BUREAU OF RECLAMATION

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Cathodic Protection Case Study

Checking Your System: Water Storage Tank Galvanic Anodes

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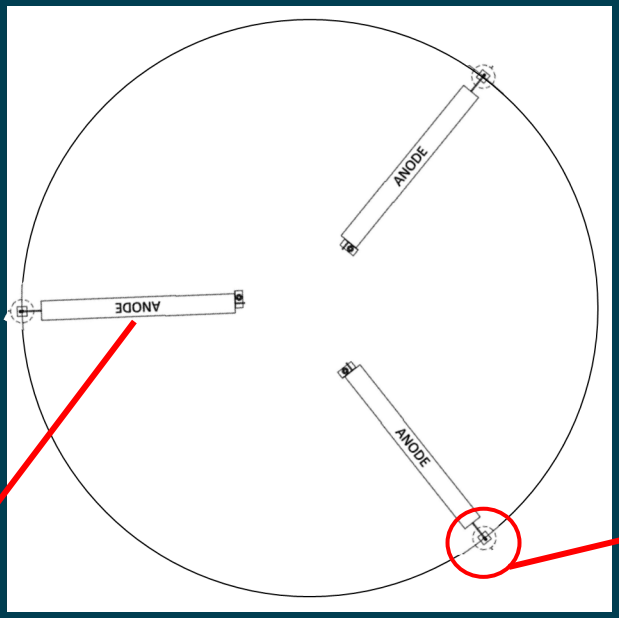
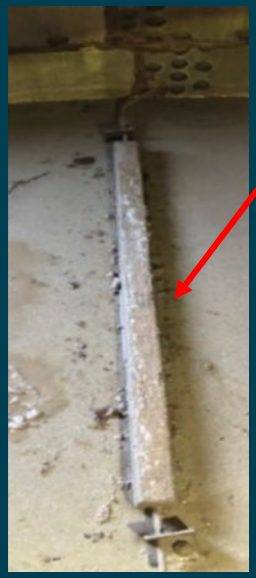
Tank Details:

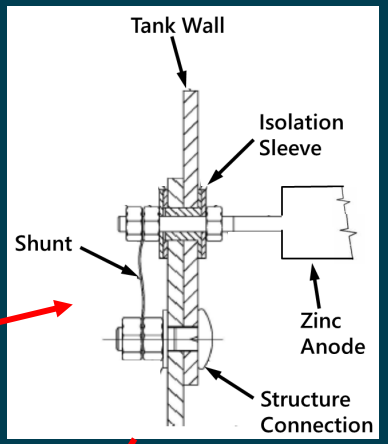
- Bolted steel tank
- Glass lined
- Concrete floor
- Floor mounted anodes

Inspection report: “The tank’s Cathodic Protection system does not seem to be performing properly.”

