

Prototype to Production

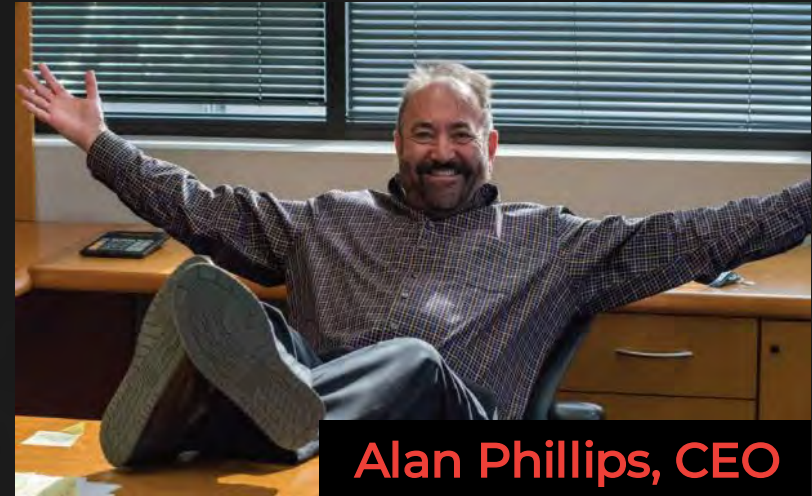
Hybrid Metal Manufacturing





PHILLIPS CORPORATION OVERVIEW

- /// Founded March 1, 1961, by Albert Phillips in College Park Maryland
- /// Mission-driven partner in manufacturing innovation
 - World's Best Supplier of Manufacturing Technology
 - Experts Providing Expertise
- /// 60+ years of service to industry, government, and education
- /// Comprehensive expertise across CNC, additive, and automation
- /// World's Largest Haas Factory Outlet (HFO)



What we do.

We partner with our metalworking customers to improve competencies for applying manufacturing technology – resulting in leaps in productivity, great prosperity, and enduring competitive advantage.

Phillips Corporation supports the future of manufacturing by providing unparalleled service, expertise, and innovative thinking for both subtractive and additive manufacturing processes.

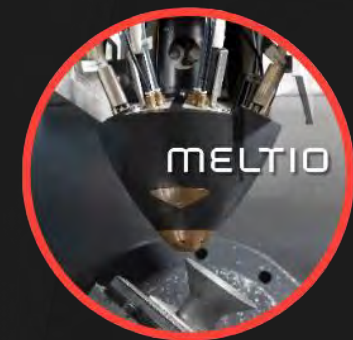
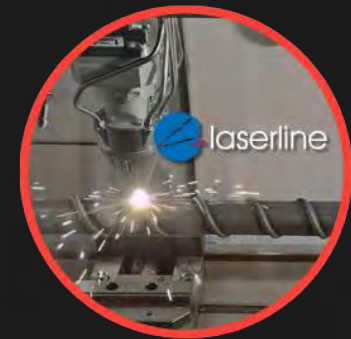


HYBRID DIVISION OVERVIEW

- /// Combining Additive + Subtractive in One System
- /// Merge CNC machining with advanced metal 3D printing in a single, streamlined machine.
 - /// Laser-Wire, Laser-Powder, or Wire Arc deposition heads with Haas CNCs
- /// Enables part build-up and precision finishing in one setup
- /// Retrofit existing Haas machines or purchase new turnkey systems
- /// Eliminates the need for multiple machines and re-fixturing
- /// Ideal for rapid prototyping, part repair, and advanced research
- /// Improved flexibility and functionality on the shop floor or in the field.

/// **Phillips**[®]
ADDITIVE HYBRID[®]

POWERED BY HAAS



/// **Phillips**[®]



Haas CNC + AM Technology = Hybrid
(Subtractive) (Additive)

DIVISION HISTORY

- /// 2019 – HYB founded
- /// 2020 – 1st Hybrid sold to Autodesk
- /// 2021 – 4 Hybrids sold (US Navy, US Army, India)
- /// 2022 – 12 Hybrids sold + 1 M450
- /// 2023 – 12 Hybrids sold + 2 M450
- /// 2024 – 25 Hybrids sold + 3 M450 + 3 M600
- /// 2025 – 30+ Hybrids sold
- /// Total DED Machines supported 100+

 **AUTODESK**

MELTIO



U.S. ARMY



- /// Meltio Hybrid Systems in Field:
 - 10 – Education (+ 13 M450/M600)
 - 15 – Navy
 - 4 – Army
 - 3 – Air Force/Aerospace (+1 M450)
 - 5 – Federal Labs & Research Institutes
 - 10 – Commercial OEMs, Contract Manufacturers
 - 7 – Energy (+1 M450)
- /// Fronius Hybrid Systems in Field:
 - 2 – Marines
- /// Total Machines Supported:
 - 56 Hybrids
 - 4 Robots/Gantry with Meltio Engine
 - 16 M450/M600

 **Phillips**[®]

How the Hybrid Works

- /// Additive deposition builds material layer-by-layer
- /// CNC machining refines part geometry and surface finish
- /// One setup, one system – complete part production



DED Technology Subset (Most common Metal AM used in Hybrid Manufacturing)

/// Laser

- Wire Feedstock
- Powder Feedstock
- Simultaneous Powder/Wire Feedstock

/// Wire Arc

- Gas Metal Arc Welding (GMAW/MIG)
- Submerged Metal Arc Welding (SAW)
- Gas Tungsten Arc Welding (GTAW/TIG)
- Plasma Arc Welding (PAW)

