Effective Water System Treatment:
Methods of Corrosion Monitoring

IDEA-Campus Energy 2017
Thermal Distribution Workshop

GE
Water & Process Technologies

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Miami, FL
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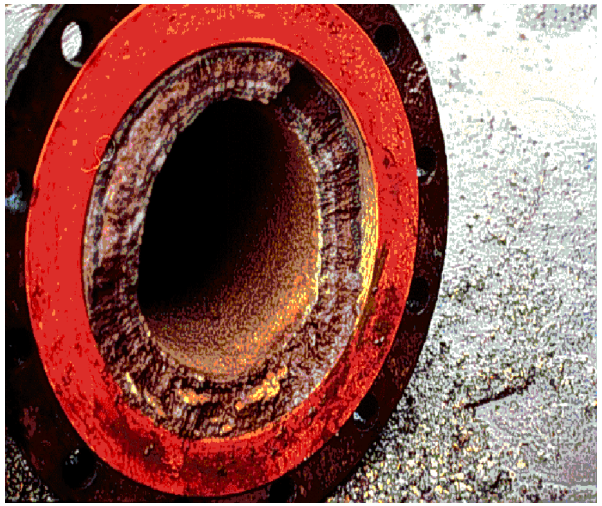
Effective Water System Treatment:
Overview of Effective Water Treatment

1. How is “Effective” defined and determined?
2. What performance factors are measured?
3. How are those factors measured? Are the methods used reliable, providing meaningful results?
4. What metrics are accepted across the industry?
5. Is there sufficient guiding reference material available?

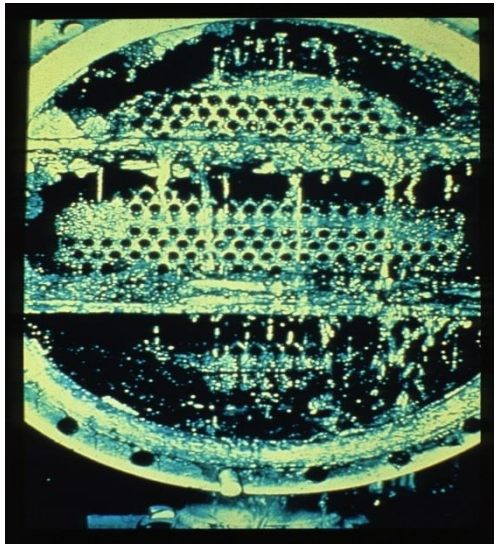
Water System Treatment Efficacy: Measured via *System Monitoring*

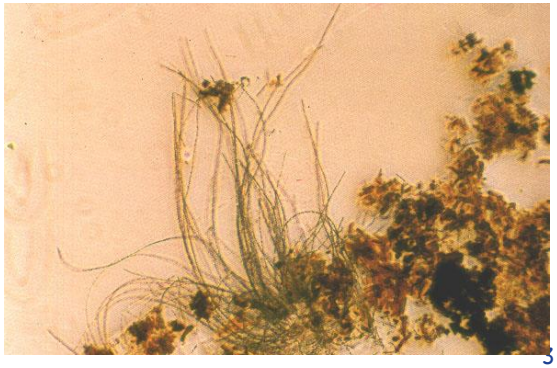
Corrosion

Deposition



Microbiological





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Water System Treatment Efficacy: Measured via *System Monitoring*

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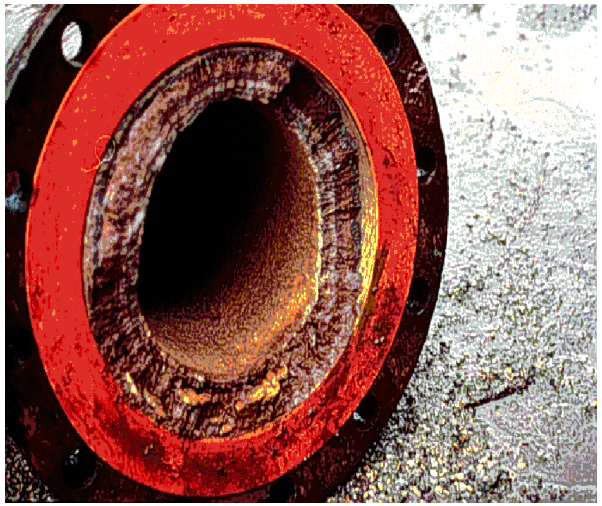

