

# Zinc-Rich Coatings Over High Strength Steel

NSRP MegaRust Meeting  
May 2024



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# Background

- Zinc-rich coatings are often avoided on high strength steels due to long held concerns of hydrogen embrittlement, particularly in heat affected zones
- Recent research suggests hydrogen embrittlement may not be an issue with zinc primers, potentially allowing for the use of more effective corrosion barriers throughout ship construction
- The team will work with Navy technical advisors to develop requirements and conduct testing to demonstrate the effects of zinc-rich coatings under environmental and hot work conditions in order to pursue future approval for use on Navy ships

# Anticipated Benefits

- Zinc-rich coatings provide additional corrosion protection during downtime and prevent excessive remediation efforts
- Inorganic zinc-rich coatings have a higher thermal stability compared to organic coatings.
  - Reduction in coating removal
- Additional labor savings from not having to restore a steel surface to a near white metal finish.

# Scope of Work

- This project will evaluate the effect that zinc-rich coatings have on high strength steel.
- Goals/Objectives
  - Establish a credible testing protocol to assess base metal and deposit filler metal susceptibility to reduced properties associated with zinc-rich coatings
  - Generate data to understand the relative impact of zinc-rich on high strength steel
  - Depending on testing results, provide list of alternative coating systems and appropriate areas of application
  - Provide recommendations for shipyard and navy consideration

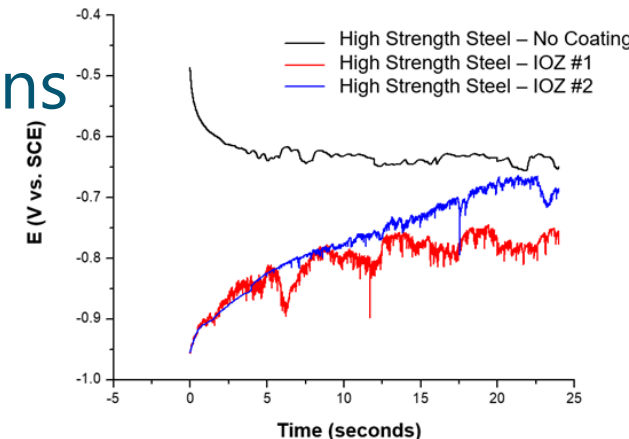
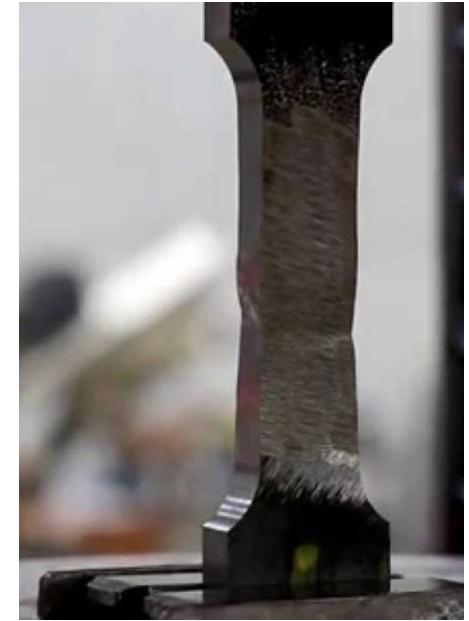
# Previous Work

- Zinc-Rich Coatings for Enhanced performance of Polysiloxane Topside Coatings, 2013
  - Research was done previously demonstrating the benefits of zinc-rich coatings with polysiloxane topcoats on Navy vessels. The study showed that the performance of such a system was beneficial overall but did not examine the possible issue of high strength steel substrate degradation from a zinc coating
- Sacrificial Coatings for the Corrosion Protection of Armor Steel, 2013
  - Research showed zinc-rich paint on armor steel offers substantial corrosion benefits. Minimal concern for EAC on non-loaded high hard armor steel



# Tasks

- Identify Target Applications, Requirements, and constraints
  - Hold kickoff meeting with project team to discuss high value target applications, identify coating types for consideration, discuss performance testing strategies.
- Select Candidate Systems, Finalize Test Requirements, and Test Plan
  - Team will work with Navy Technical advisors to develop test plan
- Fabrication of Test Articles and Laboratory Testing
  - Test articles will have the appropriate zinc-rich coatings applied in a fashion consistent with shipbuilding operations with a focus on potential worst cast situations.
- Final Report



