

# Internal Cathodic protection Of Tanks and Vessels

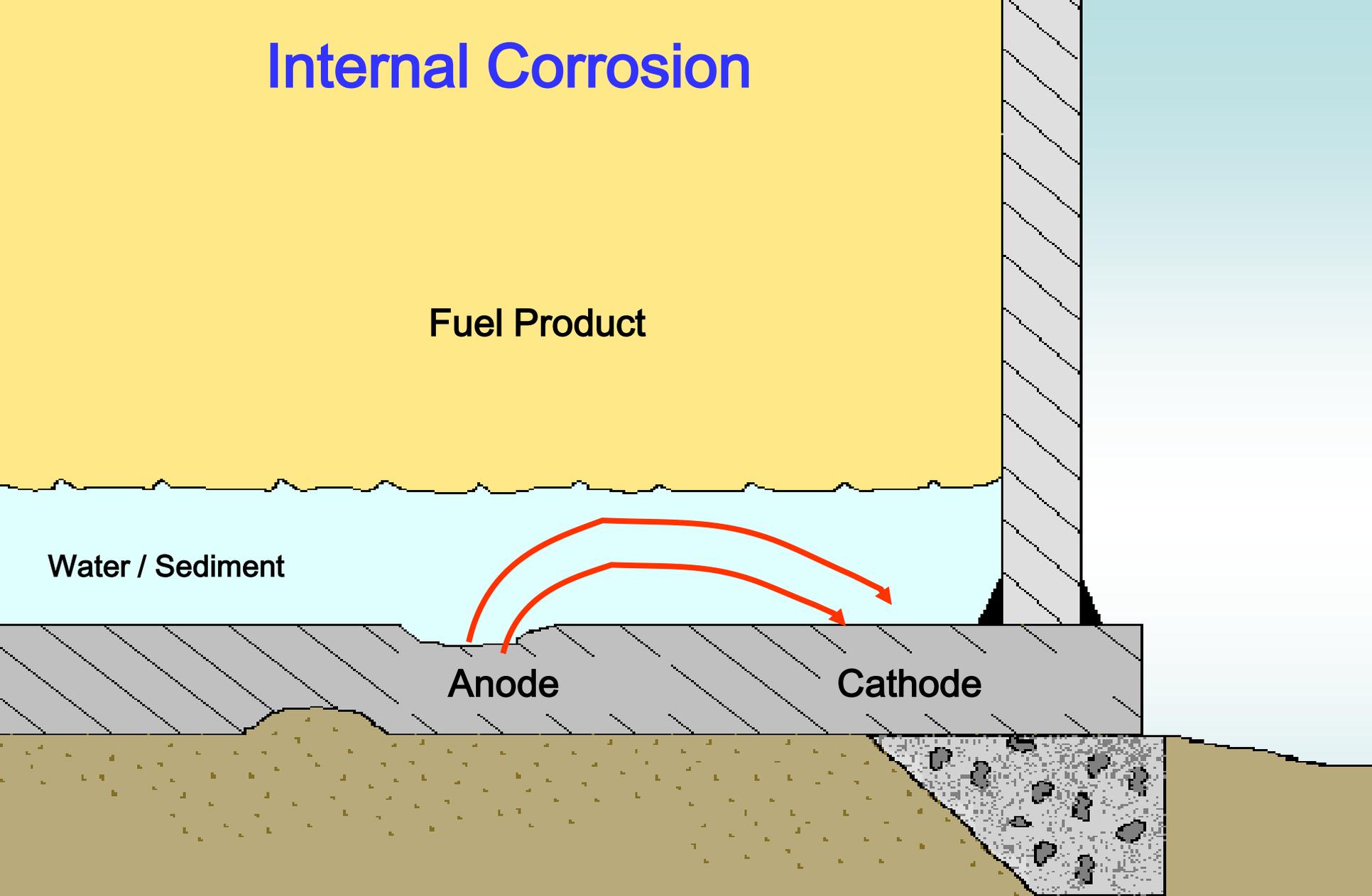


***Clive Hawkins***

***Contracts Manager / CP Specialist***

***Corpro Arabia Cathodic Protection Co. Ltd.***

# Internal Corrosion



Fuel Product

Water / Sediment

Anode

Cathode

# Internal Cathodic Protection

- Cathodic Protection Is A Proven Means of Corrosion Protection of Many Types of Storage Tank and Process Vessel

