MANAGING RISK DNV

ECDA Methodologies for Cased Crossings

PHMSA Casing Workshop – Chicago IL

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Objectives

- Discuss Rationale for Utilizing ECDA Concepts To Screen Casing Status.
- Discuss Methodologies to Segregate Suspect Cased Crossing from Non-Suspect.
- Discuss Risk of Corrosion and Methods to Detect it.

Corrosion Threats

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- External Corrosion Caused by Contact with an Electrolyte in the interstitial space (Casing Annulus)
  - Rates are assumed to be consistent with corrosion in soils’
    - 2-10 mpy in soil/water electrolyte
    - 30-150 mpy with MIC
    - 50 -100 mpy with A-C assisted corrosion
    - >250 mpy with Stray D-C
- Atmospheric corrosion
  - Rates are assumed to be <2 mpy unless accelerated by erosion/impingement

Study of External Corrosion Features in Cased Crossings

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- Random Selection of ILI Data
- 120 Cased Crossings
- Length 30 feet to 550 Feet
- 63 (53%) of Crossings contained External Corrosion Features
  - Approximately 650 Features
- 57 (47%) Crossings with no External Corrosion Features
- Feature Density is Greatest at the ends of the casings and the least towards the middle of the casing.
- Maximum Corrosion Detected 42 %
  - Average Depth 20%
- Slightly Greater Severity at Casing Ends

Cased Crossings With ILI Identified External Corrosion Features

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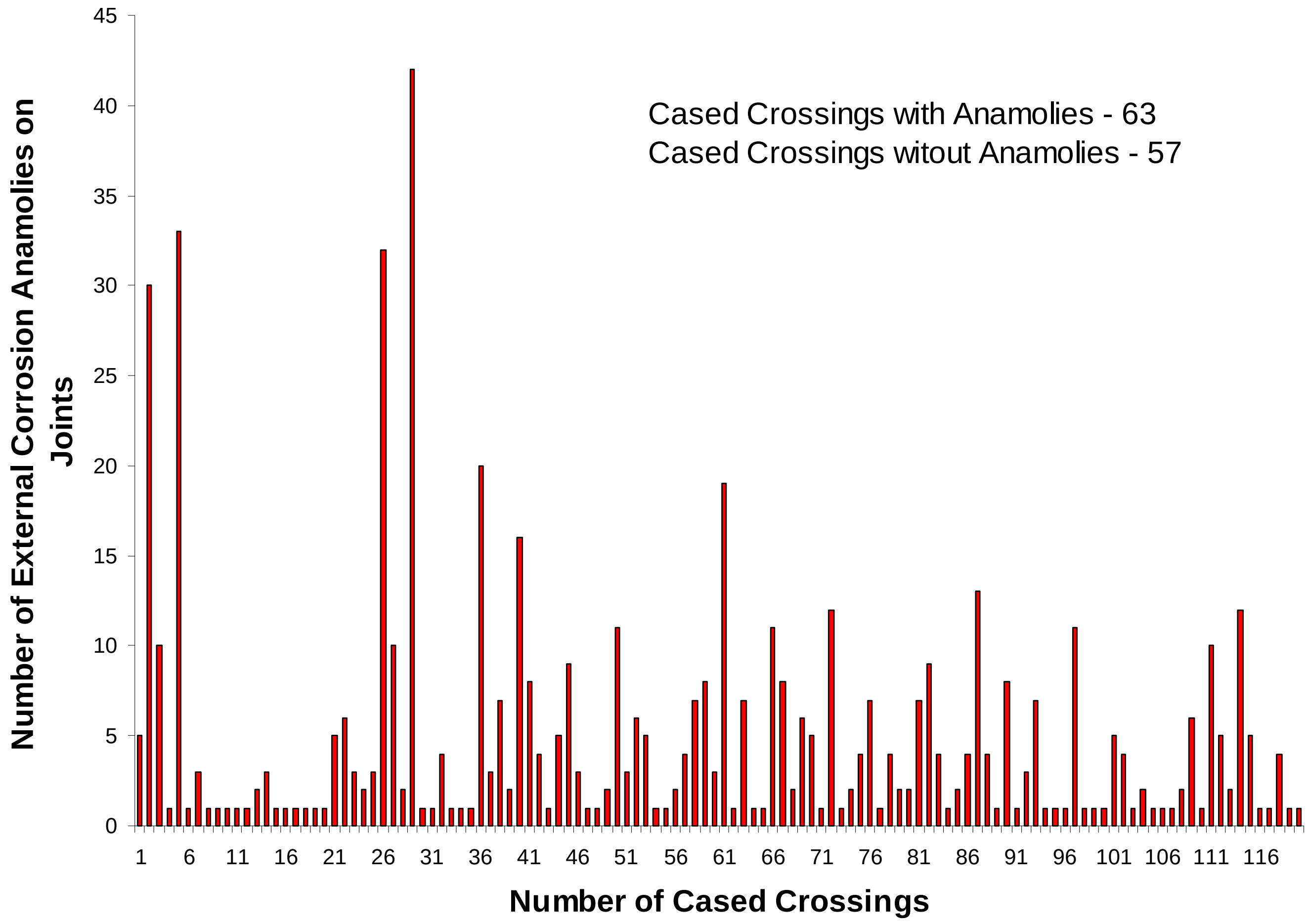