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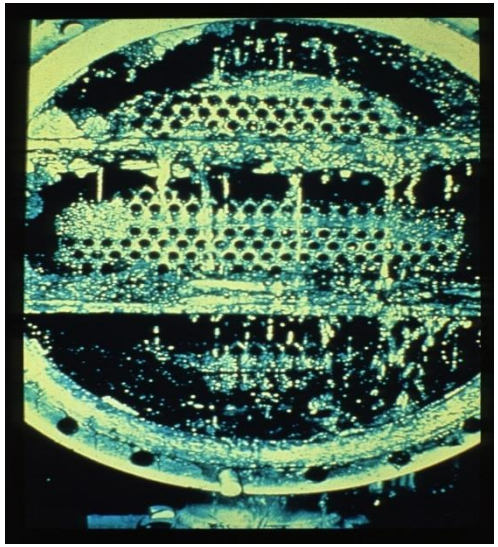

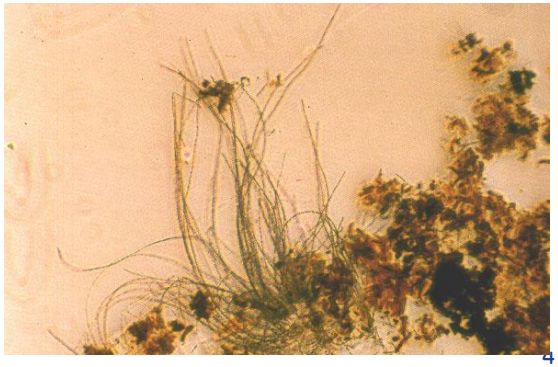

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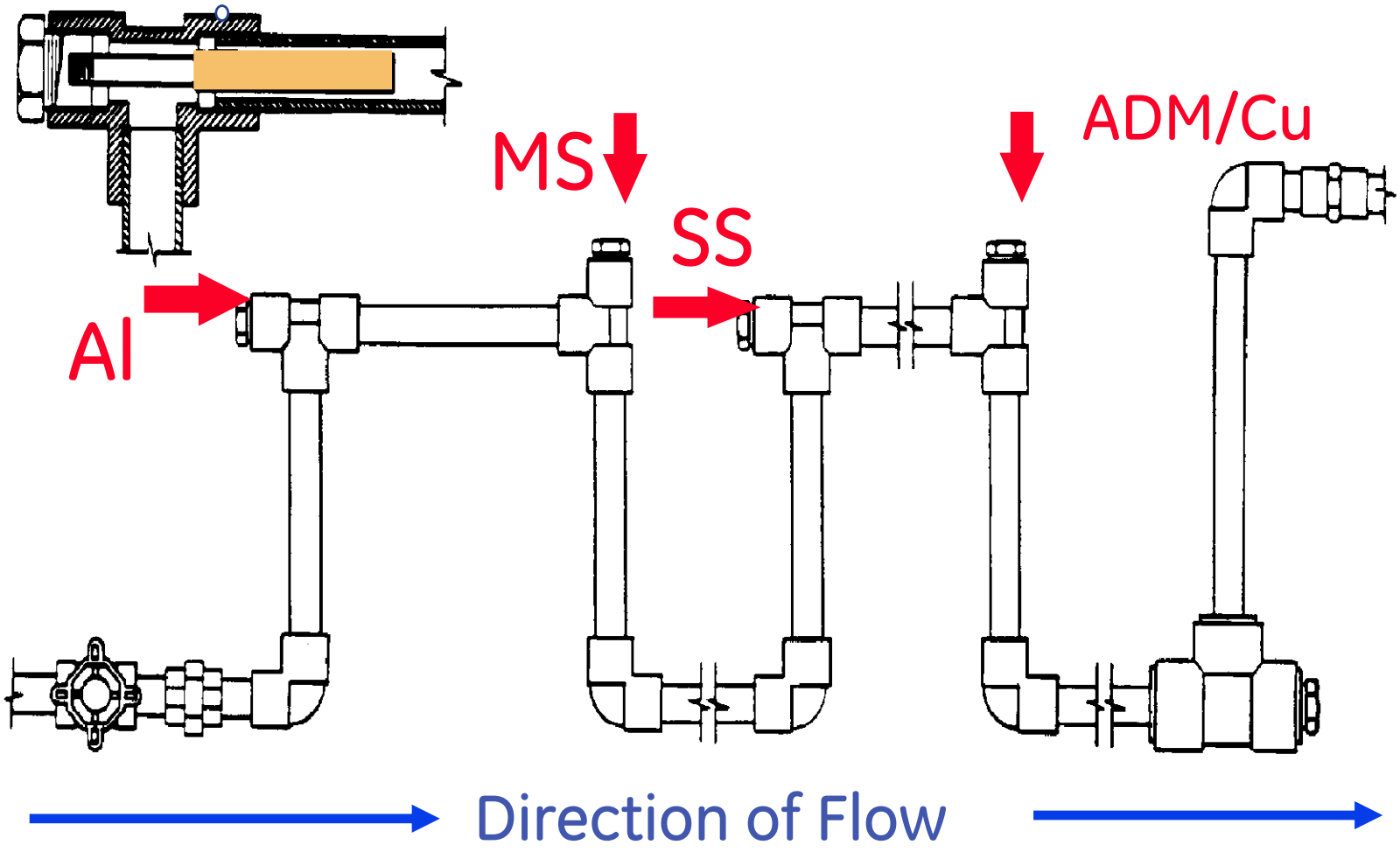
Coupon Rack