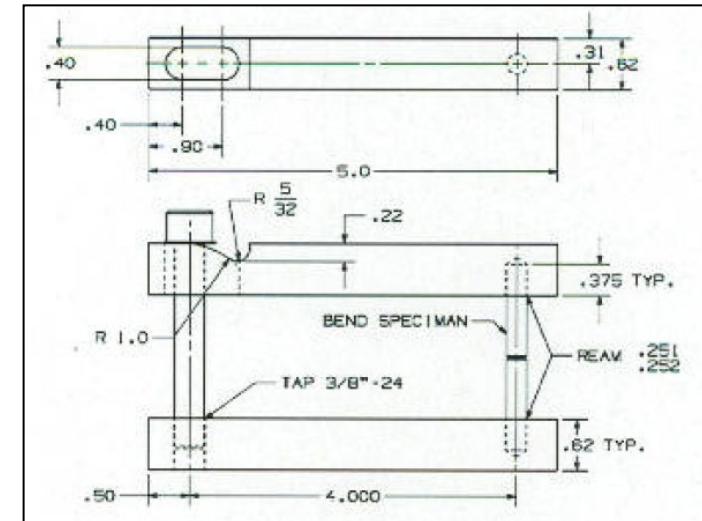
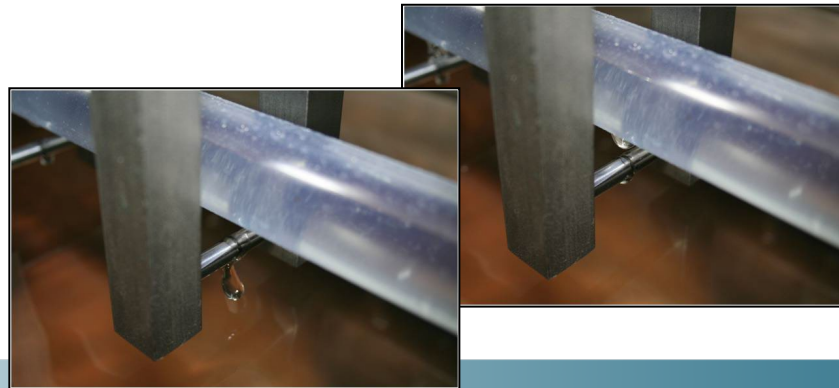
# Task 1 (Completed) - Identify Target Applications, Requirements, and constraints

- Kickoff meeting held on 11/9 with Navy Technical community
  - 6 technical community leaders in attendance
    - Coatings and Corrosion Engineering Manager, NAVSEA 05P
    - Materials Technical Warrant Holder, NAVSEA 05P
    - Structures Technical Warrant Holder, NAVSEA 05P
    - NSRP Program Manager, NAVSEA 05T
    - Mechanical Engineer, NRL
    - Branch Head of Coating and Corrosion, NRL
- Highlights:
  - Discussion on previous DoD efforts
  - Discussion on Navy concerns
  - Proposed testing
  - Proposed types of zinc coatings



## Task 2 (Completed) - Select Candidate Systems, Finalize Test Requirements, and Test Plan

- ASTM F519 Type 1C, Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments
  - Describes mechanical test methods and defines acceptance criteria for coating and plating processes that can cause hydrogen embrittlement in steels
  - Stressed notched bars exposed for 500 hours
  - Time to failure recorded; run-outs stressed to failure





# Task 2 (Completed) - Select Candidate Systems, Finalize Test Requirements, and Test Plan

- Coatings to be evaluated
  - Two IOZ PCPs
  - One IOZ
  - TTC-P-664
- Three different substrates to be tested
  - One common steel (4340); two high strength steels
- Two different environments for testing
  - Wet vs Dry
- Test plan approved by Navy Technical Community

## Task 3 (On-Going) - Fabrication of Test Articles and Laboratory Testing

- All coatings received
- High strength steel plates have been produced
- Test samples made for all but one high strength material
- Testing anticipated to begin mid June
- No Cost Extension Granted by ATI until 10.2024 due to material delays and test article fabrication

# Path Forward

- Fabricate test samples
- Begin evaluations
- Report data to technical community
- Finalize report for distribution

# Questions?

