Cold Spray Case Studies and Implementation

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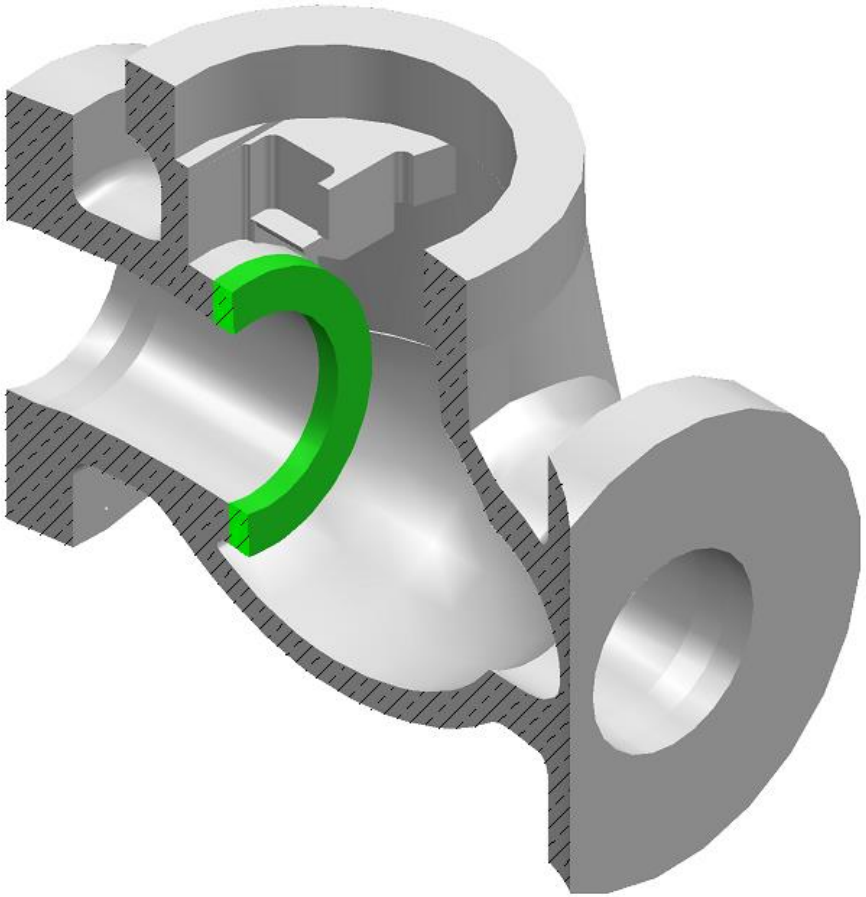
PSNS & IMF, C/260M

Overview

- Case studies
  - Swing check valve
  - Metering valve
  - Seawater Pump
- UIPI 6320-901 update
- Potential O-ring groove repair method

Case Study: Swing Check Valve



Body

Case Study: Swing Check Valve

- The problem:
  - Preferential corrosion of the body due to galvanic potential with the disc
- Repair options:
  - Epoxy
  - Welding
  - Cold spray

Case Study: Swing Check Valve

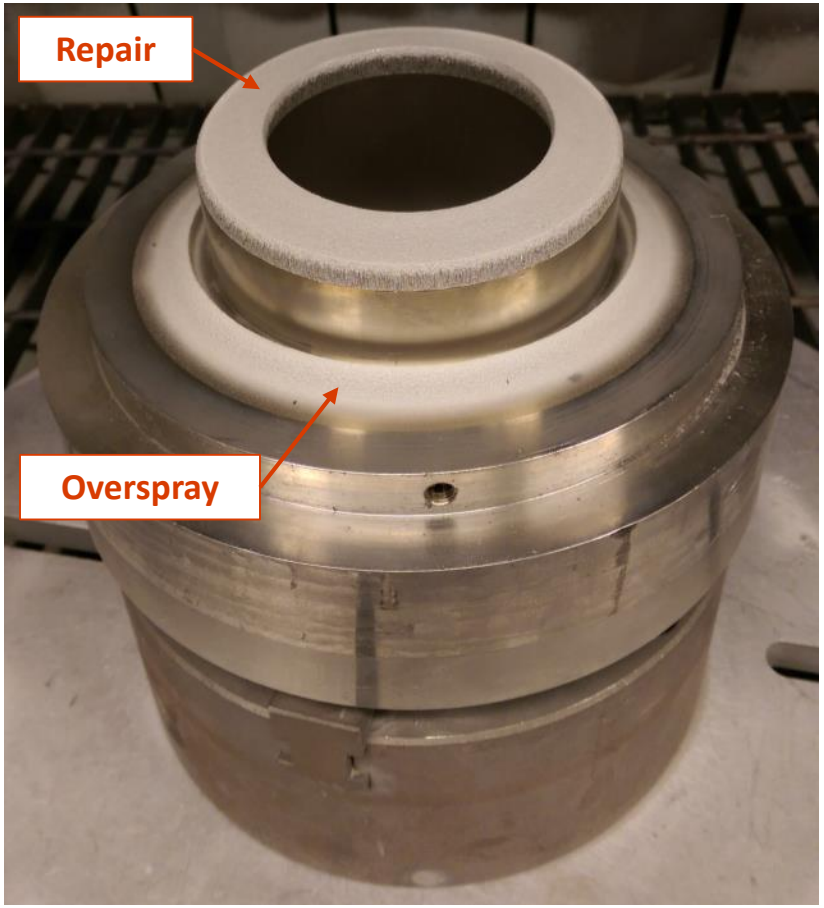
- Cold spray performed by:
  - United Technology Research Center
- Technical support provided by:
  - The Army Research Laboratory
  - Penn State Advanced Research Laboratory

Case Study: Swing Check Valve

- Spray details:
  - Substrate: CUNI 70/30
  - Powder: Praxair Ni-914-3
  - Machine: VRC Gen III