/// Electron Beam Welding (EBW)

/// Hybrid Deposition Processes

- Hotwire Laser
- Hotwire TIG

DED = Welding + Motion+ Toolpath

/// Robots

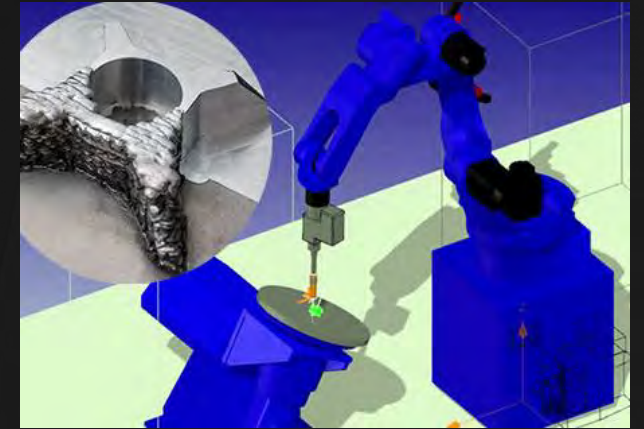
- Mostly Standalone
- Hybrids limited machining capability
- Large components
- Modular

/// Conventional CNC Kinematics

- 3-5 axis
- Standalone and Hybrid with full capability
- Small to Medium components
- Limited to CNC-nonmodular

/// Delta or Hexapod

- Standalone (non-hybrid)
- Very Highspeed
- Small to Medium components
- Application Specific



The Problem DED Hybrids Solve

/// Legacy Parts Obsolescence

/// At Depot Level:

- Limited ability/inability to manufacture legacy parts in-house
- Outsourcing replacements is costly & time consuming

/// At Field Level:

- Inability to manufacture or repair parts at Point-of-Need
- Lack of dispersed manufacturing sites/supply chain
- Readiness level is not where it needs to be

Integrated Technologies



MELTIO



Wire Arc

rugged, resilient in field, high deposition rates for larger parts



Laser-Powder

advanced material research and resolution



Laser-Wire

clean, cost-effective, safe



System Specs & Supported Materials

	 MELTIO Laser-Wire	 Fronius Wire-Arc	 laserline Laser-Powder
Technology	LW-Laser Metal Deposition	Wire-Arc Hybrid Manufacturing	LP- Laser Metal Deposition
Power + Source Option 1	1.2kW IR Laser	300A Electric Arc	4kW Blue Laser
Power + Source Option 2	1kW Blue Laser	400A Electric Arc	4kW / 6kW / 10kW IR Laser
Feedstock	Wire spool or drum, Ø 0.035 – 0.045"	Wire spool or drum, Ø 0.035 – 0.047"	Powder, particle size 30-200µ
Deposition Rate	1-2lb / hour <i>*based on machine options</i>	3-10lb / hour <i>*based on machine options and applications</i>	17lb / hour <i>*based on maximum laser power and applications</i>
Materials	Fe-, Ni-, Co-, Ti-, Cu- alloys	Fe-, Ni-, Co-, Ti-, Al-, Cu- based	Fe-, Ni-, Co-, Ti-, Al-, Cu- based
Additive Options Available	Dual wire, hot wire (with cooling plate), Power-OTF	iJobs	Zoom optic laser focus, closed loop thermal feedback, 1-4 powder hoppers, hopper sensor, cooling plate
Camera Options	XVC-700 (welding), XIR-1800 (thermal)	XVC-700 (welding), XIR-1800 (thermal), CCTV	XVC-700 (welding), XIR-1800 (thermal)
Required Haas Options	8 Spare M-function board, Wireless Intuitive Probing System	8 Spare M-function board, Wireless Intuitive Probing System, 5 additional on-board relays	8 Spare M-function board, Wireless Intuitive Probing System, Auxiliary coolant filter
Smallest UMC for Integration	UMC-750	UMC-500	UMC-750
Smallest Vertical CNC for Integration	VF-1 / TM-0 / Mini-mill	VF-1 / TM-0 / Mini-mill	VF-1 / TM-0 / Mini-mill
Equipment Included	Meltio Engine, deployment and head, SMC chiller	Fronius iWave welder, deployment and CMT torch, external feeder and hose-pack, fume extraction, chiller, cooling plate	Laserline control unit, deployment and print head, fume extraction, chiller
Machine Verticals	EDU, industry applications and production <i>*production for parts up to 50lb</i>	EDU, Industry, Production Based, Deployable	EDU, Research Labs, Tool and Die Industry
Key Advantages	Resolution, compact heat-affected zone for optimal material properties, low investment	Speed for larger parts, low investment, robust hardware, familiar technology	Small head enabling access to mold cavities, speed, powder capabilities for EDU and research

Hybrid Machine Platforms

- /// Compatible with VF, UMC, and TM Haas models
- /// Retrofit or new turnkey systems



SUPPORTED HAAS MACHINE MODELS

Recommended Haas CNC machine models for Additive Hybrid World's Best-selling Haas VMCs VF-4, VF-5, VF-6 as well as smaller and larger VF models

** Deposition head compatibility is dependent upon machine size. Contact our experts for more information.*



Haas VF Series

With a wide range of available models, these world leading Vertical Mills can match your particular shop requirements.



Haas UMC Series

These 5-axis Universal Machining Centers offer maximum versatility when printing and machining complex parts.

