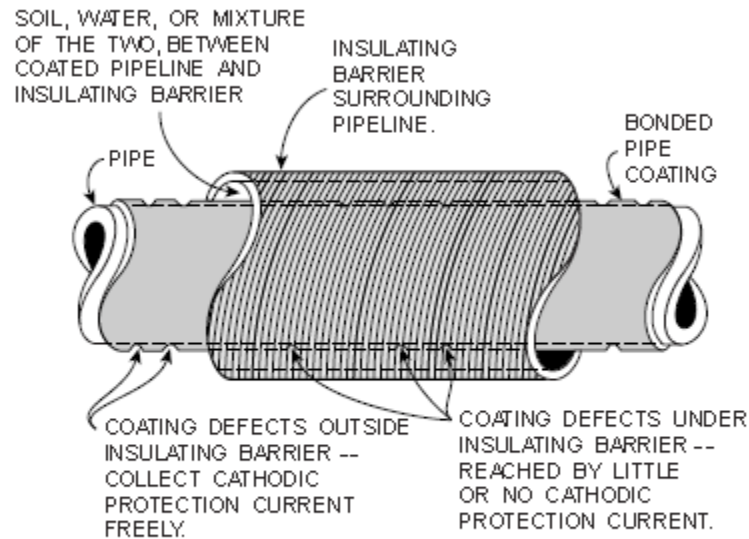


Figure 3.7 Electrical shielding by an insulating barrier.



Electrical Shielding and Cathodic Protection

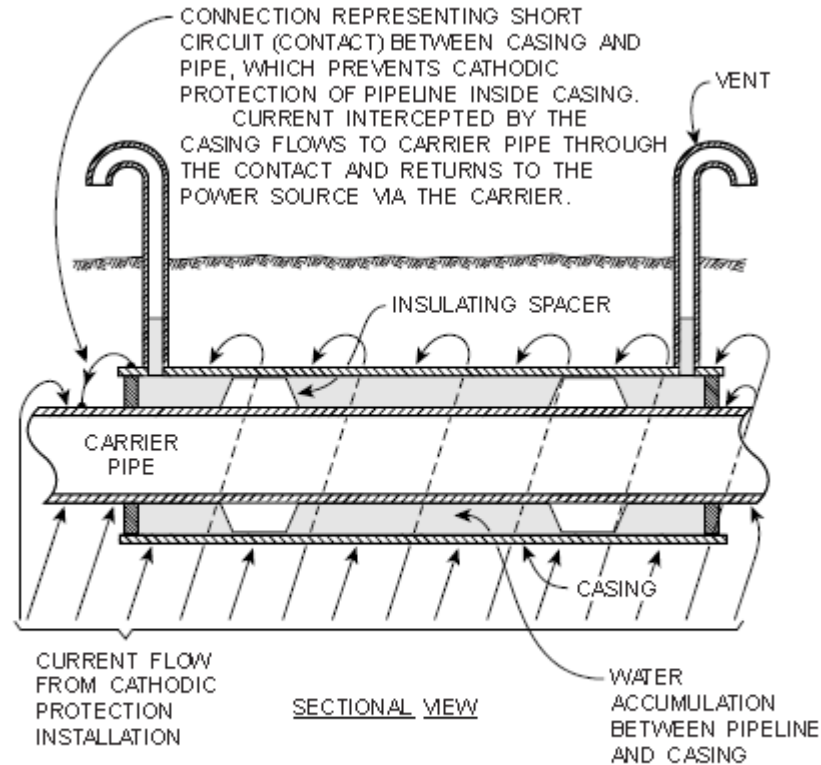


Figure 3.8 Electrical shielding by a shorted pipeline casing.



Electrical Shielding and Cathodic Protection

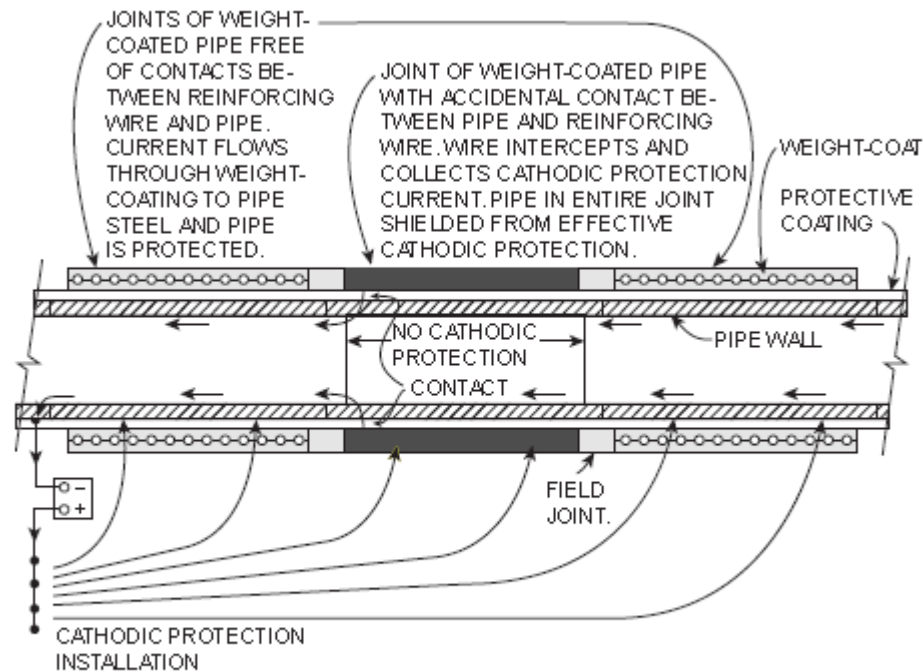


Figure 3.9 Electrical shielding by shorted reinforcing wire in weight coating.



Electrical Shielding and Cathodic Protection

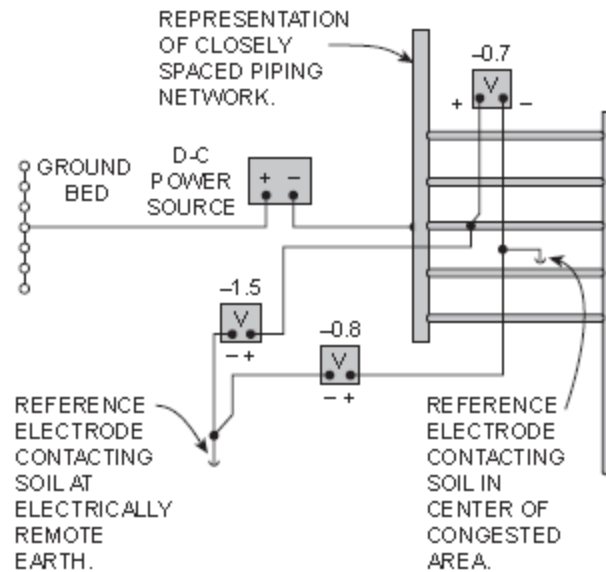


Figure 3.10 Electrical shielding in congested areas.