Length of Cased Crossings in Feet

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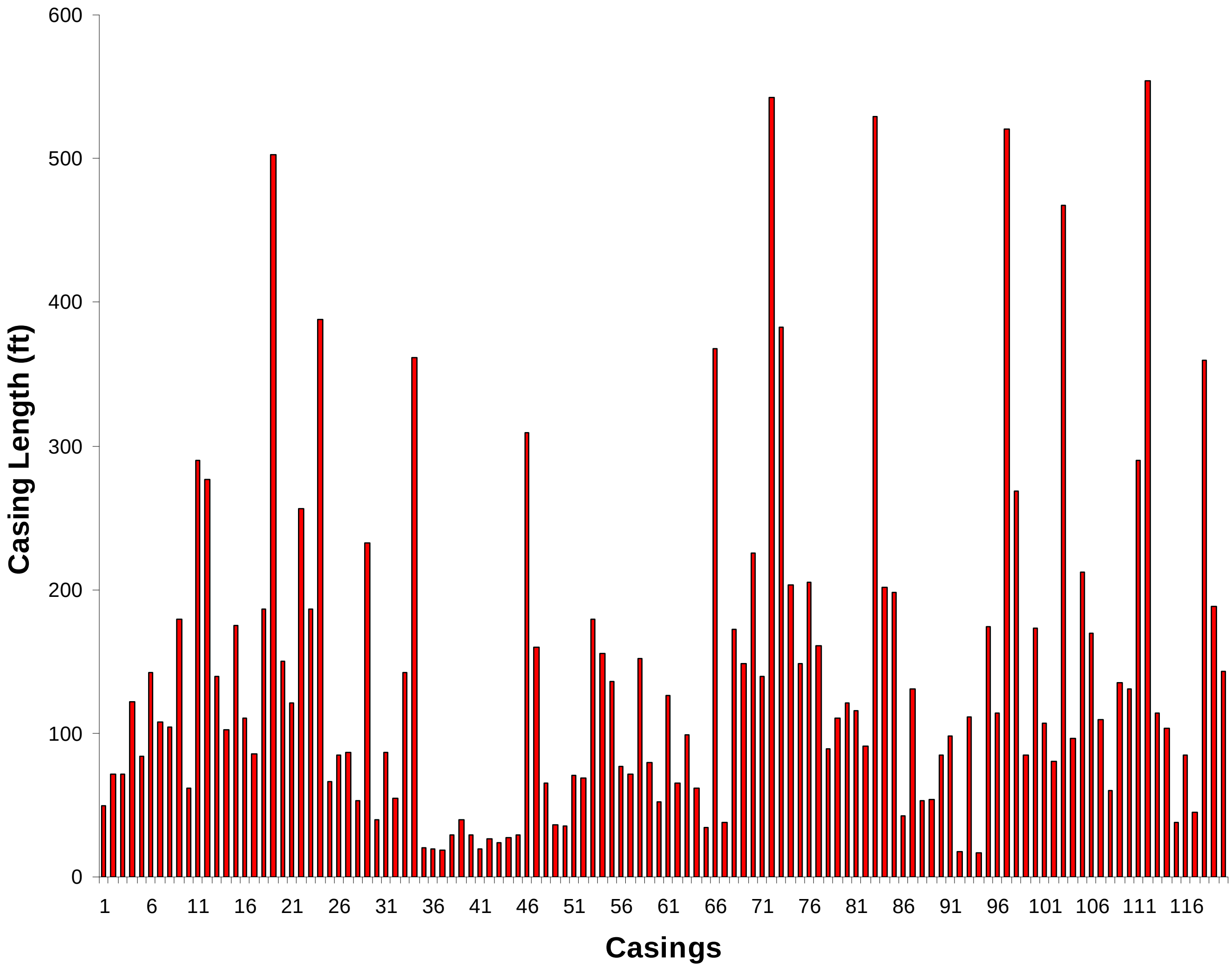

External Corrosion Feature Density

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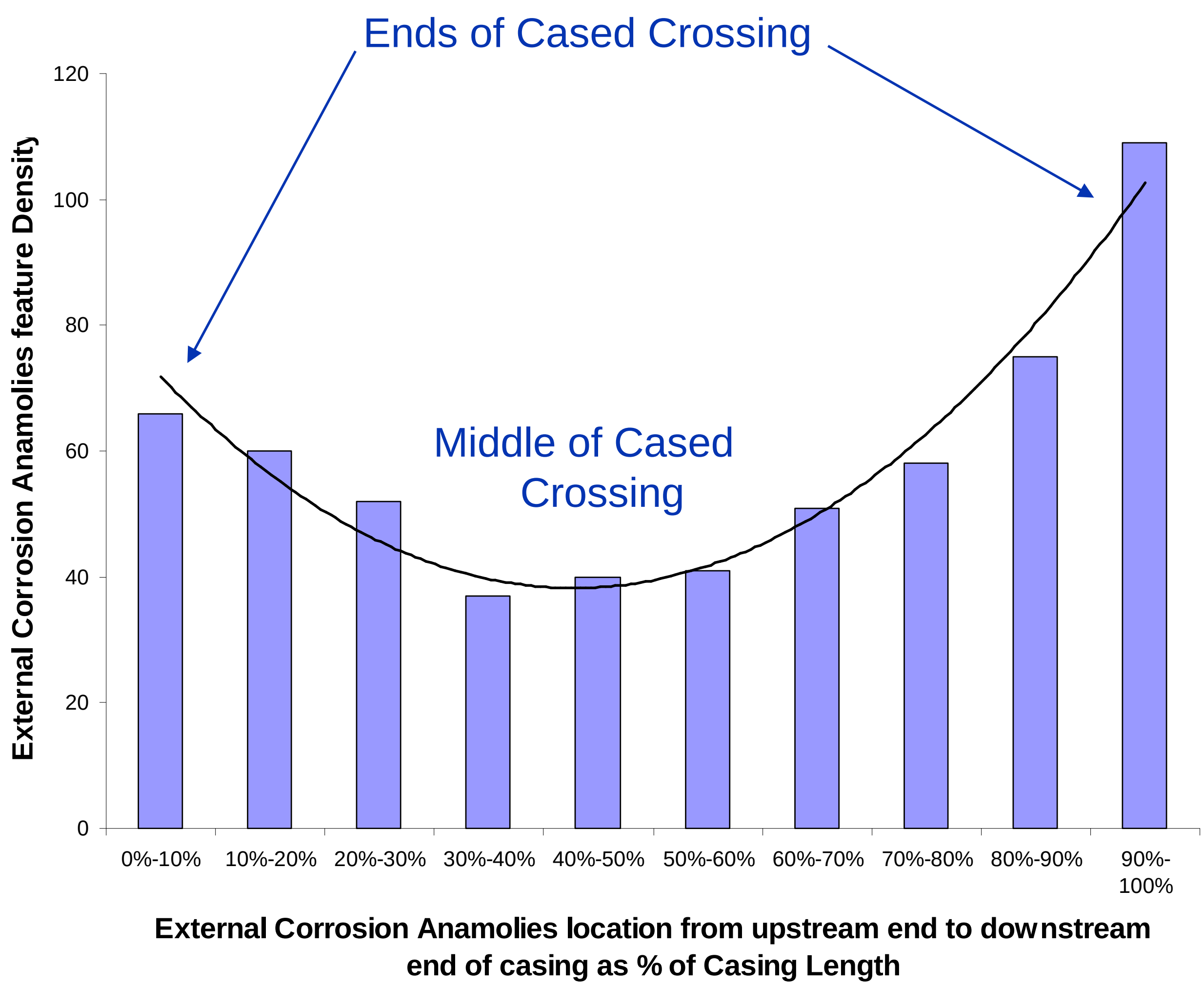