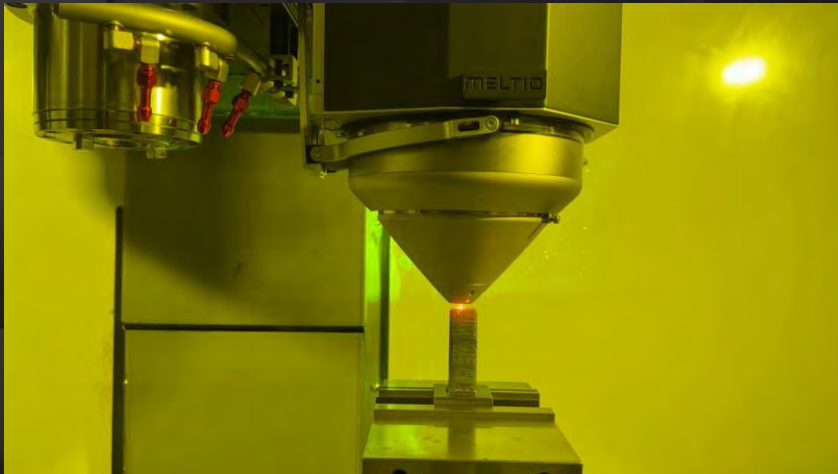


Haas TM Series

The true definition of value, these Toolroom Mills provide full CNC capabilities at affordable prices.

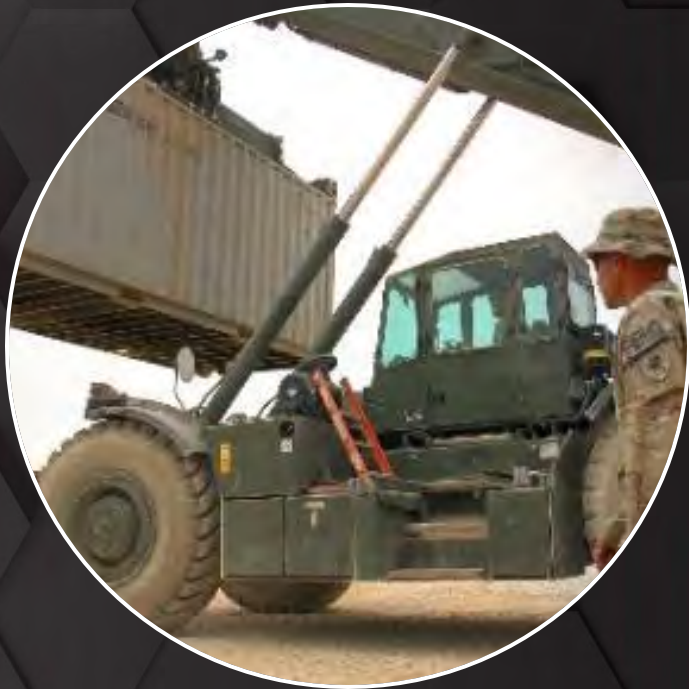
SOFTWARE + WORKFLOW

- /// Mastercam, Siemens NX, Hypermill, GibbsCAM, Fusion, Powermill, and other CAM options supported
- /// On-machine probing + standard Haas work holding
- /// Seamless transition between additive and subtractive



Why Deployable Hybrid Matters

- /// Enables battlefield repair and fabrication
- /// Reduces logistics burden for spare parts
- /// Supports mission-critical readiness



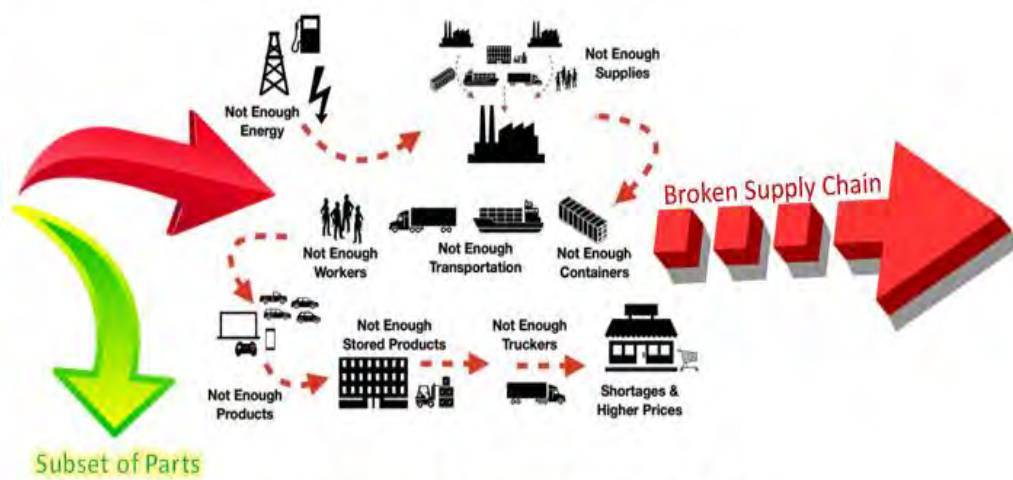
Why Deployable Hybrid Matters



Solving the Supply Chain Issues with AM

Point of Need Demand Signal

Tradition Supply Chain Procurement Channel



Supplemental AM Supply Chain Subset Closer to Point of Need Production

AM Candidacy Tool	Part Prioritisation	Printability Analysis
<p>Prioritisation of parts that increase operational readiness</p> <p>Model analysis to predict the printability of each individual part</p>	<ul style="list-style-type: none"> Screen multiple TDPs simultaneously Prioritisation based on customer specific KPIs Automatic business case creation 	<ul style="list-style-type: none"> Optimized STL file AM material and technology recommendations Wall thickness analysis TCoM per AM technology