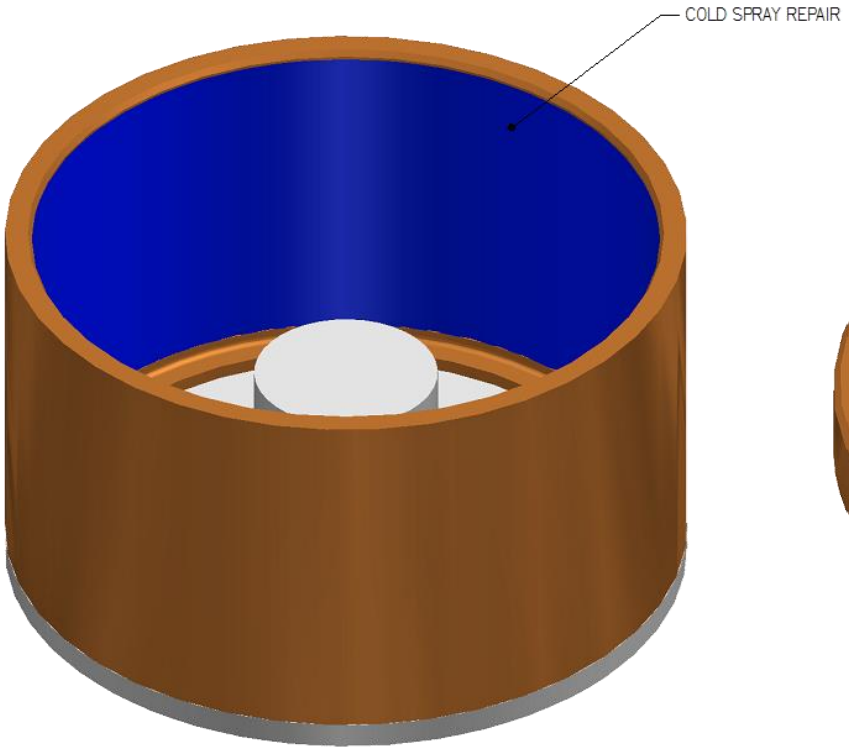
Case Study: Swing Check Valve

Spraying the Mockup

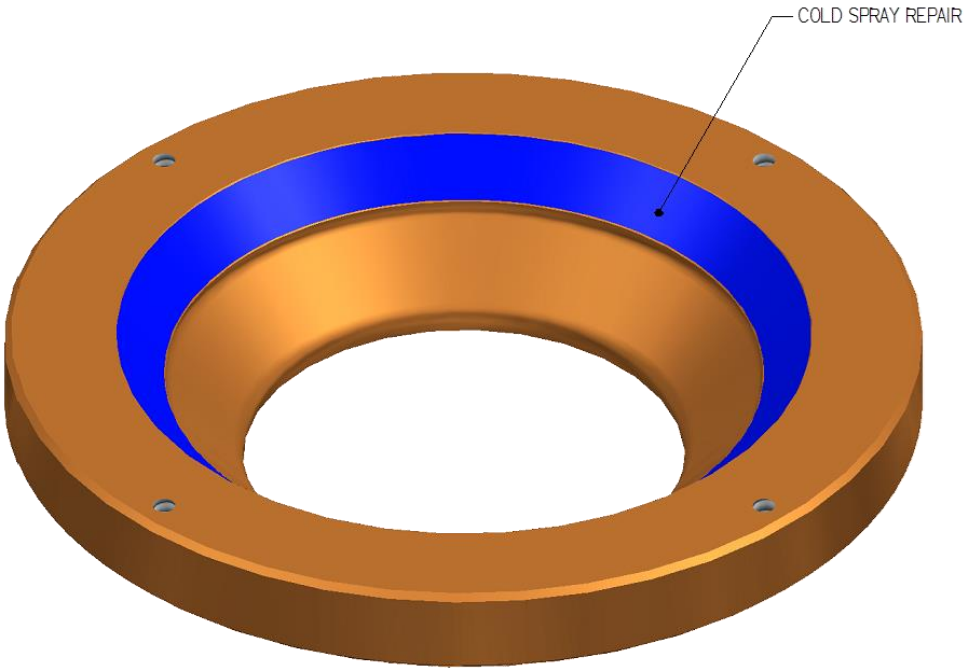


Mockup
Upper sleeve removed

Case Study: Metering Valve



Body
(mockup geometry shown)



Tailpiece

Case Study: Metering Valve

- The problem:
  - Wear damage to the body and tailpiece sealing areas
- Repair options:
  - Epoxy
  - Welding
  - Cold spray