# Objectives

- (1) Types of Tanks / Vessels
- (2) Highlight Factors Important In Design
- (3) Highlight Limitations of Internal Cathodic Protection
- (4) Highlight Common System Types
- (5) Highlight Operation and Maintenance Requirements

# Types of Tanks / Vessel

- (1) On Grade Above Ground Storage Tanks
- (2) Above Grade Process Drums and Vessels

# Above Ground Storage Tanks

- (1) Water Tanks (e.g. Fire Water, Irrigation Water, Potable Water)
- (2) Crude Oil Tanks
- (3) Diesel Tanks

# Process Vessels/Tanks

- (1) Heat Exchangers
- (2) Condenser Waterboxes
- (3) Vessels for Various Chemical Processes (e.g. Separation, Degassing, Desalting etc.)
- (4) Process Tanks (Decoking, Sludge etc.)

# Applicability

## CP Will Function

- Generally Where Process Fluid is Water Based or May Have Water as a separate phase.
- If no water Cathodic Protection may be designed to cover possible contamination with Water e.g. Crude Oil Tanks.

# Exclusions

## CP Will Not Function

- Generally Where Process Fluid is Not Water Based (e.g. Organic Solvents) and Does not Have Water as a separate phase.
- Water of very high resistivity e.g. demin. water
- Extremely Hot Tanks e.g. molten sulphur
- Where Process Liquids Prevent Functioning of Cathodic Protection Components e.g. Acid and Alkali Tanks.

# System Design Considerations

## Design Information Required

- Description of Process Liquid (water content, whether liquid will be single phase or separate phases)
- Expected Resistivity of Water Content
- Operating Temperature
- Details of Internal Coating