Coupon Considerations

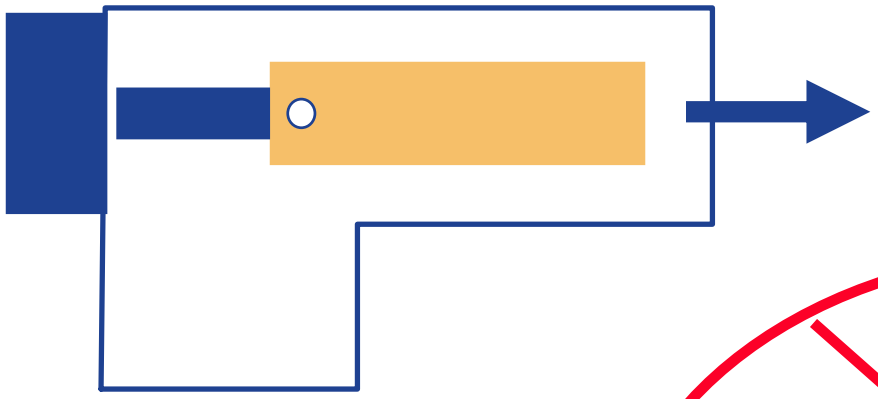
- Match system metallurgy
- Place in 1” rack on hot return
- Pretreated vs. non-pretreated???
- Galvanized coupons?

