FORTIUS METALS

Making the unweldable weldable

Through **Machine Intelligence** and **Materials**

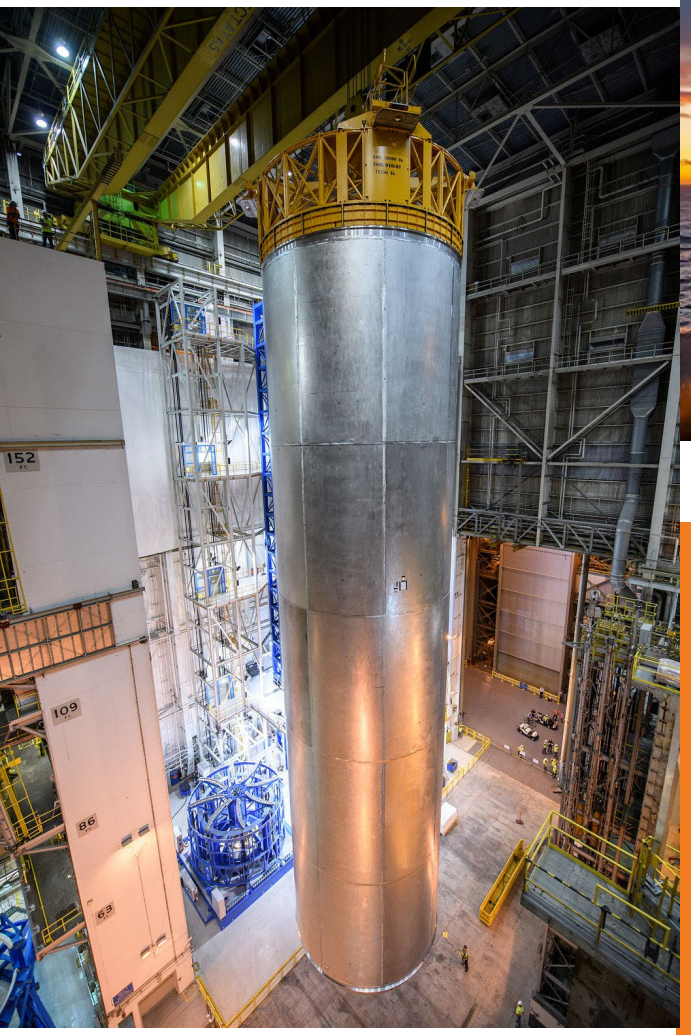
About Fortius Metals

- Founded in 2021
- Located 16 km outside of Boulder, CO
- 13 employees total
- Raised $6M total in pre-Series A investment
- Annual Turnover: $1.4-1.8M
- Investors include:
  - AM Ventures
  - 412 Venture Fund
  - Finindus
  - M7 Holdings
  - Elementum 3D

Products
Performance Weld Filler Wire for DED, Predictive Welding (DED) Software and Service

Markets
Aerospace, Defense Naval/Maritime, Energy

Regions
USA, EU, JPN, KR, …



North American Maritime/Naval, Defense, Aerospace and Space constitute nearly **$1.2 trillion**, welding is critical in all…

Fortius Metals' Mission

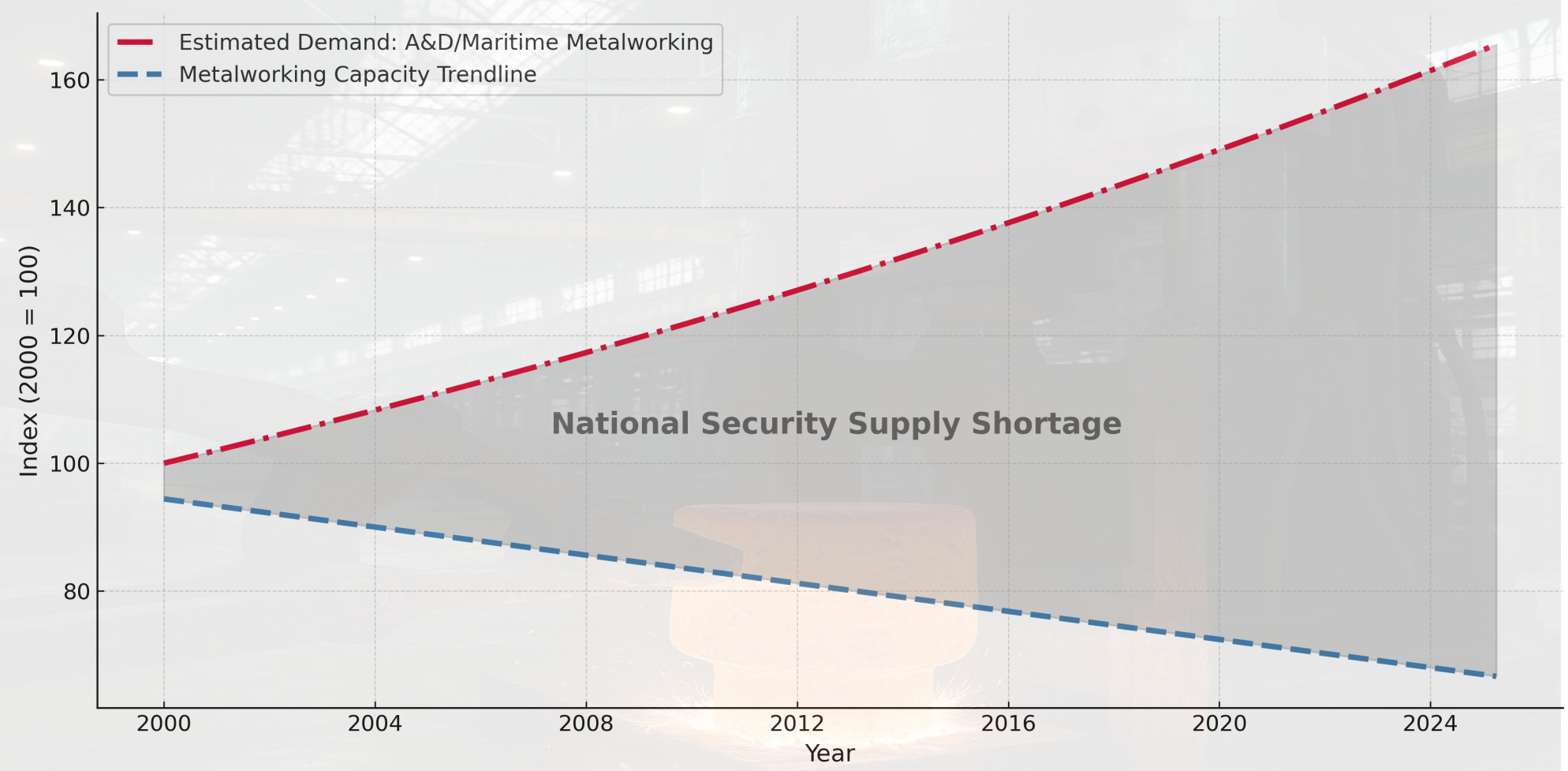
Accelerate and Enable **advanced manufacturing** through next generation materials, welding prediction and design for manufacturing.

Fortius Metals' Vision

Become the **industry leader** of next-gen directed energy deposition (DED), Robotic Welding and welding manufacturing.

"making the unweldable weldable"

North American Metalworking capacity, capabilities, and workforce are declining, while demand is increasing



"***Resilient supply chains*** *that can securely produce the products, services, and technologies needed* ***now and in the future at speed, scale, and cost.***"

U.S. Department of Defense - National Defense Industrial Strategy Priority 1

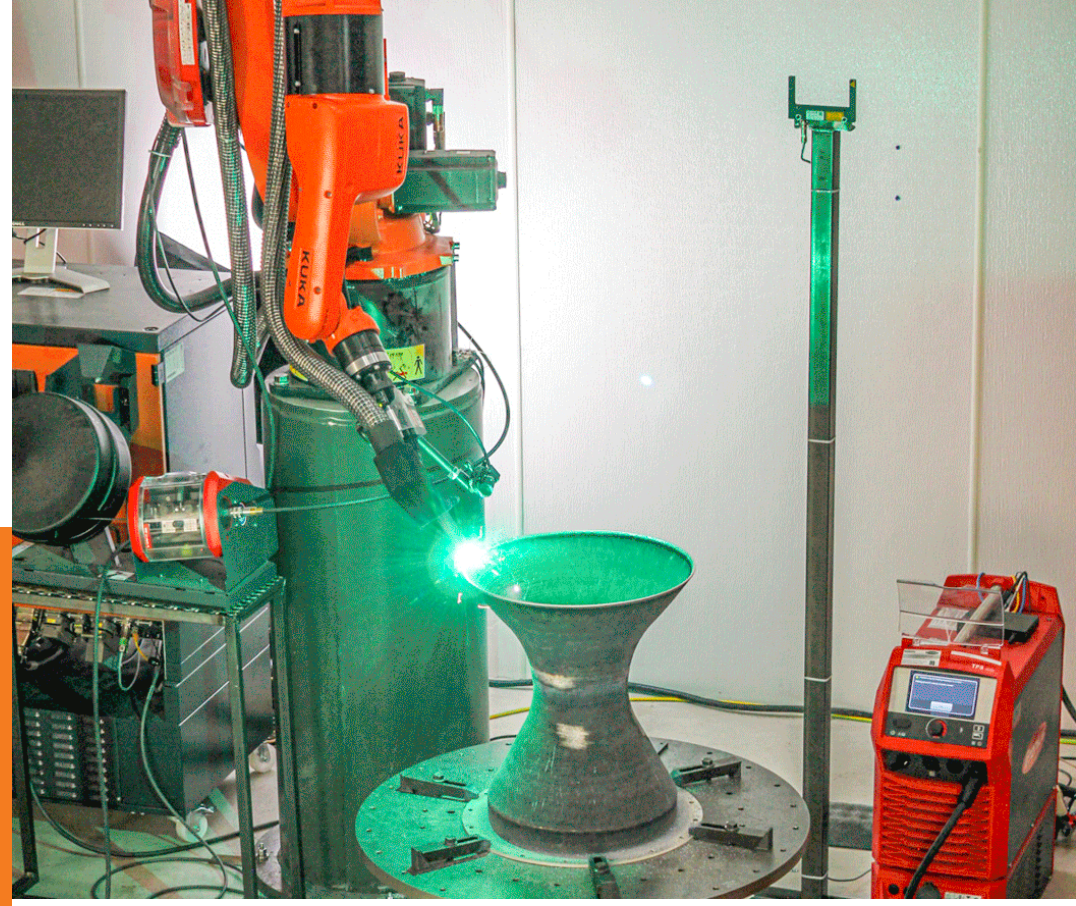
Fortius AI platform enables up-tooling of any industrial robot into automated welding systems that are