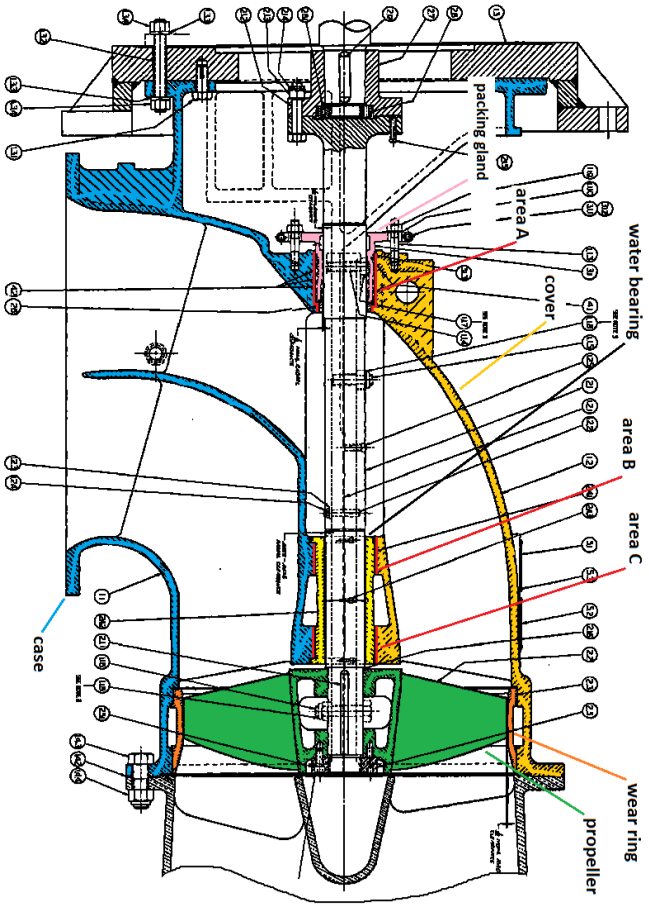
Case Study: Metering Valve

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

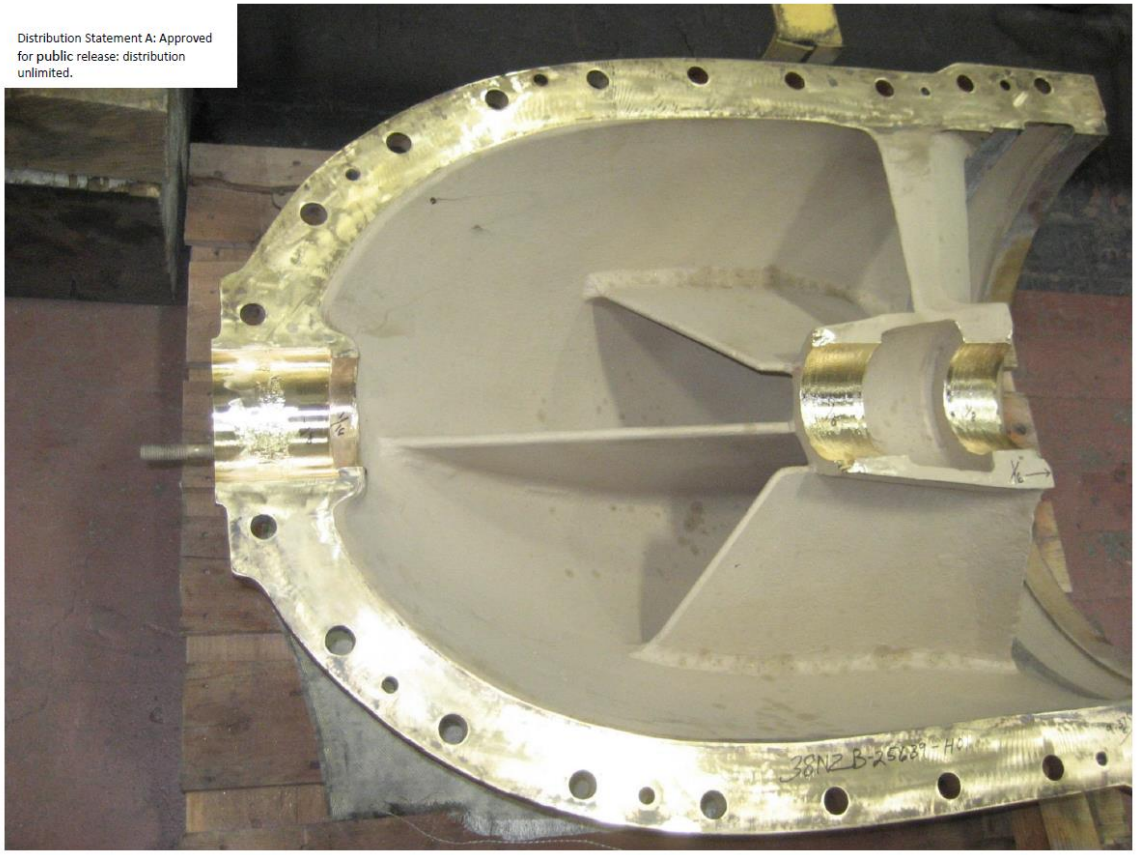
Case Study: Metering Valve

- Spray details:
  - Substrate: CUNI 70/30
  - Powder: CrC and Ni-914-3
  - Machine: VRC Gen III
- Takeaways:
  - Communication is important
  - Communication is hard
  - Changes in powder affect everything down the line