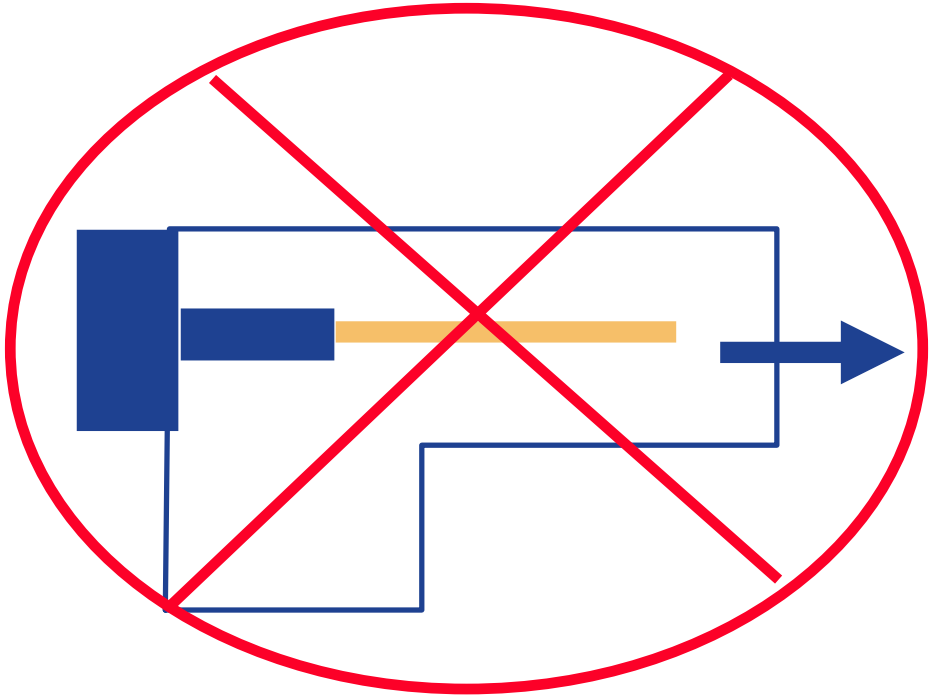
1018 Carbon Steel Zinc Copper

System Considerations

- Use nylon screws and nuts or match coupon metallurgy.
- Ensure pressure differential (drop) between inlet and outlet for proper flow.
- Use established procedures and guidelines [CTI Code STD-149(00) and ASTM D 2688-99]