Deliver Ideal AM Candidate for DFAM TDP

Part Business Case	Bracket	Production Database
<p>Machine learning algorithms calculating cost savings, lead-time, CO2 consumption* considering total cost of ownership</p>	<p>Overview</p> <p>Cost Savings: -€28,549,19</p> <p>Lead Time: -20 days</p> <p>CO2 Savings: -378 kgCO₂e</p>	<p>Embedded materials, machines* and workflows; evaluating manufacturability and costs</p>

SLS Technology

DED/WAAM Technology



Why Deployable Hybrid Matters

Contested Logistics



USS Bataan and USS Wasp



Deployable Hybrid



xTech International 2023



Navy Afloat Additive Manufacturing

- /// USS Bataan system with Meltio integration
- /// First-of-its-kind maritime additive CNC hybrid
- /// Empowering sailors with on-demand repair capability



Metal 3D Printer Installed on USS Bataan

04 November 2022

From Naval Sea Systems Command Office of Corporate Communications

"The installation of Additive Manufacturing (AM) into vessel operations supports real needs and self-sufficiency," said Rear Adm. Jennifer McLean, commander, Naval Surface Force Atlantic.



BATAAH TURNS CONCEPT TO REALITY WITH 3-D PRINTER

26.11.2022

NAVY Sailors Repair using Hybrid

/// De-ballast Air Compressor (DBAC) Sprayer Plate

- System adjusts the ship's draft
- Five (5) days to produce vs. one (1) year procurement
- \$40 repair vs. \$400,000 replacement

• <https://breakingdefense.com/2023/08/exclusive-how-the-navys-chief-engineer-sees-3d-printing-rebuilding-the-fleet/>



Potential Impact

- /// (5) days to produce vs. one (1) year procurement
- /// Warfighters are familiar with Haas CNC machines.
- /// Agile manufacturing system capable of new, repair, and replacement parts.
- /// Decrease reliance on supply chain and required stock materials.
- /// Applicable for use cases across the entire DoD.
- /// Tele-operate; engineering done in research locations.

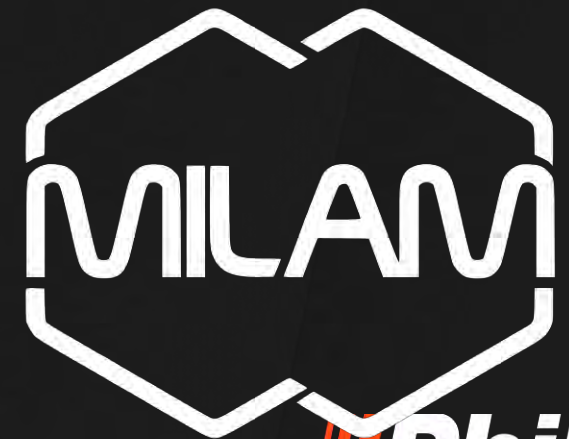


"The introduction of Additive Manufacturing (AM) into naval operations supports readiness and self-sufficiency."

*~ Rear Adm. Brendan McLane,
commander, Naval Surface Force
Atlantic*

ORNL System

- /// Deployed with Oak Ridge National Laboratory
- /// Research-focused with high-performance configuration
- /// Proving ground for DoD-relevant technologies
- /// Simplify machine operation for deployable users:
 - Use additive program templates to print blocks of metal to near net shape
 - Run subsequent machining program templates for final part



Advancements in DED Hybrid Processes

/// New Deposition Systems

/// CAM software solutions → over a decade of feedback

/// Technical Publications for Certification

/// Reduction of Additive to Subtractive offsets

/// Simplification of Path Planning

New Deposition Systems

- /// 2023- Fronius releases the iWave productline-allowing of AC GMAW deposition
- /// 2024- Meltio releases their 1kw Blue Laser deposition engine
- /// 2024- Laserline releases their Multi-wire deposition head

Fronius iWave

- /// Alternating Current can be used to GMAW (MIG/MAG) for materials like aluminum.**
- /// AC reduces oxidation in aluminum deposition (still validating)**
- /// Fortius Metals releases 6061 and 7075 equivalent materials**



