Cold Spray Advantages for Aerospace - OEM Perspective

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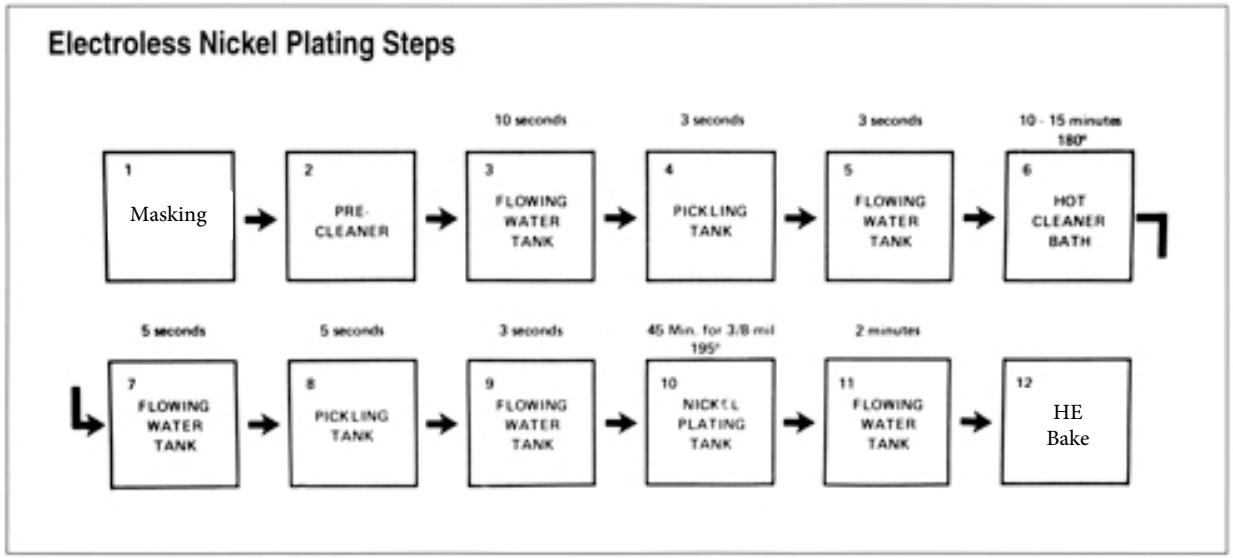
Materials and Processes Technologies

Agenda

- **Cold Spray As Replacement Technology**
- **Cold Spray Competition**
- **Unique Advantages**
- **Cold Spray Barriers**
- **Mesa Cold Spray Programs**

Cold Spray As Replacement Technology



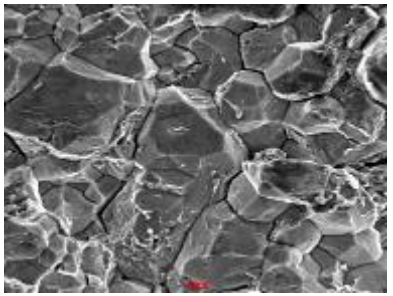
Cost and Flow Drivers:

