

# WAAM for Maritime Alloys

NSRP Welding Technology Panel Meeting  
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13-May-2026



**LWS**

LASER WELDING SOLUTIONS

# LASER WELDING SOLUTIONS

## Additive Manufacturing and Laser Cladding Service Provider

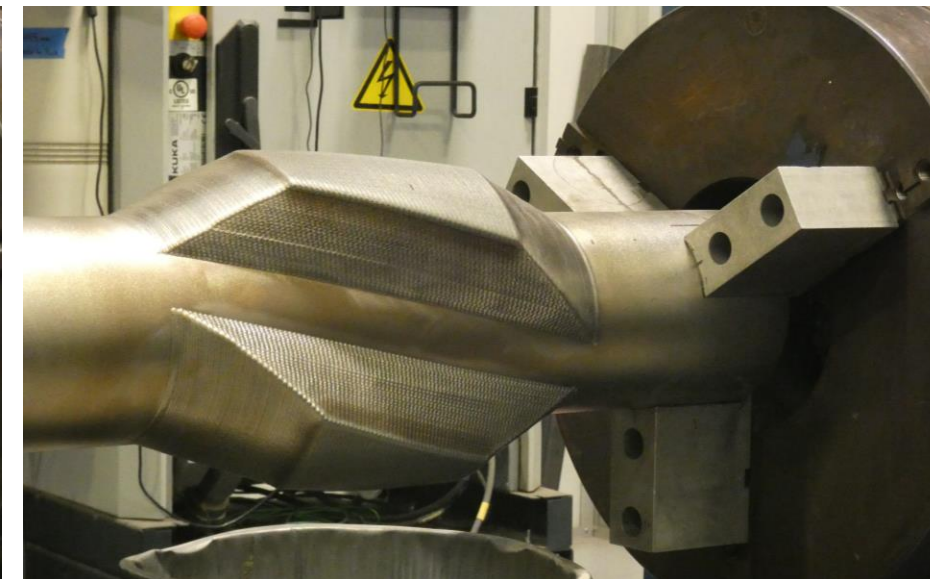
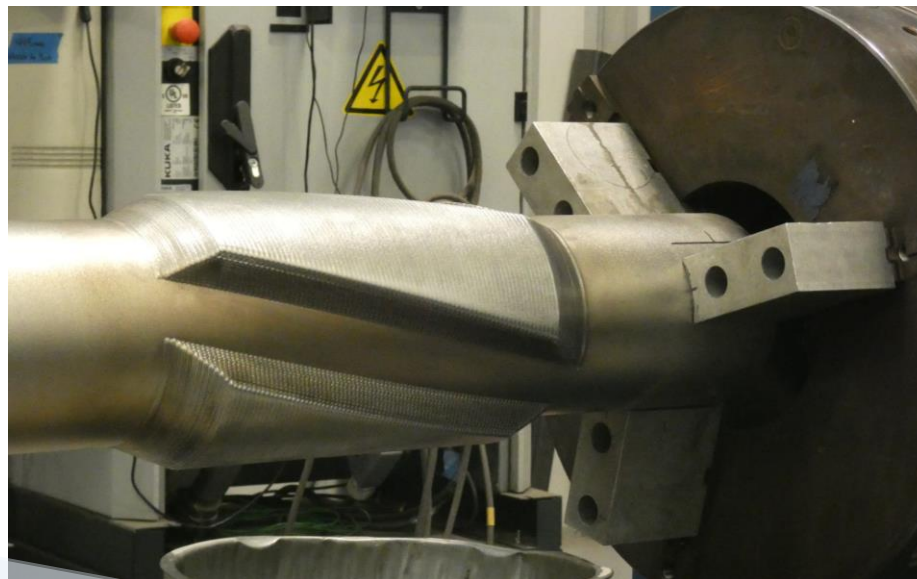
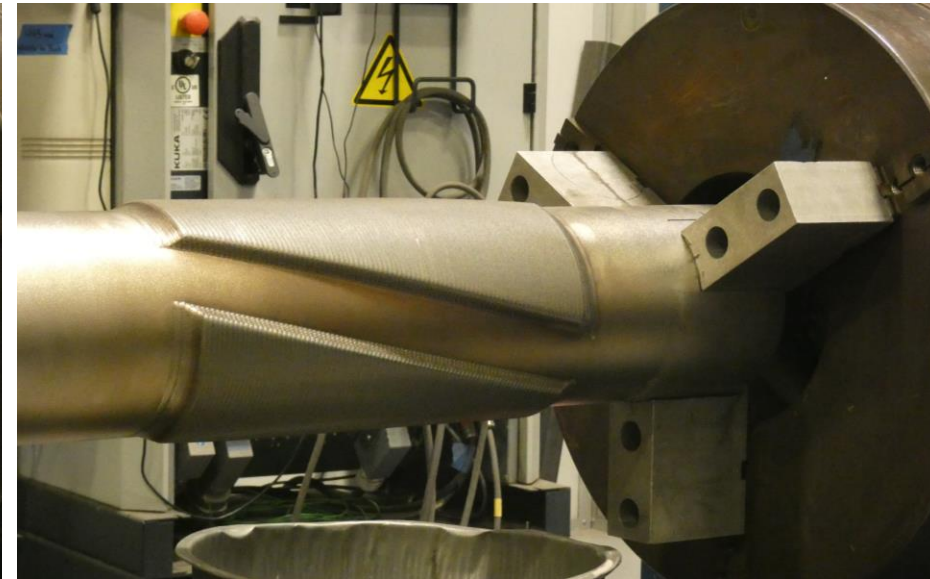