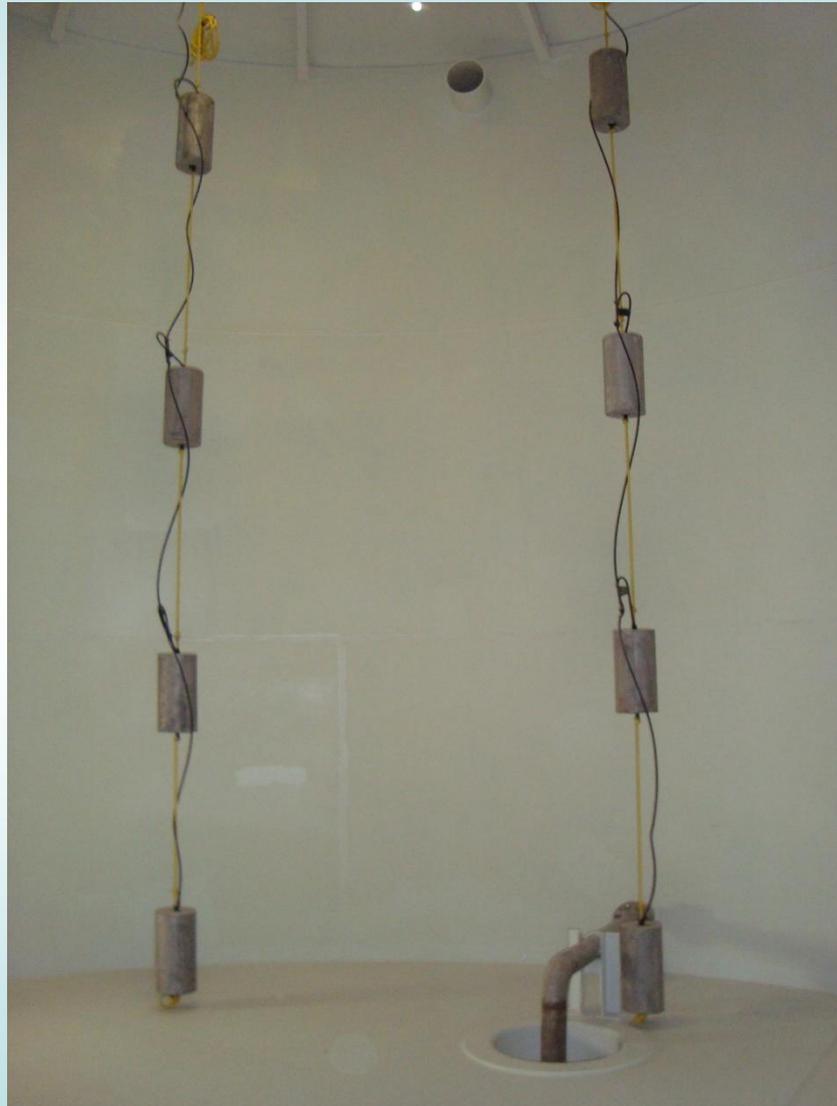
# Sacrificial Anode System

- Generally Feasible Only for Coated Surfaces Due to Low Current Requirements
- Best Suited to Smaller Tanks / Vessels.
- More Practical for Low Resistivity Liquids
- Can be Used for Multi-Phase Liquids Where the Bottom Phase is Water.

# Types of Sacrificial Anode Systems

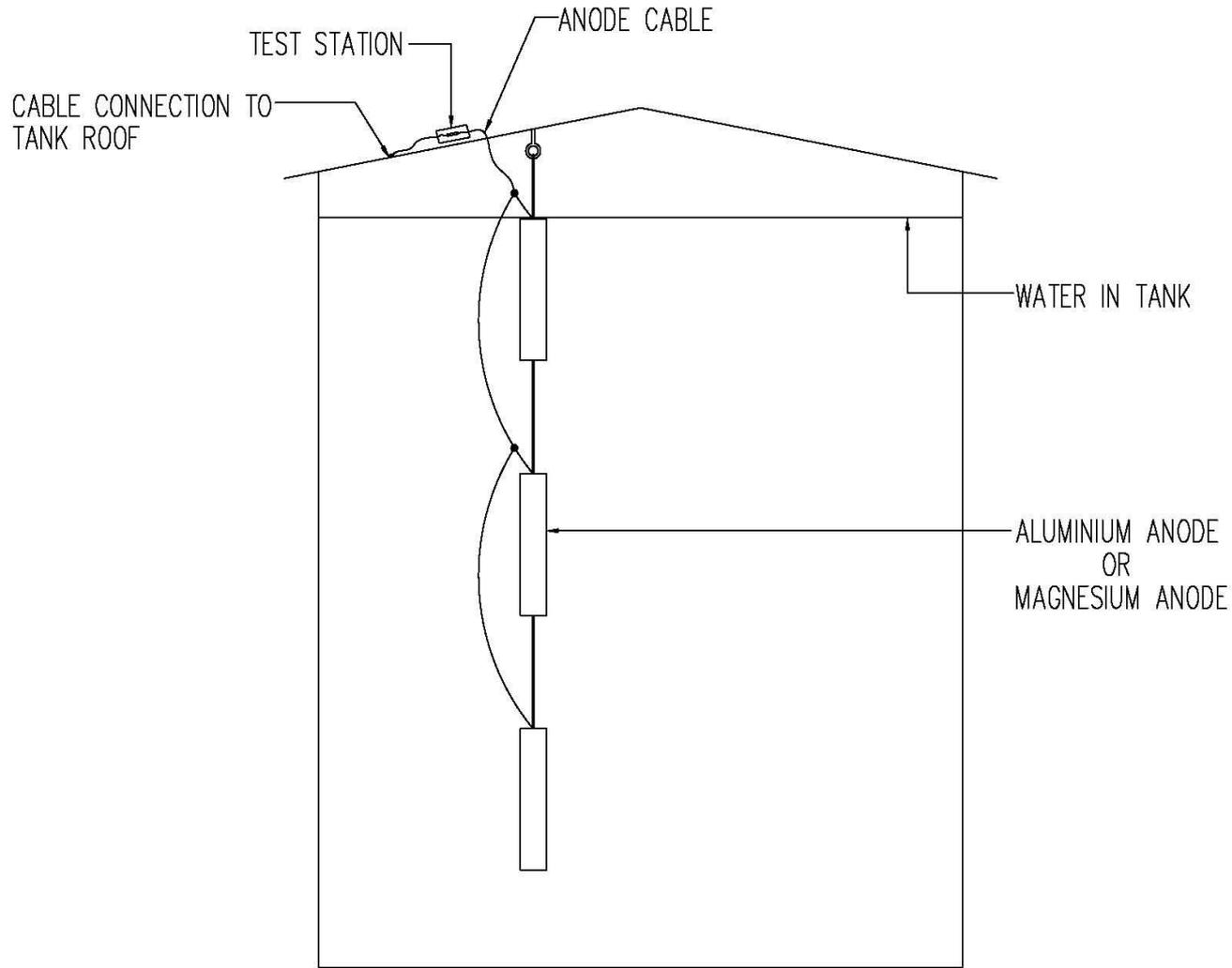
Type	Type of Sacrificial System	Features
Above Ground Storage Tank With Roof Containing Water As Single Phase	String System Suspended from Tank Roof	<ul style="list-style-type: none"> <li>•Anode Strings Connected to Tank via Roof Mounted JB</li> <li>•Current Output of Each Anode String Can Be Measured Using Shunt in JB</li> <li>•Portable RE can be Suspended from Tank Roof</li> </ul>
Open Top Tank With Water As Single Phase	Anode Bolted Directly to Inside Surface	Portable RE can be suspended From Access Stairs
Open Top Tank With More Than 1 Phase	Anode Bolted Directly to Inside Surface	Potential Measurement not possible due to difficulties in placing in water phase
Closed Vessel	Anode Bolted Directly to Inside Surface	Potential Measurement Usually not carried out due to difficulties placing RE inside and routing cable outside