Masking

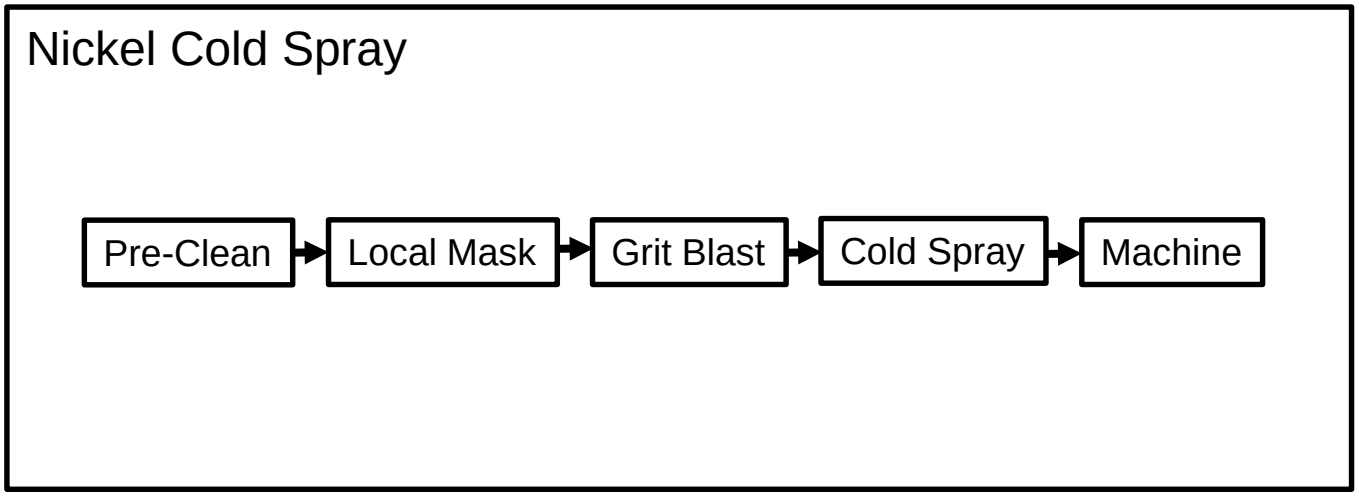
Bath Maintenance

Environmental/ Health & Safety

Post Processing

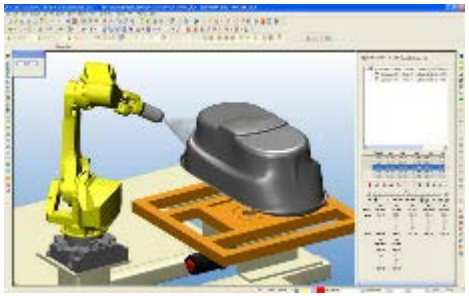


Cold Spray As Replacement Technology

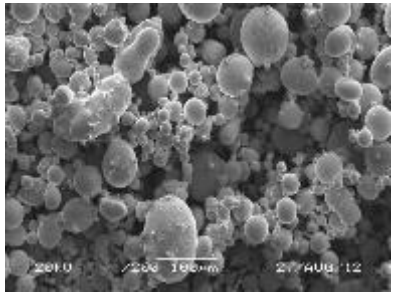


Cost and Flow Drivers:

