Electrospark Deposition for U.S. Navy Component Repair Applications

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Denise M. Aylor
NSWC Carderock Division
West Bethesda, MD
Email: denise.aylor@navy.mil
# Electrospark Deposition for U.S. Navy Component Repair Applications

## ABSTRACT

26th Replacement of Hard Chrome and Cadmium Plating Program Review Meeting, January 24-26, 2006, San Diego, CA. Sponsored by SERDP/ESTCP.
Targeted Applications

• Steering & Diving Control Rods
• Hull Valve Stems
• Alloy 625 Seawater Components
Control Rods and Seawater Hull Valve Stems

- **ISSUE**
  Unacceptable corrosion/wear of Alloy K500 control rods and valve stems

- **SOLUTION**
  Electrospark deposition of Alloy 400 to re-establish original dimensions
Hull Valve Stem
Steering and Diving Control Rod
Steering and Diving Control Rod
ESD Control Rod Repair

Before Repair

Defect Measured
0.016” to 0.021” in Depth

After Repair
ESD Control Rod Repair

Defect Measured
0.012” to 0.017” in Depth
ESD Control Rod Repair

Defect Measured
0.006” Maximum Depth

Before Repair

After Repair
ESD Control Rod Repair

Before Repair

Defect Measured
0.003” to 0.013” in Depth

After Repair
ESD Repair Section #4
ESD Repair Sections
After 127 Days in Seawater

Section #1

Section #3
Blunt Chisel Defects
ESD Repaired with Alloy 400

Defect #1

Defect #2

400um
Blunt Chisel Defects
Rounded Out with Dremel Tool
ESD Repaired with Alloy 400

Defect #1

Defect #2
ESD Control Rod

Demonstration Repair Status

- Identified voids and microcracks within narrow groove repair area and corrosion after seawater immersion
- Simulated defect study identified improvements in ESD repair with less severe defect geometry
- Additional research need to identify NDE methods to assure optimum repair quality
Crevice Corrosion Repair of Alloy 625 Components

- Develop NSWCCD Capability to Deposit Crevice Corrosion Resistant Ni-Cr-Mo Alloys on 625 Substrates
  - Alloy C276
  - Alloy 59
  - Alloy 686
ESD of Ni-Cr-Mo Alloys on Alloy 625
Crevice Corrosion Testing

- ESD Coatings of Alloy 686, C276, and 59 Applied on Alloy 625 Panels
- Control Specimens Include Uncoated Alloy 686, C276, 59, and 625
- Triplicate Specimens Exposed per Condition for 180 and 365 Days in Filtered, Natural Seawater Immersion
ESD of Ni-Cr-Mo Alloys on Alloy 625

Crevice Corrosion Testing in Natural Seawater

Non-Metallic Crevice Former

1/2-in Through Hole with Sleeve

1/4-in. Nominal

Electrically Isolated Through Bolt (CP Ti)
Crevice Corrosion Testing of ESD Ni-Cr-Mo Alloys on 625
Crevice Corrosion Test Results After 365 Days in Seawater

- ESD Alloy C276 Coated Specimens Showed Crevice Susceptibility at Crevice Sites
  - Corrosion initiated between 9 and 14 days’ immersion
  - Maximum depth of attack = 0.005 in. (0.13 mm)

- ESD Alloys 686 and 59 on 625 & Wrought Control Specimens of Alloys 625, 59, 686, and C276 Remained Corrosion Resistant After 365 Days
ESD Alloy C276 Coated Specimens After 180 Days in Natural Seawater

Maximum Depth of Attack = 0.005 in. (0.13 mm) Initiated After 9-14 Days’ Immersion