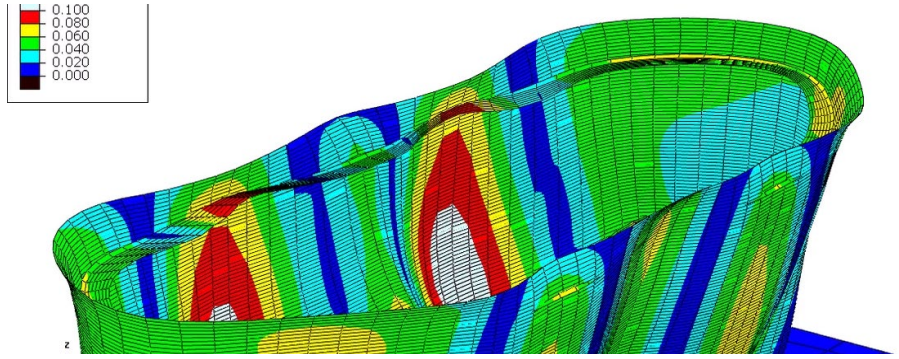
10x faster than foundry, **50% less expensive**, **90% less** reliant on tooling

Eliminates need for PhD-level expertise—Fortius makes robotic welding accessible and scalable.

Auto adjustment to material, tool, and part requirements. **Full weld-path delivery** improves right **first time yield by >200%**

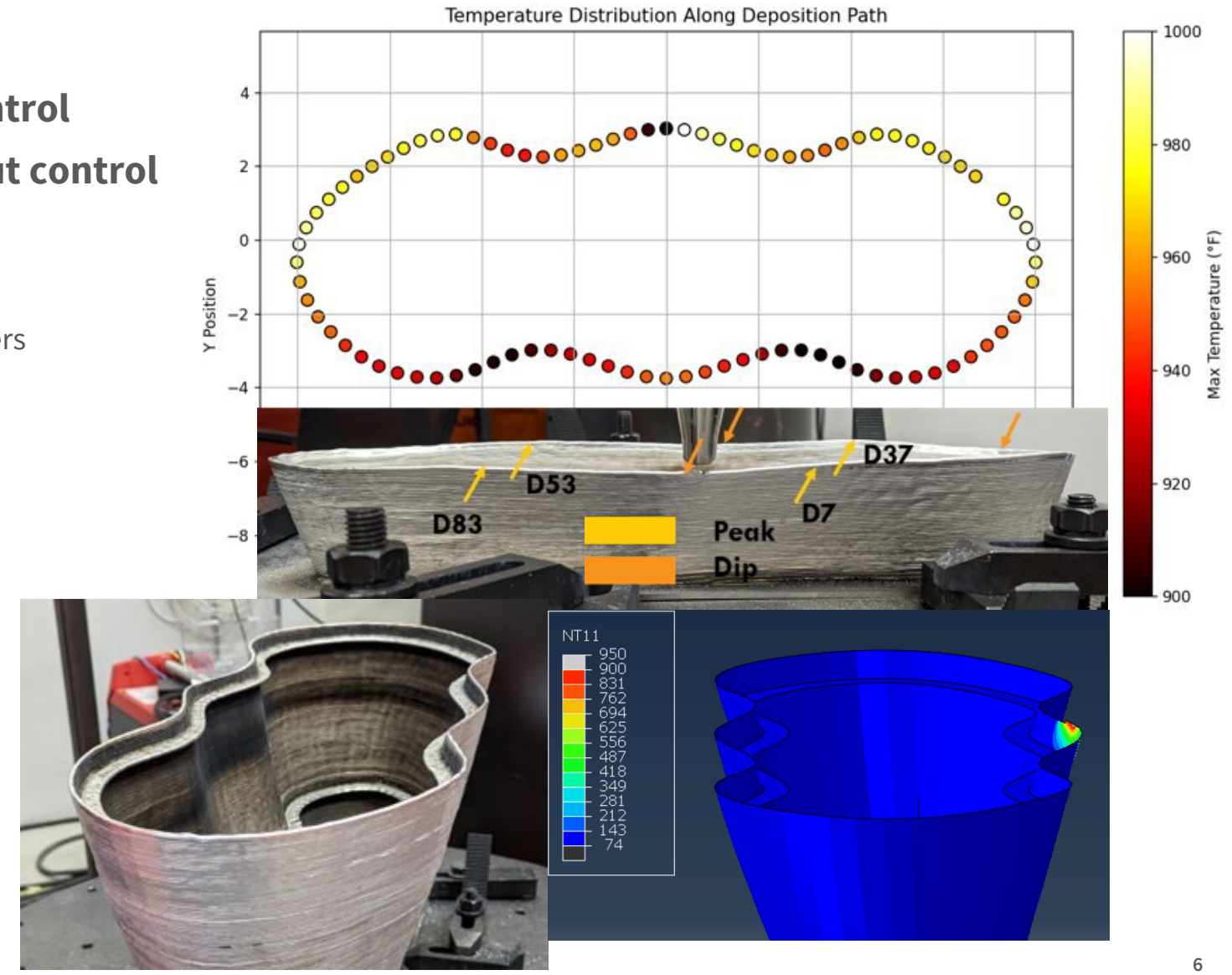
Enables latent capacity of **380,000** US Industrial Robots





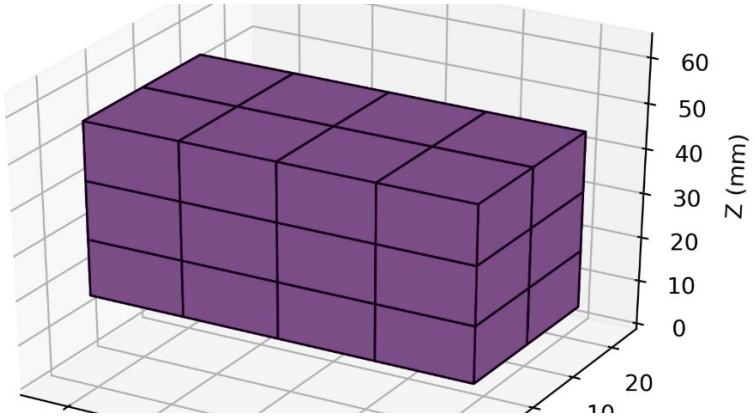
Process Technology - Print simulation

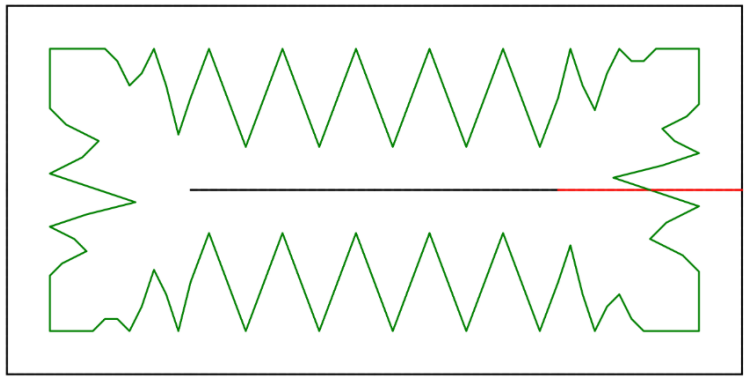
- Simulation of printing process
  - Prediction of weld shrinkage » **distortion control**
  - Prediction of welding parameters » **heat input control**
  - Toolpath/robot program directly generated
    - Compensated (for distortion)
    - Each point associated with predicted welding parameters
- Benefits
  - Key feature of ‘Digital Twin’
  - Printing of complex geometry
  - Faster prototype development cycle
  - Minimizes in-process changes
    - Consistency from one part to another
    - Increase manufacturing readiness level (MRL)

