

# Cold Spray at PSNS & IMF

by

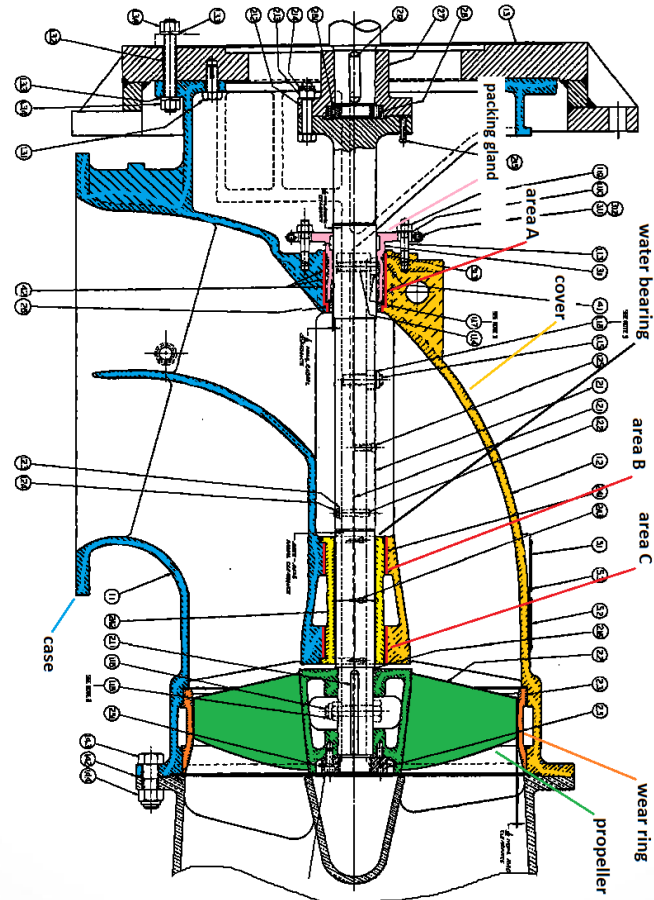
Tom Stamey, C/260M, 6/22/16



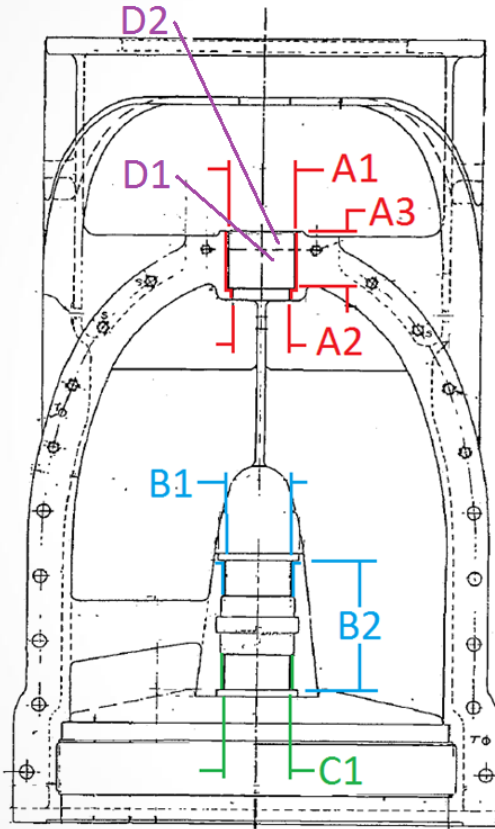
# Overview

- Case study:
  - CVN main circ water pump (MCWP)
- Cold spray work at Puget and in the Navy