Case Study: Seawater Pump



Case Study: Seawater Pump



Cover: As prepped

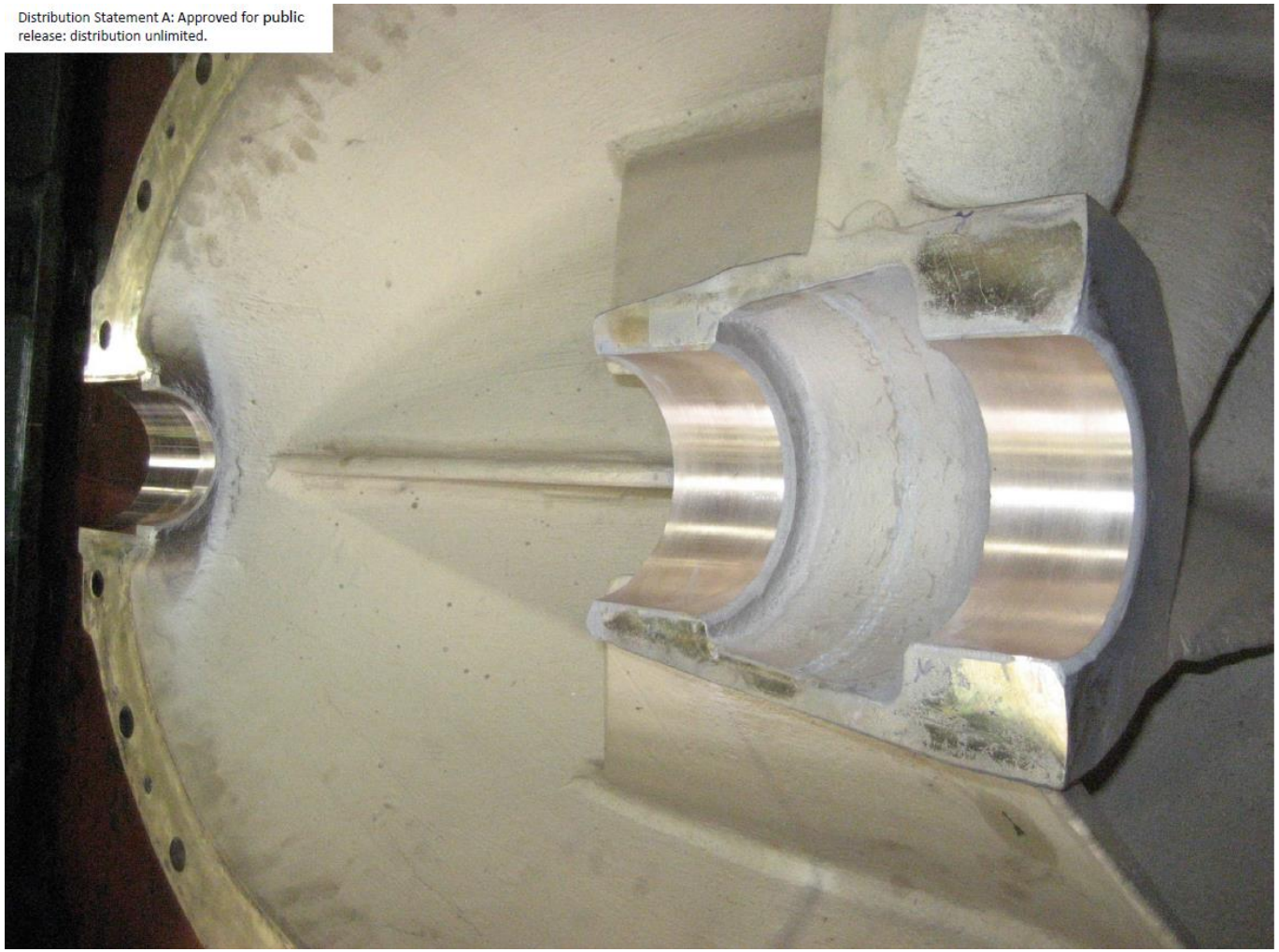
Case Study: Seawater Pump

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

Case Study: Seawater Pump

Case: As sprayed

Case Study: Seawater Pump



Cover: Finish machined

Like a sledgehammer in a dryer.

