Cathodic Protection

Track 1

The Definition of Corrosion

- Corrosion is the deterioration of a substance (usually a metal) or it’s properties because of an electrochemical reaction with it’s environment.

The Definition of Cathodic Protection

- CP is, very simply, the use of direct current electricity from an external source to oppose the discharge of corrosion current from anodic areas so the entire surface in contact with an electrolyte becomes a single cathodic area.

Metal Removal Power of Corrosion Current

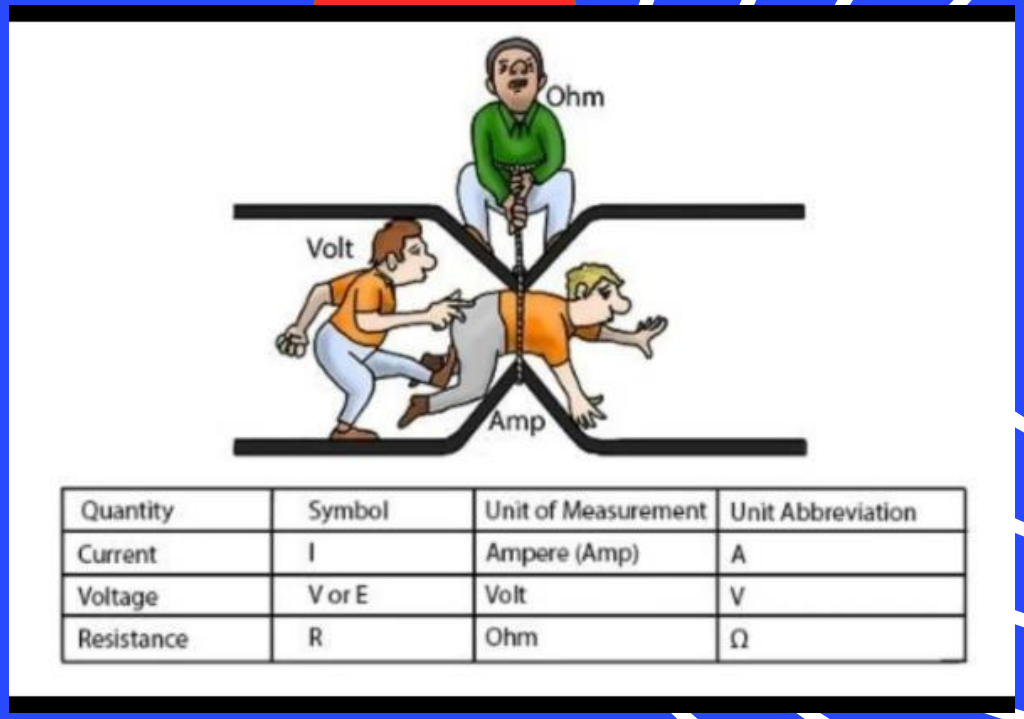
- In one year's time, ***a single milliamp***,

if restricted to a few small points of discharge, (such defects on a coated pipeline), could cause ***seven*** ¼ inch diameter holes in 2" steel pipe of standard wall thickness.

Basic Electricity

Electricity units are

- Volts (Voltage) **E**
  Electromotive **Force**
- Amps (Current) **I**
  Rate of which electrons flow
- Ohms (Resistance) **R**
  How difficult it is for current to flow
- Watts (Power) **W**
  Electrical power equal to one amp under the pressure of one volt



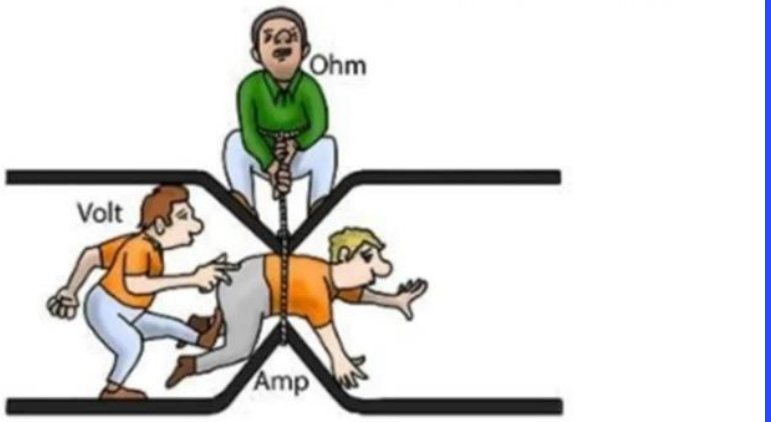
Quantity	Symbol	Unit of Measurement	Unit Abbreviation
Current	I	Ampere (Amp)	A
Voltage	V or E	Volt	V
Resistance	R	Ohm	Ω