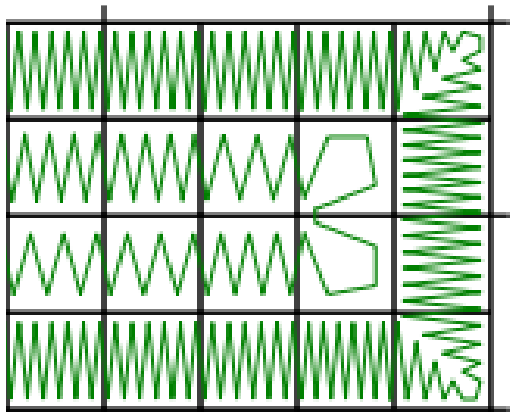


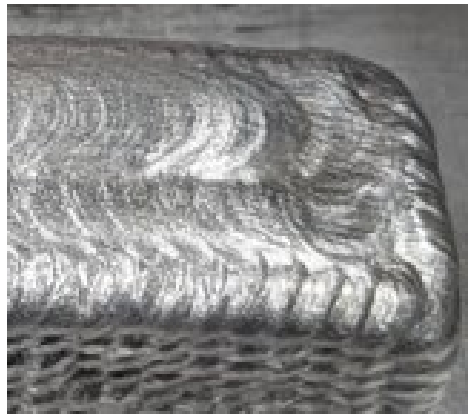
ENHANCED PRINTING CAPABILITY

Weaving controlled by simulation generated toolpath

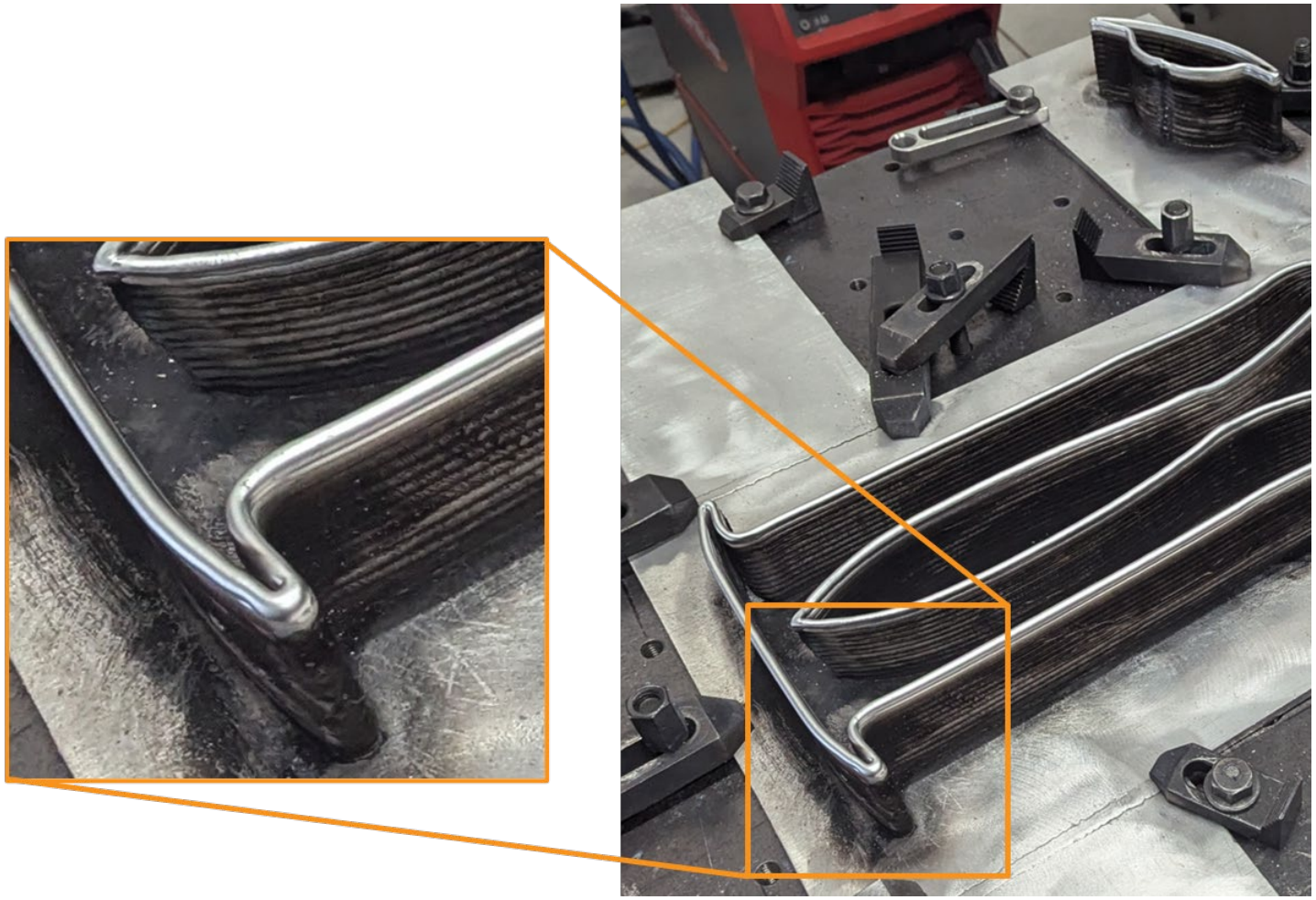








ENABLING COMPLEX PRINT GEOMETRIES



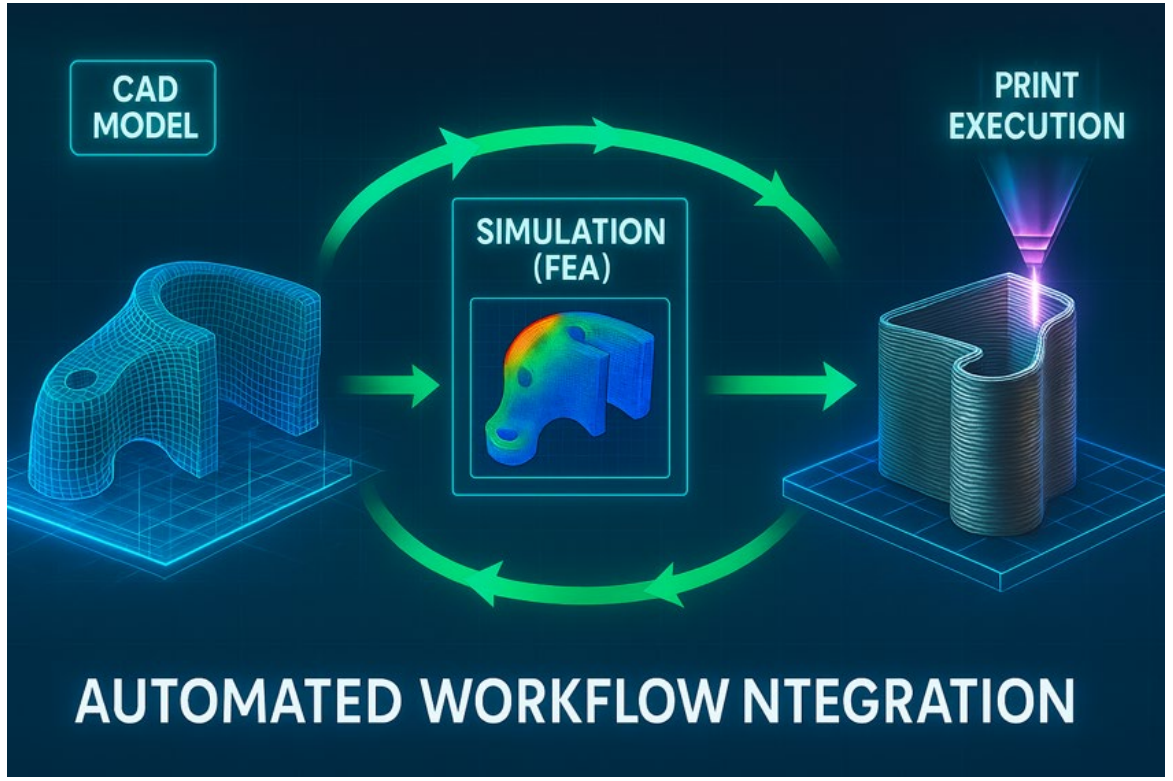
Simulation Roadmap

Phase 1: Baseline Development & Validation

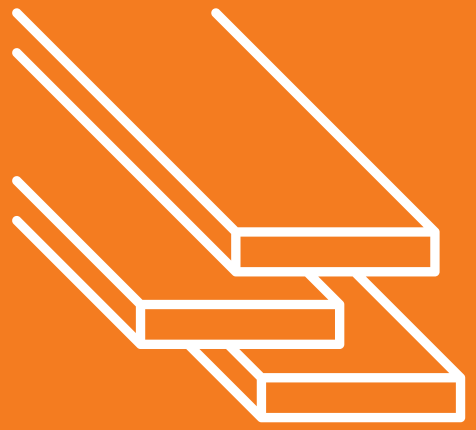
Phase 2: Sensor Integration & Data Architecture

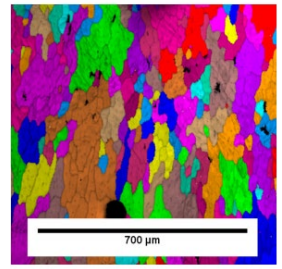
Phase 3: ML Integration & Simulation Scaling

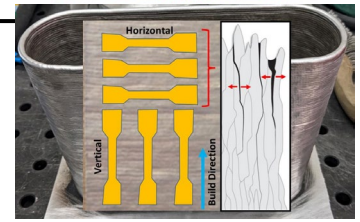
Phase 4: Workflow Integration & Automation