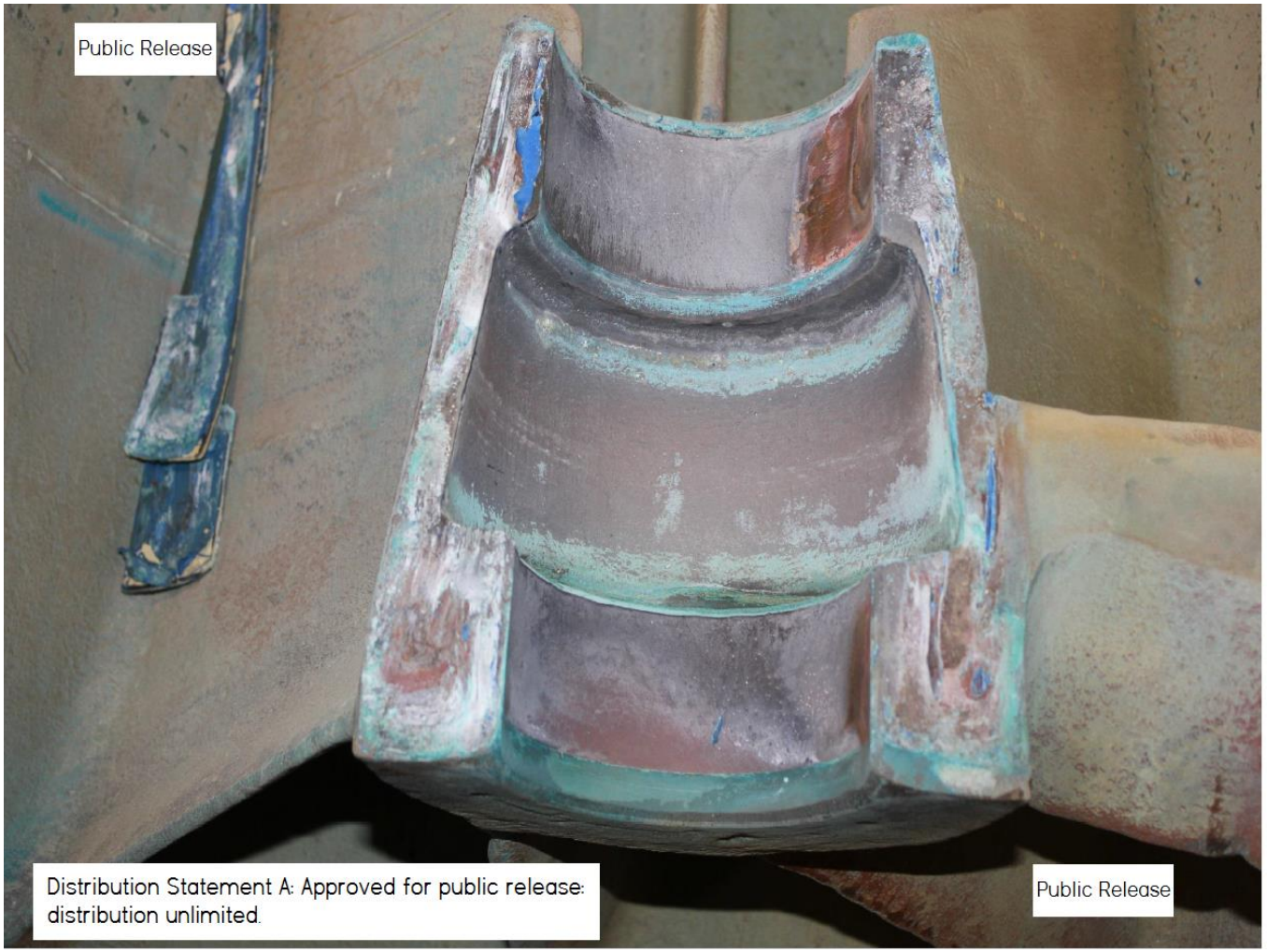
Case Study: Seawater Pump

Case: With Water Bearing

Case Study: Seawater Pump

Case: Without Water Bearing

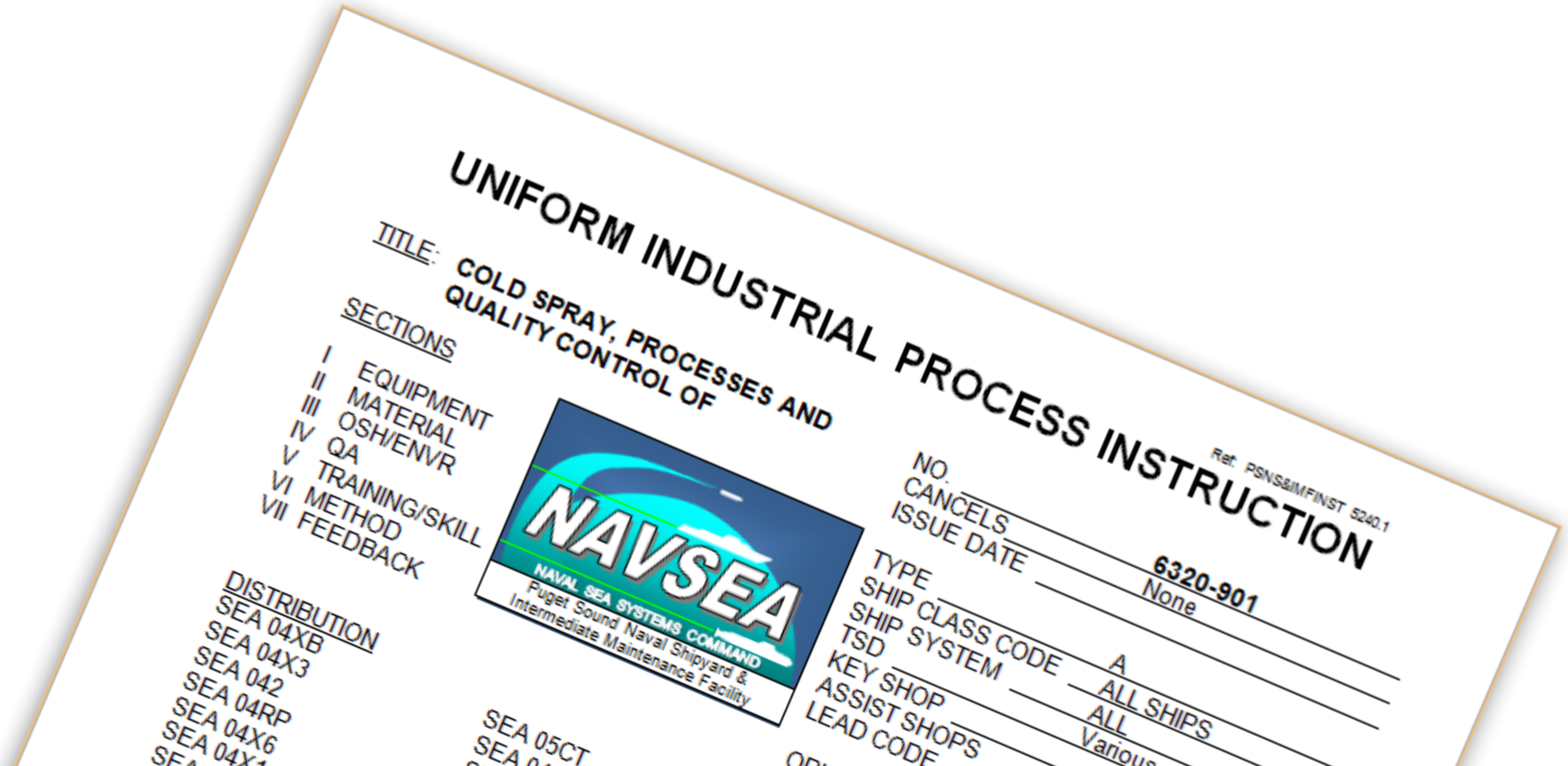
Case Study: Seawater Pump



Cover

UIPI 6320-901

- Provides a method for developing and approving cold spray procedures for NAVSEA applications.
- Provides requirements for use of those procedures.