From electronic_and_communication Instagram

Basic Electricity

- Ohms law is **E=IR** Volts= Current x Resistance

- Electricity must have a complete circuit to perform work or function
- Large wire has less resistance and a better design for CP
- The amount of current that can applied to a CP structure is controlled by the amount of resistance



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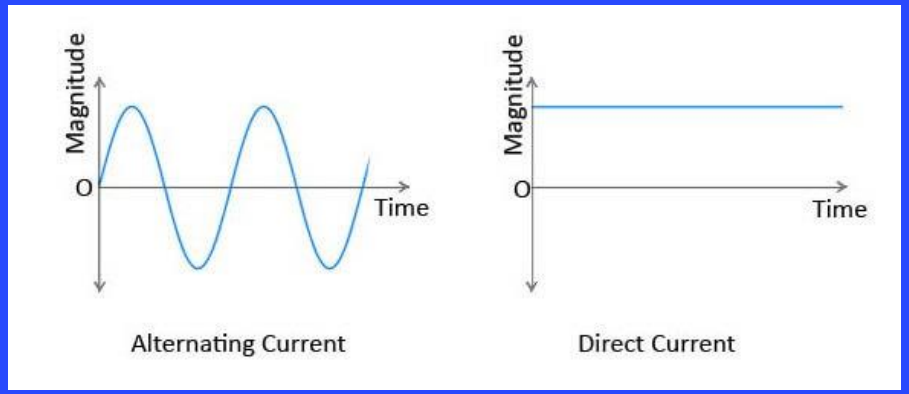
Basic Electricity

Two Types of Electricity

- AC- Alternating Current reverses polarity 60 times a second (60 cycles)

- DC- Direct Current flows in one direction only



Resistance affects both DC and AC circuits!

Basic Electricity

Shunt- device with a known resistance to measure voltage to obtain current

A 50mV 20amp shunt has a reading of 30 mV. The DC current present would be 12 amps

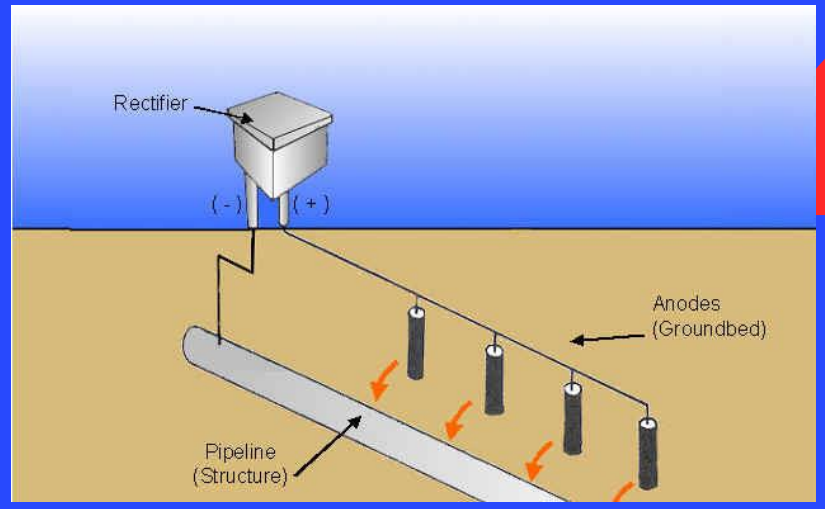
20 / 50= .4 .4 x 30 mV = 12

A 50mV 50 amp shunt has a reading of 30 mV. The DC current present would be 30 amps

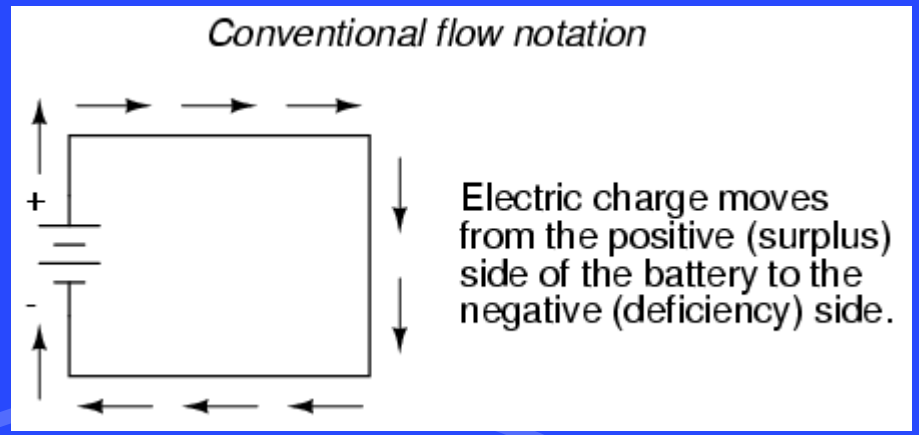
50 / 50= 1 1 x 30 mV = 30

Basic Electricity

The rectifier negative lead is connected to the structure.