Average Corrosion Depth vs. Distance Inside Casing

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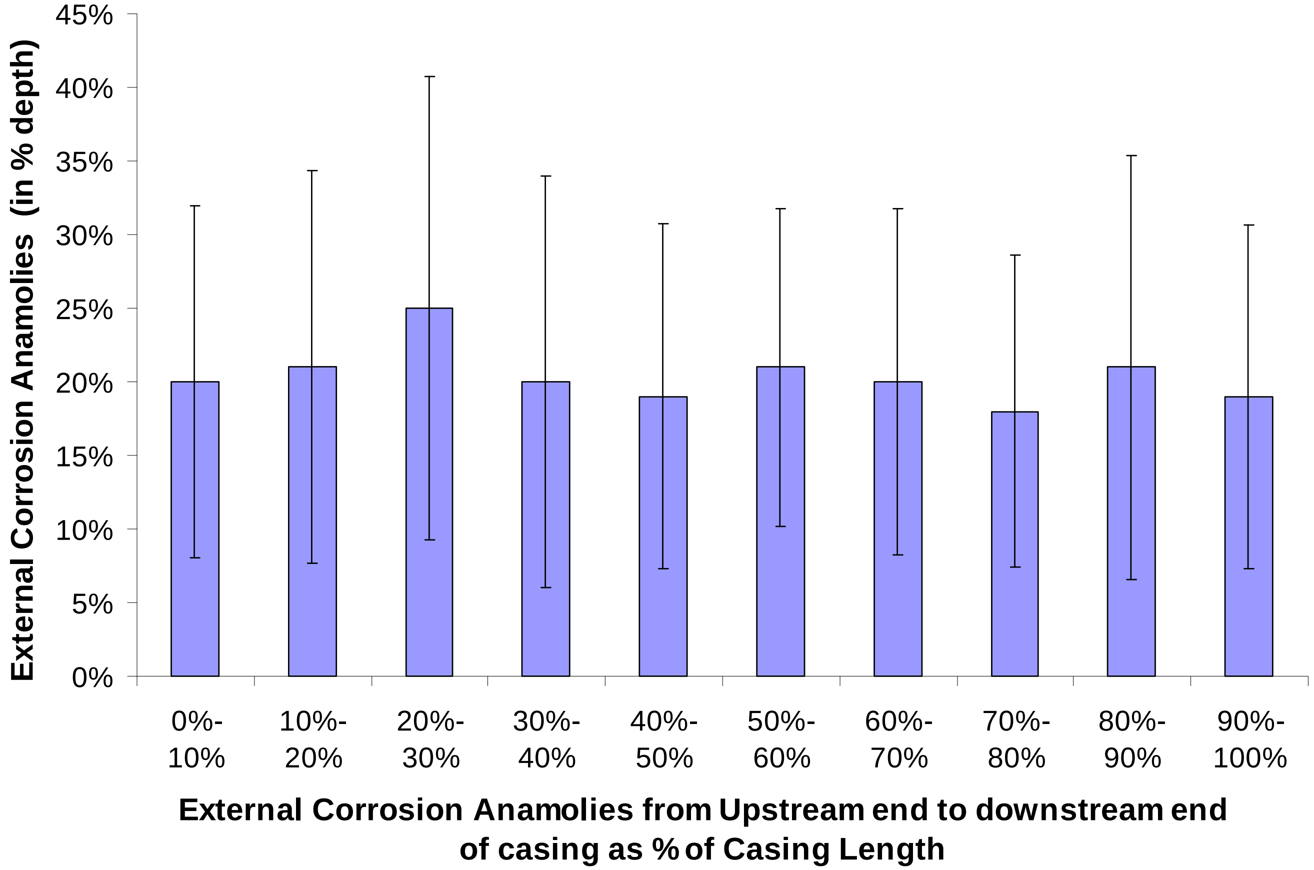

Implications

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- If this data set it representative
  - It is reasonable to conclude that more corrosion occurs near the ends of the casing than in the middle.
  - Likely driven by differential aeration where more oxygen is available at the ends and pipe inside the casing is in lower oxygen content.
- It is reasonable to conclude that conventional Indirect survey techniques will detect these conditions
  - If there is an electrolyte present in the casing

ECDA Methodology

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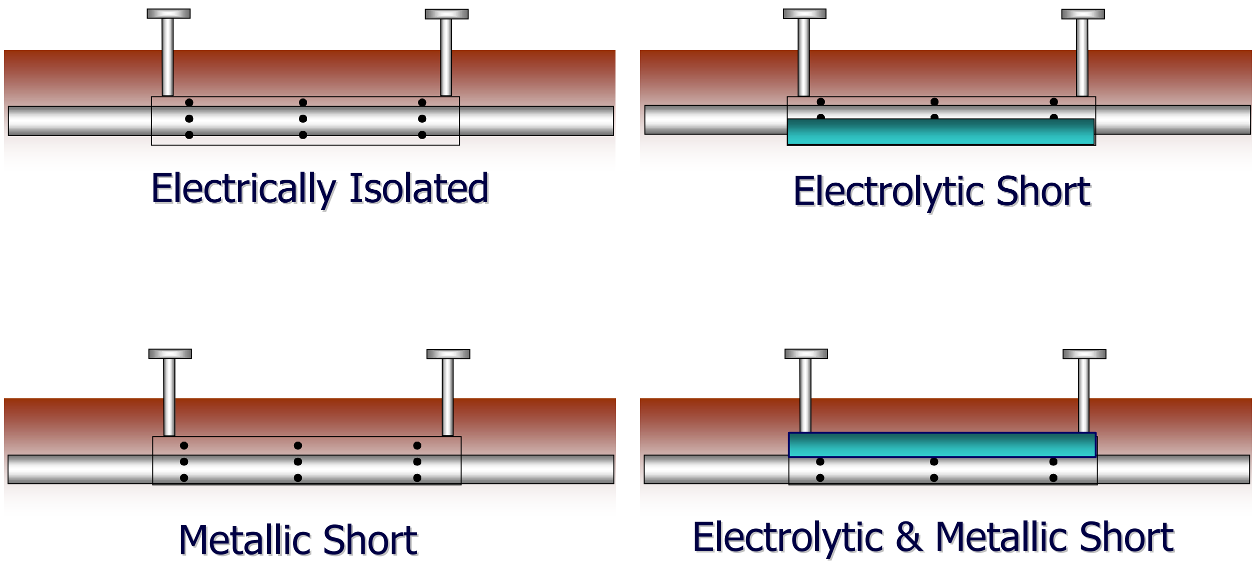
- Minimum of two indirect survey techniques
- Plus an Assessment of Casing Electrical Status