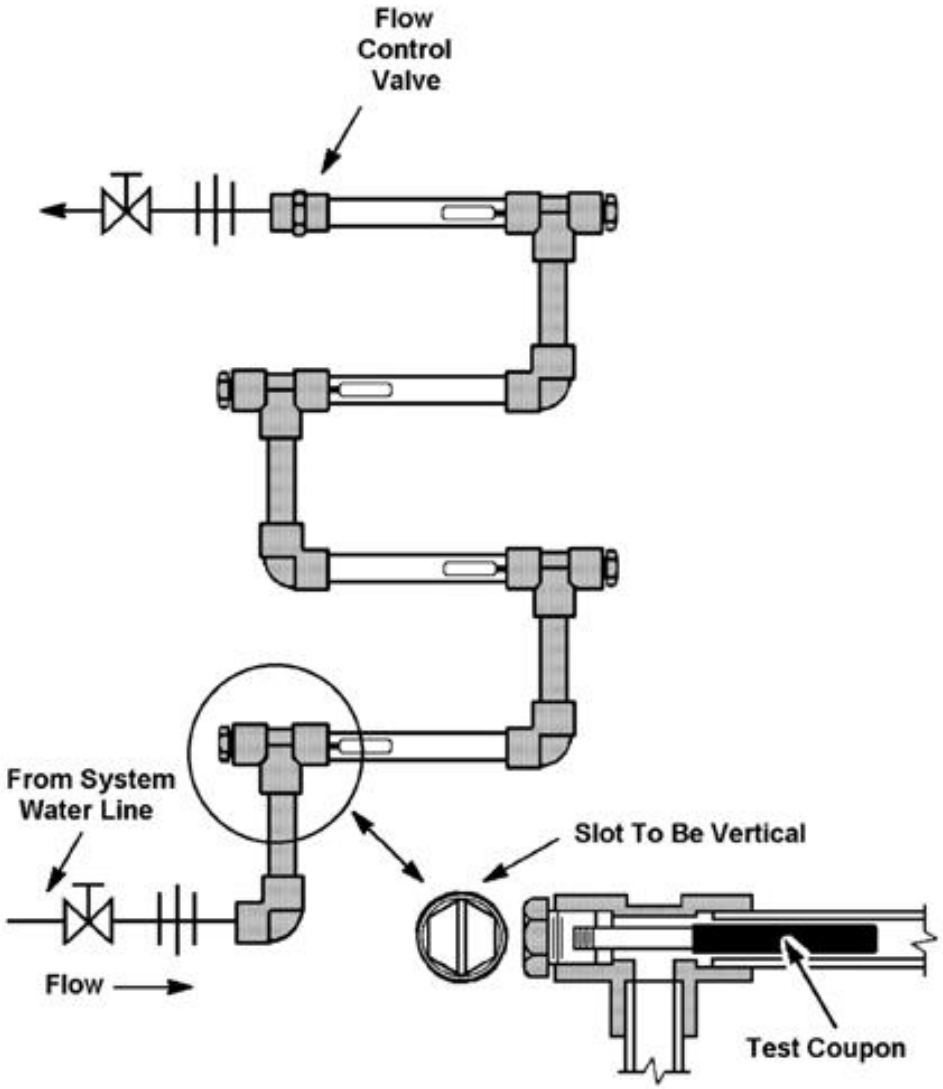
Coupon Placement





Align edges (not faces) with direction of flow.

Flow Control Valve



Various Models– Retractable Test Coupon Assembly

Example: Model 75 Specifications

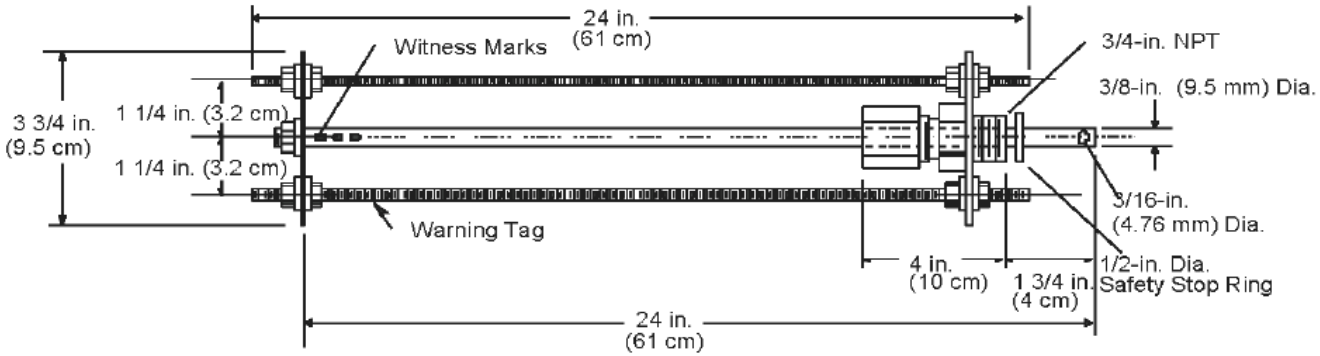
- Material of construction is 303 SS with plated steel safety rods ¾" MNPT

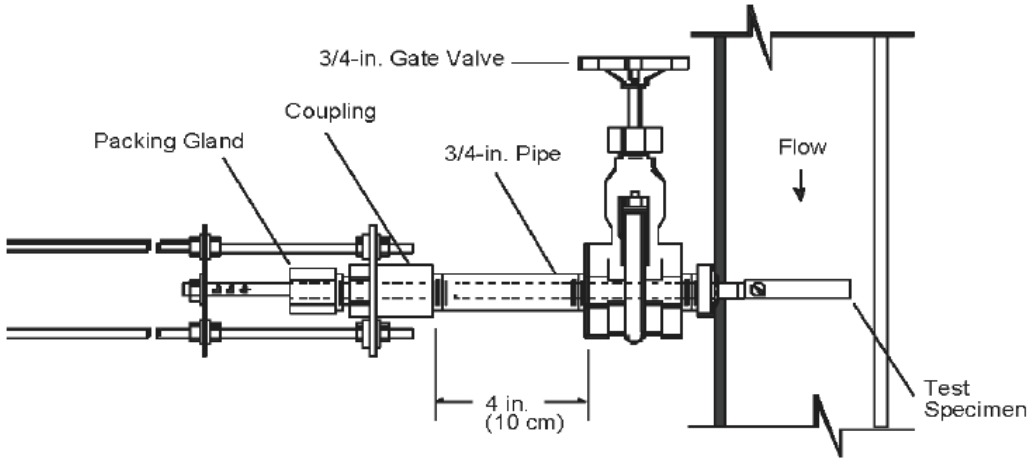
- Rating:
  - —Pressure: 450 psig (31 bar)
  - —Temperature: 700˚F (371 ˚C) (Graphite Packing)