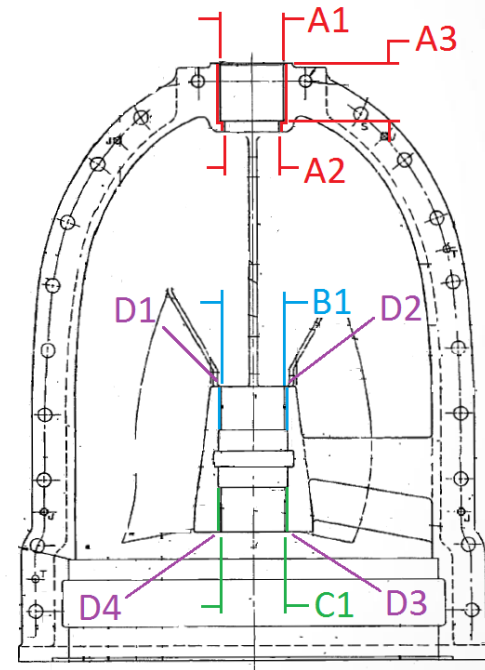
# Case study: MCWP



# Case study: MCWP



Case

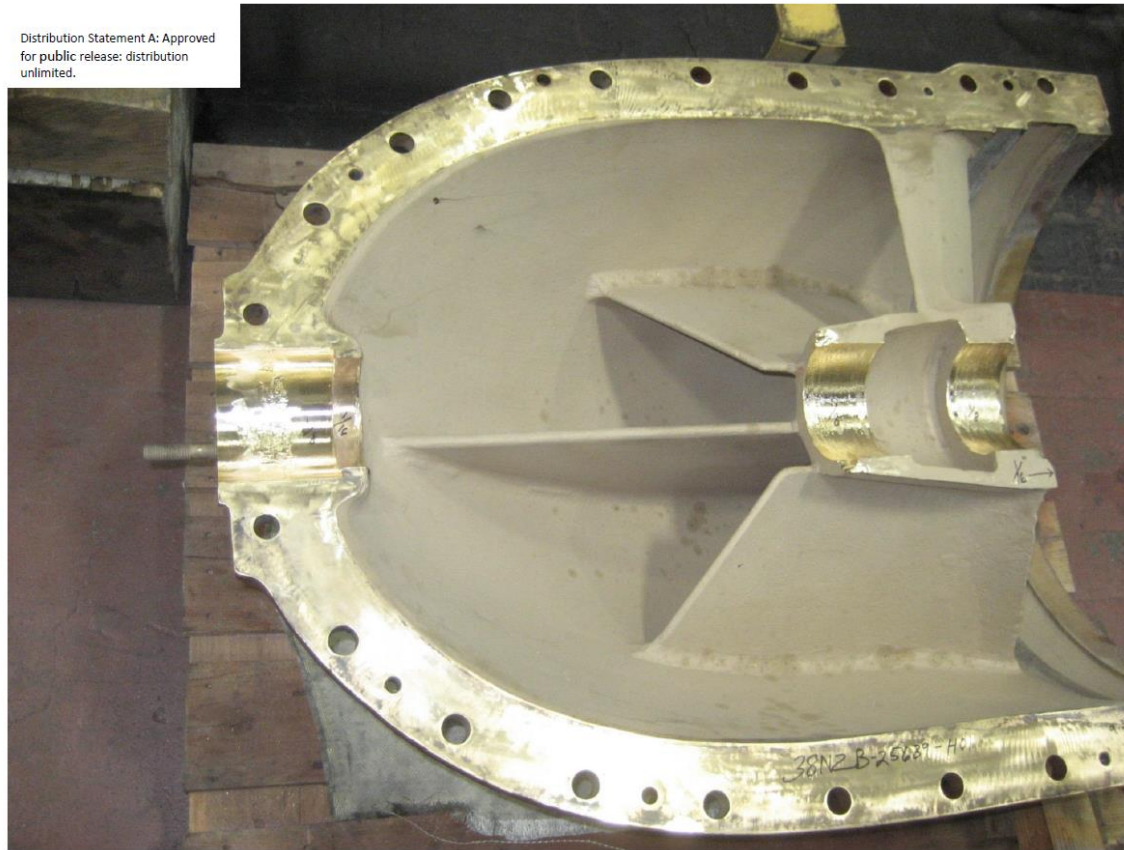


Cover

# Case study: MCWP

- The problem:
  - Surfaces A, B, and C were damaged in service.
  - Surface A can be epoxy repaired.
  - Surfaces B and C are commonly epoxy repaired, but the effective life of the repair is shorter than the maintenance periodicity of the pump.
  - The gun metal (tin bronze) base material of the pump is not readily weld repairable. It builds up poorly and is prone to cracking.
  - Replacement pumps are extremely expensive ( $\approx$ \$500,000).
- The solution:
  - Cold spray repair.