Conventional current flow is positive to negative

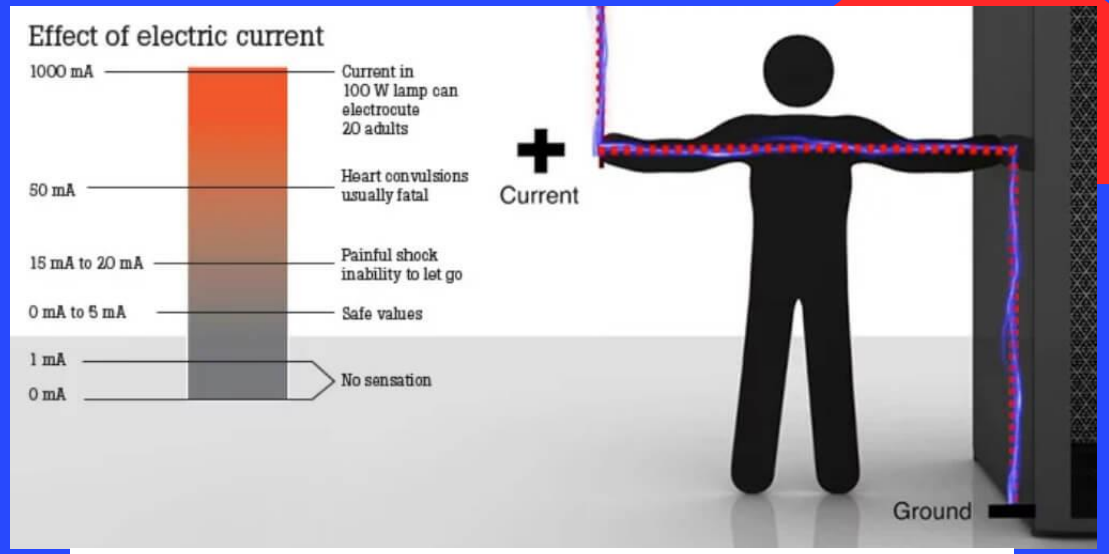


Electricity Safety

OSHA Considers 50 Volts AC or 120 Volts DC or above hazardous

Most Standards-15 V AC or above are dangerous

- Voltage Tester
- Multimeter
- One Hand Touch



BODILY EFFECT	MEN/WOMEN	DIRECT CURRENT (DC)	60 HZ AC	100 KHZ AC
Slight sensation felt at hand(s)				
	Men	1.0 mA	0.4 mA	7 mA
	Women	0.6 mA	0.3 mA	5 mA
Threshold of pain				
	Men	5.2 mA	1.1 mA	12 mA
	Women	3.5 mA	0.7 mA	8 mA
Painful, but voluntary muscle control maintained				
	Men	62 mA	9 mA	55 mA
	Women	41 mA	6 mA	37 mA
Painful, unable to let go of wires				
	Men	76 mA	16 mA	75 mA
	Women	60 mA	15 mA	63 mA
Sever pain, difficulty breathing				
	Men	90 mA	23 mA	94 mA
	Women	60 mA	15 mA	63 mA
Possible heart fibrillation after 3 seconds				
	Men and Women		500 mA	100 mA

Fundamentials of Cathodic Protection

Fundamentals of Cathodic Protection

Cathodic protection can not totally eliminate corrosion

Cathodic protection is present when polarization occurs at the cathode

Metal loss occurs at the anode

When cathodic protection is present hydrogen gas is formed at the cathode and oxygen is formed at the anode

Corrosion is controlled by several methods including Cathodic protection, corrosion inhibiters, and coatings

A Reference Electrode or Half cell is placed close to the structure to measure voltage

Electrochemical corrosion takes place when two dissimilar metals come into contact with a conductive electrolyte

Current required to protect bare steel is high because of the surface area exposed to the electrolyte

Because of the reduced exposed surface area of a coated structure polarization will occur faster than on bare steel structures

Soil structure and restively are important considerations when designing a cathodic protection system

