Qualification of Mg Housing Cold Spray Repairs -
Progress to Date

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OUTLINE- 2014….

• Background/History
• Mg Housing Repair

Non-structural:
   Overhaul & Repair Instructions
   MRB parts

Structural:
   Material Qualification
   Testing
   Process Control
   Implementation:

• Milestones
• Summary
SIKORSKY

Defense Systems & Services

Commercial Systems & Services

Operations

Engineering

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Sikorsky has more than 25 years of experience applying thermal spray repair processes.

Sikorsky was an industry leader on the ESTCP program.

Sikorsky is actively working to implement cold spray on dynamic components.
THERMAL SPRAY COATINGS – Mg REPAIR

1987
Plasma spray

1991-1994
HVOF

1998
HVOF
No bond coat

Mg substrate
HVOF coating

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COLD SPRAY

History at Sikorsky

- 2004: Sikorsky & ARL reviews cold spray technology for component repairs
- 2005: Mg housing sprayed with HP-Al cold spray at ARL
- 2006: Mg housing sprayed with HP-Al cold spray at ARL
- 2007: Completed 1st trial of Mg Housing with CP-Al cold spray
- 2008: Completaed 1st trial of Mg Housing with CP-Al cold spray
- 2009: Sikorsky Specification on Cold Spray released
- 2010: CP-Al cold sprayed Mg coupons at ARL & suppliers; evaluated at Sikorsky
- 2011: ESTCP funds provided for “Supersonic Particle Deposition Technology for Repair of Magnesium Components”
- 2012: Completed 2nd trial of part with 6061 Al cold spray repair
- 2013: Overhaul & Repair Instruction documents approved for repair of several parts
- 2014: Expand cold spray supplier base
- 1st Structural Repair test in-progress

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Al CSD MICROSTRUCTURE

Al CSD Coating

Magnesium substrate

Al cold sprayed Mg coupons using high pressure process & He carrier gas
COLD SPRAY DEPOSITION

Sikorsky Vision:

Validated processes, techniques, and machinery that accomplish repairs to magnesium housings that salvage parts previously scrapped and/or extend lives beyond current limits.
MAGNESIUM HOUSING CSD REPAIR

Al 6061 cold spray deposition at ARL – machined at Sikorsky O&R

Area 1

Al 6061 coating
NON-STRUCTURAL CSD REPAIR

MIL-STD-3021 “Materials Deposition, Cold Spray” (initiated by ARL)

Sikorsky Specification for Thermal Spray Processes:

December 2010:
Added: Cold Spray System
CP-Al powder.

September 2011:
Added: Aluminum 6000 series powder

March 2012:
Align CSD process, inspection, testing and met. exam with MIL-STD-3021.

February 2013:
Additional CSD changes based on supplier and customer feedback.
NON-STRUCTURAL CSD REPAIR

Field Returned parts:

Overhaul & Repair Instructions

Production parts:

MRB’s (Casting/Machining issues)

Cost Benefit Analysis

* Reduce lead times and cost
STRUCTURAL CSD REPAIR

Material Qualification/Design Data
- Cold Spray and Substrate
- Material Characterization
- Producibility

Component Test
- Sub-element
- Full-Scale Validation

Process Control
- Sikorsky Specification
- Overhaul & Repair Instructions

Implementation
- Overhaul and Repair
- Production
COLD SPRAY DEPOSITION

Few Milestones

• Released Cold Spray Specification
• Powder for Structural Application Further-Refined
• Approved Cold Spray Supplier
• In-Plane Tension Test Method Developed
• Number of Non-Structural ORIs Released or In-Work
• Material Characterization on-going
• Structural Repair testing project in 2014
SUMMARY

Industry Leader in Cold Spray Implementation

• Specifications
• Authorized Repairs
• Developing Supplier Base
• Growing Data Base
• Sikorsky is pleased to partner with the government to implement cold spray technology- OSD ManTech CSRRT
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**SIKORSKY: Cold Spray Repair Team**
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O&R Facility, Production Dept., Ground Test, A/EDC Lab