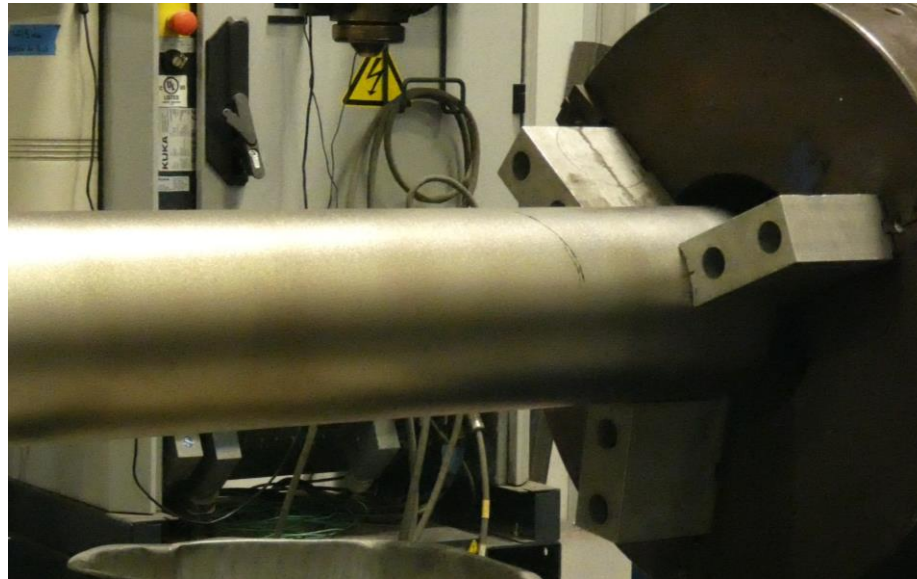
- Specialized in Laser Cladding and large-scale Additive Manufacturing since 2005
- Services Offered:
  - Metal 3D Printing: WAAM & Laser DED
  - Laser Cladding for Abrasion, Erosion and Corrosion Protection
  - Laser Joining & Laser Hardening
- 24,000 SQFT Facility
- ISO 9001 Certified, ITAR Registered, ASME PRT Stamps