Fortius makes the world's only, high strength aluminum welding wire



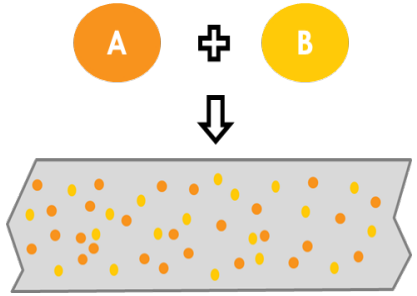


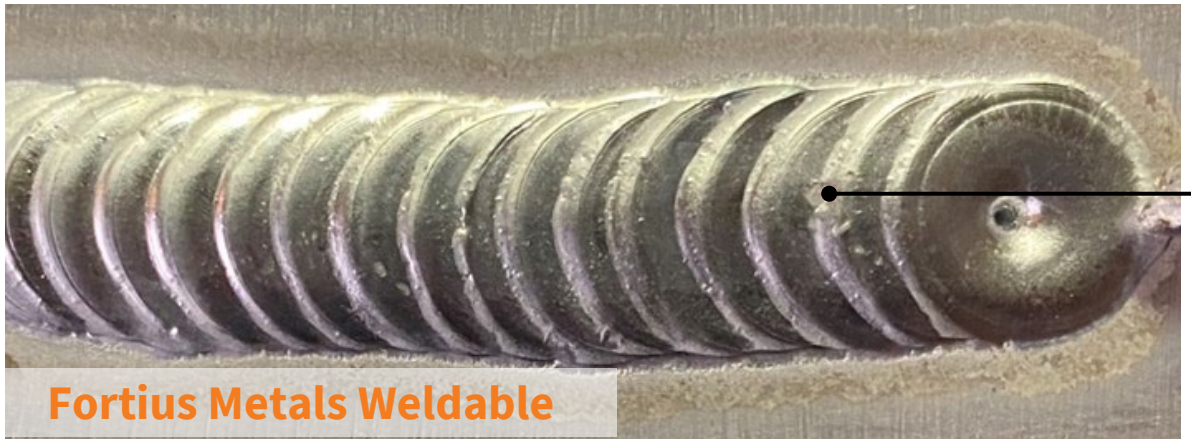


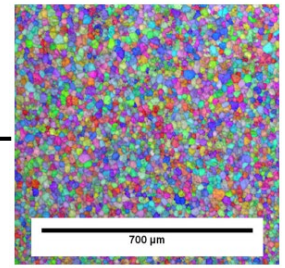
Coarse, weak metal grains

Patented

"Pixie Dust"

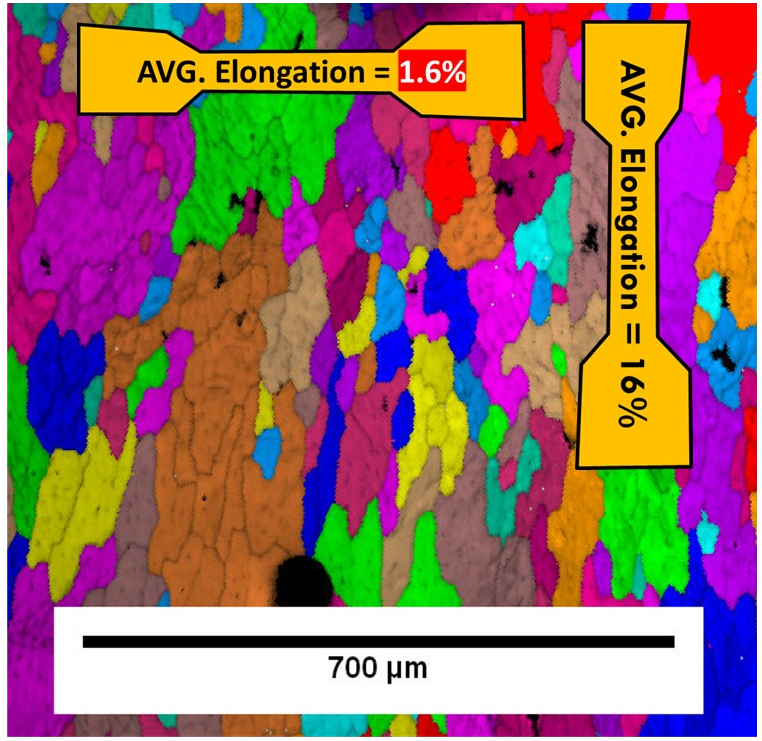


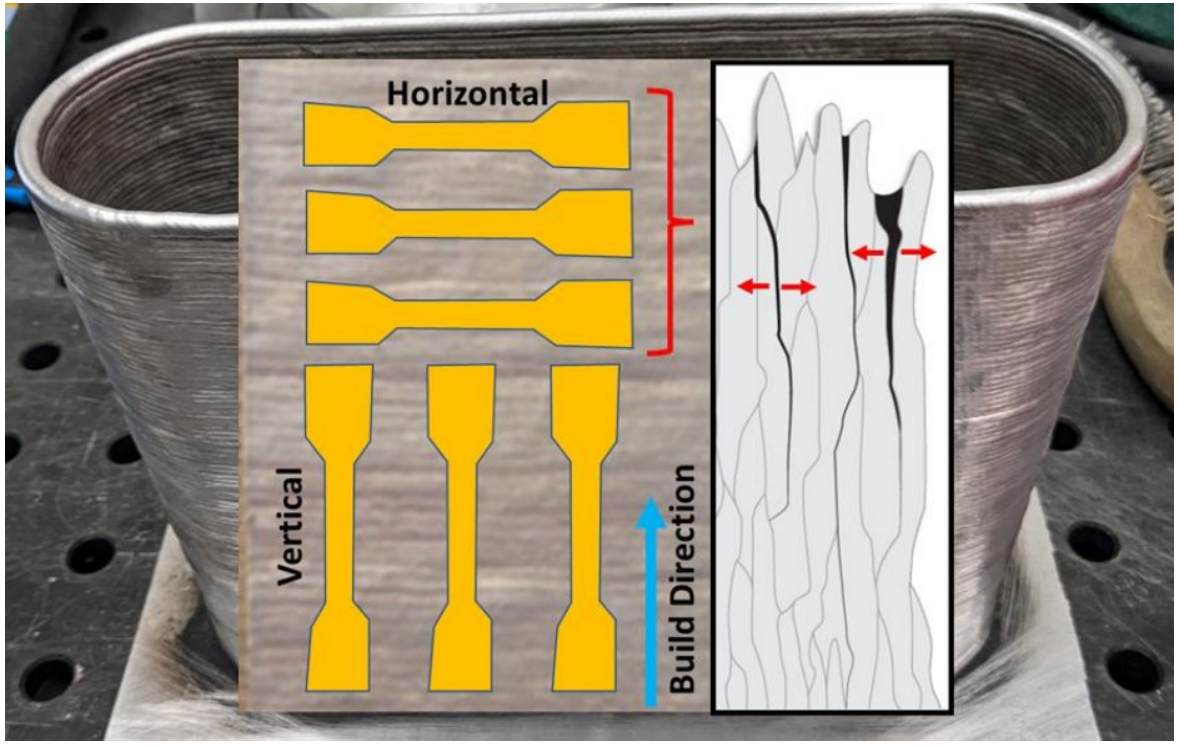


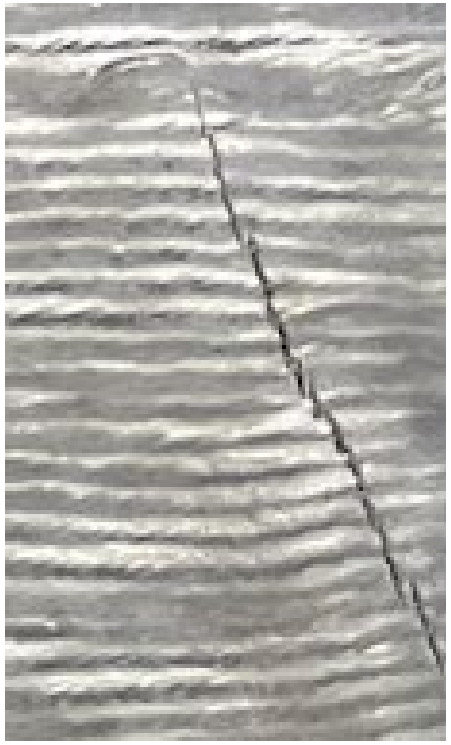


Fine, strong metal grains

Wire-DED Material Challenges



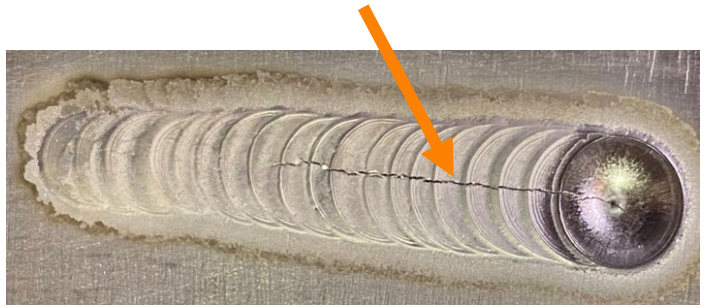


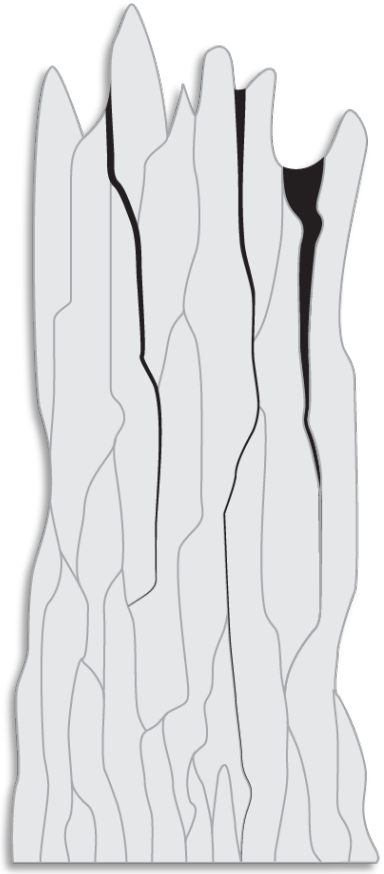


NUCLEATION WITHOUT FORTIUS

- Columnar grain growth promotes cracking
- Hot tearing (in black)
- Brittle fracture at low strength