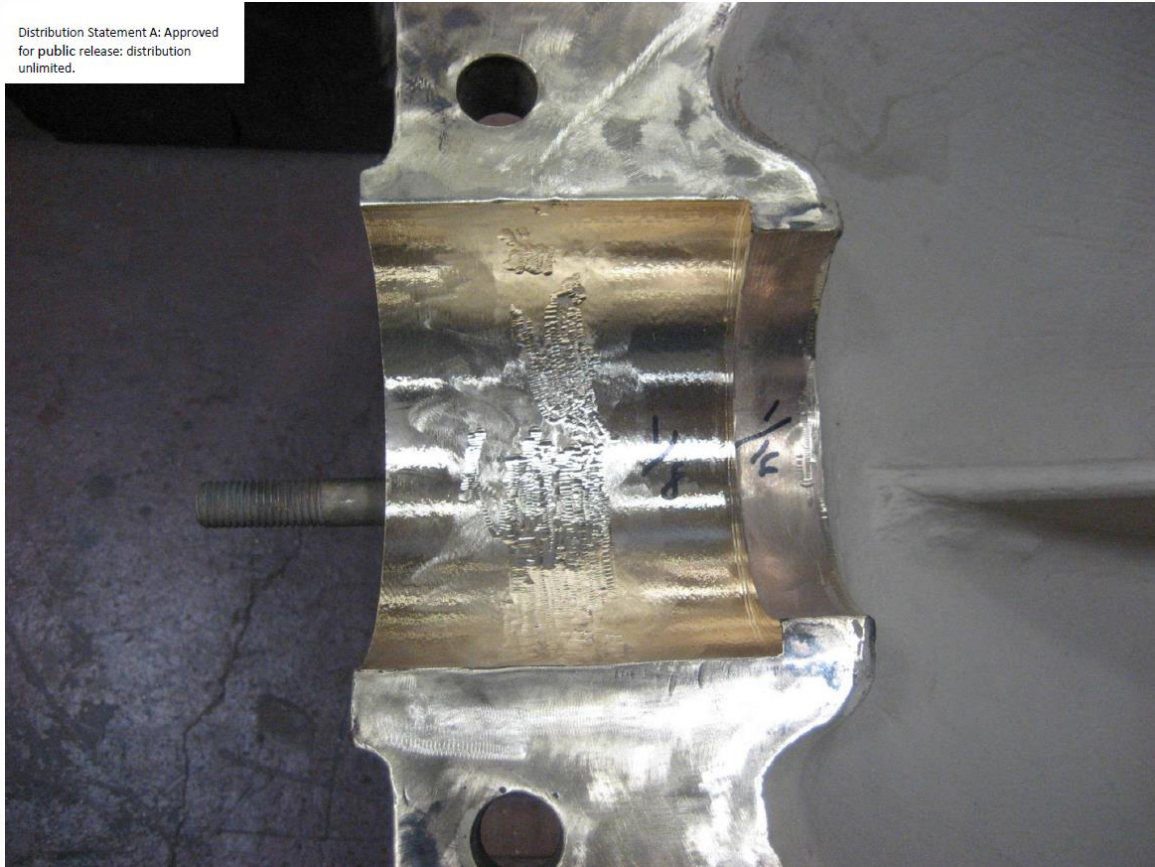
# Case study: MCWP



Cover: As prepped

# Case study: MCWP

Distribution Statement A: Approved  
for public release: distribution  
unlimited.



Cover: As prepped  
Area A detail



# Case study: MCWP

- Cold spray performed by:
  - United Technology Research Center
- Technical support was provided by:
  - The Army Research Laboratory
  - Penn State Advanced Research Laboratory





# Case study: MCWP



Video provided by UTRC.



