

State of the Art Cathodic Protection Practices and Equipment

State of the Art

Definition:

The level of development (as of a device, procedure, process, technique, or science) reached at any particular time usually as a result of modern methods

Cathodic Protection

- ✓ Type
- ✓ Materials
- ✓ Installation
- ✓ Monitor / Survey Techniques

Types of Cathodic Protection

Sacrificial Anode

- Small Current Requirement
 - Well Coated Structures
 - Isolated Structures

- Low to Medium Soil Resistivity

Types of Cathodic Protection

Impressed Current

- Large Current Requirement
 - Poorly Coated Structures
 - Shorted Structures

- High Soil Resistivity

Sacrificial Anodes

Magnesium & Zinc Typical



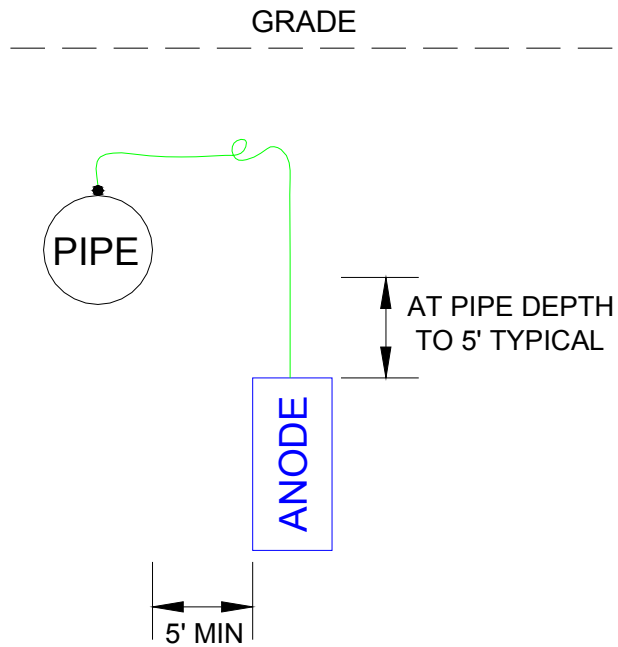
Sacrificial Anode

Zinc Ribbon

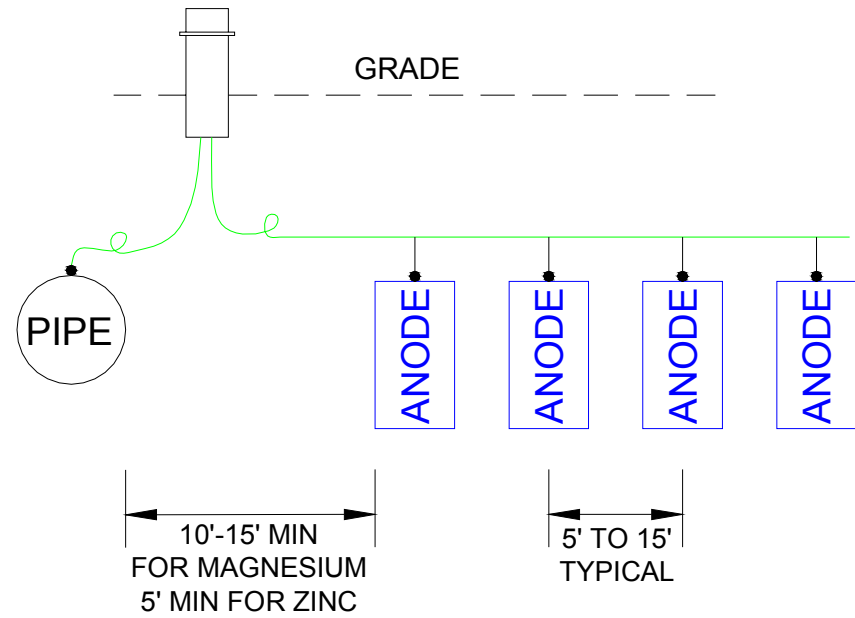


TYPICAL SACRIFICIAL ANODE INSTALLATION

SINGLE ANODE



MULTIPLE ANODE



Typical Sacrificial Anode Installation