Non-Reoccuring



Gas/Powder



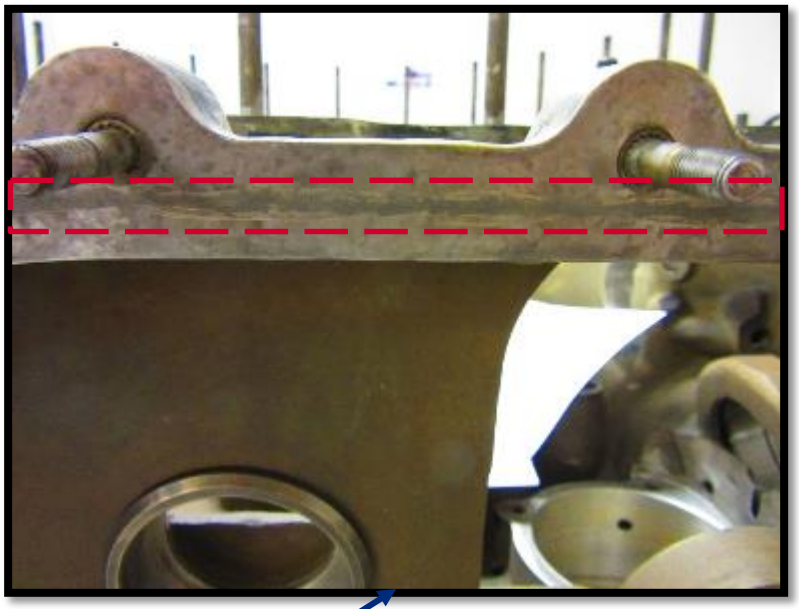
Competition – Al and Mg Components

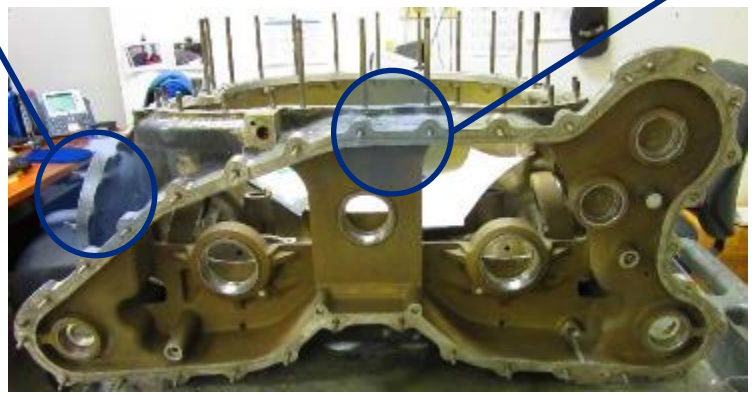
- **High Temperature Adhesive/Devcon**
  - Why we use it:
    - Extremely inexpensive
    - Requires little to no additional equipment
    - Applied in-house
  - Limitations:
    - Repair longevity – commonly will need replacement multiple times over part life
    - Temperature sensitivity

- **Sleeve Repair**
  - Why we use it:
    - Relatively inexpensive
    - Requires little to no additional equipment
    - Applied in-house
  - Limitations:
    - Minimum wall thickness requirements

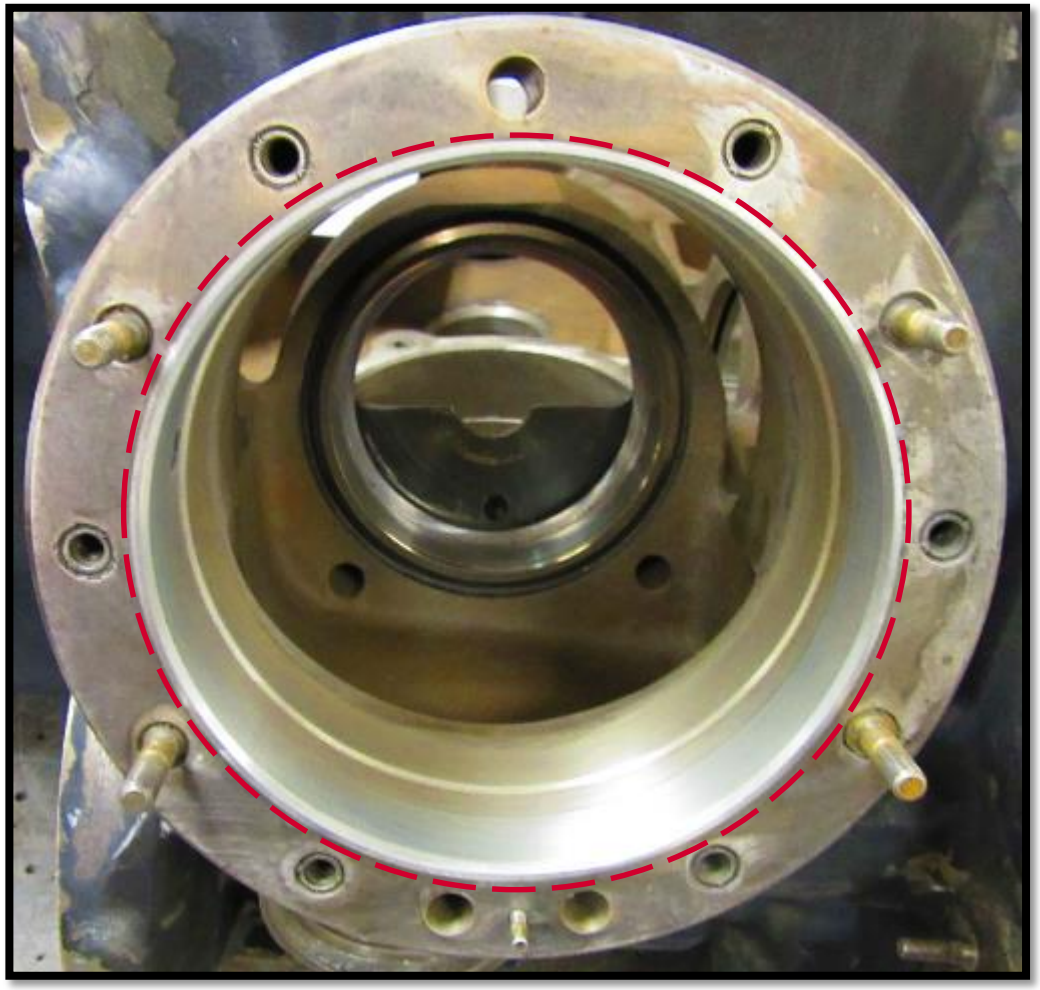
- **Aluminum Thermal Spray**
  - Why we use it:
    - Restores part with like material
    - Successful repair history
  - Limitations:
    - Cost
    - Thickness build up limitations