UNIFORM INDUSTRIAL PROCESS INSTRUCTION

Ref: PSNS&IMFINST 5240.1

TITLE: COLD SPRAY, PROCESSES AND QUALITY CONTROL OF

NO. 6320-901
CANCELS None
ISSUE DATE

SECTIONS

I EQUIPMENT
II MATERIAL
III OSH/ENVR
IV QA
V TRAINING/SKILL
VI METHOD
VII FEEDBACK

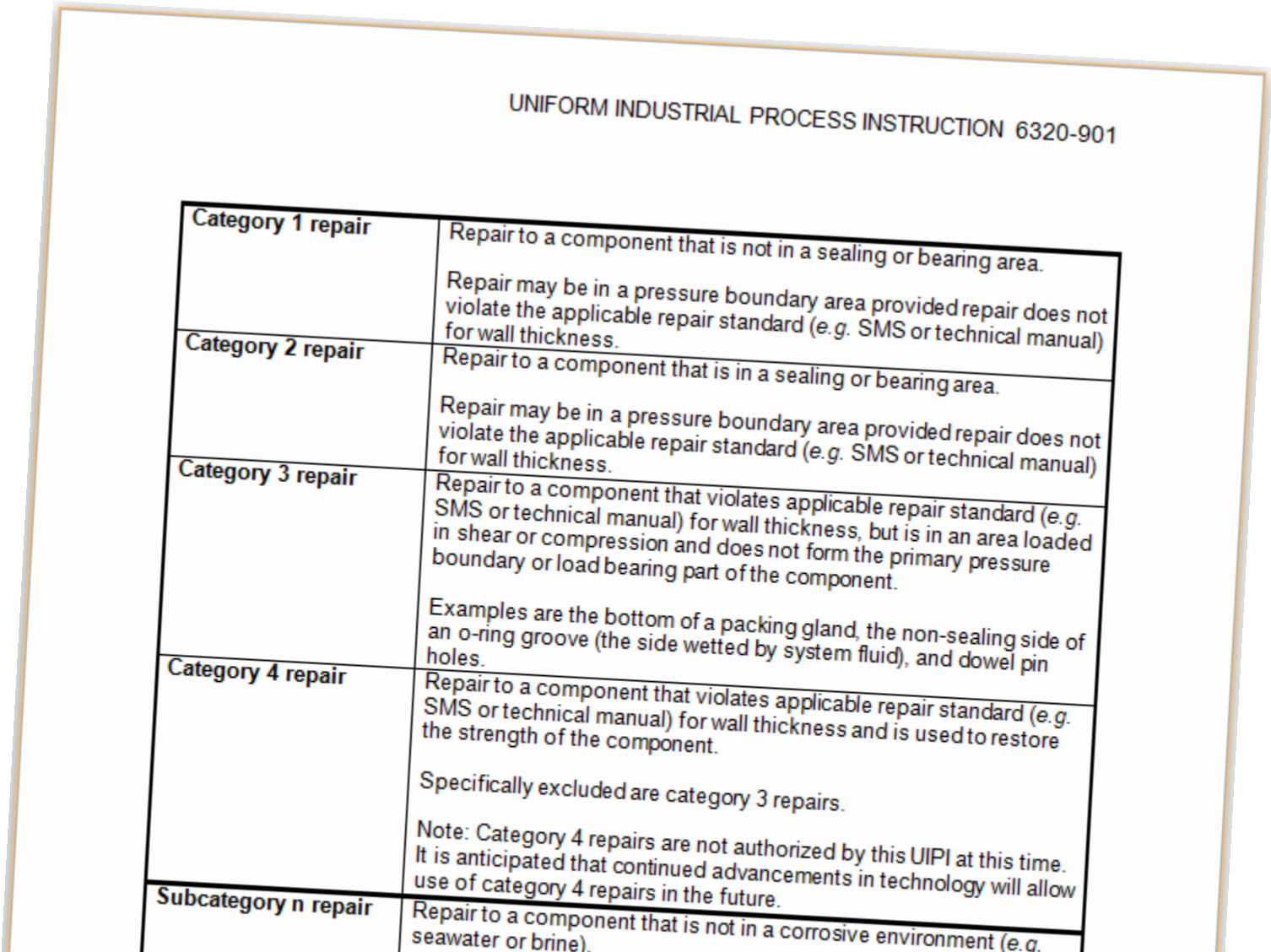
NAVSEA
NAVAL SEA SYSTEMS COMMAND
Puget Sound Naval Shipyard & Intermediate Maintenance Facility