Typical Sacrificial Anode Installation



Typical Sacrificial Anode Installation

Ribbon Anode



Impressed Current Rectifier

- Constant Voltage
- Constant Current
- Auto Potential
- Pulse

- Alternative Power
 - Solar
 - Thermo Electric
 - Wind
 - Hydro



Impressed Current Anode *Graphite*



Impressed Current Anode

High Silicon Cast Iron

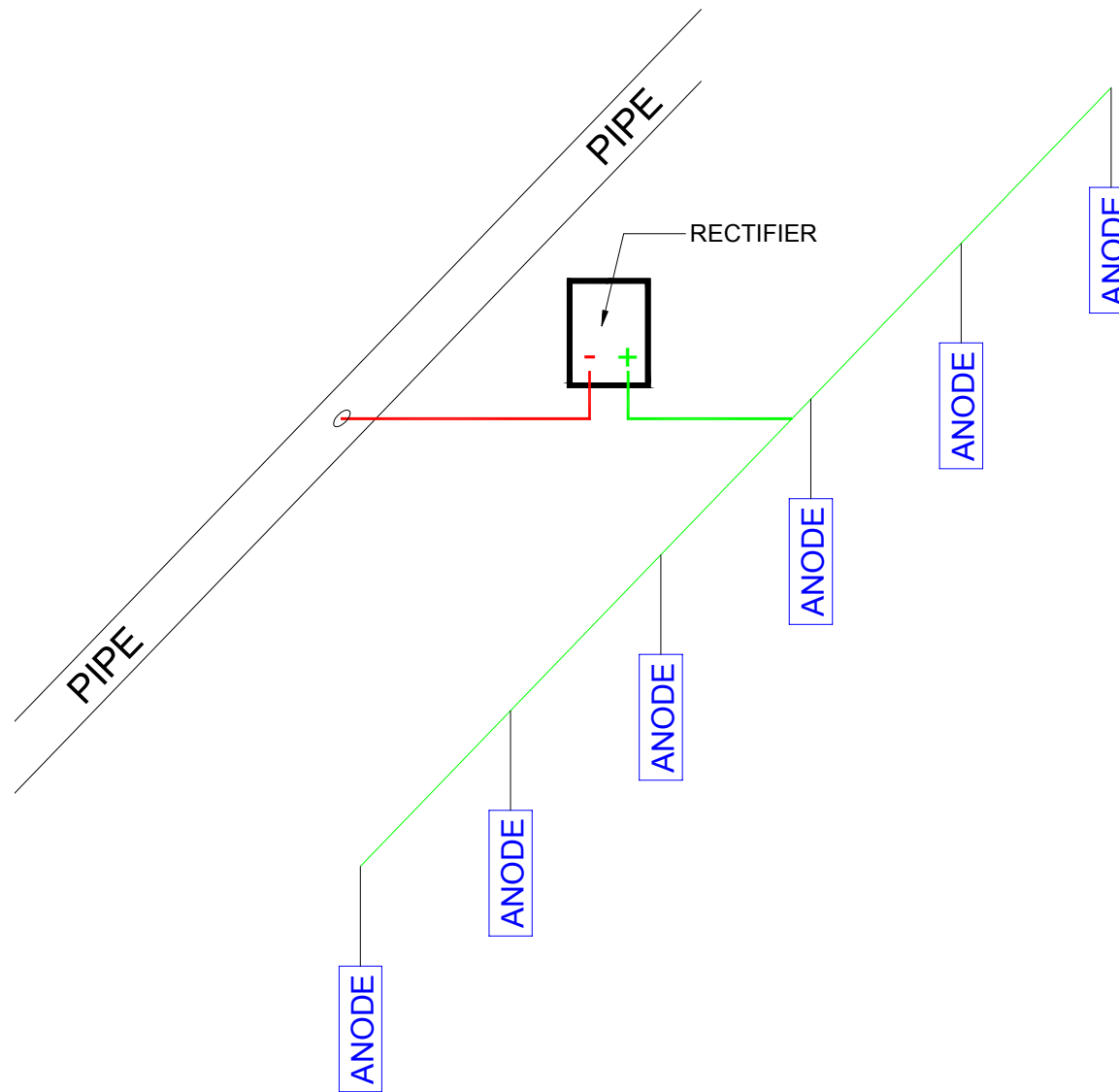


Impressed Current Anode

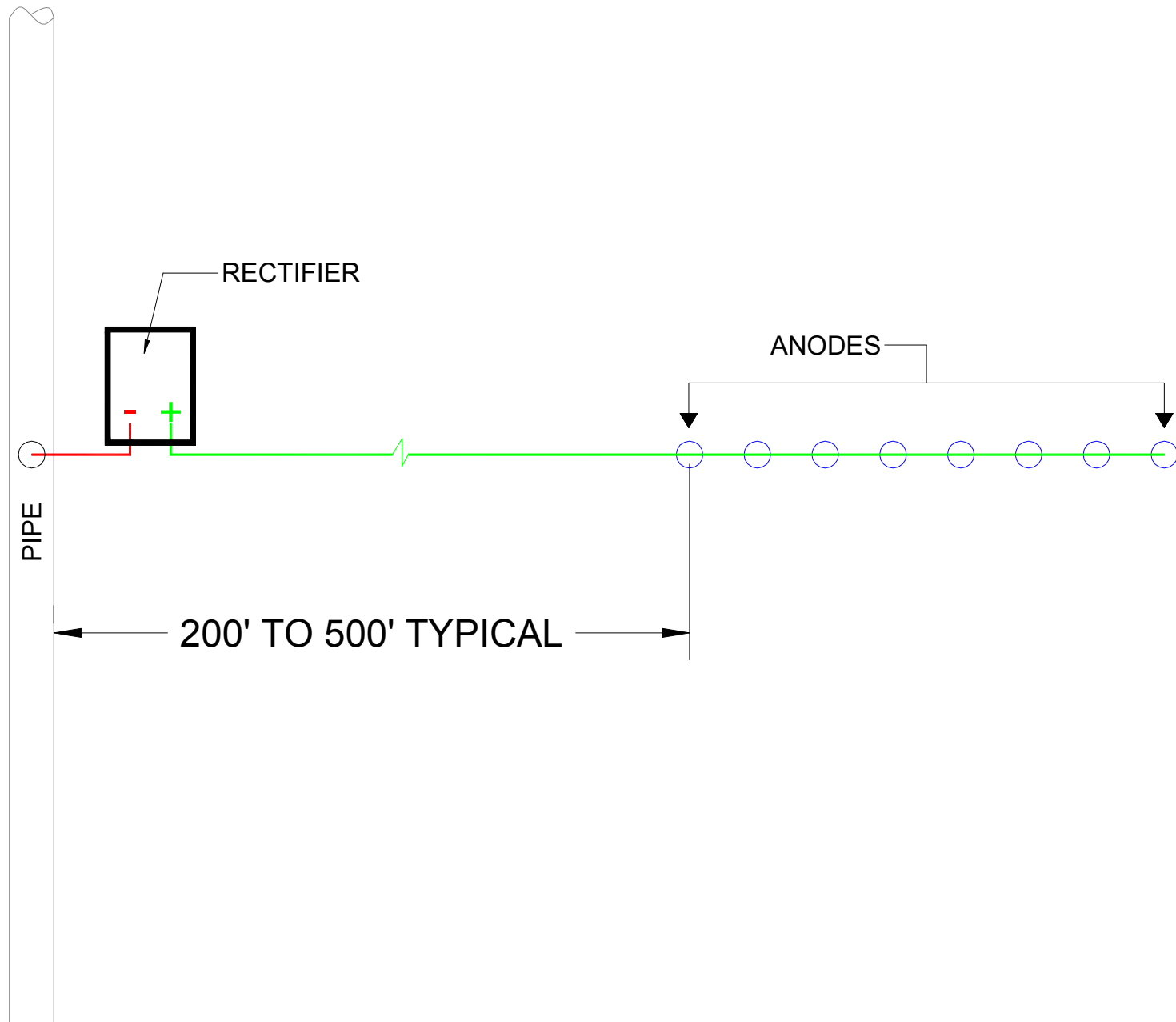
Mixed Metal Oxide