ECDA Methodology

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- Followed by a Direct Examination of Suspect Casings
  - Visual
  - Camera/Scope
  - Guided Wave
  - LPR Probes, etc.

Process to Prioritize Casings for Likelihood of Corrosion

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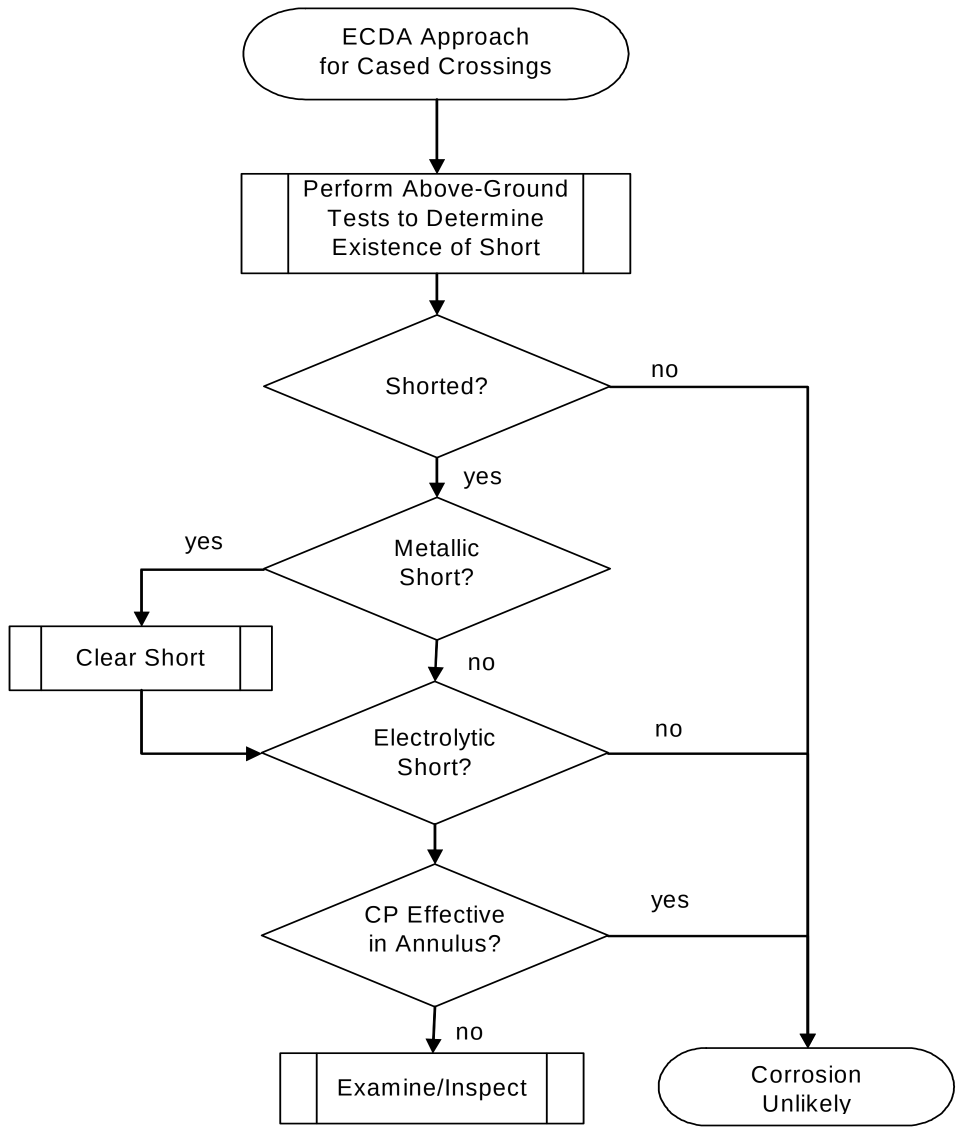

Potential Profile Example

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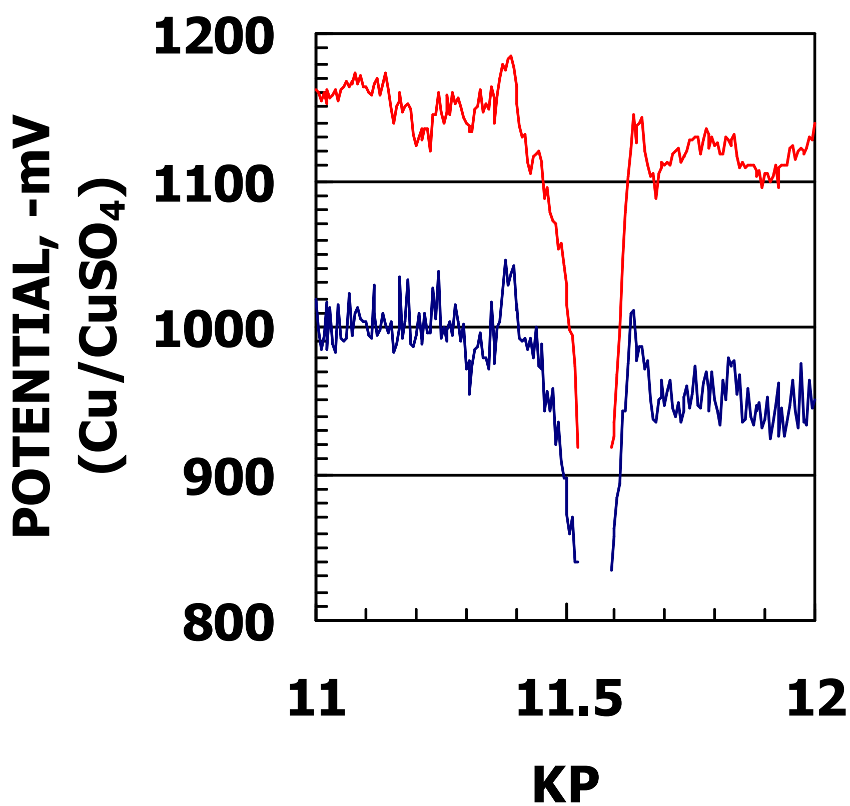