Problem: Hot Cracking

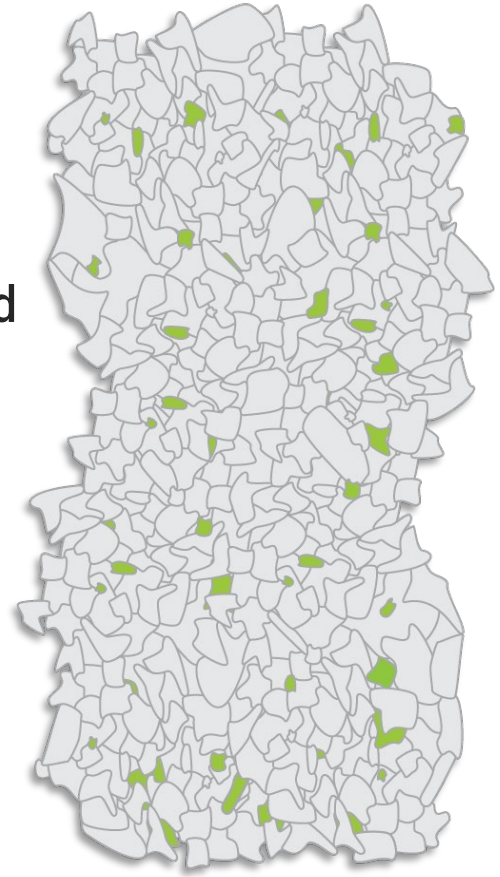




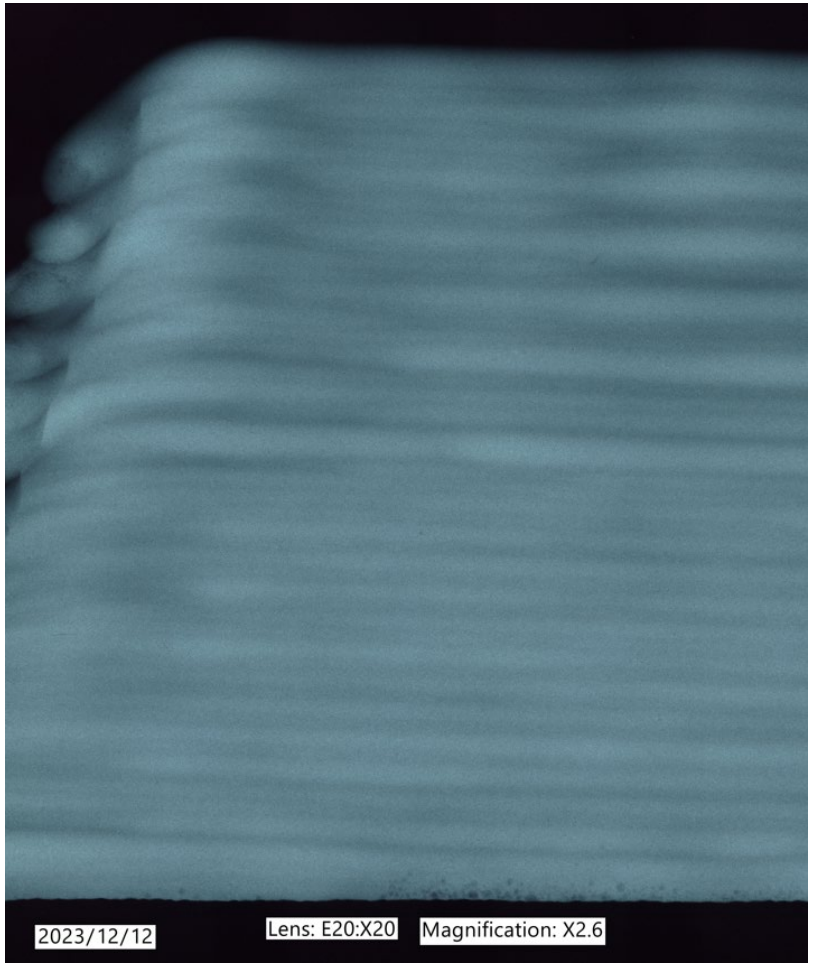
NUCLEATION WITH FORTIUS

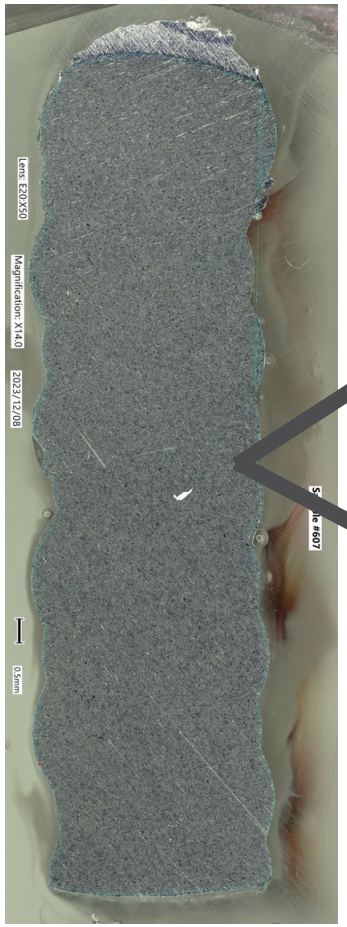
- Small, equiaxed grains inhibit cracking
- Bimodal reinforcements
- High strength, stiffness, and fatigue strength