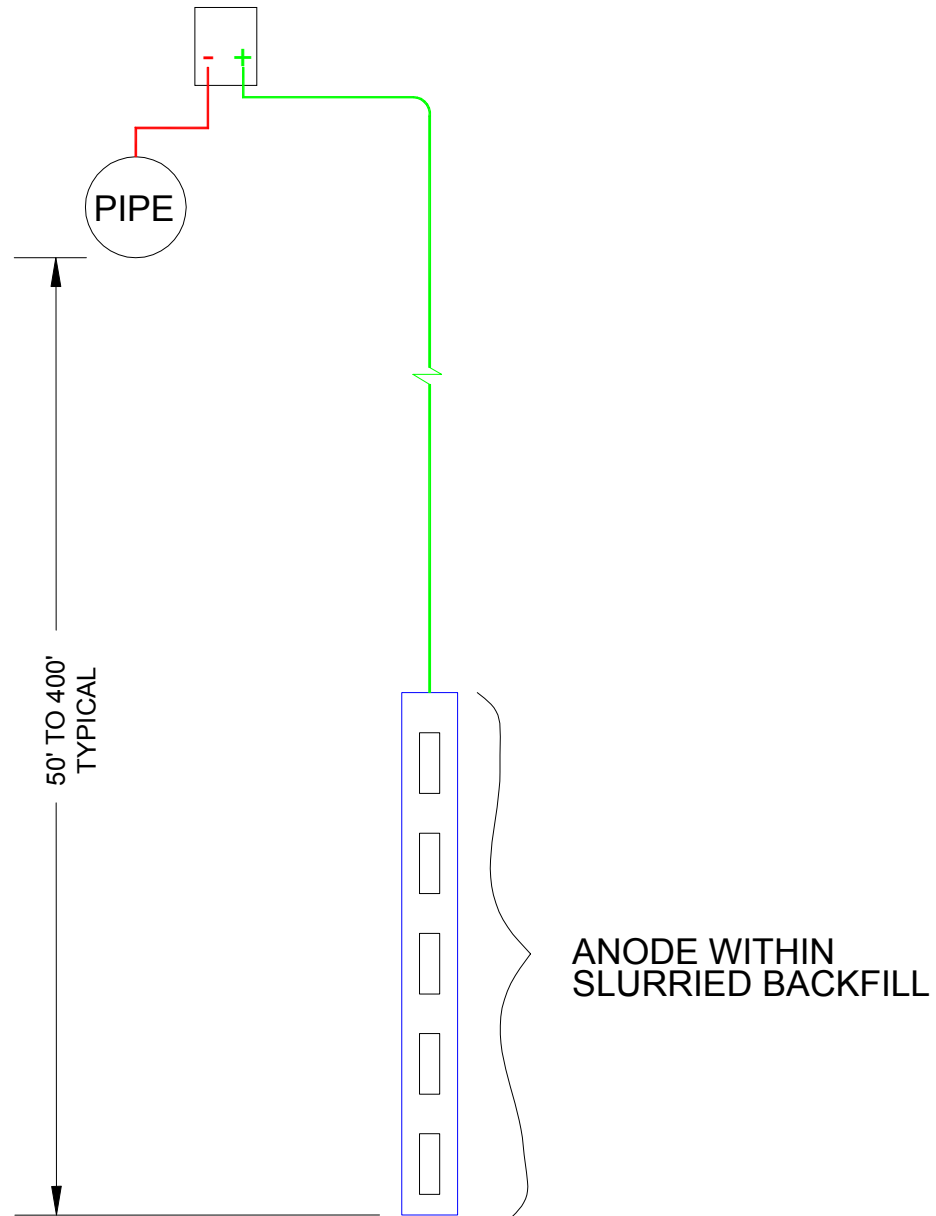
TYPICAL IMPRESSED CURRENT ANODE INSTALLATION DISTRUBUTED

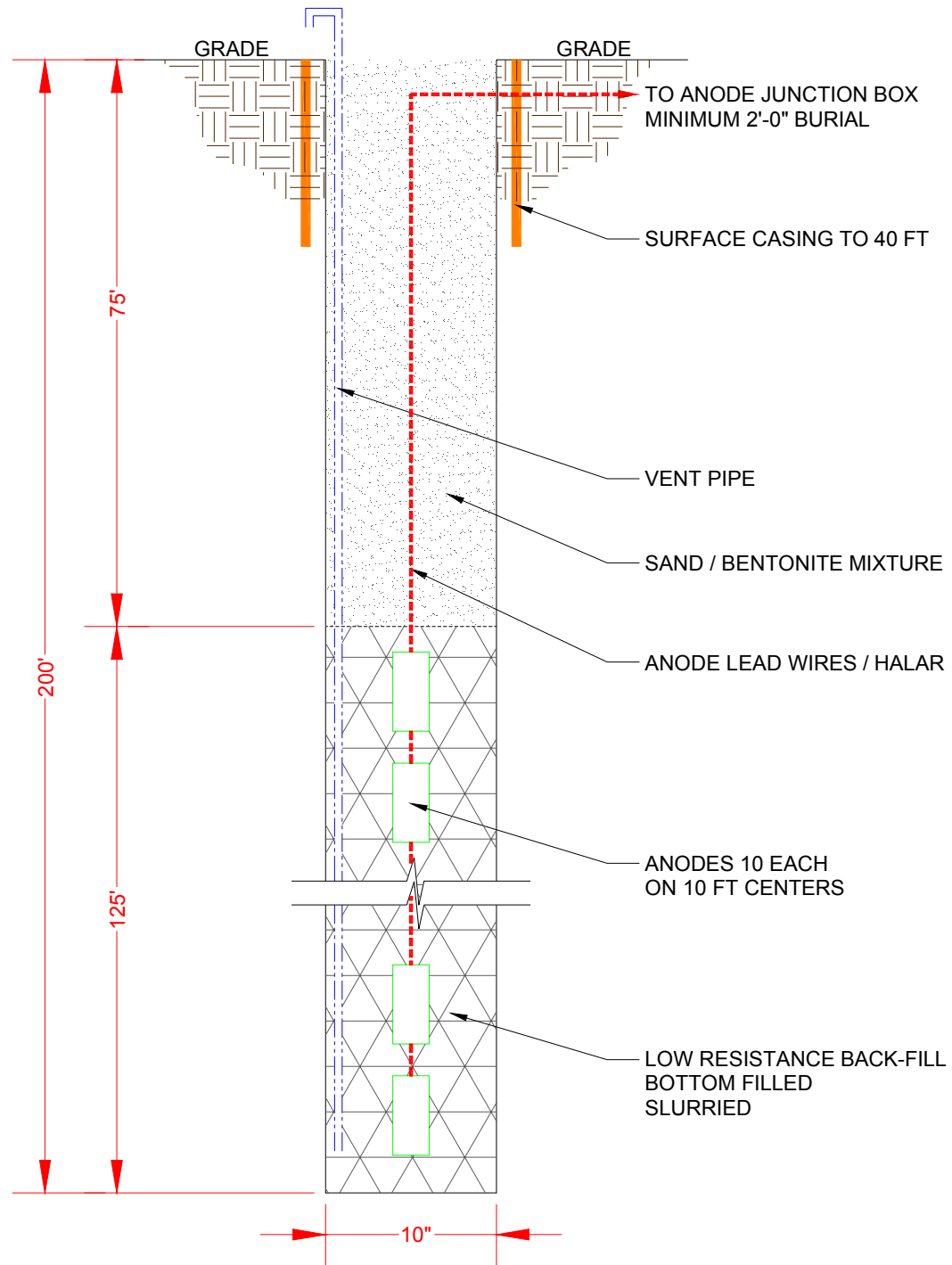


TYPICAL IMPRESSED CURRENT ANODE INSTALLATION REMOTE



TYPICAL IMPRESSED CURRENT ANODE INSTALLATION DEEP





Impressed Current Anode Installation *Distributed or Remote*



Impressed Current Anode Installation *Deep*



Storage Tank Bottom CP

New

Existing



Vacuum Excavation

- *Utility Locating*
- *Anode Installation*