# INITIAL INTRODUCTION TO ADDITIVE MANUFACTURING

## Laser DED

- Drill Collar Adding Stabilizer Features
- Material Alloy 625
- Base Tube  $\text{Ø}7.5''$
- Blades after Modification  $\text{Ø}12.25''$
- Last 1/8" of Blades is Tungsten-Carbide Hardfacing

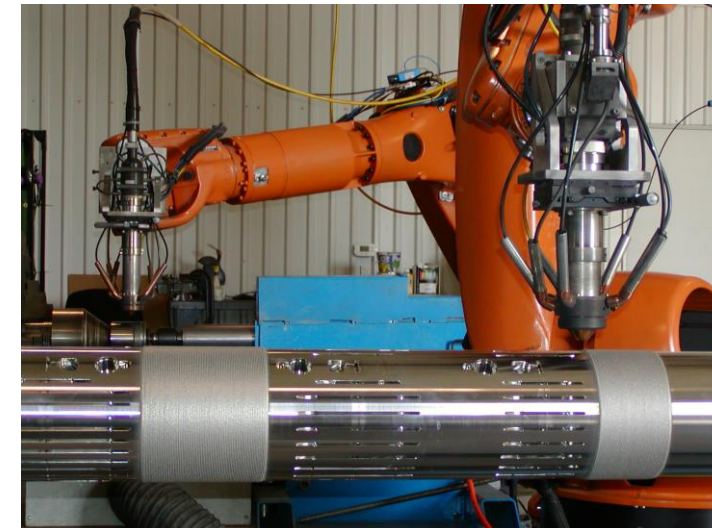
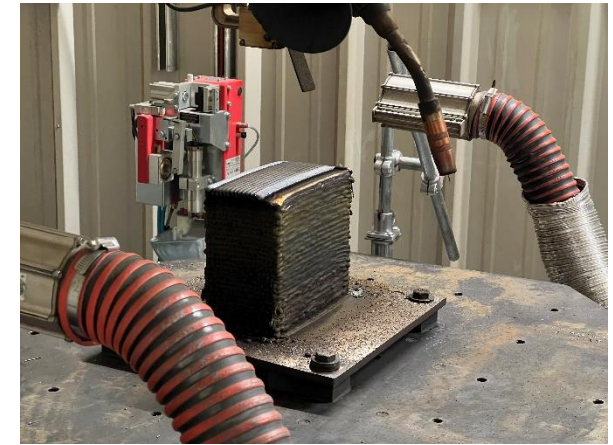


# Solutions for 3D Metal Printing

Laser DED & Laser Cladding - 5 Machines

Wire-Arc Additive Manufacturing (WAAM) - 5 machines

- Wide range of wire or powder materials (SS, Ni-& Co-Alloys etc)



# Laser Welding Solutions

## WAAM Maritime Alloys

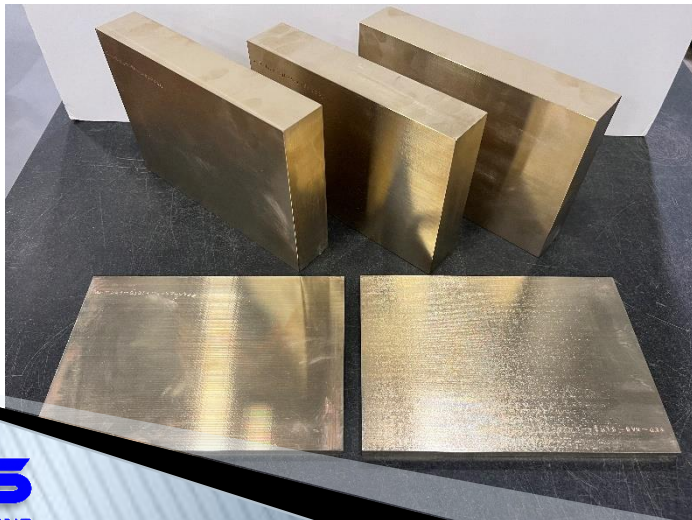
- Nickel-Aluminum-Bronze
- Copper-Nickel (70-30)
- Alloy 625
- 316L Stainless Steel
- Carbon Steel
- Nickel-Copper (Monel 400)
- Monel K500
- MIL-100S-1

# WAAM Materials

## Nickel-Aluminum-Bronze (NAB) Material Properties

### ➤ Material Testing & Qualification

	ASTM B148 Requirements	LWS WAAM (HT)
Tensile Strength (ksi)	85	<100
Yield Strength (ksi)	35	<50
Elongation (%)	15	<20