Solution: No Cracking



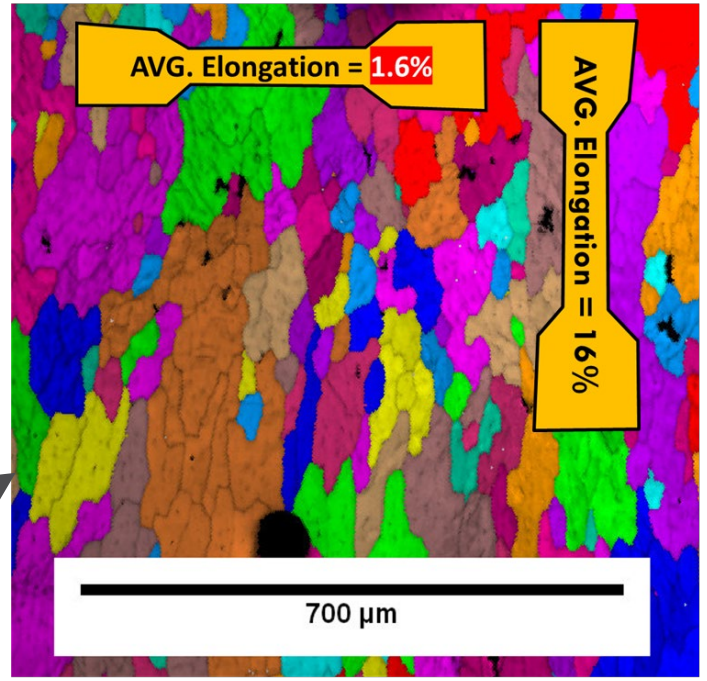
A6061-RAM2

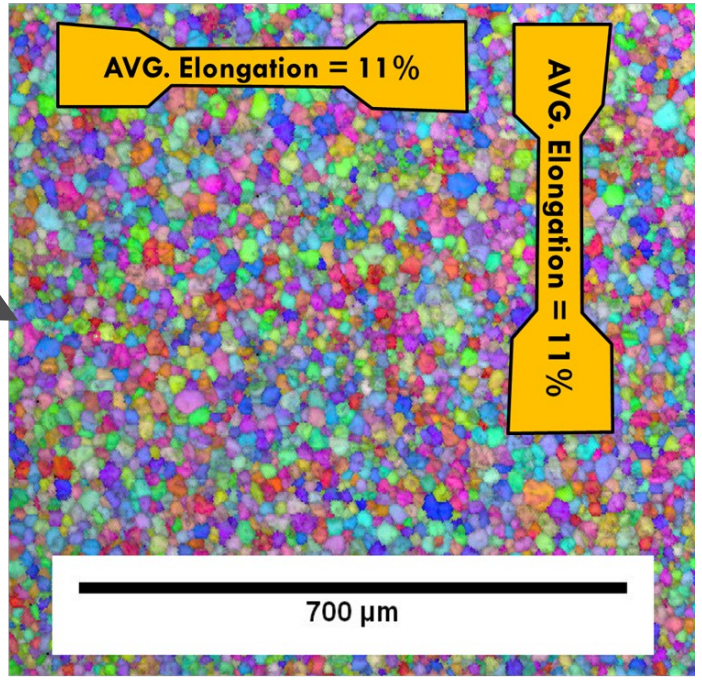




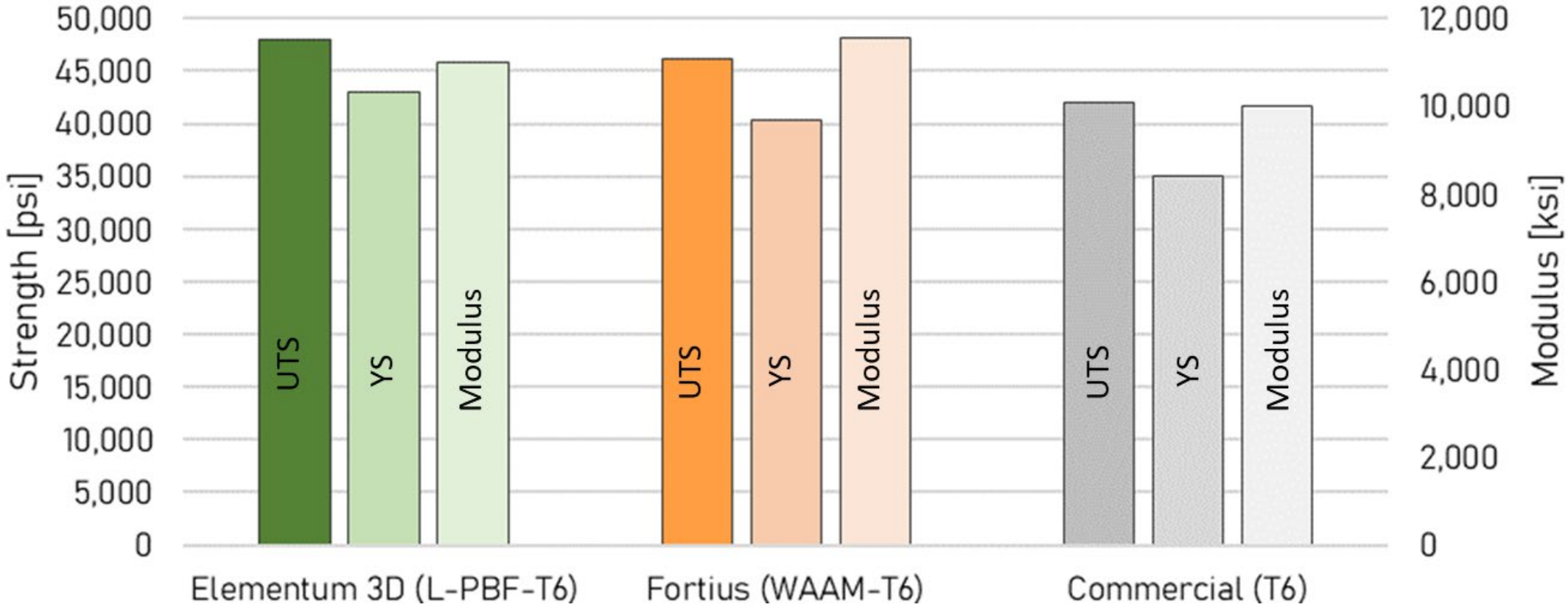
No RAM

RAM2



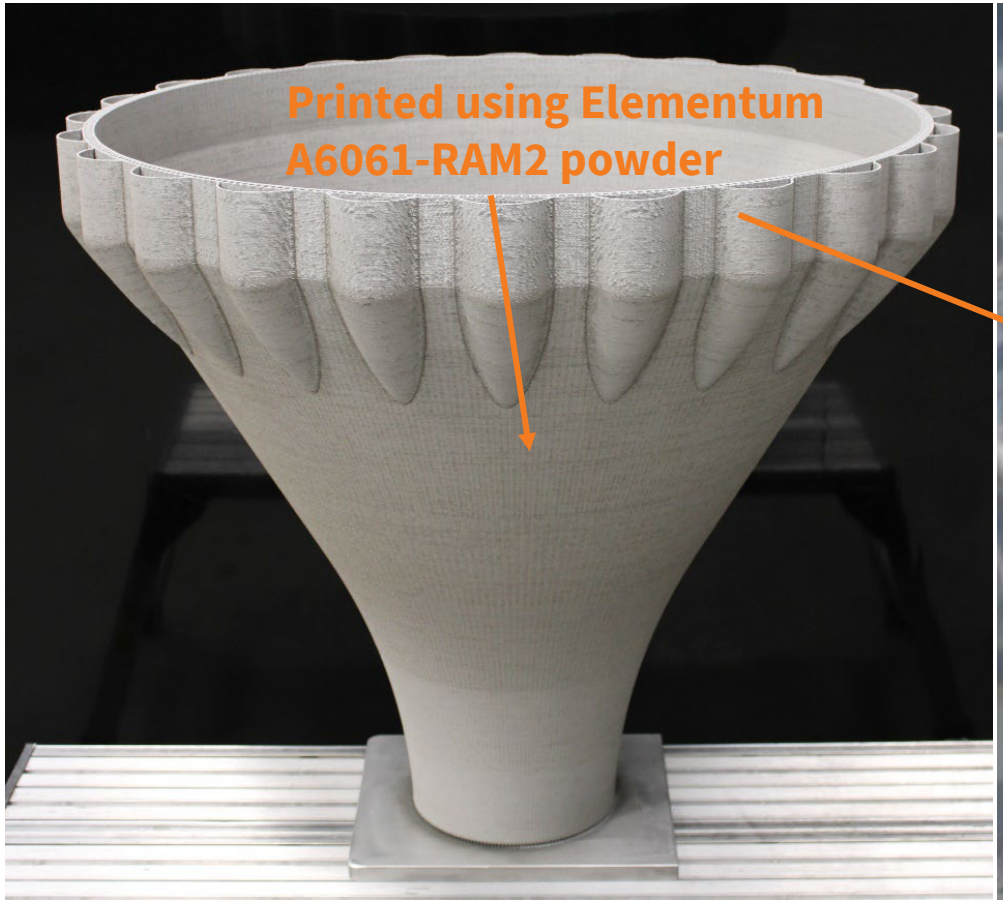


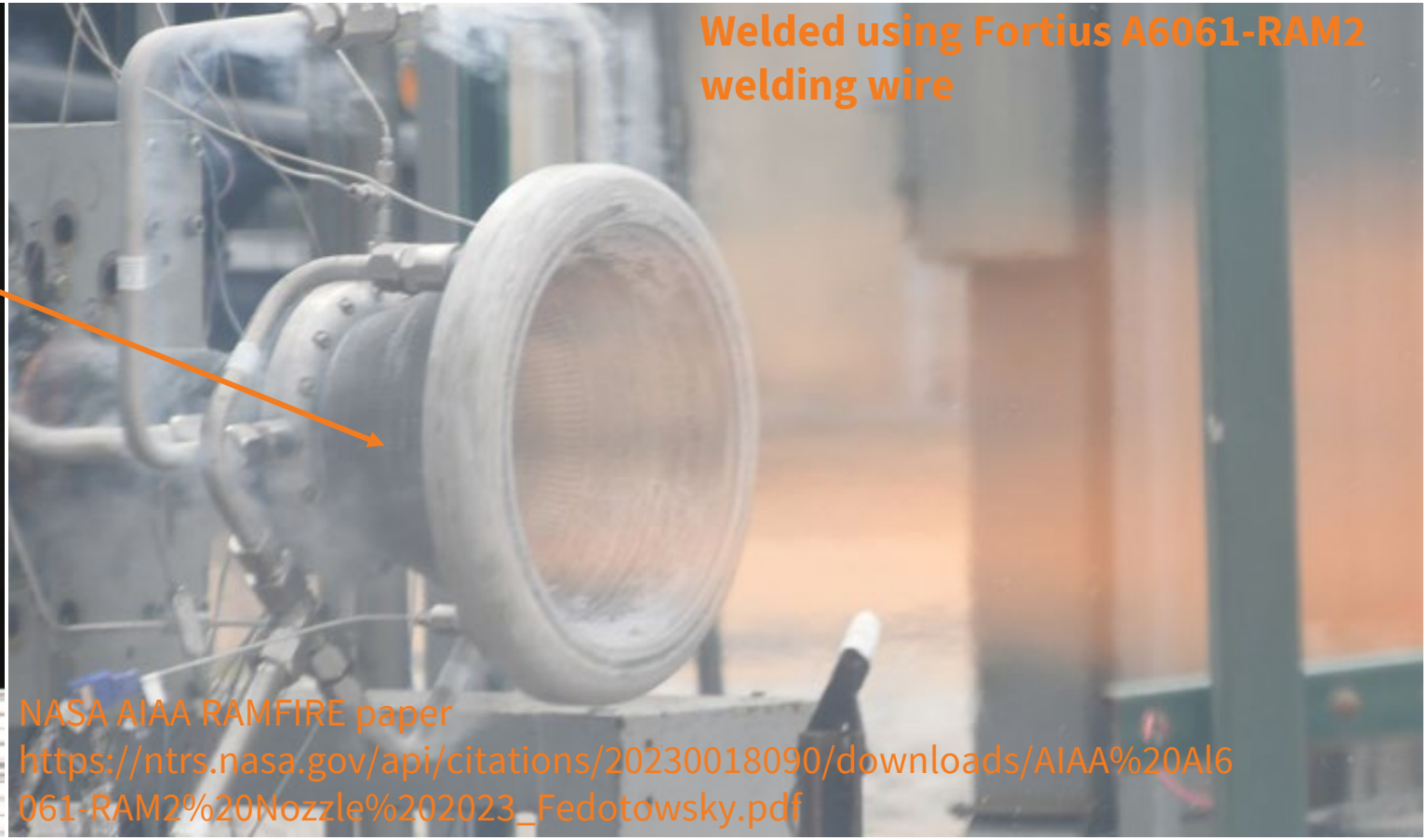
A6061-RAM2


Strength [psi]
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Modulus [ksi]
12,000
10,000
8,000
6,000
4,000
2,000
0
UTS
YS
Modulus
Elementum 3D (L-PBF-T6)
Fortius (WAAM-T6)
Commercial (T6)