- *Reference Cell Installation*
- *Test Station Installation*
- *Depth of Cover Survey*
- *Expose Pipeline for Coating Inspection*
- *Subsurface Utility Engineering*



Vacuum Excavation

Utility Locate

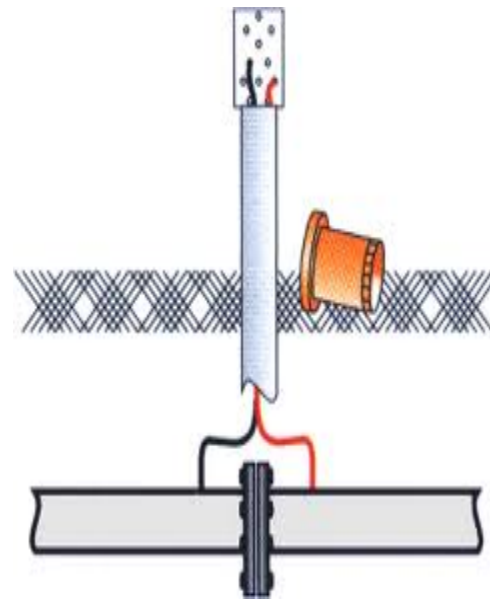


Vacuum Excavation *Anode / Test Station Installation*

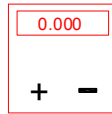


Cathodic Protection Testing

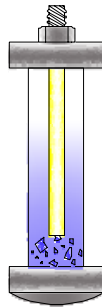
- Equipment
- Tools
- Materials
- Survey Methods