Tank Anode and Cables



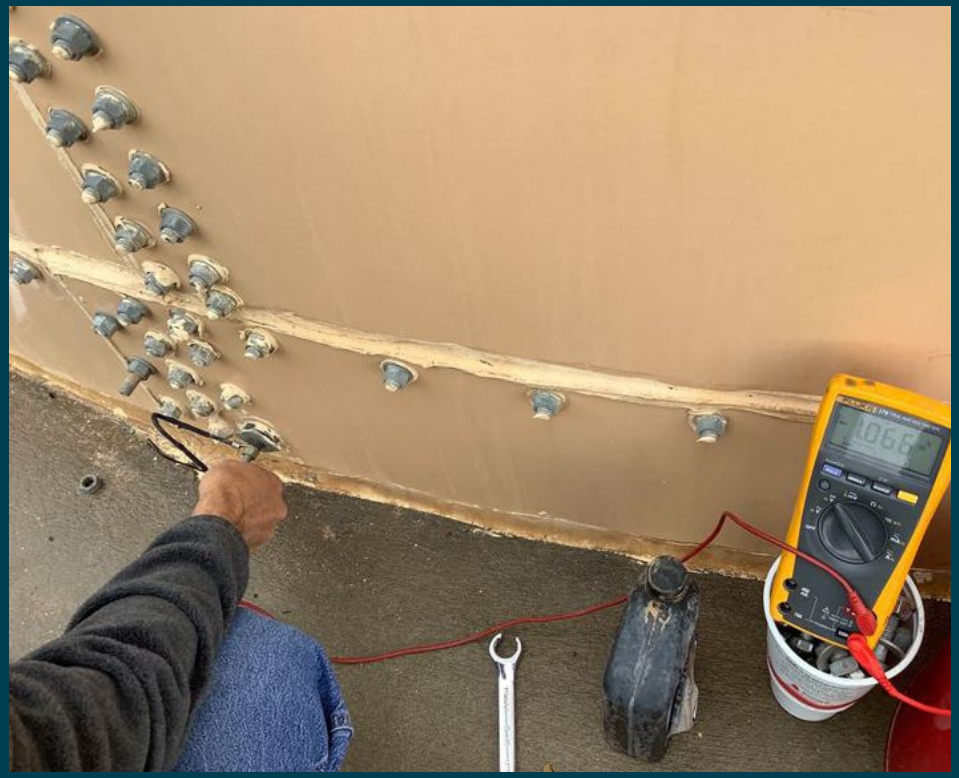




How to Check Your CP System

Learning Objectives

- Spot check your system
- Use equipment to test it
- Troubleshoot problems

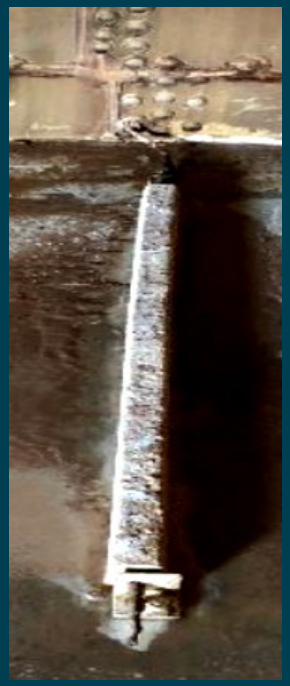


CP System Check: Procedure

Steps: Test with voltmeter and reference electrode

1. Identify system components & ensure anode is submerged
2. “ON” potential
3. “instant OFF” potential
   - Record 2nd reading on voltmeter
   - Reconnect within 2-3 seconds
4. Anode current
5. Anode potential
6. Retest system

Visually inspect interior tank surfaces (if possible)

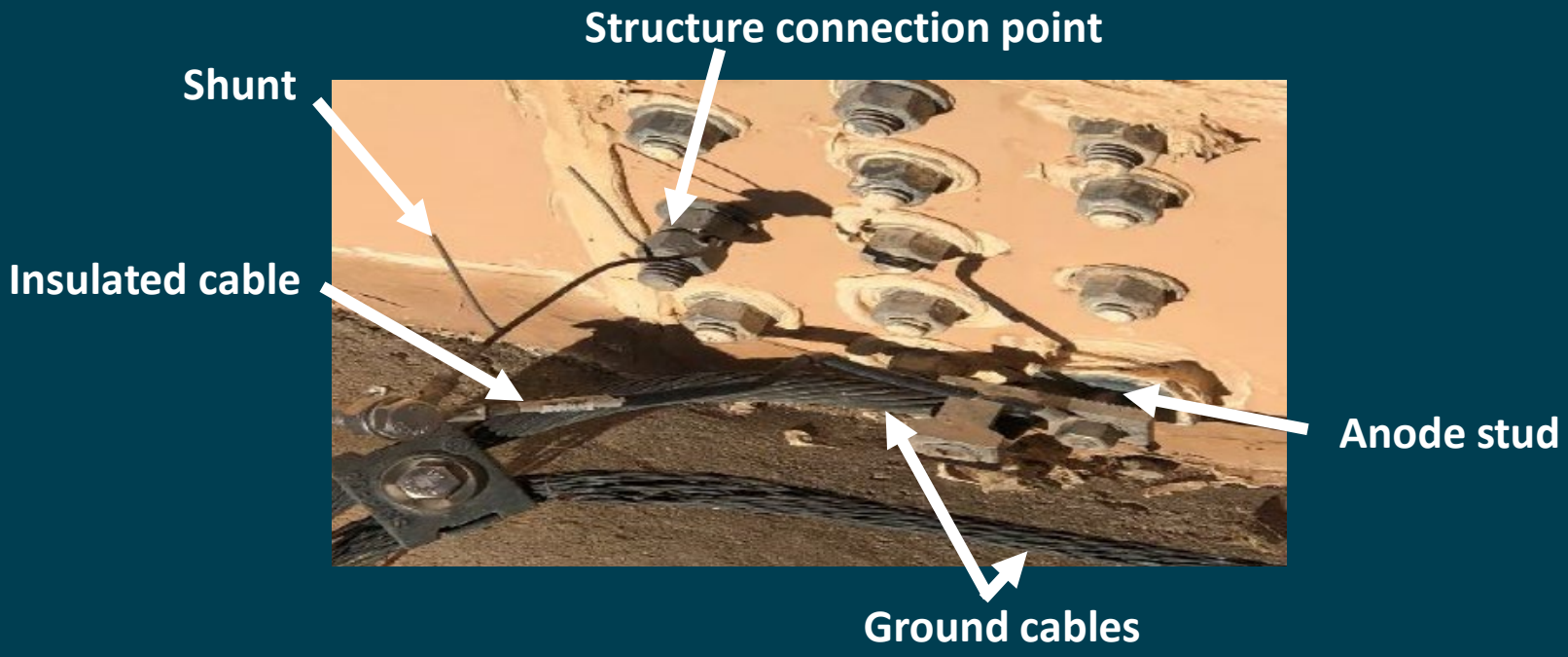


Coating Condition

Corrosion Damage

Anode Consumption

Step 1 – System Components



- Thin insulated cable and shunt connects anode and structure
- Large non-insulated cables are for grounding
  - May have grounded anode