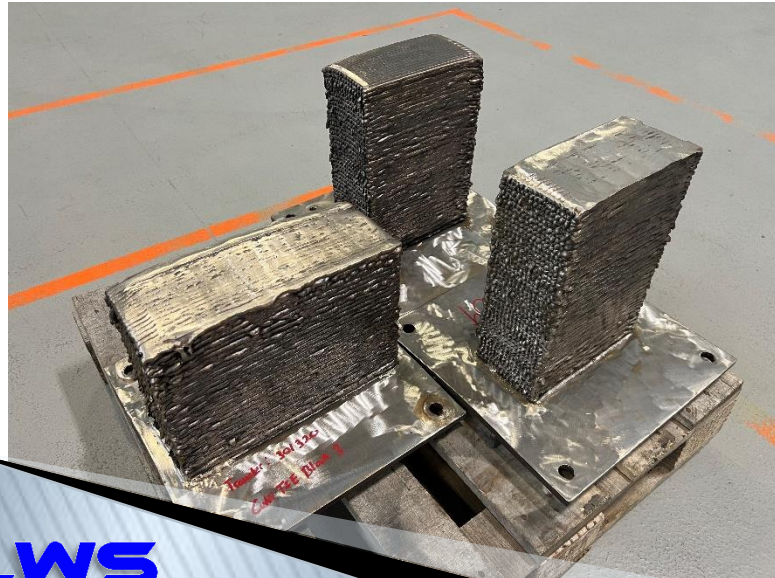


# WAAM Materials

## Copper-Nickel (70/30) Material Properties

### ➤ Material Testing & Qualification

	NAVSEA CuNi MIL-PRF Requirements	LWS WAAM (HT)
Tensile Strength (ksi)	60	<63
Yield Strength (ksi)	32	<36
Elongation (%)	20	<30



# Application Examples

## WAAM Integrated Flange

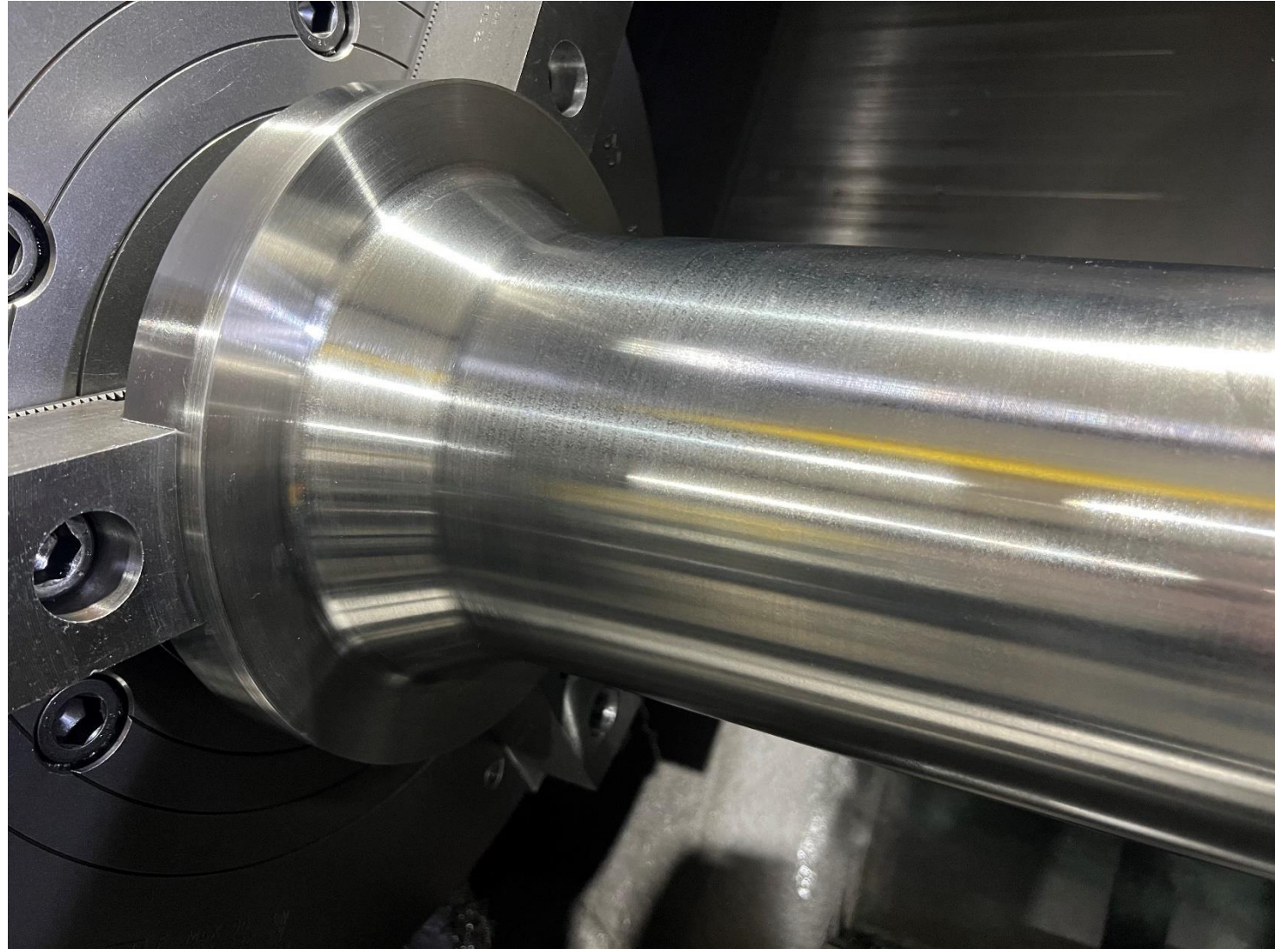
➤ Material Copper-Nickel (70/30)