Potential Attenuation Example

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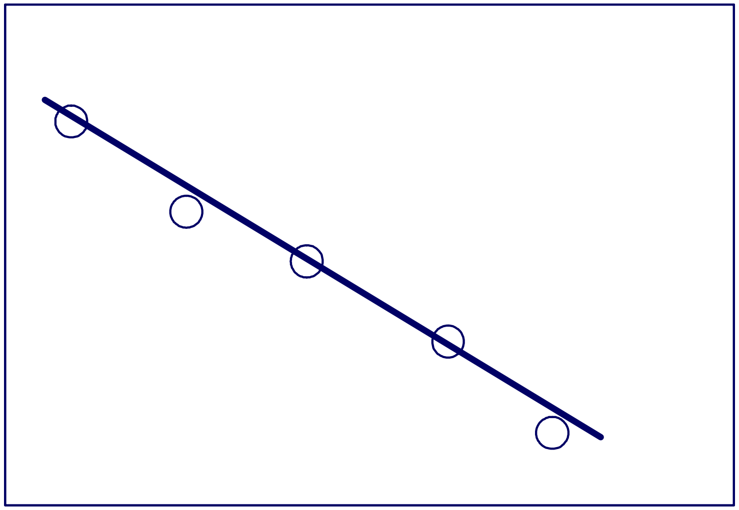
Ln V/V_0



Distance

External Current Source Annulus Resistance Diagram

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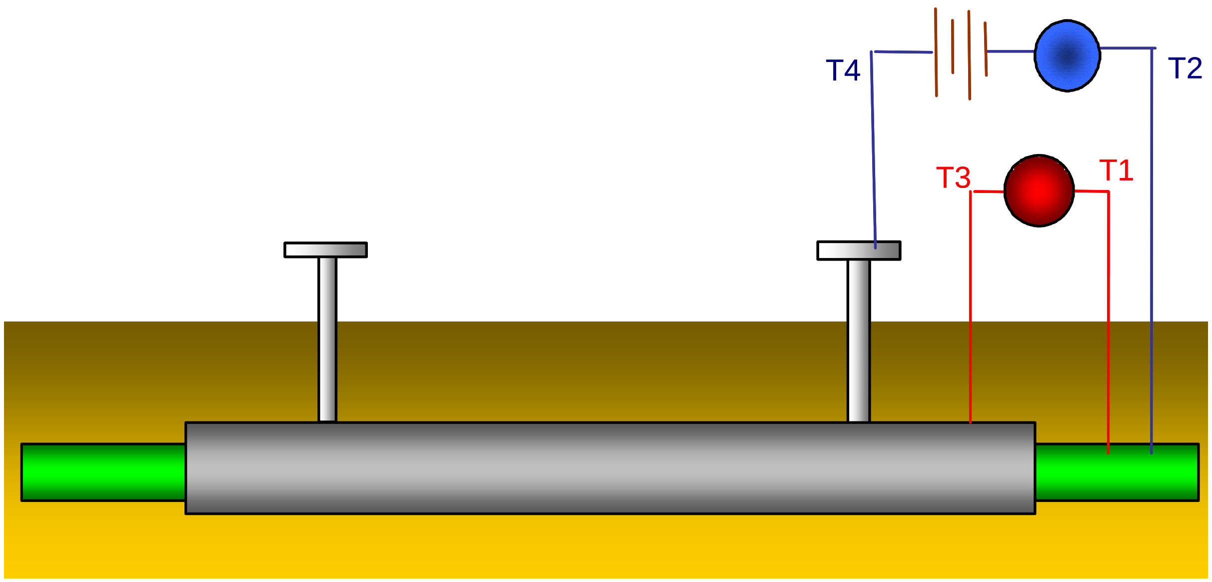

Annulus Resistance Calculation for Bare or Ineffectively Coating Pipe

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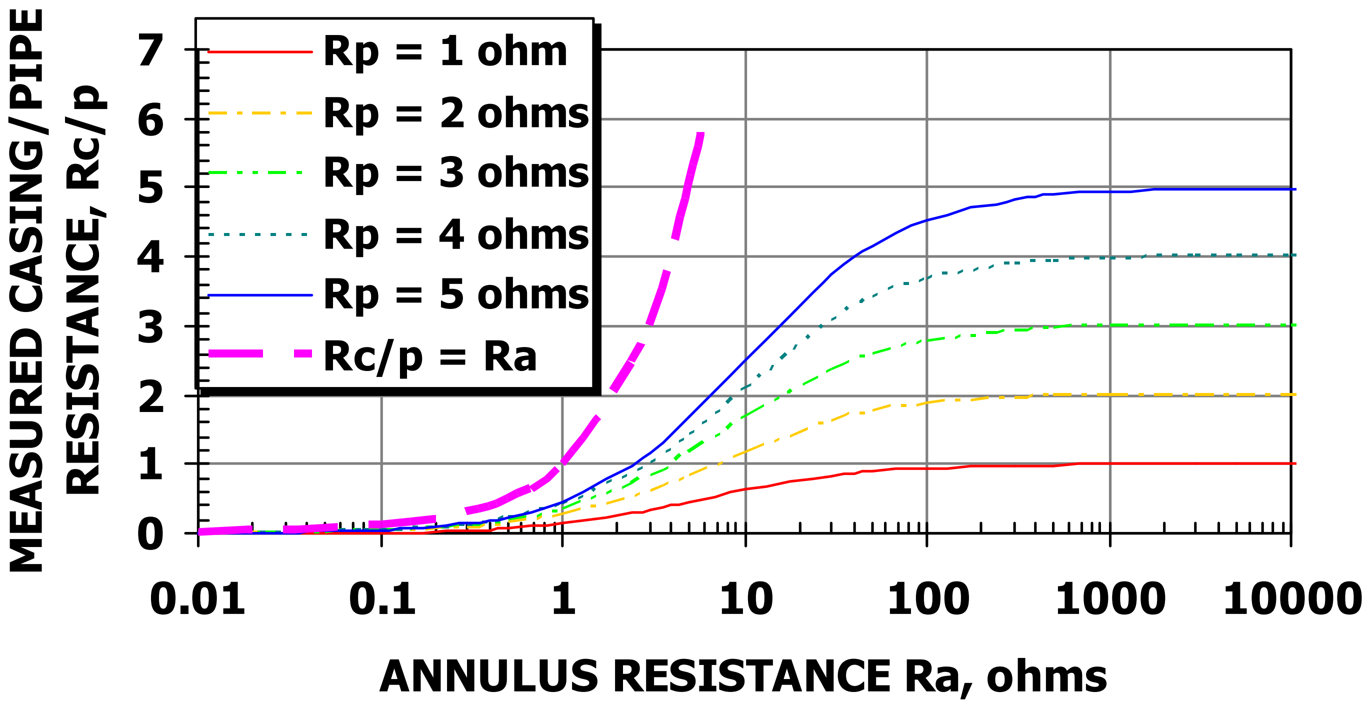