# Sacrificial String Anodes

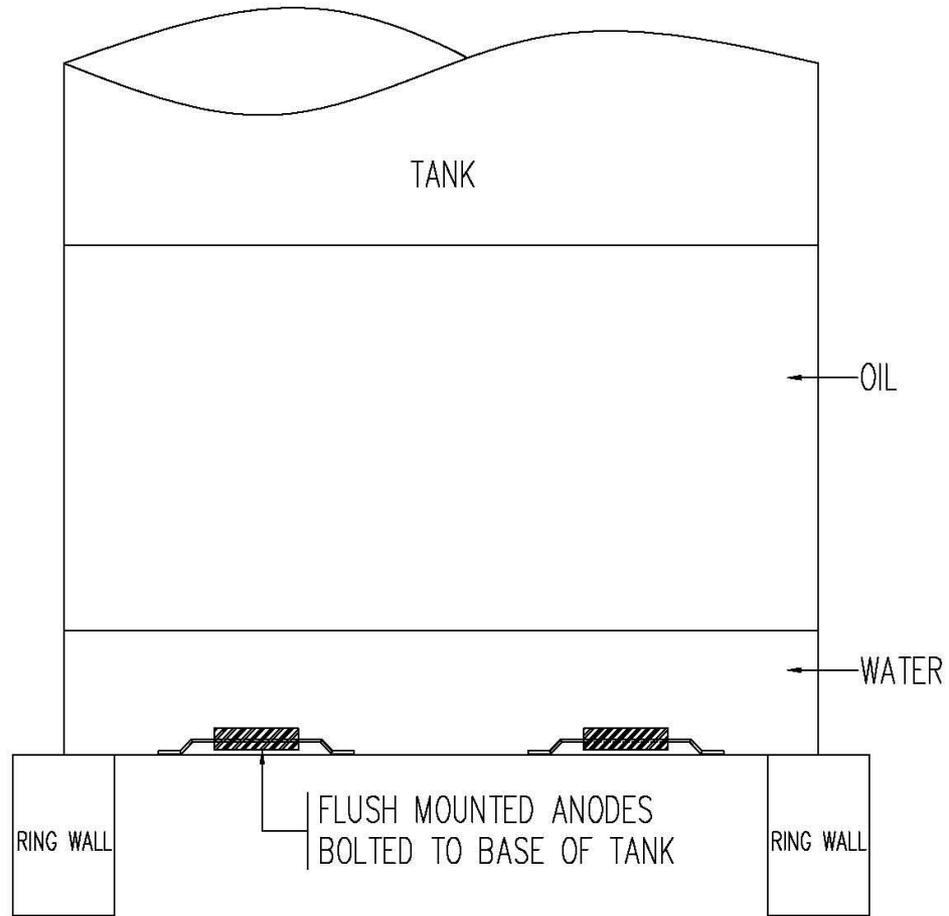


# Sacrificial Anodes Bolted to Inside Surface





TANK INTERNAL  
SACRIFICIAL STRING ANODE CATHODIC PROTECTION SYSTEM



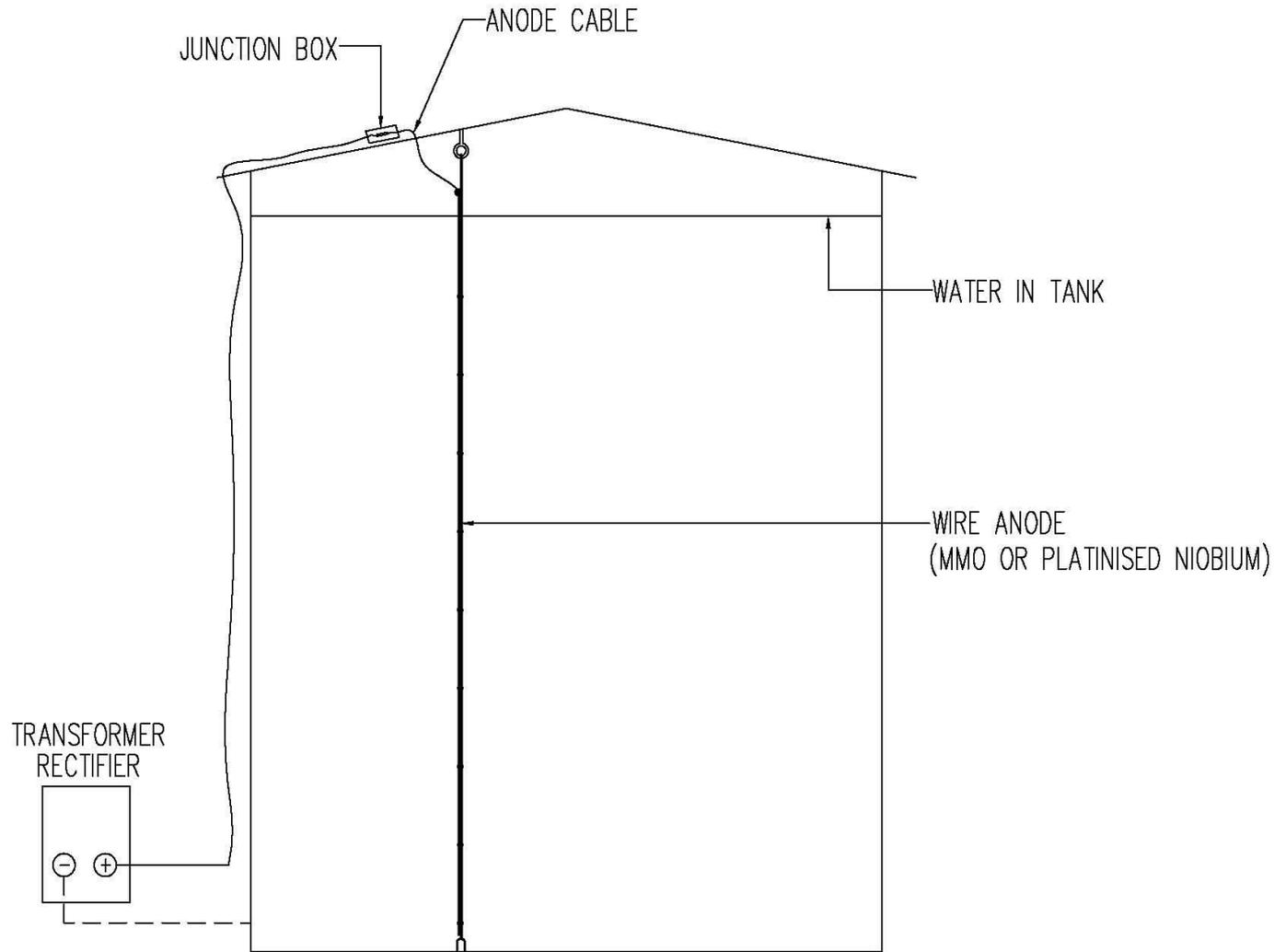
TANK INTERNAL  
CATHODIC PROTECTION WITH FLUSH MOUNTED ANODES