# Case study: MCWP



Case: As sprayed

# Case study: MCWP

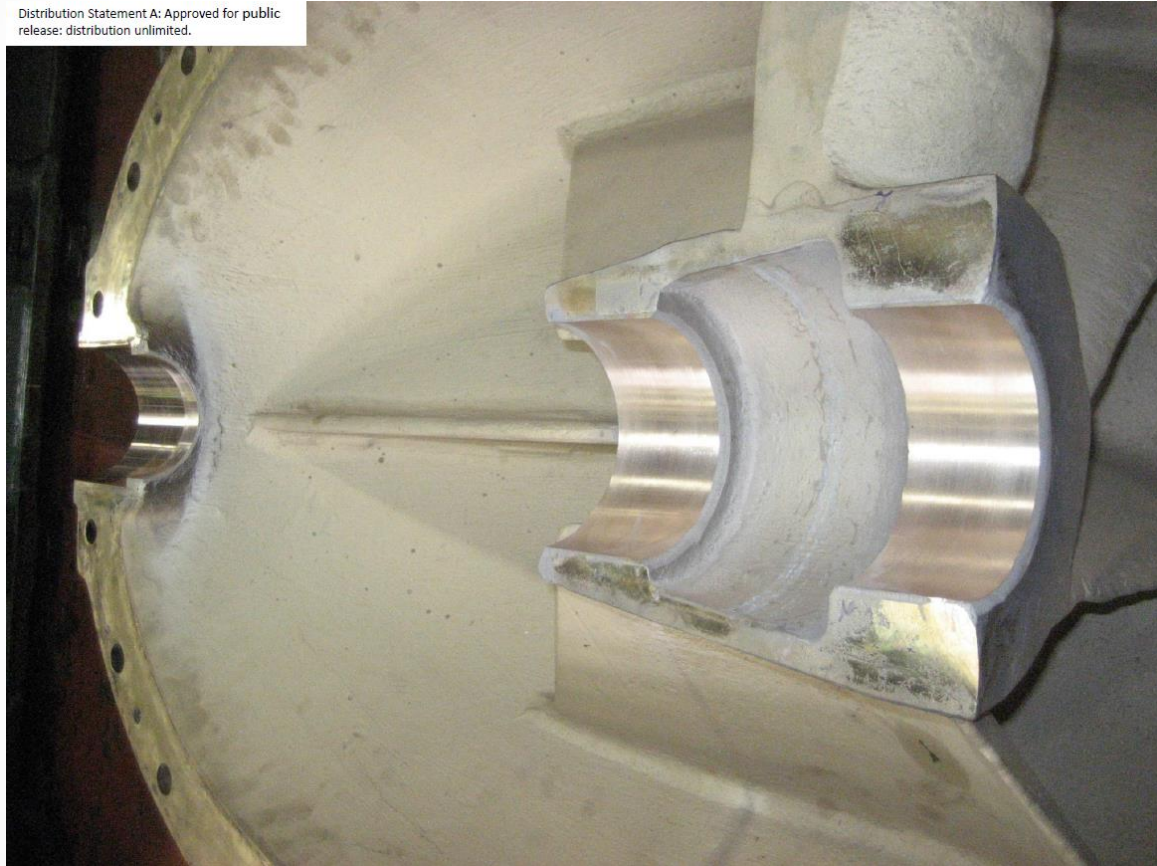
Distribution Statement A: Approved for public release: distribution unlimited.



Case: As sprayed  
Area A detail

# Case study: MCWP

Distribution Statement A: Approved for public release: distribution unlimited.



Cover: Finish machined



# Case study: MCWP

Distribution Statement A: Approved for public release: distribution unlimited.



Cover: Finish machined  
Area A detail

# Case study: MCWP

- Spray details:
  - Substrate: Cast gun metal (tin bronze)
  - Powder: AcuPowder DT-31 bronze (similar to tin bronze)
  - Machine: UTRC CS1 (experimental cold spray system)

# Case study: MCWP

- Tensile testing:
  - Test coupons (dog bones) manufactured per ASTM E8.
  - Test coupons were entirely cold spray.
  - Tensile strength of the cold spray was 55,700 psi.
  - Min tensile strength of the pump body is 40,000 psi.
  - Elongation was not measurable (<1%).
- Bond testing:
  - Testing performed per ASTM C633.
  - For critical surfaces, bond strength is in excess of 8,600 psi.
  - Testing was limited by the strength of the glue used not the cold spray.
- Metallurgical examination:
  - Examination of test coupons and mock-up showed less than 1% porosity.
  - The reentrant corner porosity was not measurable.