Electrolytic Short Calculations for Bare or Ineffectively Coated Pipe

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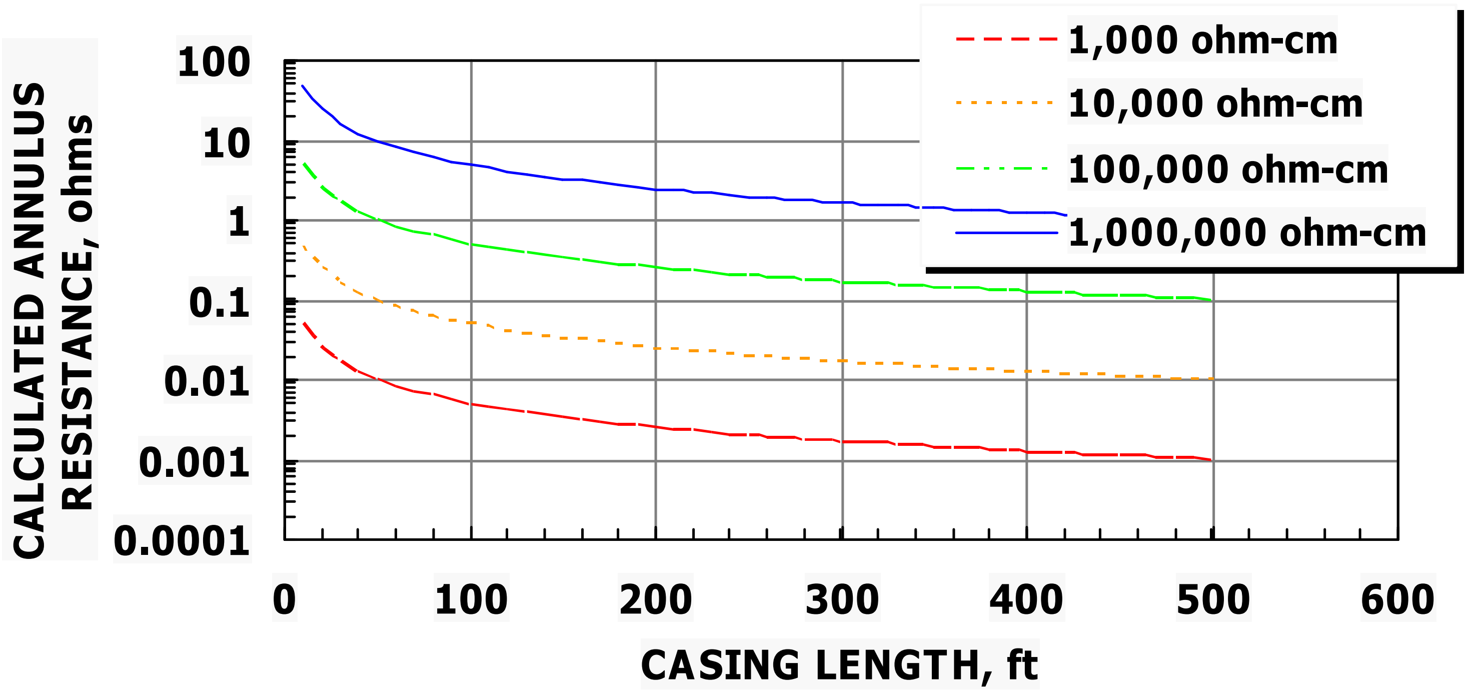