Step 2 – “ON” Potential

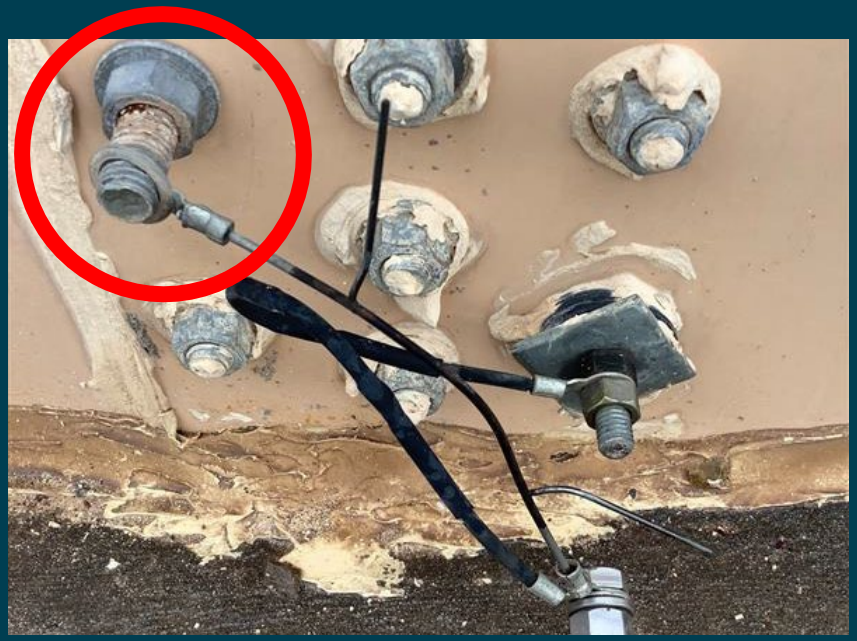
- Positive terminal connected to tank manhole
- Negative connected to reference electrode (RE)

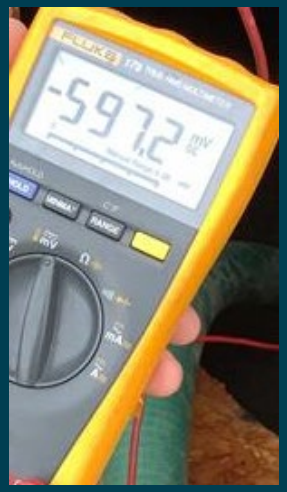
- -0.597 V vs $Cu/CuSO_4$ RE

Step 3 – "Instant OFF" Potential

(Also known as the polarized potential)

- Briefly disconnect anode at nut
- Reading should change





"ON"
-0.597 V

"Instant OFF"
-0.597 V

(no polarization observed)

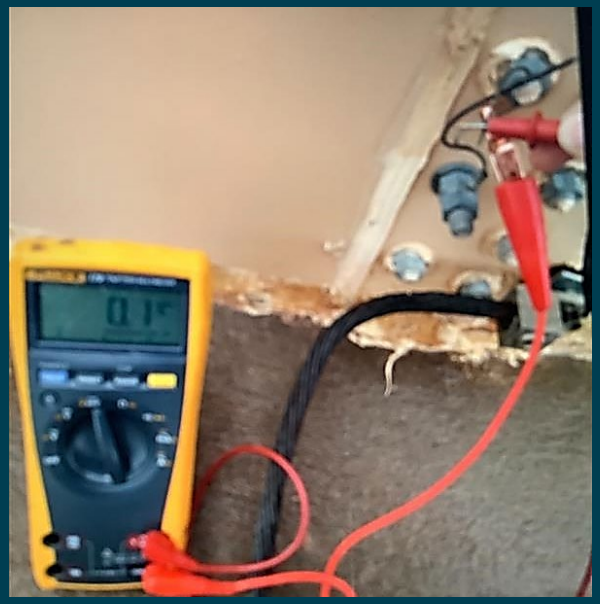
Steps 1-3 - Troubleshooting

- Possible reasons:
  - CP system is not connected
  - Anode has been consumed
  - Anode type is incorrect or is passivated
    - Is it Zinc (Type I or II) or is it Magnesium?
    - What does water chemistry indicate?
  - Lightning system connected to anode is causing issue