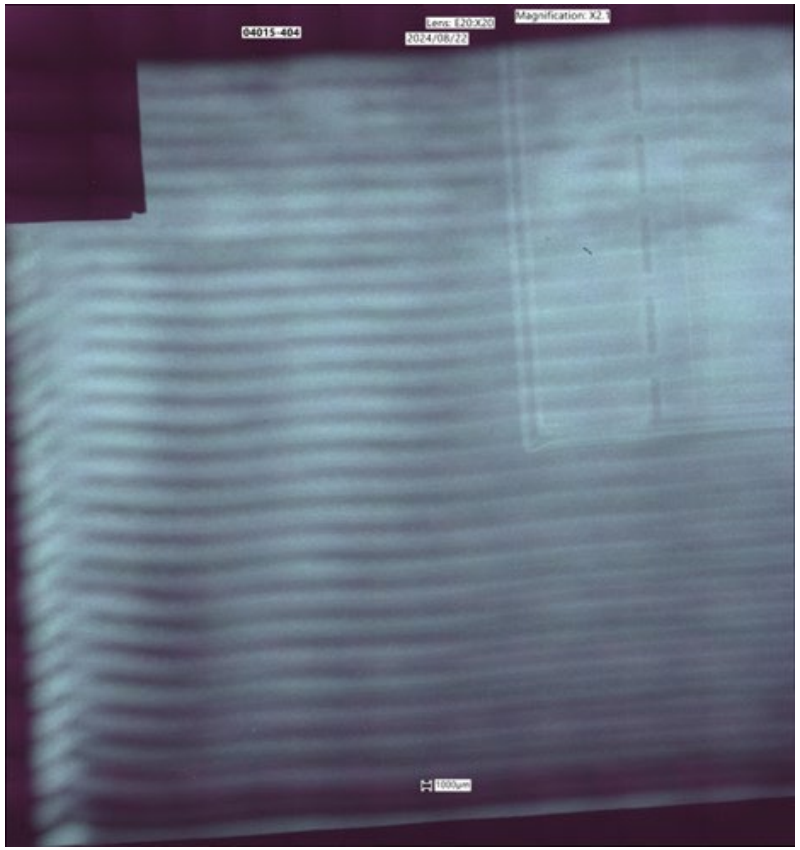
A6061-RAM2

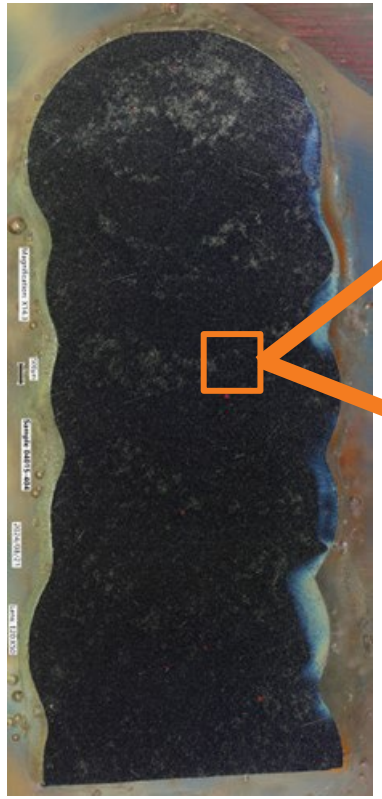
First successfully tested aluminum rocket nozzle, after 22 hot-fire tests at NASA