# Impressed Current Systems

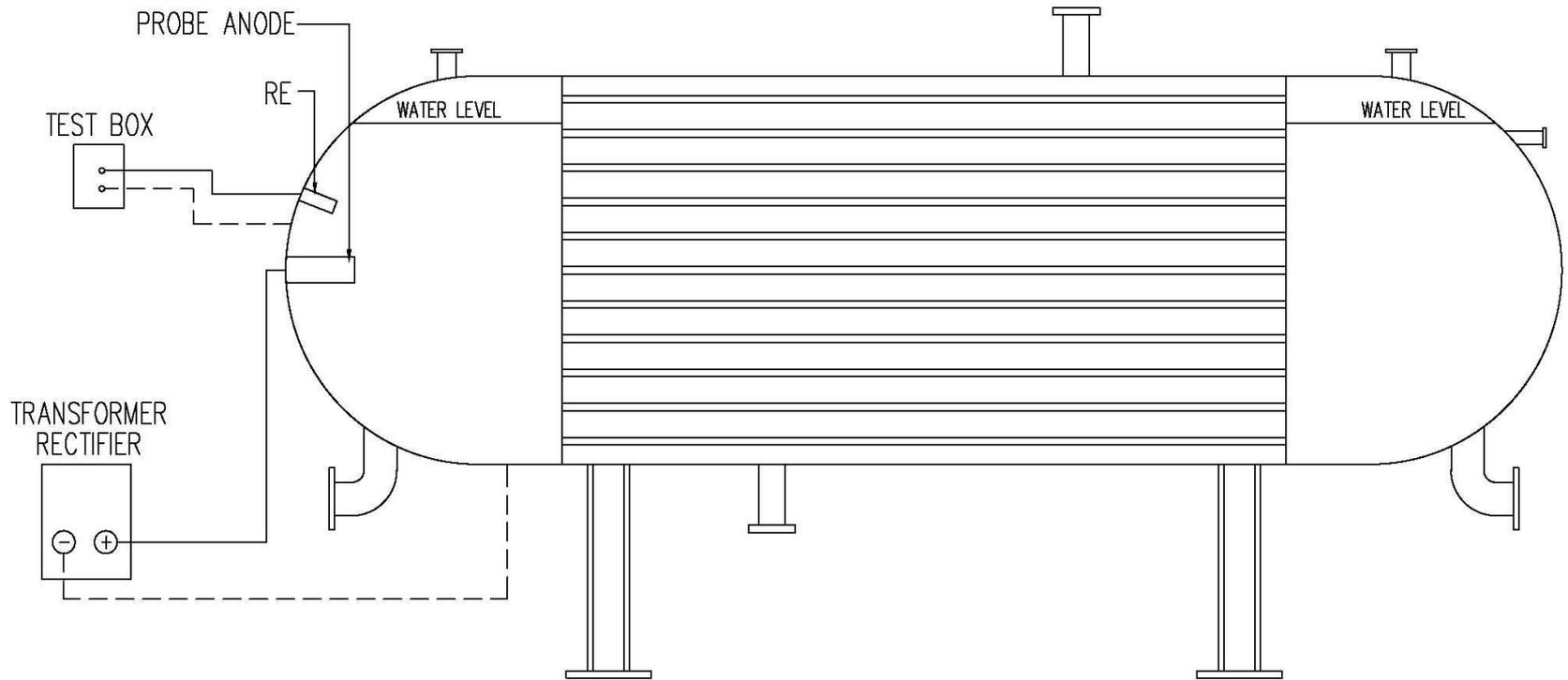
- Economic where current requirements are higher e.g. large or uncoated tanks
- Can Be Used on High or Low Resistivity Liquids
- Usually Applicable to Single Phase Water Based Liquids