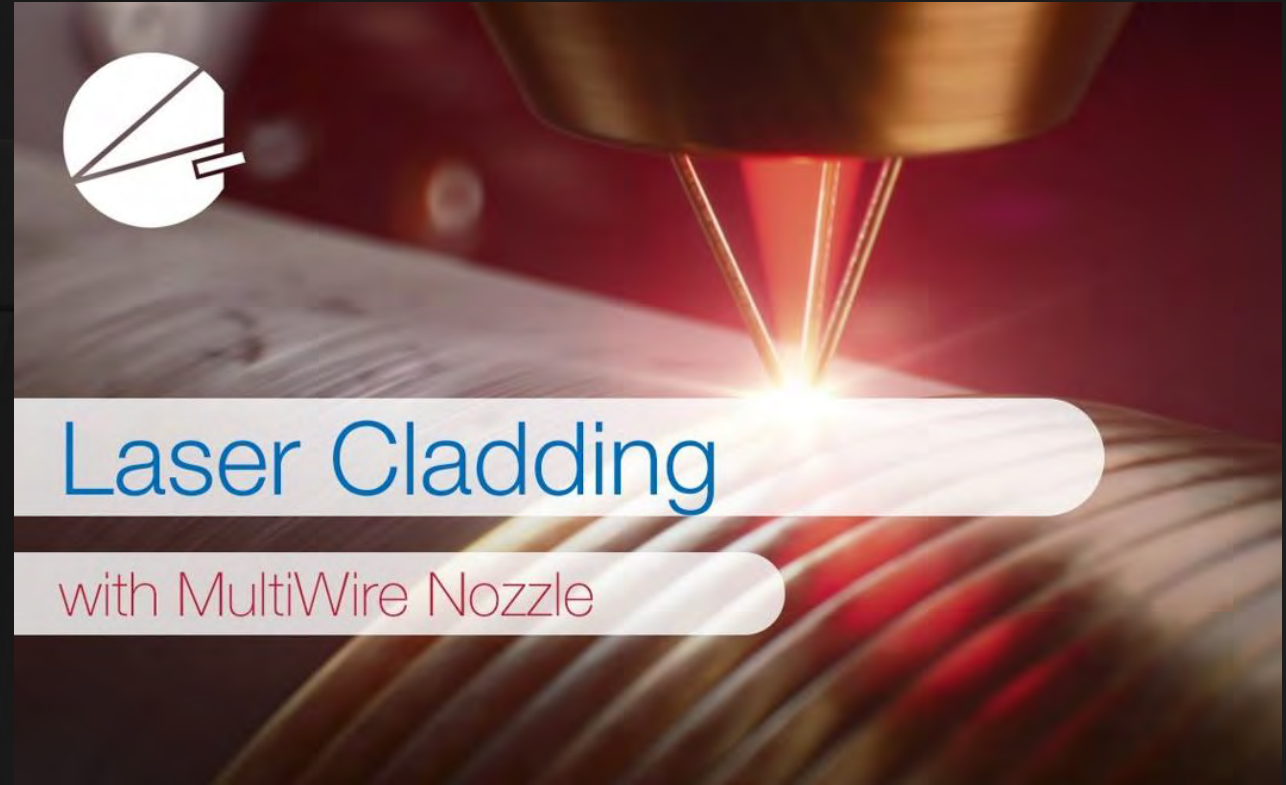
Meltio-Blue Laser Technology

- /// Fiberless Multi-laser system using a center fed wire
- /// Higher number of lasers creates a more circular melt-pool, which enhances omnidirectional feeding
- /// Blue Laser allows for faster deposition rates and higher absorption in materials like copper.



Laserline Multi-wire

- /// Restriction of a single wire feed stock is mitigated (physically feeding one wire a challenge for high deposition rates).
- /// Can use very large power sources in the 10kw+ range
- /// Multi-wire with hot-wire could be a breakthrough in deposition rate.
- /// Zoom Optics also make this a very interesting topic as it allows spot size to be adjusted on the fly.