Model 75 Test Coupon Assembly

- With ½" safety stop ring. Requires a ¾" full port or globe valve.

Dimension Details





Coupons / Corrator

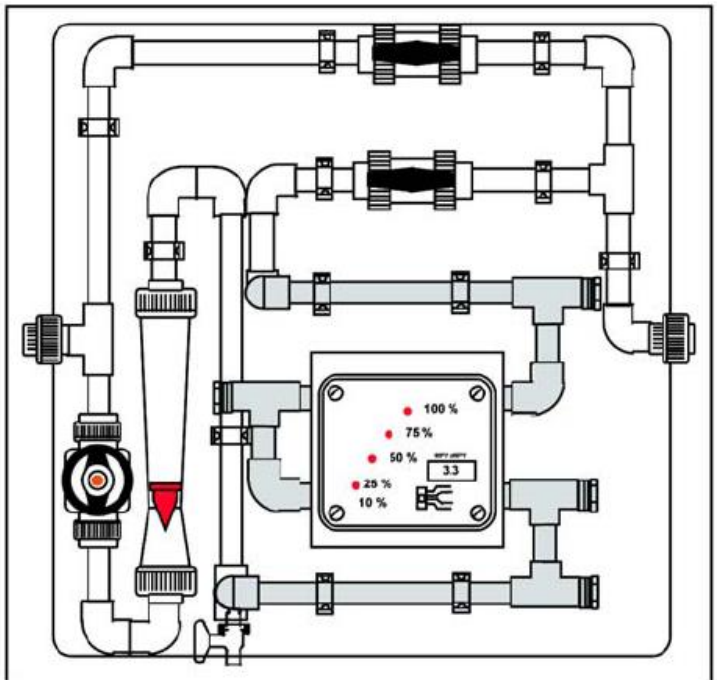
Corrosions Rack Panel

- All electrical inputs and outputs are marshaled together in one standard panel
- Isolating valves
- Model SCA 1 corrator probe
- Space for 3 corrosion coupons
- Corrosion rack flow control by regulating valve and variable area meter
- Sample point
- By-pass to supply other modules

Coupons/Corrator

Corrosions Rack Panel

- Manufactured from chemically resistant materials
- Pre-wired and pre-piped for ease of installation
- Modular, so that any number of panels can be linked, without additional pipework
- Ready available support literature
- “Fast Loop” sampling to minimize response time
- Pre-drilled polypropylene back-board