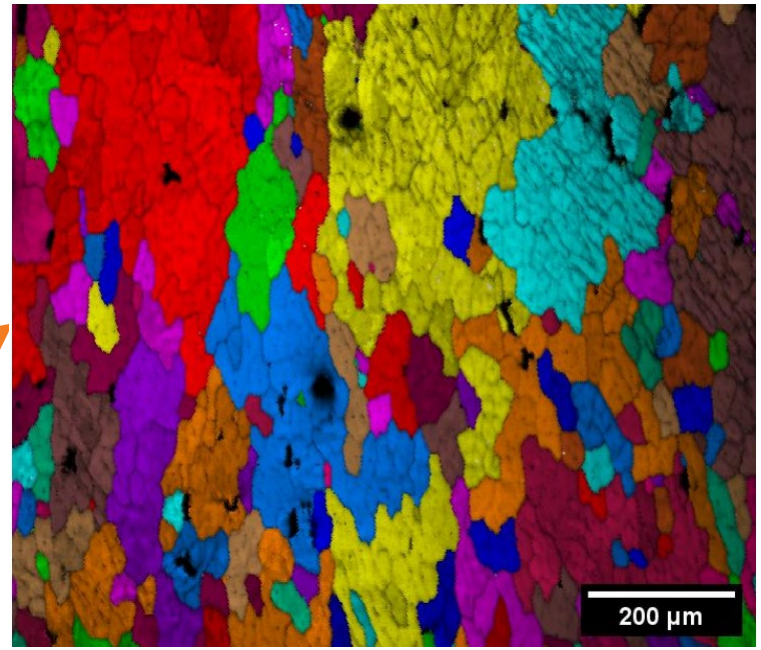
A7075-RAM2

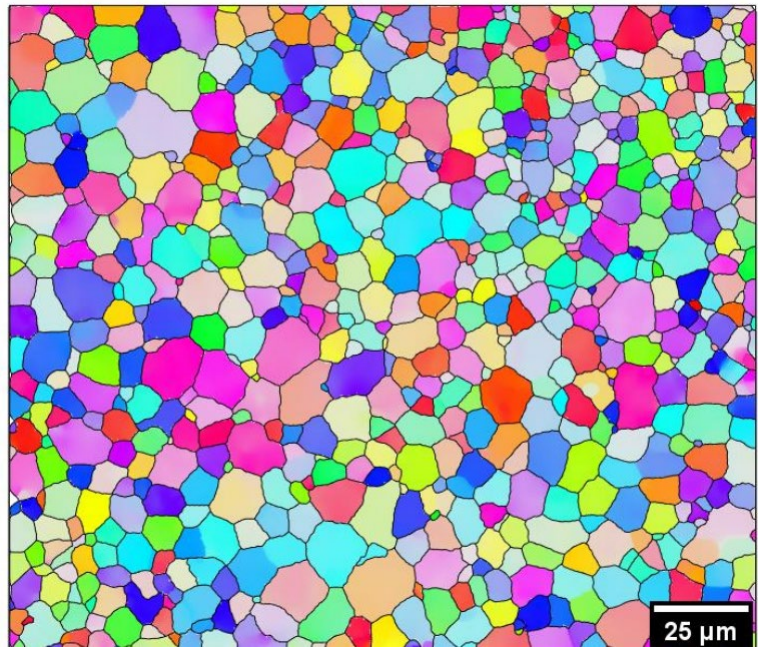




No RAM

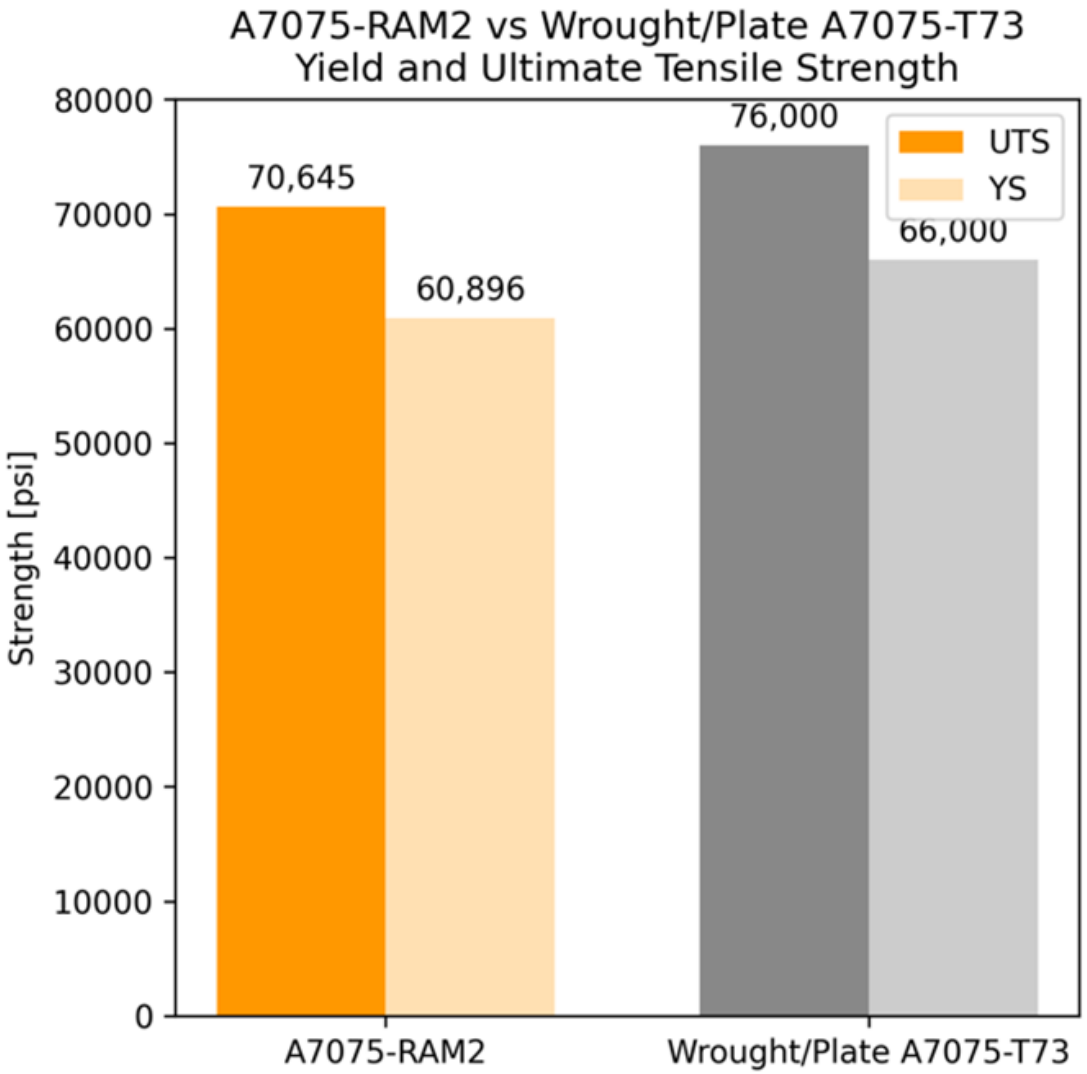
RAM2



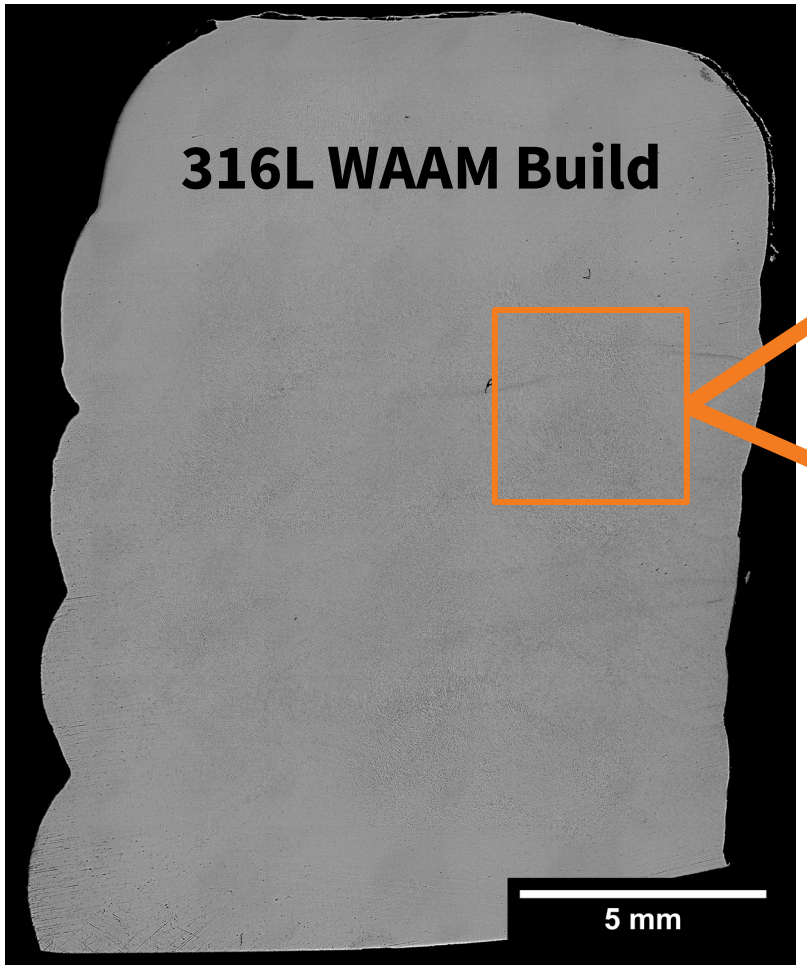


A7075-RAM2
Average grain size: 15µm

A7075-RAM2


A7075-RAM2 vs Wrought/Plate A7075-T73
Yield and Ultimate Tensile Strength
Strength [psi]
80000
70000
60000
50000
40000
30000
20000
10000
0
70,645
60,896
76,000
66,000
UTS
YS
A7075-RAM2
Wrought/Plate A7075-T73

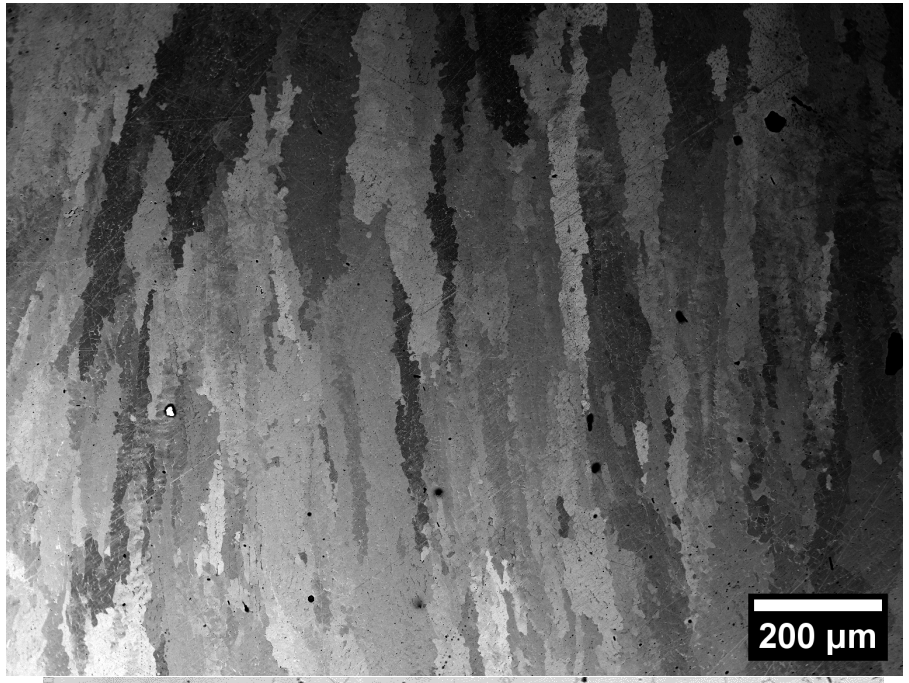
Stainless Steel

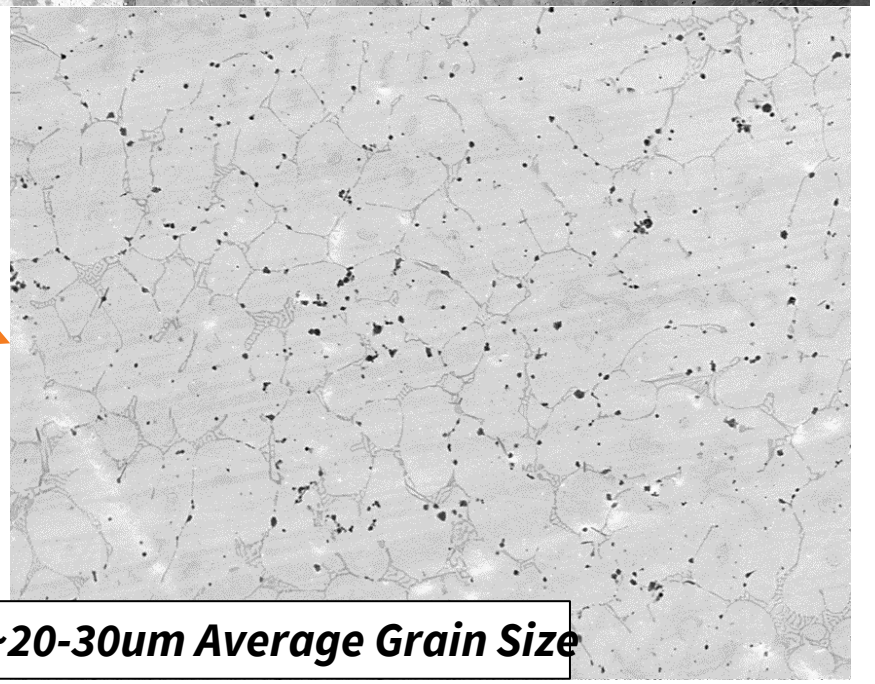


Columnar grains growing up the build

No RAM

RAM





~20-30um Average Grain Size

Significantly refined grains

Potentially more Isotropic Properties

GrCop-42

- Successfully fabricated .045” GrCop 42 wire
  - Inert atmosphere to prevent oxidation
    - Constant flow of Nitrogen
- Wire sample sent out for composition
  - Confirmed desired ratio of Cr:Nb
  - Confirmed low Oxygen content (<400ppm)

Future Alloys

- Aluminum 5xxx
  - Fortius Metals' has been awarded a three-phase contract from the Office of the Secretary of Defense (OSD), Innovation Capability and Modernization (ICAM) Office, in collaboration with the National Center for Defense Manufacturing and Machining (NCDMM) to advance a **rare-earth-free, corrosion-resistant (reduced sensitization) 5000-series aluminum** to TRL-8+ was accepted and we are contracting.
  - Over 2.5 years, Fortius will deliver a fully qualified material set with three ecosystem partners, with NAVSEA directly teaming and strong dual-use demand signaled by NASA, General Atomics, and Relativity.
- Aluminum 2024-RAM2
  - Produced already 2 pilot runs that have been utilized by NASA and other commercial space companies.
  - Continued development commensurate with demand towards TRL/MRL 7 level in 2027

Software That Unlocks Capacity Utilization and Powers a Recurring Revenue Engine. A scalable business model.

Our business model allows us to deliver the right solutions to meet our customers along their journey.