Cathodic Fundamentals

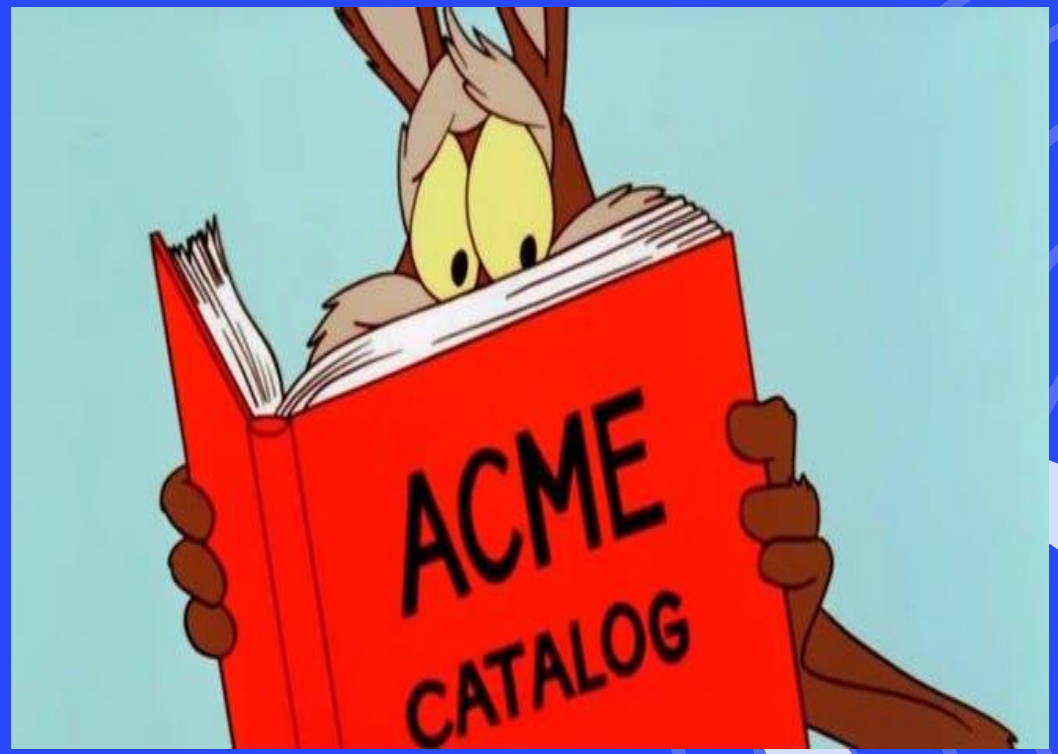
The four parts of a corrosion cell-

Anode

Cathode

Metallic Path

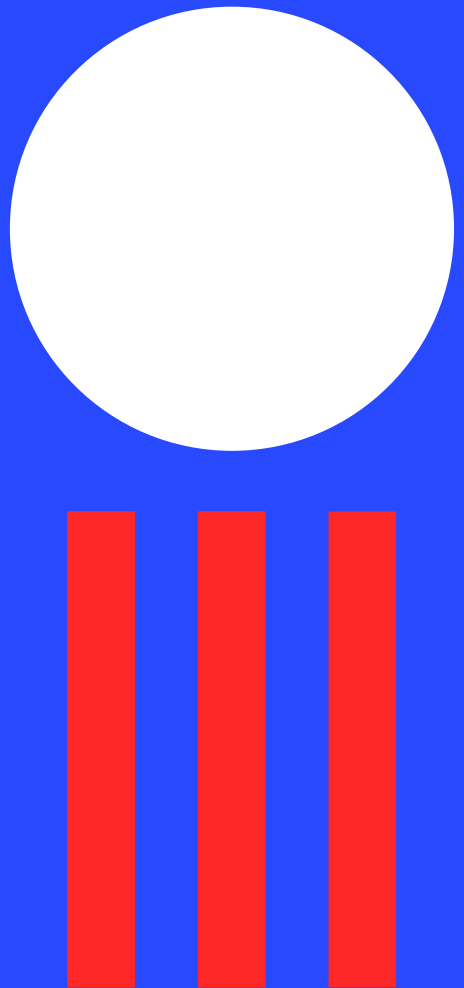
Electrolyte



Cathodic Protection Review

- 4 Parts to a corrosion cell
- Eliminate any 1 to stop corrosion
- CP drastically eliminates anodic areas
- Design for useful life
- Design to adequately protect
- Test and Maintain to avoid problems.