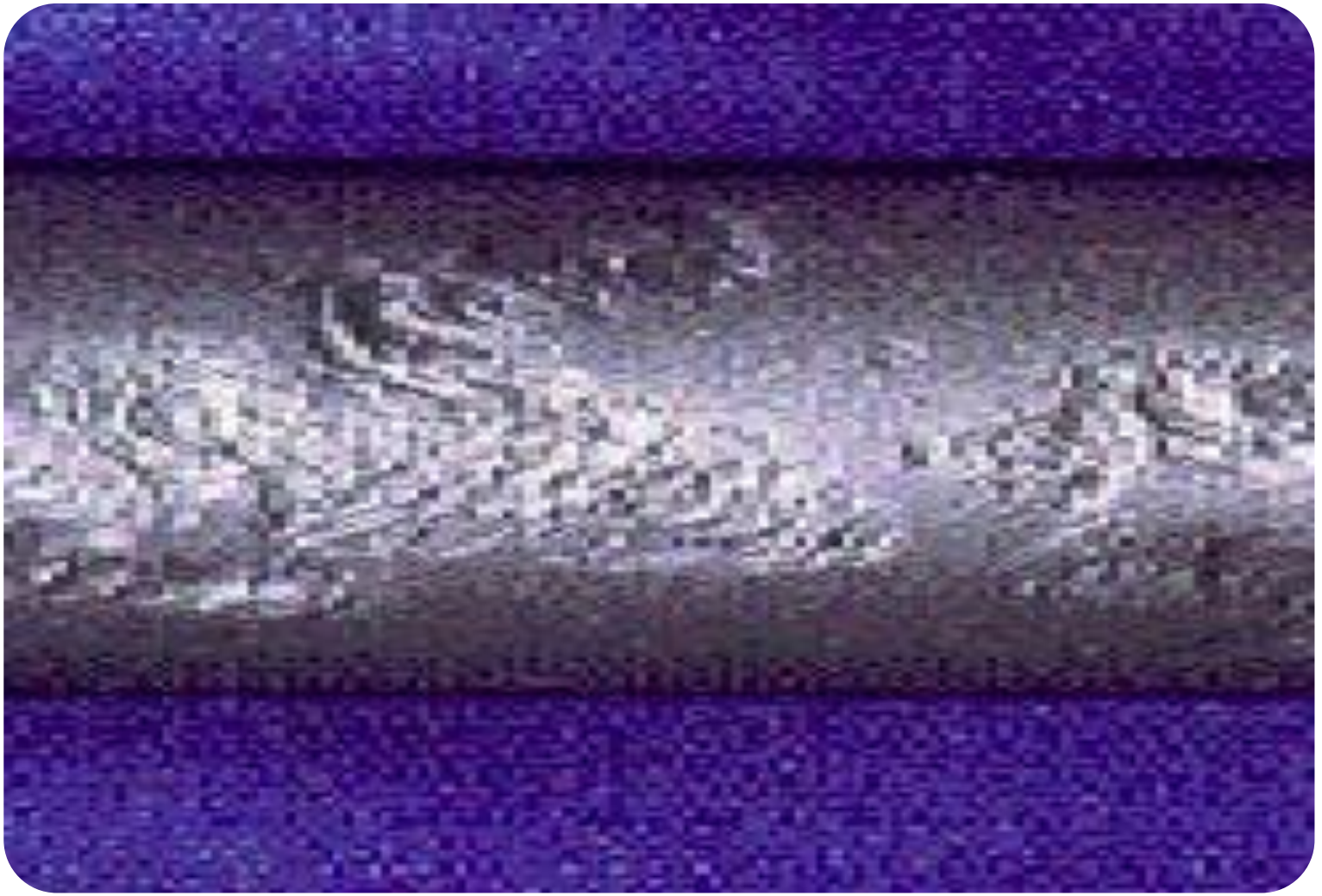


Dezincification

General Corrosion

MB Attack – Before Cleaning (Steel)

MB Attack – After Cleaning (Steel)



MB Attack – Steel vs. Admiralty Brass

Pitting (Localized Corrosion)

Stress Corrosion Cracking – Chlorides / SS

Corrosion Study Time Intervals

- Short time intervals for the **1st time series** to establish rate at which passivity occurs.
- Removal of 3 or 4 sets of coupons at **4 - 7 days**.
- For **2nd time series** longer intervals are used - establish steady-state corrosion rate.
- Remove one set of coupons at **30 days** and the remaining sets at **60 / 90 days**.