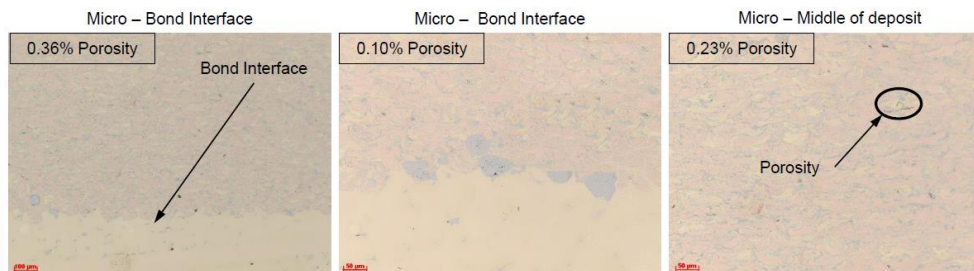


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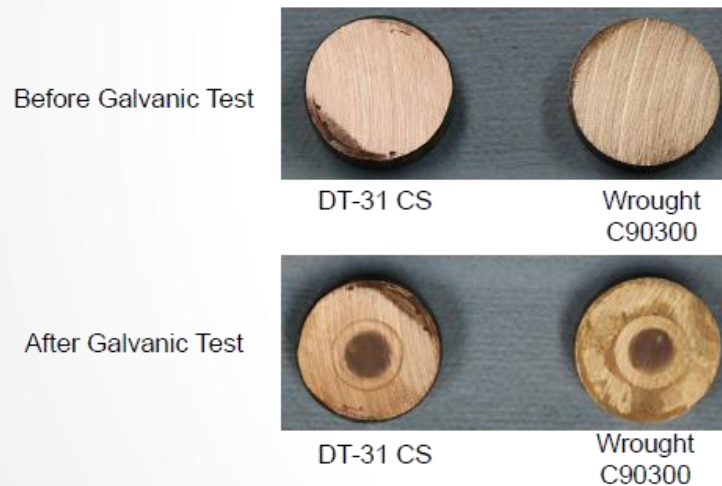
Mosaic Images of Cross Section



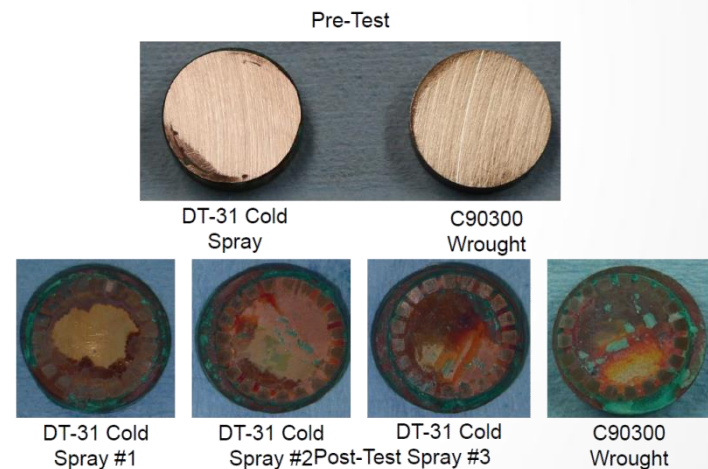
Images provided by UTRC.

# Case study: MCWP

- Corrosion:
  - General corrosion testing per ASTM G71
  - Crevice corrosion testing per ASTM G78



ASTM G71 testing



ASTM G78 testing

# Cold spray at Puget Sound Naval Shipyard and the Navy

- Successful repairs at Puget:
  - TD-63 actuator (aluminum). Installed on an SSN 21 class submarine.
  - TD-16 actuator (aluminum). Installed on an SSN 21 class submarine.
  - MCWP (tin bronze). Installed on a CVN 68 class carrier.
- In-process repairs at Puget:
  - TD swing check valve (CUNI 70/30). Powder selection in progress.
  - TD actuator (aluminum repaired with 5056 aluminum). Spray optimization in progress.
  - Potable water pump (tin bronze). Mock-up work in progress.
- In-process repairs elsewhere:
  - LPAC cone (bronze). Final authorizations in progress at PNSY.
  - Motor end bell repair (steel). Powder selection, spray optimization in progress at IMF Bangor.
  - NUWC Keyport Inovati SBIR project. Machine is in place. Data is being gathered.

# Cold spray at Puget and the Navy

- Global authorization?
  - UIPI 6320-901 for cold spray has been initialized.
  - It is in the data gathering phase.

# Questions?