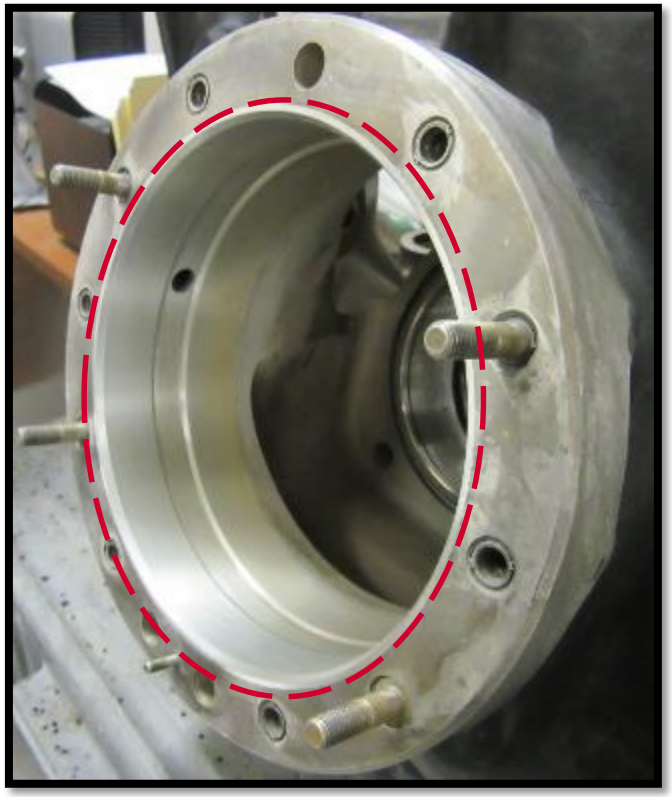
High Temperature Adhesive/Devcon Repair





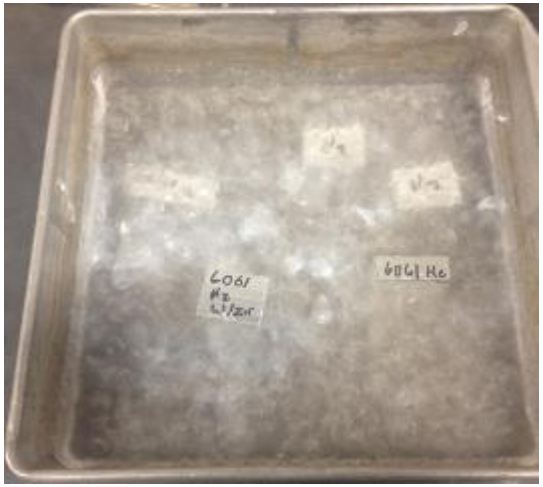
Sleeve Repair

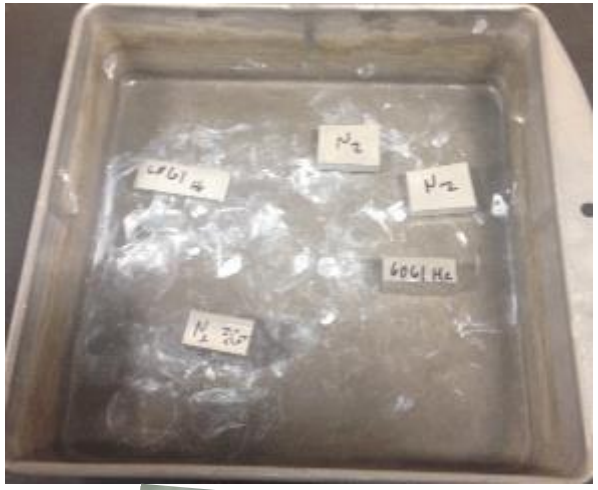


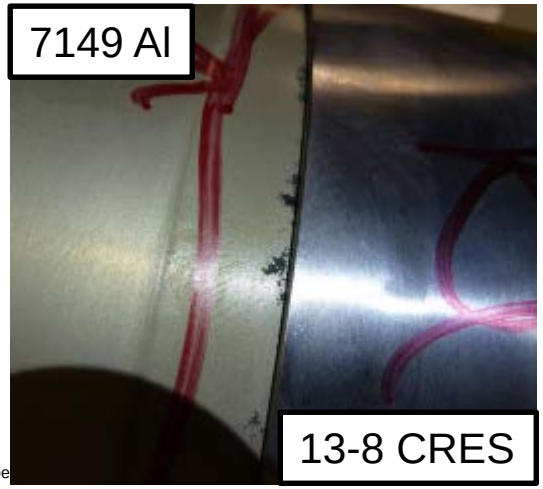


Unique Advantage – Extreme Temperature

- **Applications with extreme temperature changes**
  - Example: Components with shrink fit liners or collars







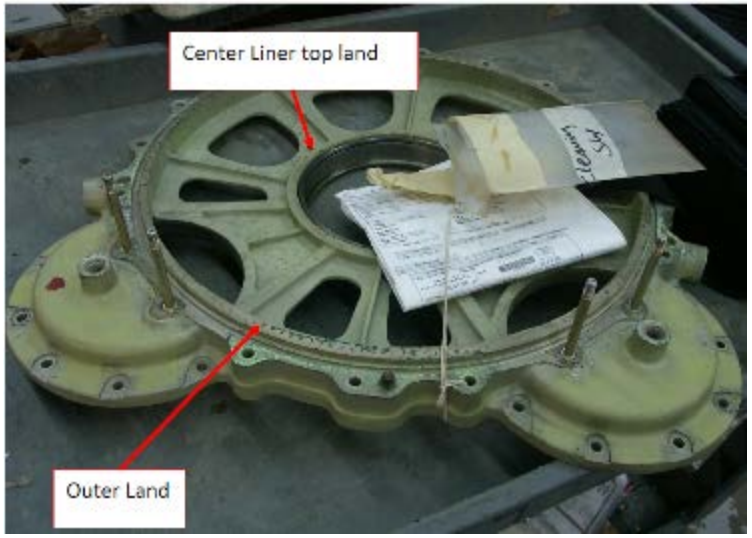
Unique Advantage – Localized Repairs

- **Current Process**
  - Strip everything
    - Very long process due to nickel removal rate
    - Part serviceability not known until after process is complete
  - Reapplication of all plating and coatings
  - Limitations on thickness buildup

- **Proposed Process**
  - Machine local area of damage until corrosion is removed
  - Locally mask area
  - Cold spray nickel powder on top of whatever is left
  - Part limits thickness as opposed to application process

Unique Advantage – Part Specific Opportunities

- **Specific limitations due to unique attributes**
  - Interference fit liners with special heat treatment requirements
- **Restoration of dimensional requirements due to distortion during overhaul and repair operations**
  - Warping after a liner is removed and replaced
- **Improving corrosion protection by moving dissimilar metal interfaces to areas of protection**



What is Preventing Cold Spray?

- **Major factors preventing cold spray implementation**

1) Non-reoccurring costs can be significant
   - Robot programing
   - Masking and mounting strategies

2) Repair vs Buy Decision*
   - Total Repair Cost = Cold Spray + other required repairs
     - Cold spray cost fairly high compared to other repair techniques

3) Accepted structural design allowables by cold spray process
   - Minimum – USG established testing protocol for qualification of structural repair

*Additional Program Considerations:
TSN – Life Remaining
Inventory Health
Configuration

Mesa Cold Spray Programs

- **2015 funding in place to develop nickel repair of main rotor support mast**
  - High scrap rate causing part serviceability issues
  - Proposed restoration will provide for deeper allowable repair over traditional plating
  - Testing will include full component fatigue
- **Working with Apache PM and ARL to develop repairs for additional opportunities**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