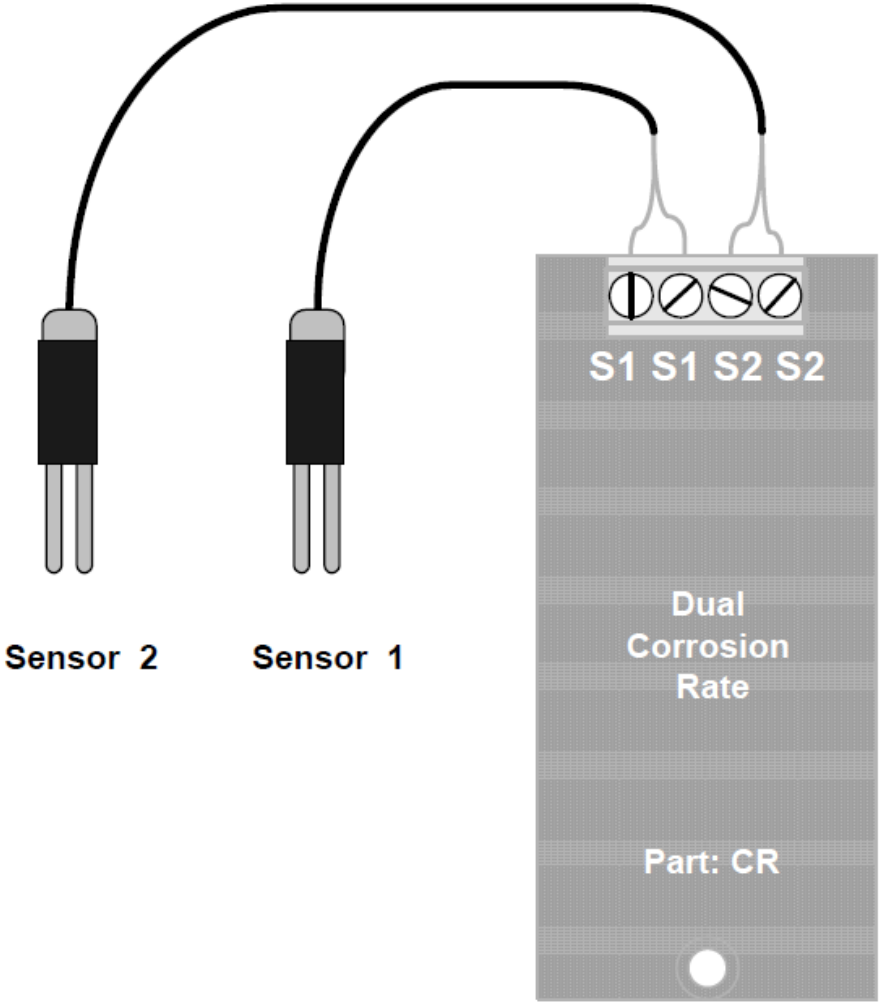
ProMinent LPR Corrosion Rate Sensor Package

LPR Method

LPR uses two standardized cylindrical metal coupons, nominally 0.1875" D x 1.25" L of the same metallurgy, typically both steel, copper, admiralty, copper-nickel or zinc. The coupons are polarized to several mV and the resulting current measured. The polarity is reversed & the current re-measured. The corrosion rate is calculated using the measured currents, the polarization voltage corrected for process resistivity and constants based on the coupon metallurgy.

AEGIS

Corrosion Rate



Services

The CR driver measures one or two corrosion rates using Linear Polarization Resistance.
Dual CR drivers allow two alloys, copper & steel for example, to be monitored concurrently.
Up to two dual and one single 'CR' drivers may be installed in an Aegis controller.

Corrosion Rates

Electrochemical Reaction

Corrosion rates generally increase as:

- Temperature increases
- pH decreases
- Alkalinity decreases
- Conductivity increases
- LSI decreases

Corrosion Rates

Industry Standards for Cooling Systems:

Mild Steel	<	**2-3 mpy**
Copper	<	**0.2 mpy** (low % Cu in system)
Copper	<	**0.1 mpy** (higher % Cu in system)
Aluminum	<	**1 mpy**
Stainless Steel	<	**0.1 mpy**

Additional References

1. Table of typical corrosion rates
2. Corrosion bypass rack guidelines
3. Flow vs. velocity through PVC bypass racks
4. ASTM D 2688-99: standard test methods for corrosivity
5. CTI corrosion testing procedures STD-149(00)
6. GE corrosion rate guidelines for open evap. cooling
7. Corrosion coupon study best practices guidelines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