Prolongation Test Results:

Tensile Strength > 63ksi

Yield Strength > 38ksi

Elongation > 31%



## LWS Alloy 625 Material Properties

As-Printed Condition	XY-Direction Results (>20 Test Average)	Z-Direction Results (>20 Test Average)	ASTM B446 Grade 1 and others
Tensile Strength (ksi)	112.1	108.8	110
Yield Strength (ksi)	73.0	69.9	50
Elongation (%)	50.7	52.9	25

Test results include multiple wire lots, thicknesses, parameter variations, etc. Multiple recent prints have met all B446 Grade 1 requirements.

Solution Annealed	XY-Direction Results (>10 Test Average)	Z-Direction Results (>10 Test Average)	ASTM B446 Grade 1 and others
Tensile Strength (ksi)	107.7	108.1	110
Yield Strength (ksi)	52.5	51.9	50
Elongation (%)	61.7	57.6	25



# Application Examples

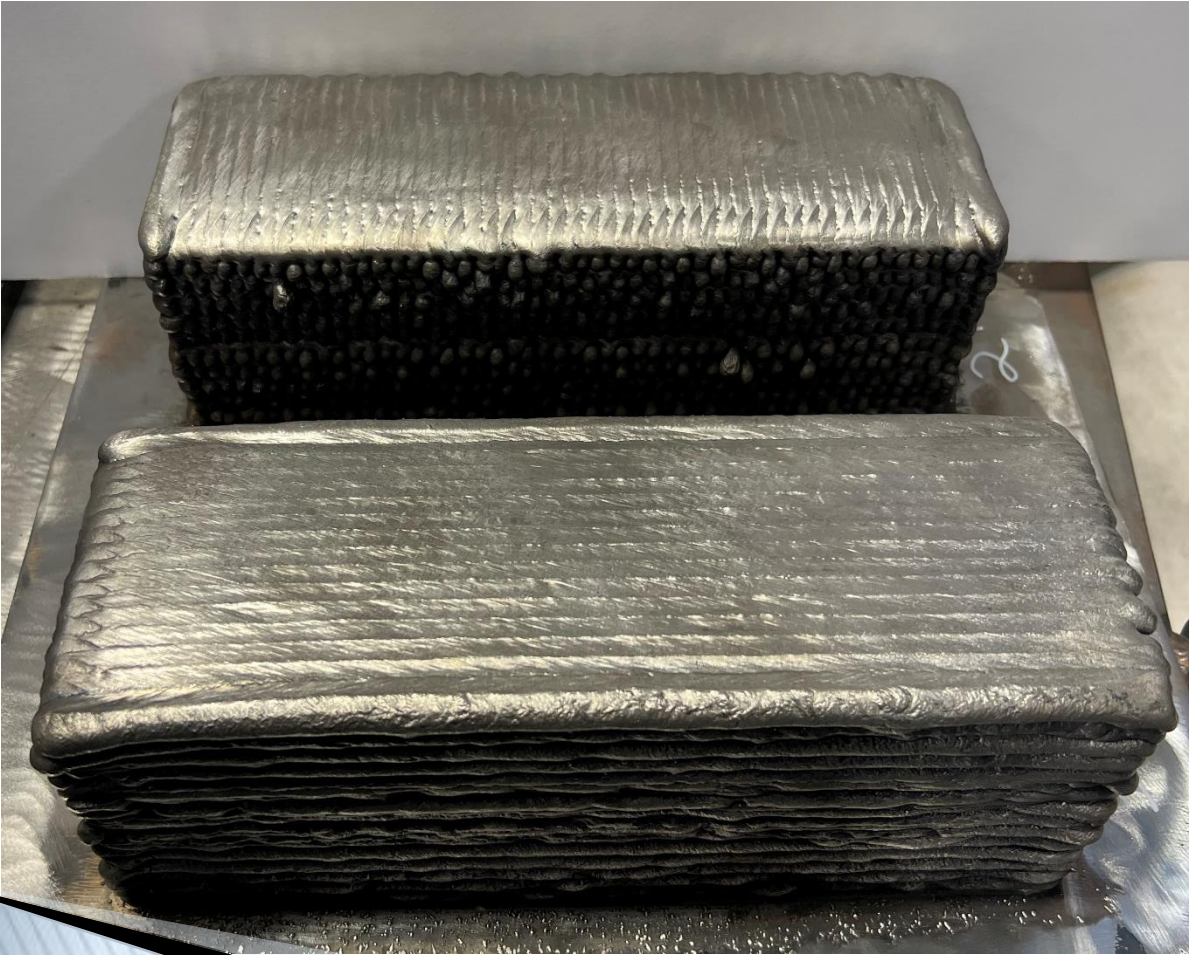
## WAAM Valve Body

- Weight 270 lbs
- Material Alloy 625



# WAAM Materials

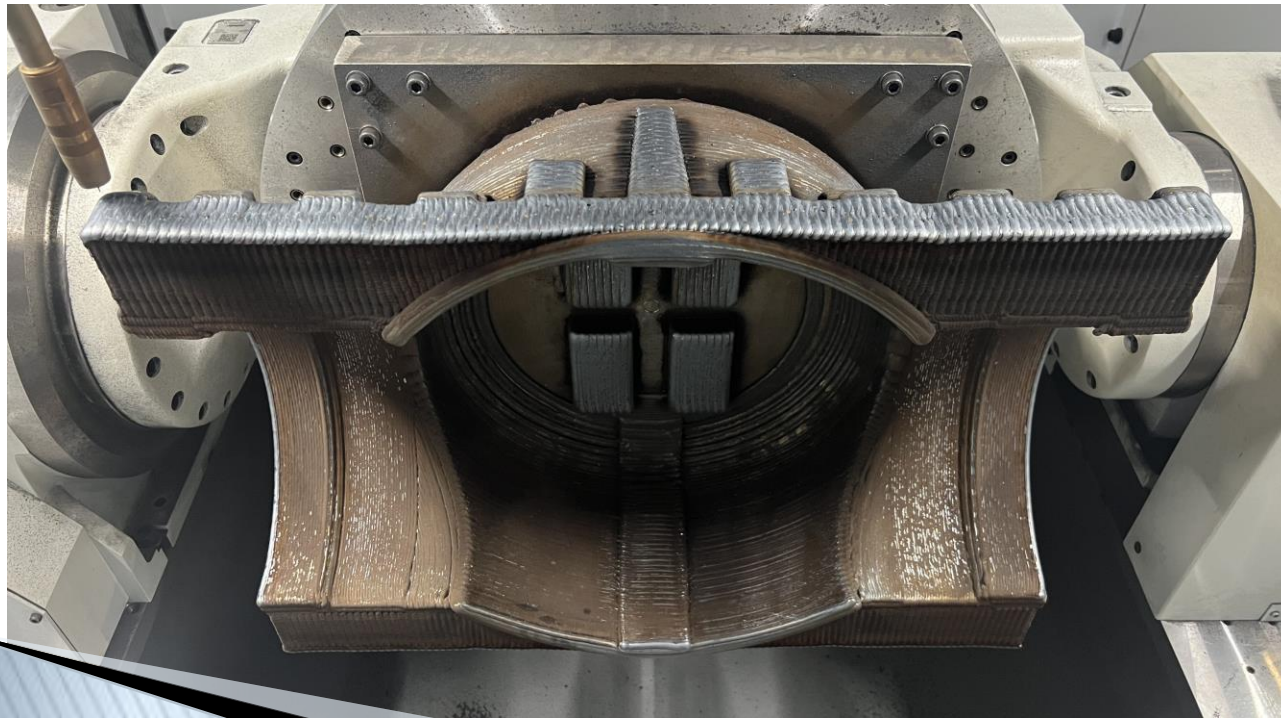
Nickel-Copper (Monel 400)