Electrolytic Short Calculations for Coating 20" Diameter Pipe

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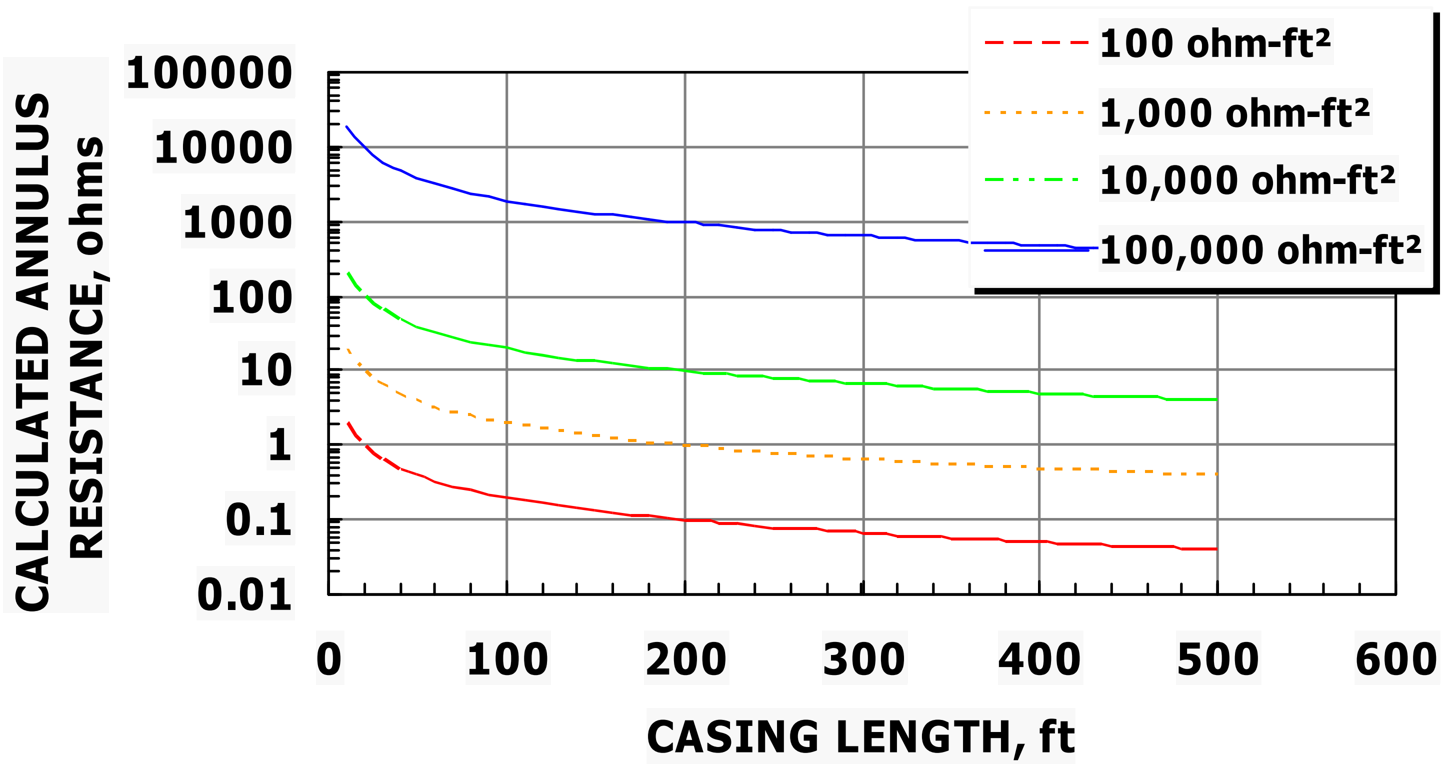

Annulus Resistance Method using Soil Resistivity Meter

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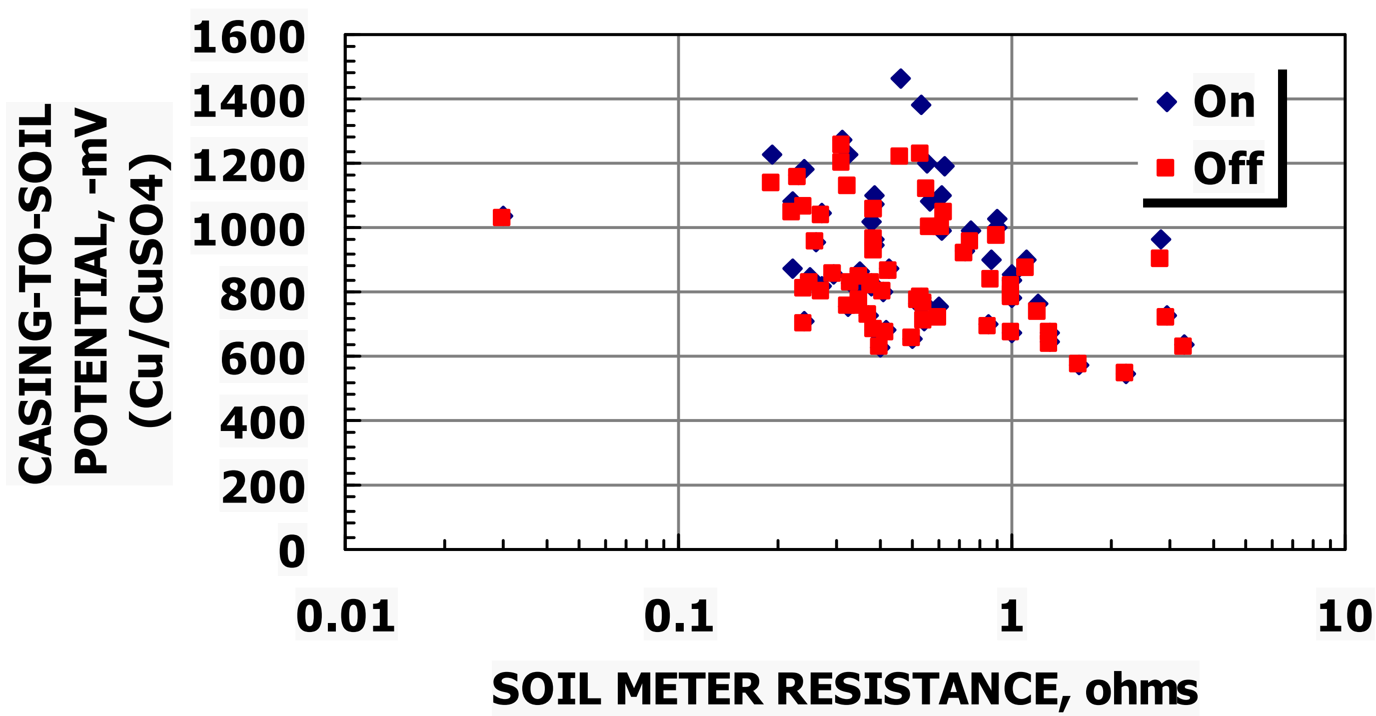