- Possible solutions:
  - Clean connection points to ensure electrical continuity
  - Proceed with next steps
  - Get technical expert involved

Step 4 – Anode Current

- 0.01-ohm shunt
- Measure voltage across two posts and calculate current
- Measured 0.1 mV may be rounded



Current (I) = voltage (V) / shunt resistance (R)

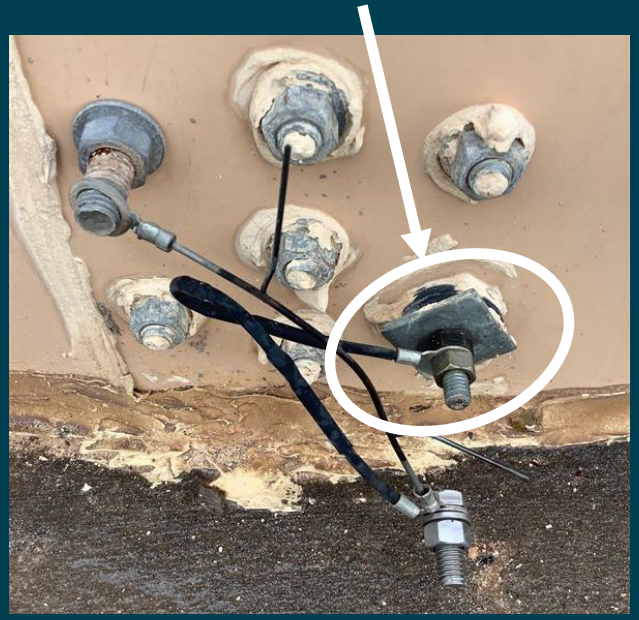
I ≤ 0.1 mV / 0.01 ohm

I ≤ 10 mA (little or no current)

Step 5 – Anode Potential

- One bolt has isolation kit, which should be anode
- Anode potential when disconnected = -1.066 V = Zinc
  - Zinc anode = -1.1 V
  - Magnesium anode = -1.5 to -1.7 V

Isolation prevents direct contact between anode and tank wall



Anode

Anode potential shows anode is not passivated

Step 6 – Retest

Always retest the CP system:

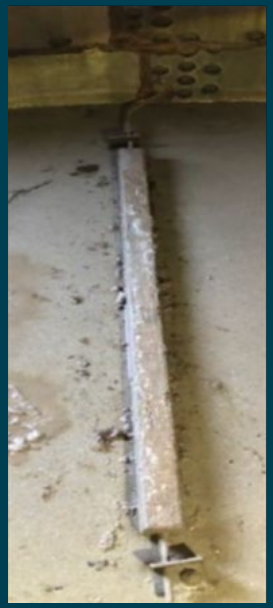
- After all connections are secured to ensure it is operating
- After any adjustments are made

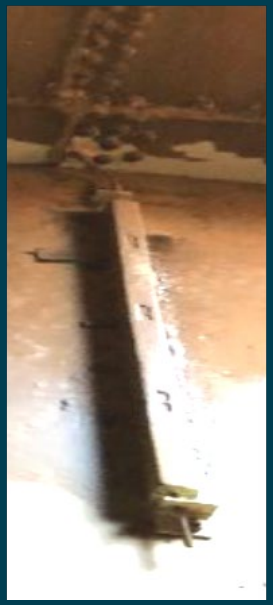
Retested hours later: "ON" = -0.882 V
"OFF" = -0.672 V

Original "ON" of -0.597 V may be native potential (if disconnected for a significant amount of time allowing the tank to depolarize)

Visual Inspection

Zinc anodes with minimal degradation in each tank





Interior ladder corroding

- Aluminum poor choice in high chloride environment

Summary

1. Cable connections:
   - ALWAYS check that CP system is operating (if potential drops when anode disconnected then the system was operating)
   - External connections are vulnerable to damage
     - Did someone snag the cables and pull them apart?
     - Connection issues
       - Are bolts coming undone over time?
       - Oxidation of surface disrupting electrical connection?
   - Labels help future testers
   - Avoid connecting anode directly to lightning and ground system

2. Visually inspect anodes
   - Active anodes change shape and degrade with time
     - No change could mean it is passivated or not connected
     - Potential readings aid in determining anode passivation
   - Can be used to determine when to replace the anode

Questions?

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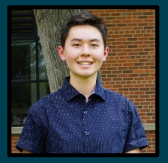

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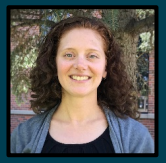

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