# Application Examples

## WAAM General Industry Lower Housing

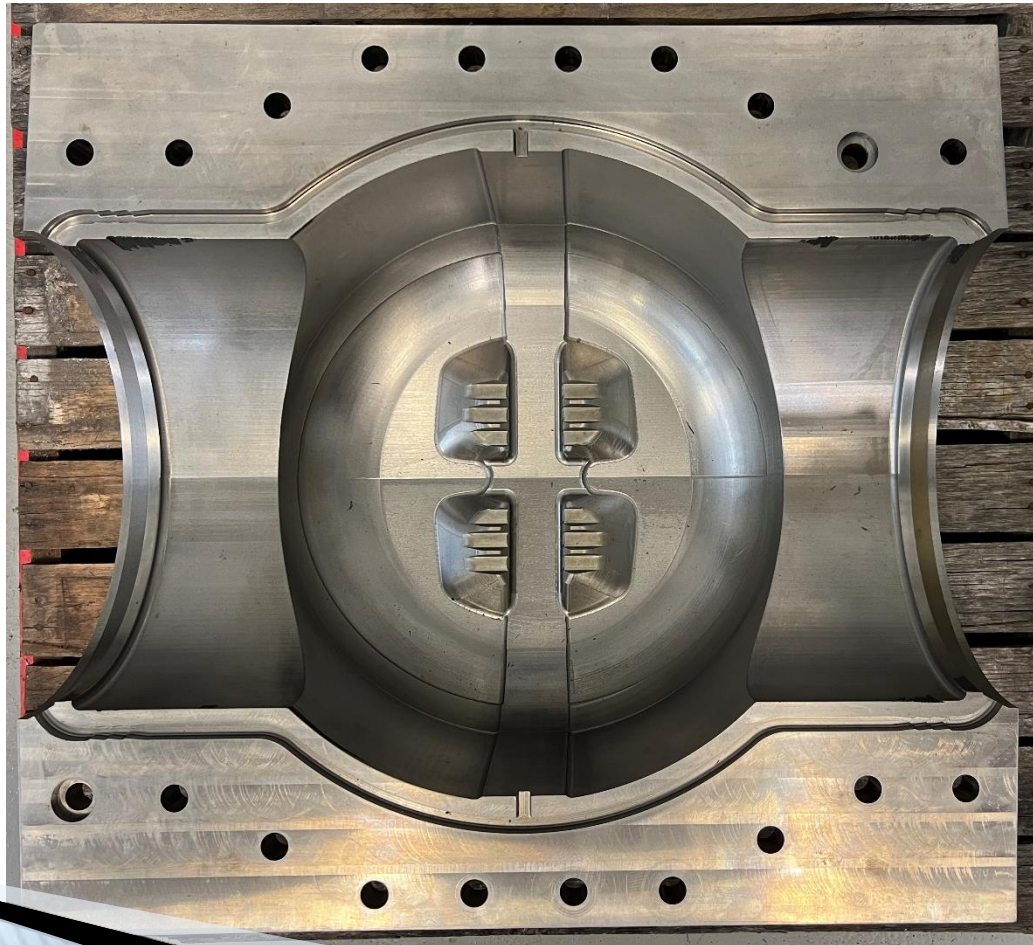
- Material Carbon Steel
- Prototype Component
- Weight 400 lbs



# Application Examples

## WAAM General Industry Lower Housing

- “Flanges”, seal surfaces and inside are finish machined



# Application Examples

## Fluid Motion Industry

- Material 316L Stainless Steel
- Hollow Shaft Design, Difficult to Conventional Manufacture
- <60% Weight Saving vs Traditional Machining
- Hybrid/Integrated pre-machined Substrate
- Excellent As-Printed Properties:
  - Qualified to Customer's Spec
  - Met tensile and yield strength requirements for wrought
  - Passed ASTM Corrosion Test



## **SUMMARY** Laser Welding Solutions Services

# Summary

- Many Maritime Alloys can be additively manufactured using WAAM
- WAAM easily exceeds casting quality and mechanical properties, often approaching forged equivalent
- NAVSEA has a clear qualification framework for WAAM and AM parts are being installed on boats/ships (S9074-A4-GIB-010/AM-WIRE DED)

# LASER WELDING SOLUTIONS

Innovative. Experienced. Customer Driven.

**Let's Work Together**