Forced Depolarization Method for Metallic Short Example

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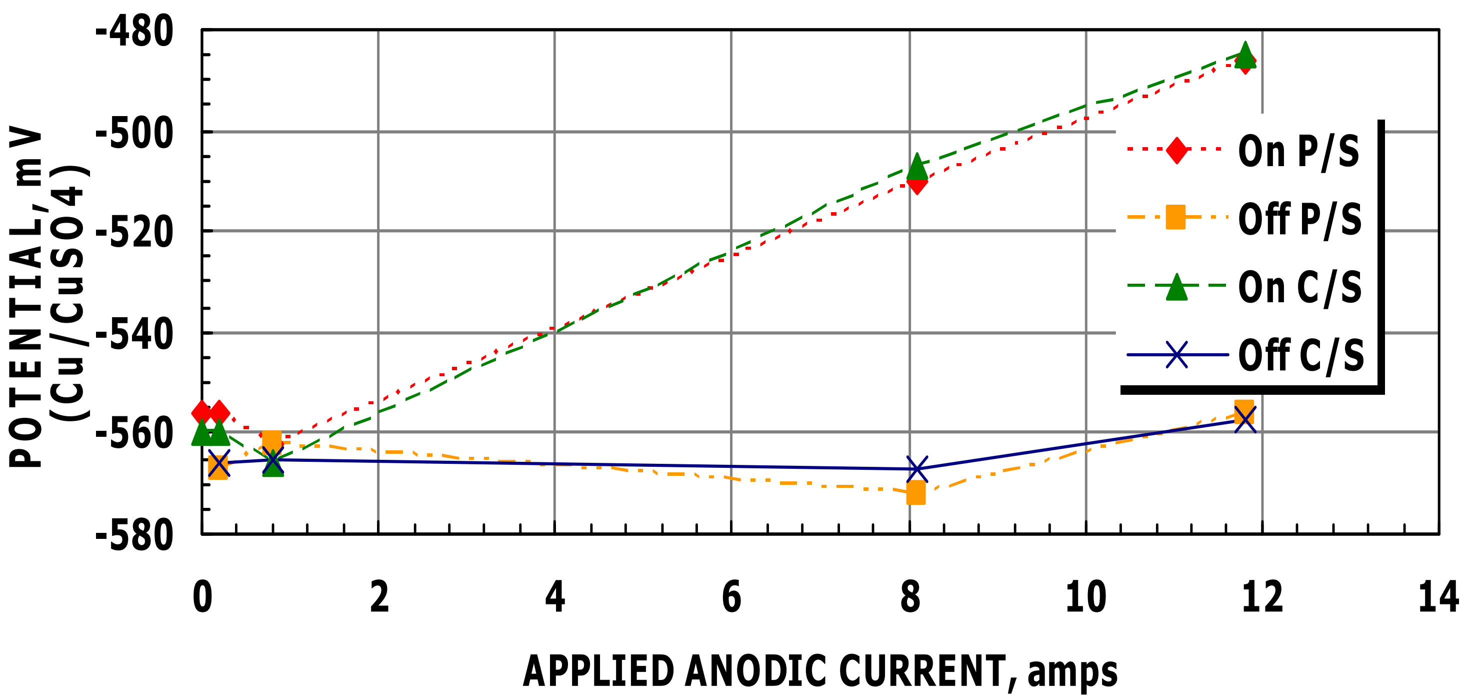

Forced Depolarization Method

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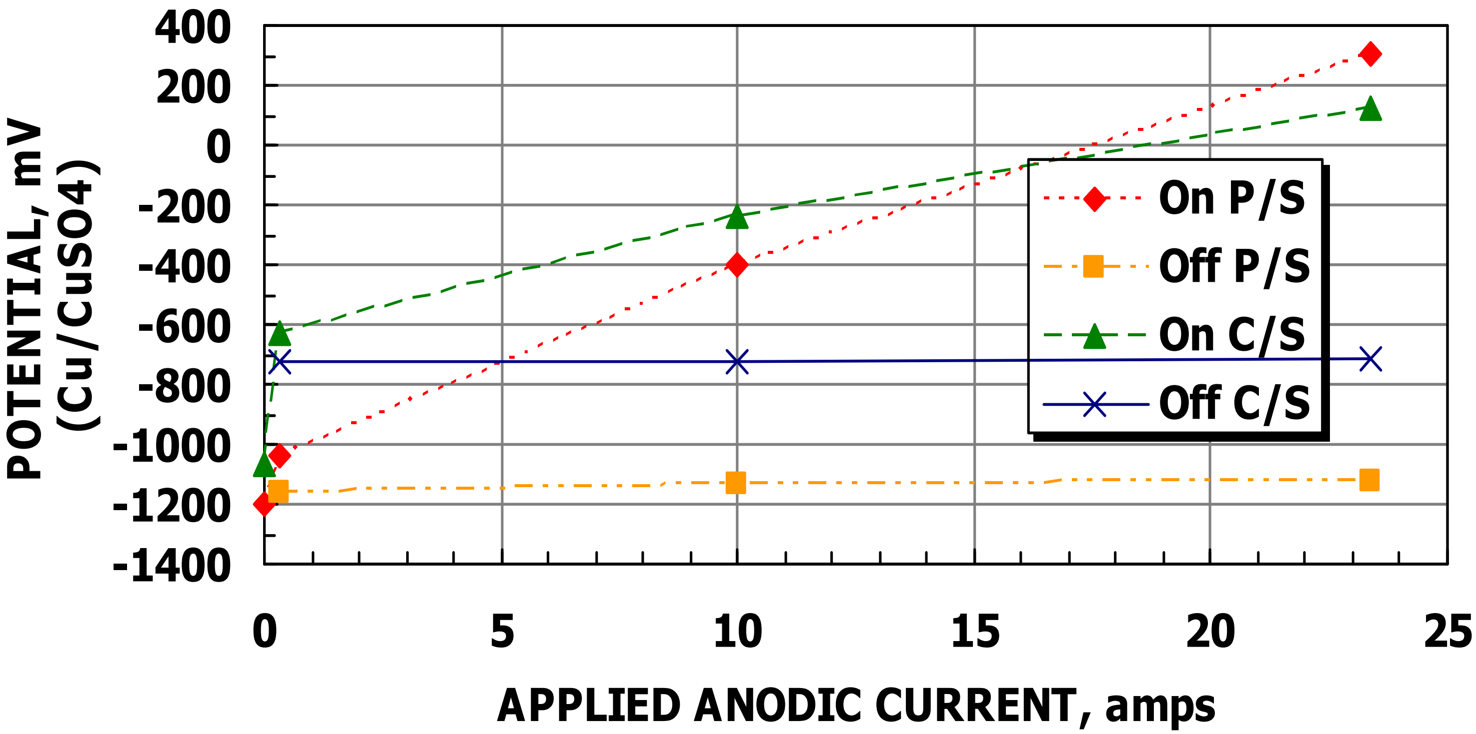

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