IR Drop



1. IR Drop is a voltage drop due to a flow of current in a resister
2. Frozen soil, sand and pavement have resistance so cause invalid P/S potentials
3. The Reference electrode (half cell) must be placed close to the structure being tested, a remote reading increases the IR drop and error
4. When IR drop increases the P/S potential readings become more negative
5. IR is a term used to describe voltage change from Ohms law E=IR
6. The resistivity of metals is usually less than the resistivity of electrolytes
7. Interrupting all the direct current sources of the CP system will minimize or eliminate Soil IR drop
8. Wet clay is less resistive than dry sand therefore will reduce the IR drop component
9. To be a valid interpretation of a potential measurement IR drop must be considered
10. The CP criteria than will minimize or eliminate IR drop is a minimum voltage shift of 100mv. The polarization voltage shift must be determined by interrupting all the protective current and measuring the polarization decay.

Line Locator

Locater depth readings are measured from the center of the pipeline

Bleed off onto other underground utilities is more likely to happen when using the higher voltage frequencies

The universal colors for marking are

Gas –Yellow

Electric - Red

Sewer – Green

Water - Blue

Ground rods are best placed away from and perpendicular to the line being located

The peak mode uses two antennas in the receiver

Induction mode by placing the transmitter on the ground gives the best results when the receiver is more than 30 feet away from the transmitter

60Hz or power Mode is a passive locate frequency that does not require a separate transmitter

Locaters are not effected by cement or asphalt

Locaters signal is weaker the father away therefor less accurate the at deeper depths

In conductive mode the transmitter is connected direct to the line by cables.

Final tips & takeaways

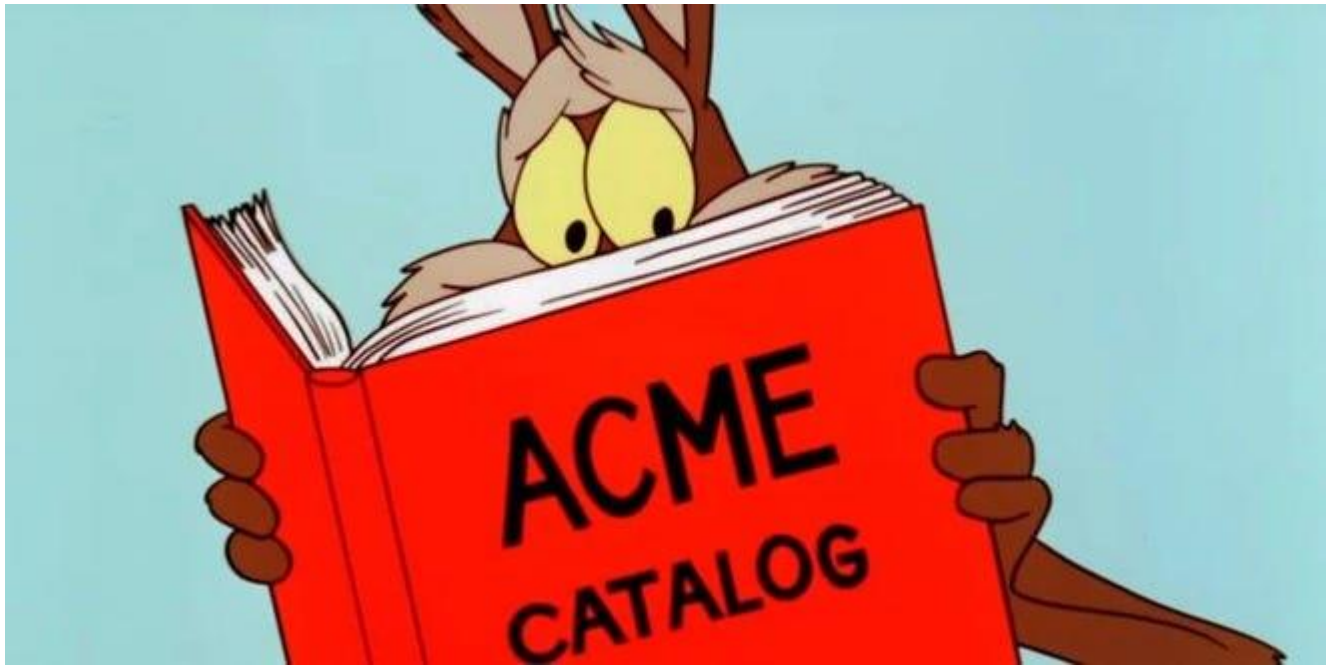
Test tomorrow afternoon

Hands on training in the morning

- Multi Meter / Half Cell
- Rectifier

Hands-on Test and Written Test afternoon

Wiley E. way to Remember



Thank you

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