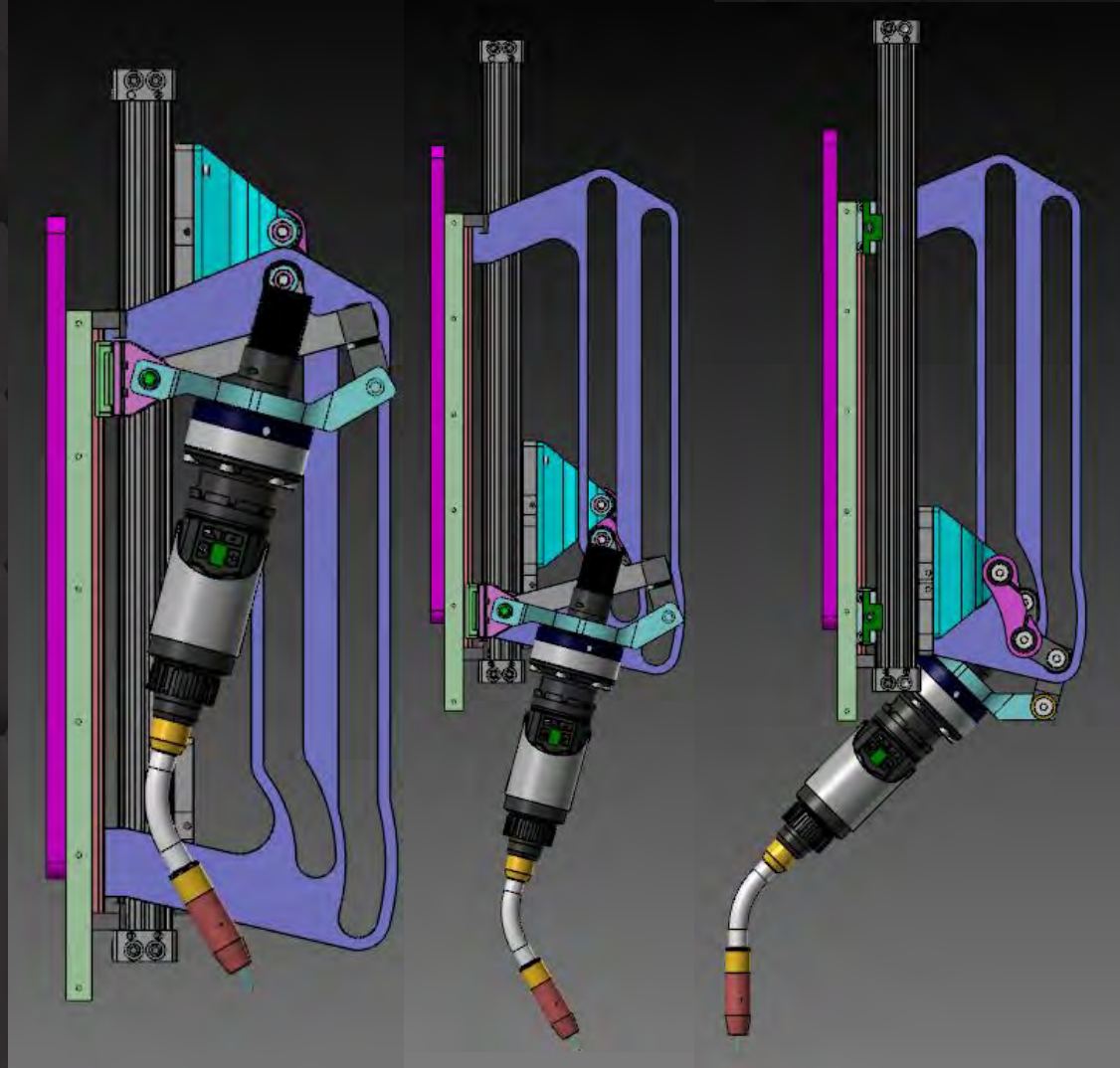


Ease of Use

- /// Toolpath or Path Planning has had 10+ years of maturity
- /// Certification dictating control of parameters
- /// Reduced Additive head offsets

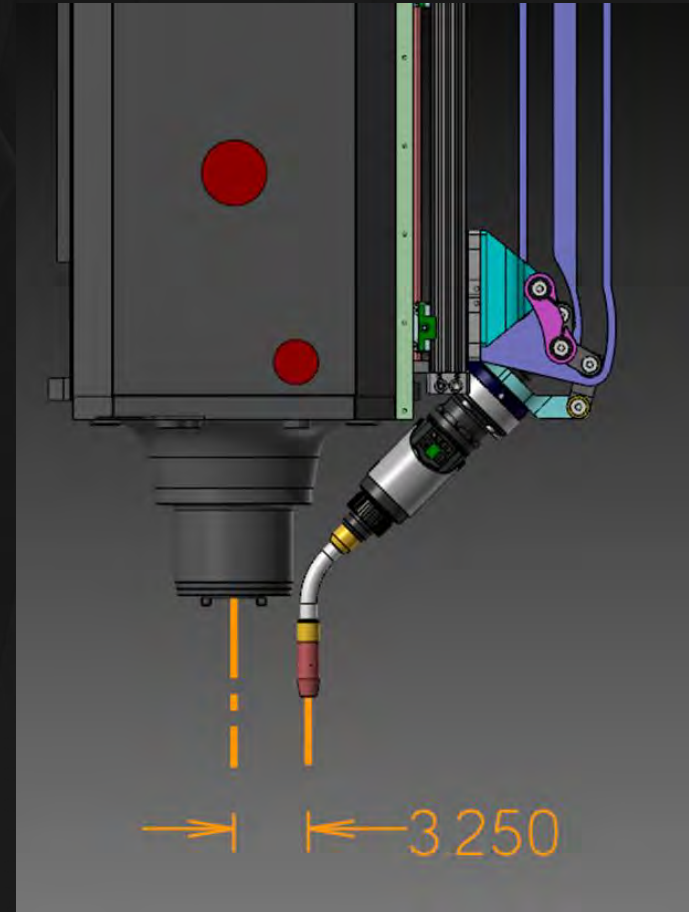
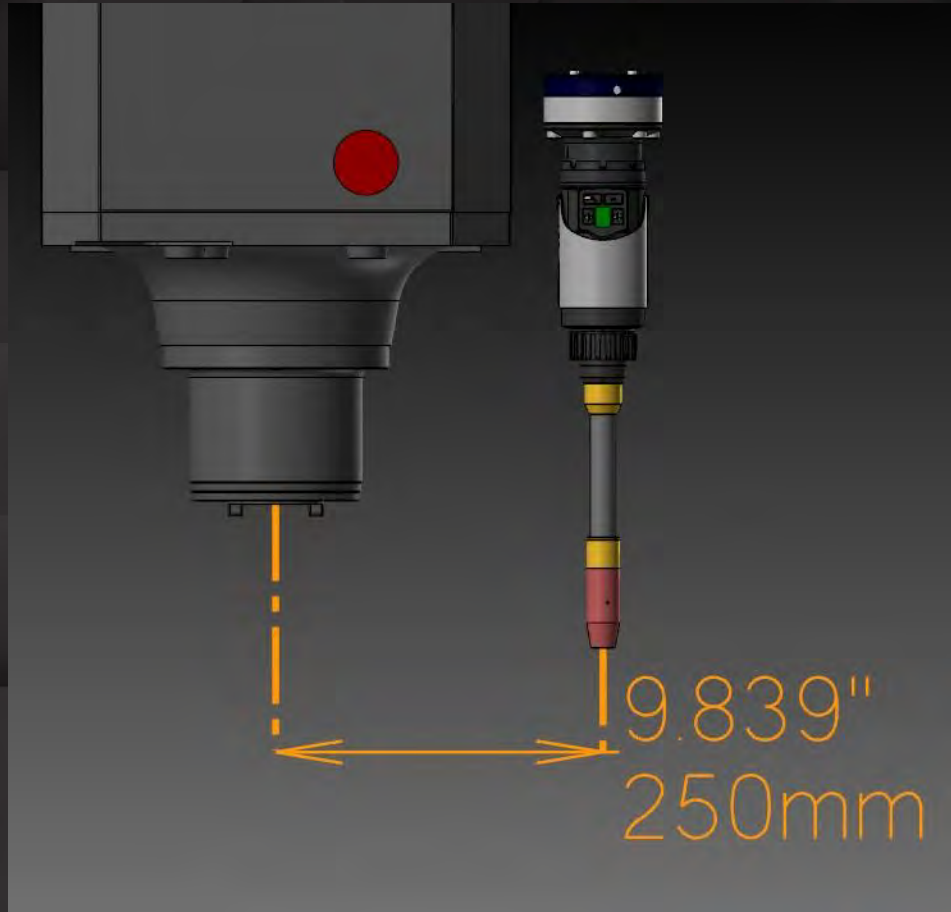
2-Stage Deployment Mechanism for Welding Arm