# Types of Impressed Current Systems

Type	Type of Impressed Current System	Features
Above Ground Storage Tank With Roof Containing Water As Single Phase	ICCP anodes suspended from tank roof	<ul style="list-style-type: none"> <li>•Auto-potential control TR</li> <li>•Anodes may be tubular MMO or HSCI or Wire (MMO / Platinized Niobium)</li> <li>•Permanent RE Suspended from Tank Roof</li> </ul>
Open Top Tank With Water As Single Phase	ICCP Anodes Fixed Within Perforated Pipe Fixed to Tank Wall	<ul style="list-style-type: none"> <li>•Auto-potential control TR</li> <li>•Anodes may be tubular MMO or HSCI or Wire (MMO / Platinized Niobium)</li> <li>•Permanent RE Through Tank Wall</li> </ul>
Closed Vessel	Probe MMO Anode Through Vessel Wall	<ul style="list-style-type: none"> <li>•Auto-potential control TR</li> <li>•Probe Anode With Sealed Fitting through Vessel Wall</li> <li>•Permanent RE Through Tank Wall</li> </ul>



TANK INTERNAL  
IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM



VESSEL INTERNAL  
IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM

# Operation and Maintenance of SACP Systems

Type	Operation	Maintenance Requirements
Storage Tank With Roof Containing Water As Single Phase	<p>Measure Current Output of Anode Strings</p> <p>Measure Tank Potential With Portable RE</p>	<p>When Current Output and Tank Potentials Fall Tank to be Emptied so anodes can be inspected.</p> <p>Condition of anodes to be inspected</p> <p>Depleted Anodes to be Replaced.</p>
Open Top Tank With Water As Single Phase	<p>Measure Tank Potential With Portable RE</p>	<p>When Potentials Fall Tank to be Emptied so anodes can be inspected.</p> <p>Condition of anodes to be inspected</p> <p>Depleted Anodes to be Replaced.</p>
Open Top Tank With More Than 1 Phase	<p>None</p>	<p>Condition of anodes to be inspected whenever tanks/vessel are empty (during shutdown).</p> <p>Depleted Anodes to Be Replaced.</p>
Closed Vessel	<p>None</p>	<p>Depleted Anodes to Be Replaced.</p>

# Operation and Maintenance of Impressed Current Systems

Type	Operation Requirements	Maintenance Requirements
Above Ground Storage Tank With Roof Containing Water As Single Phase	Measure Potentials, TR current and voltage. Adjust TR outputs if required	Replace parts as and when required
Open Top Tank With Water As Single Phase		
Closed Vessel		



***Questions / Comments ?***