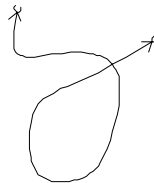
C.P. TEST EQUIPMENT



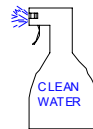
HIGH INPUT IMPEDANCE DIGITAL VOLT METER
• 10 M Ω OR GREATER



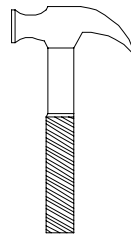
COPPER/COPPER SULFATE REFERENCE CELL
• CLEAN, FULLY CHARGED & CALIBRATED



TEST WIRES WITH ALLIGATOR CLIPS
• SELECTION OF SHORT & LONG WITH NO SPLICES



CLEAN WATER
• TO SATURATE THE TEST LOCATION



MISC. HAND TOOLS
• TO MAKE MINOR REPAIRS ON-SITE

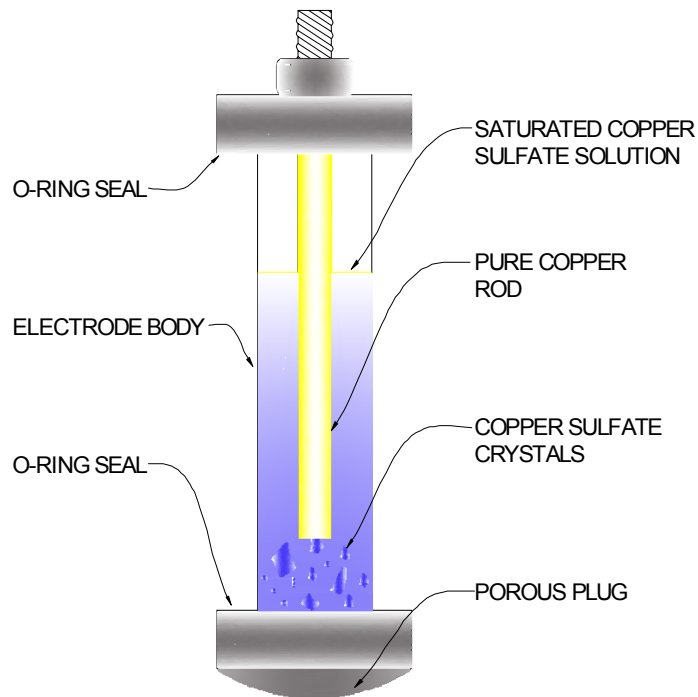
Data Collection

Read Only

Self Storage



Reference Cell / Electrode