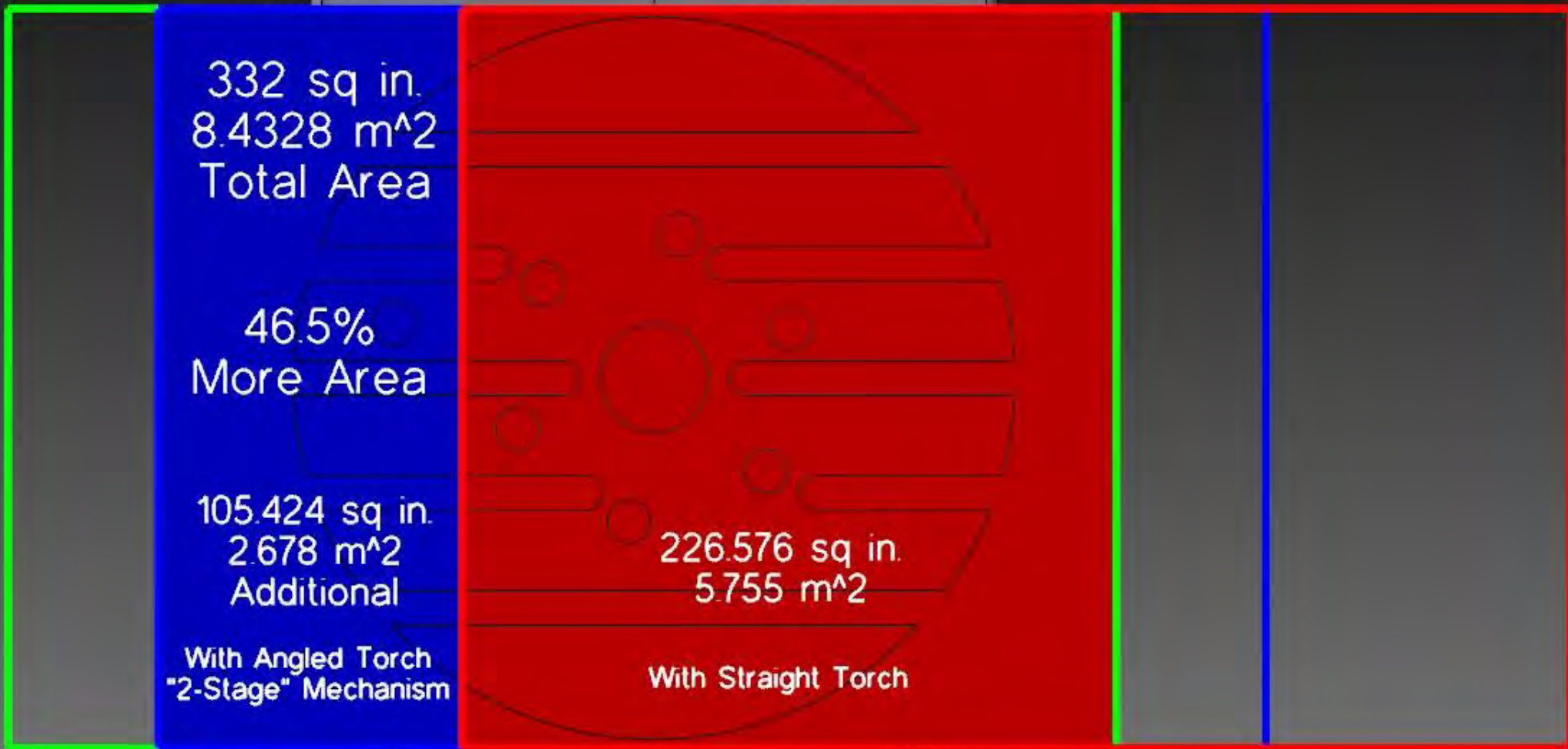
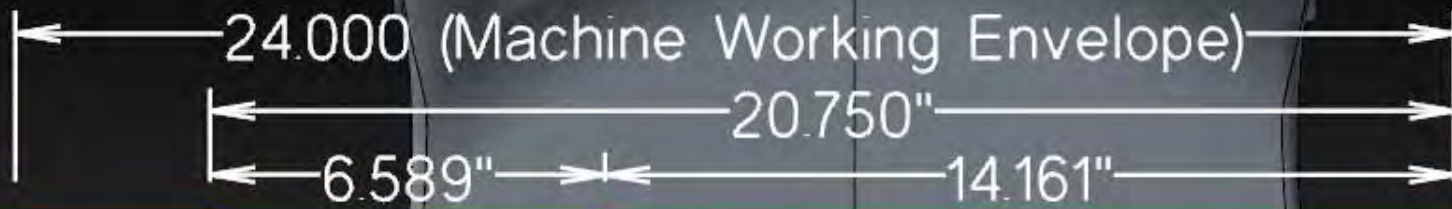
*Patent Pending