TYPE A
SHIP CLASS CODE ALL SHIPS
SHIP SYSTEM ALL
TSD Various
KEY SHOP
ASSIST SHOPS
LEAD CODE

DISTRIBUTION
SEA 04XB
SEA 04X3
SEA 042
SEA 04RP
SEA 04X6
SEA 04X1

SEA 05CT

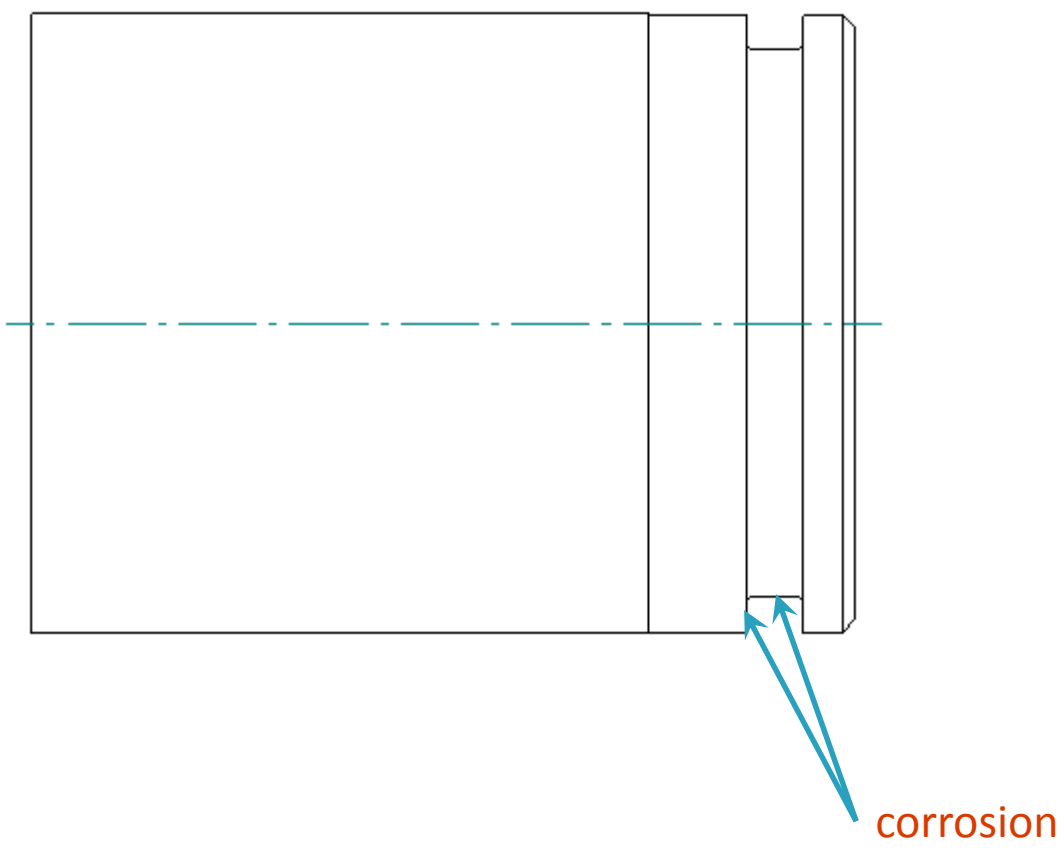
UIPI 6320-901: Repair Categories



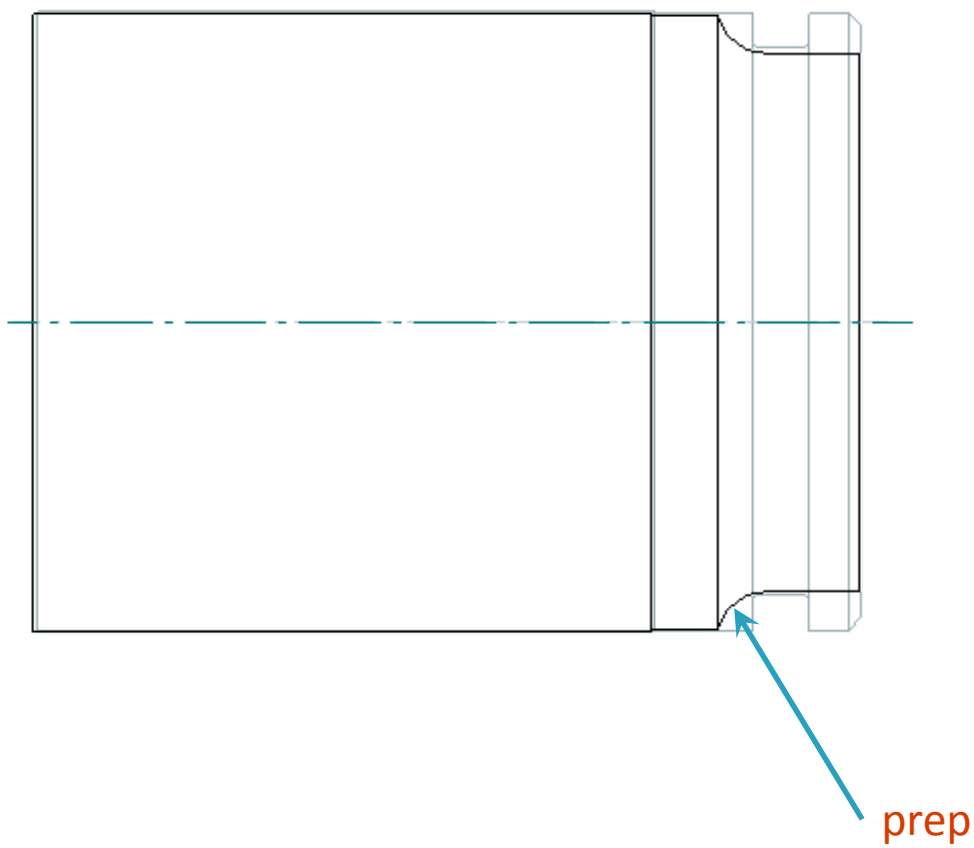
UNIFORM INDUSTRIAL PROCESS INSTRUCTION 6320-901