- *Contaminated every time it gets used*

✓ *Clean Regularly*

✓ *Check Regularly*

- *The “Weakest Link” in Cathodic Protection Testing*

Cathodic Protection Criteria

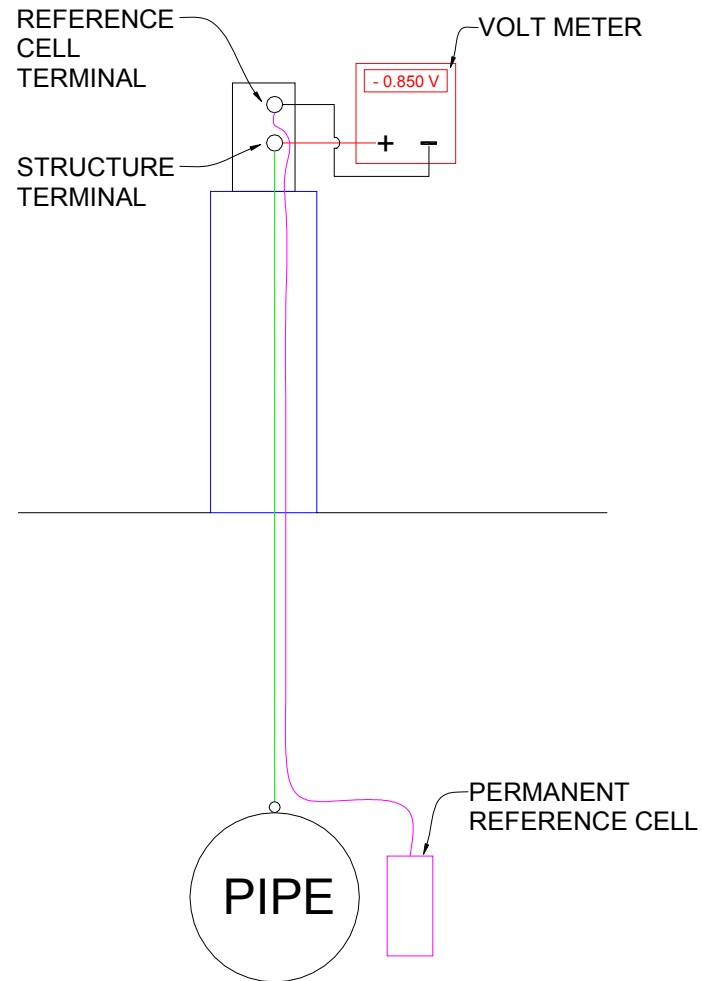
NACE SP0169

1. -850 mV with IR Drop Considered
2. -850 mV Polarized
3. 100 mV Polarization

CP Test Location / Test Station



C.P TESTING - PERMANENT REFERENCE CELL

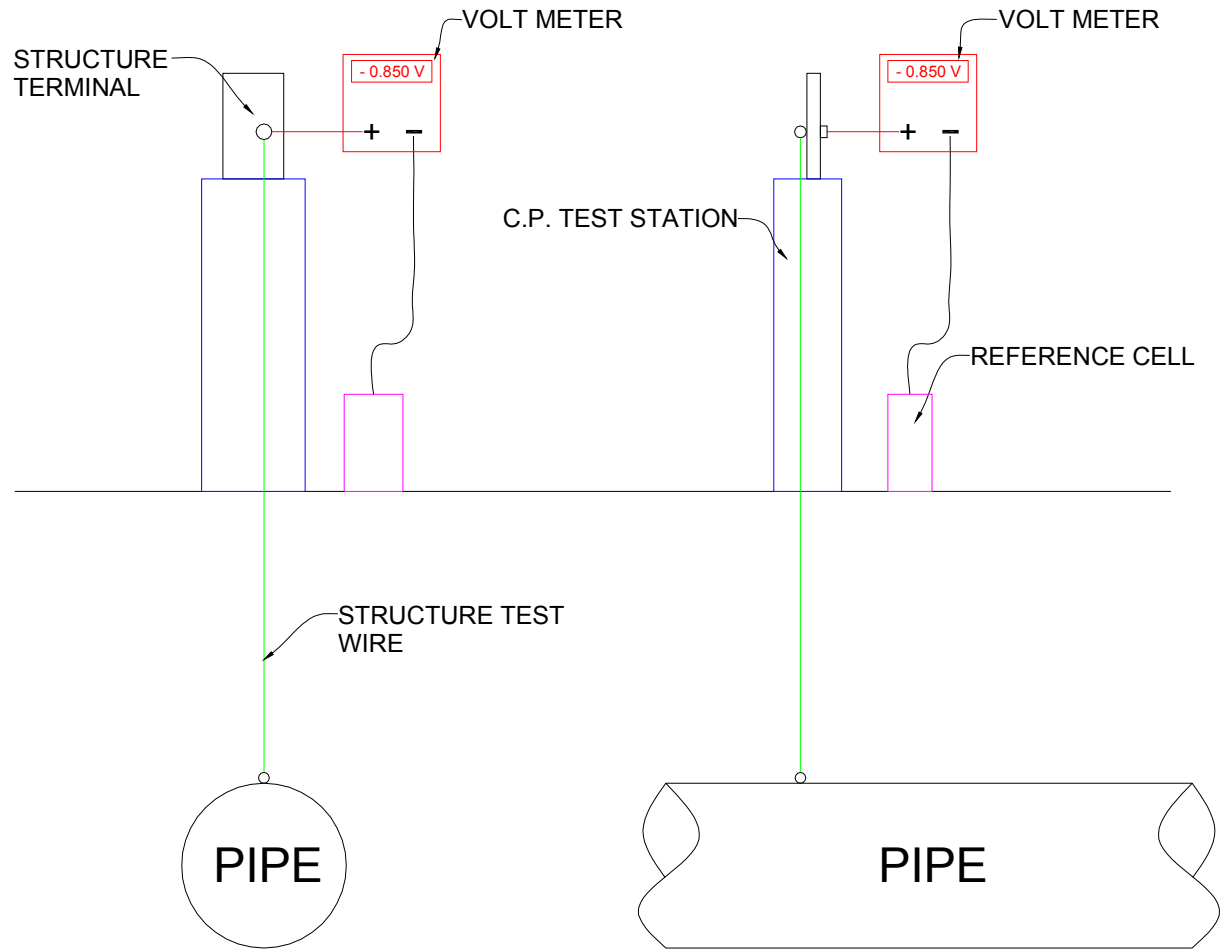


1. CONNECT (+) LEAD OF VOLT METER TO STRUCTURE TERMINAL
2. CONNECT (-) LEAD OF VOLT METER TO REFERENCE CELL TERMINAL
3. READ & RECORD MEASURED POTENTIAL