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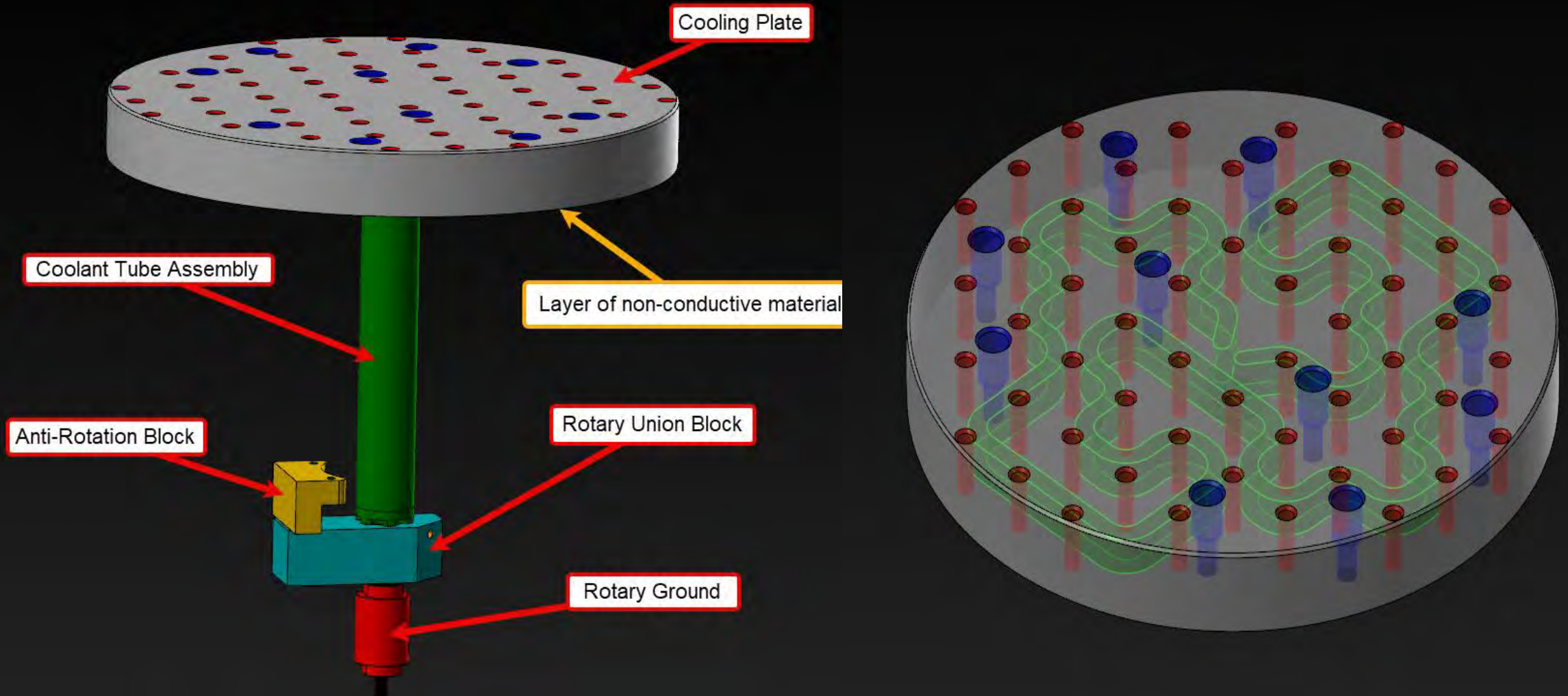
Straight vs. Bent Torch Comparison





Electrically Isolated Rotary Cooling Plate Assembly

*Patent Pending



iWave User Interface (iJobs)



- /// Set material printing parameters as “jobs”
- /// Ability to switch between “jobs” on the fly during printing
- /// Adjust wire feed speed & power from welder
- /// Ability to restrict access/lock the job using RFID card

Path to Commercialization

/// Systems already commercially available

/// Qualification

- Establish certification processes for Hybrid-manufactured parts
- Navy Tech Pub for DED

/// Workforce Development

- Significant demand to train and improve manufacturing competency in US, both within DoD and among civilians

/// Ongoing Product Development

- Material Parameter Development
- Closed Loop Feedback/Melt Pool Monitoring
- Improve machine operation (wire straighteners, on-the-fly parameter adjustment, etc.)
- Partnering with Software OEMs to improve ease-of-use

Impact

/// Ability to sustain weapons systems

- Minimizes downtime
- Improves readiness stateside and in-field
- Dispersed manufacturing capability → No single point of failure

/// Easy adoptability

- Many Haas machines already used nationwide
- Machinists in familiar with Haas control, easier learning curve

/// Opportunities for career growth

- Improve programming competency
- Design for Advanced Manufacturing (DFAM)
 - Optimize part design for better production time and material usage