Category 1 repair	Repair to a component that is not in a sealing or bearing area. Repair may be in a pressure boundary area provided repair does not violate the applicable repair standard (*e.g.* SMS or technical manual) for wall thickness.
Category 2 repair	Repair to a component that is in a sealing or bearing area. Repair may be in a pressure boundary area provided repair does not violate the applicable repair standard (*e.g.* SMS or technical manual) for wall thickness.
Category 3 repair	Repair to a component that violates applicable repair standard (*e.g.* SMS or technical manual) for wall thickness, but is in an area loaded in shear or compression and does not form the primary pressure boundary or load bearing part of the component. Examples are the bottom of a packing gland, the non-sealing side of an o-ring groove (the side wetted by system fluid), and dowel pin holes.
Category 4 repair	Repair to a component that violates applicable repair standard (*e.g.* SMS or technical manual) for wall thickness and is used to restore the strength of the component. Specifically excluded are category 3 repairs. Note: Category 4 repairs are not authorized by this UIPI at this time. It is anticipated that continued advancements in technology will allow use of category 4 repairs in the future.
Subcategory n repair	Repair to a component that is not in a corrosive environment (*e.g.* seawater or brine).

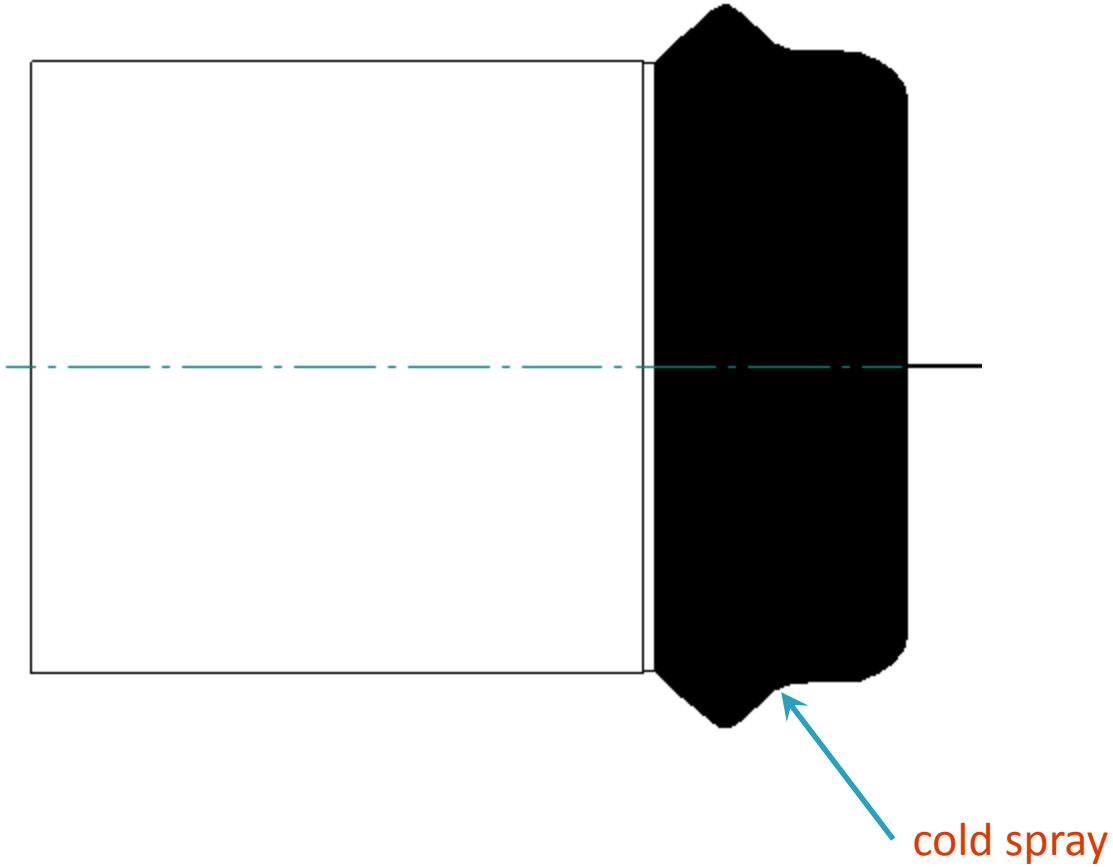
Example: O-ring groove



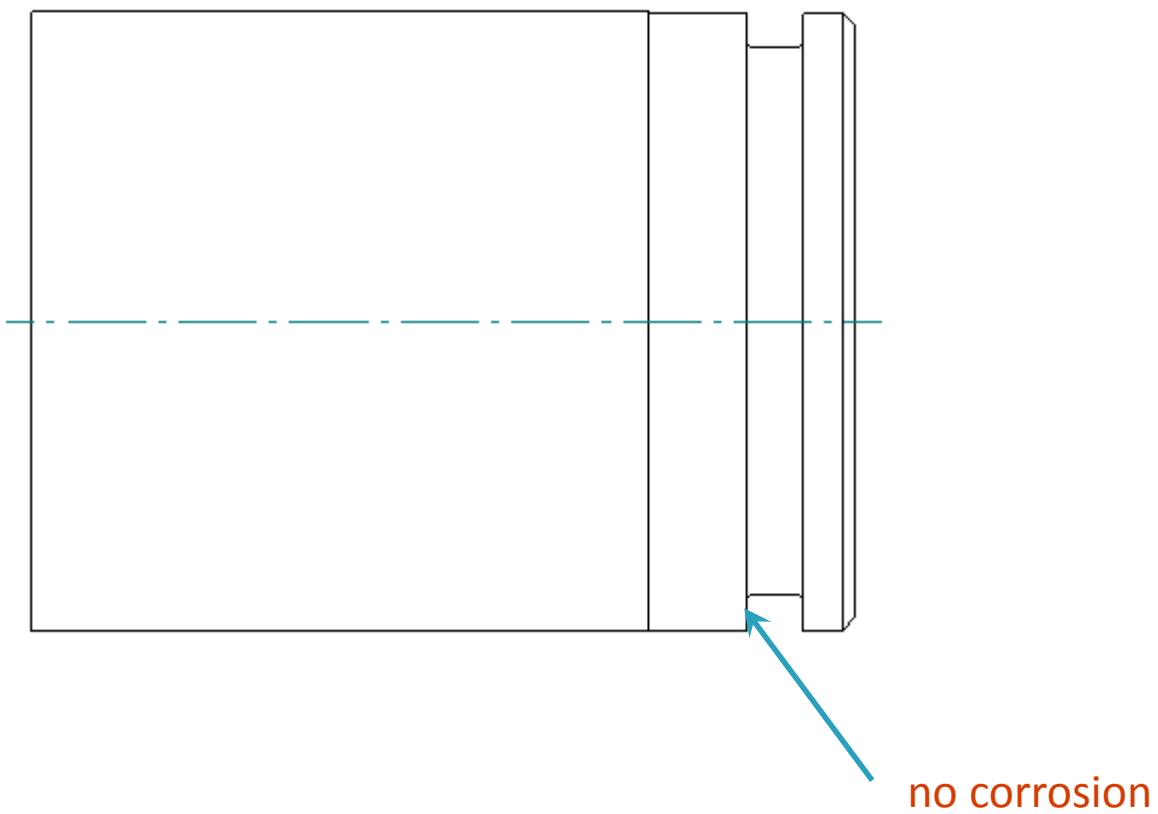
Example: O-ring groove



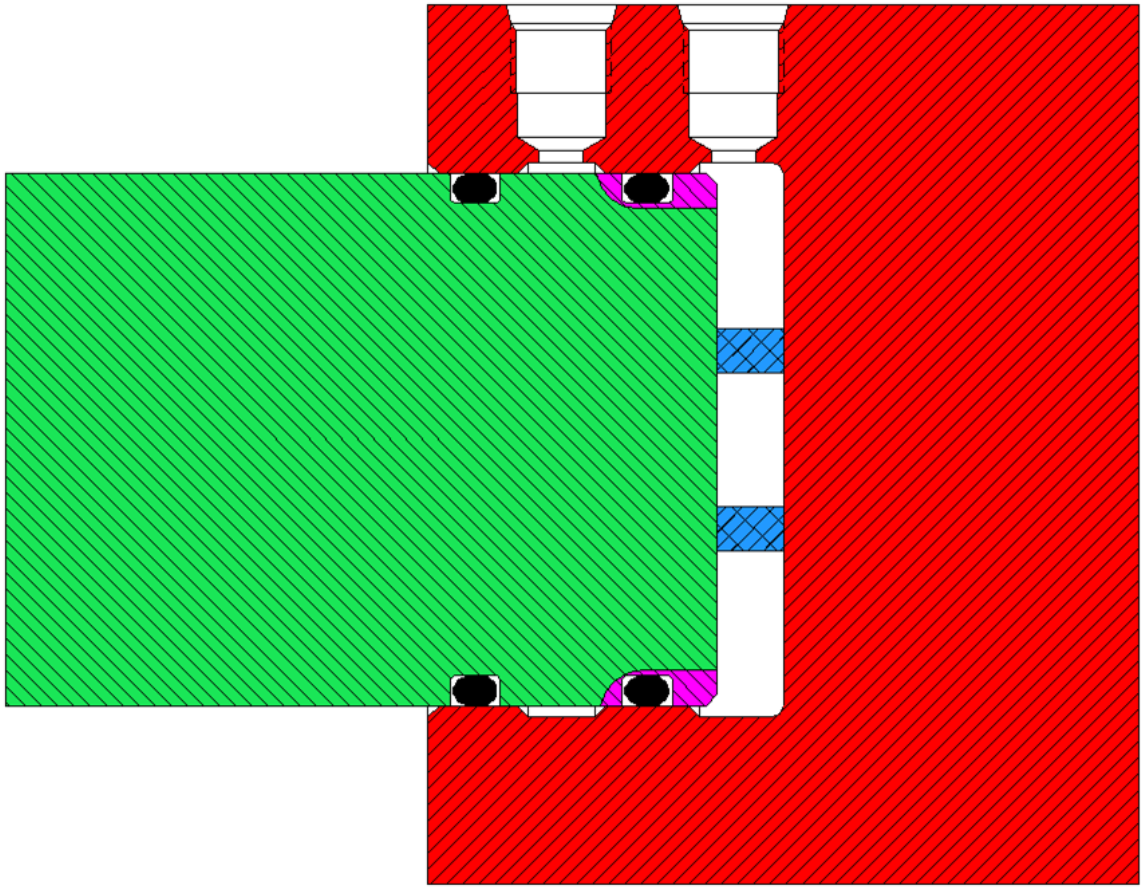
Example: O-ring groove



Example: O-ring groove



Example: O-ring groove



Example: O-ring groove

- Takeaways:
  - Basic repair methodology is sound.
  - Surface prep and spray angle are critical even when spraying on top of cold spray.
  - Communication and transparency are key.

Where are We Going?

- Current state:
  - Work with vendors to perform cold spray on components
  - In process of installing VRC GEN III systems at PNSY & PHNSY
- Near future:
  - Install a VRC GEN III system at PSNS and NNSY
  - Approve the cold spray UIPI to allow use of cold spray without requiring technical approval through the departure (non-conformance) process
- Less near future:
  - Use portable (hatchable) cold spray system to perform shipboard repairs

Questions?