Permanent Reference Electrode

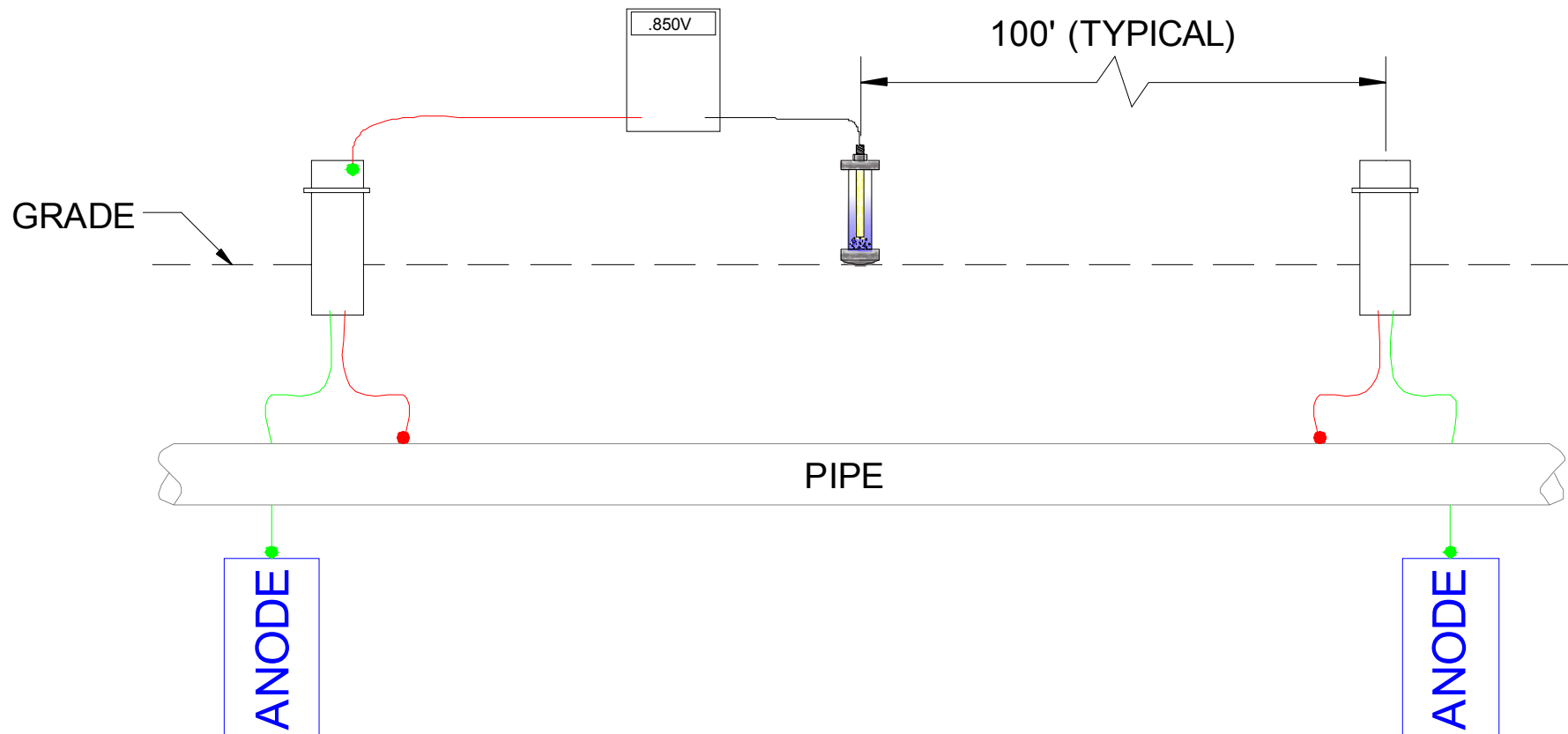


C.P. TESTING - PORTABLE REFERENCE CELL



1. CONNECT (+) LEAD OF VOLT METER TO STRUCTURE TERMINAL
2. CONNECT (-) LEAD OF VOLT METER TO REFERENCE CELL TERMINAL
3. PLACE REFERENCE CELL DIRECTLY OVER OR ADJACENT TO PIPE
4. READ & RECORD MEASURED POTENTIAL

PROPER REFERENCE CELL PLACEMENT



Coupon Test Station



- IR Free Potential Reads
- No Need to Interrupt:
 - ✓ Rectifiers
 - ✓ Sacrificial Anodes
 - ✓ Foreign Bonds
- Calculate Metal Loss

Remote Monitoring

- GPS Controlled
- Automatic Pipe-to-Soil Potential Reads
- Automatic Rectifier Voltage & Amperage Reads
- Alarm Notification
- Interruption Capabilities
- Cellular, Satellite & Radio Communication



Circuit Interruption



- Rectifiers & Foreign Bonds
- Sacrificial Anodes
- GPS Controlled
- Programmable Schedule

Fault Protection & Grounding

- Solid State
- Induced AC Voltage Mitigation
- Stray DC Voltage Blocking
- Insulated Joint Protection



Ultrasonic Thickness (*UT*) Gauges



Thermite Welding



Over-the-Line Survey Techniques



Over-the-Line Survey Techniques

- Close Interval Survey (CIS)
 - *Cathodic Protection Potential Profile*
- Pipeline Current Mapping (PCM)
 - *Maps Cathodic Protection Current Loss due to Coating Failure or Shorted conditions*
- Direct Current Voltage Gradient (DCVG)
- Alternating Current Voltage Gradient (ACVG)
 - *Pinpoints Coating Defects*

THIS
COULD
HAPPEN
TO
YOU!

