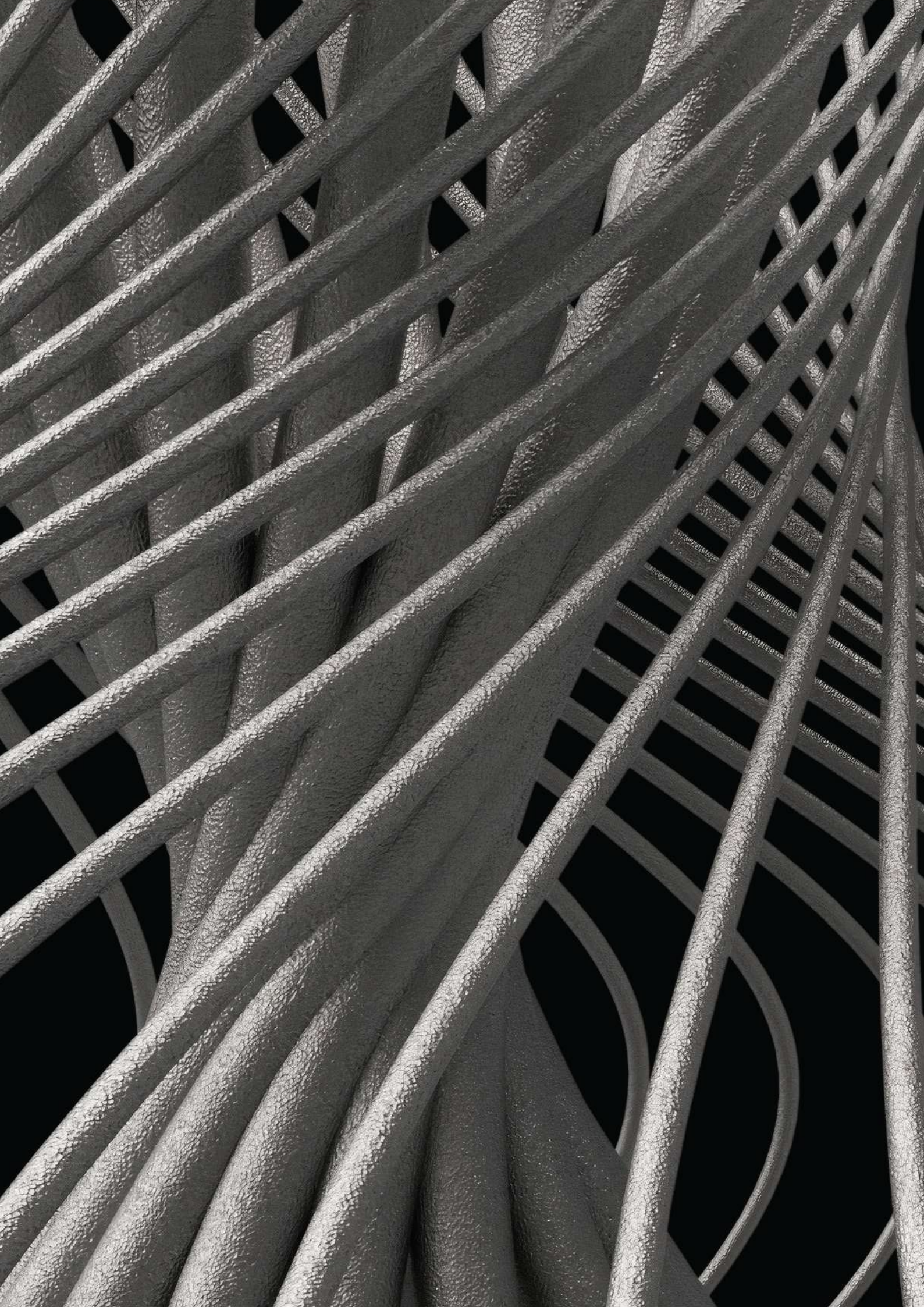
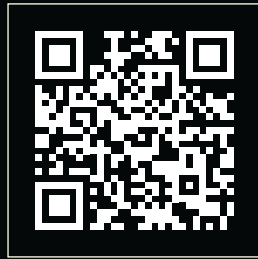


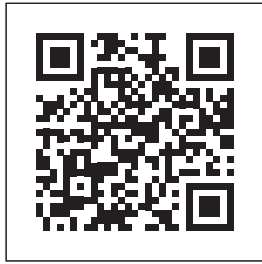
 **METALWORM**

Cutting Edge Technologies on
Robotic Additive Manufacturing





JUST LIKE SILKWORMS



JUST LIKE SILKWORMS

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MetalWorm Brand Story

The inspiration of the METALWORM brand is "Silkworms". Like silkworms weave silk and stack fibers, METALWORM weaves metal and stacks molten metal.

The trademark METALWORM has been associated with the additive manufacturing process in cutting-edge manufacturing technologies, which shortens production time and minimizes the amount of raw materials.

Mission

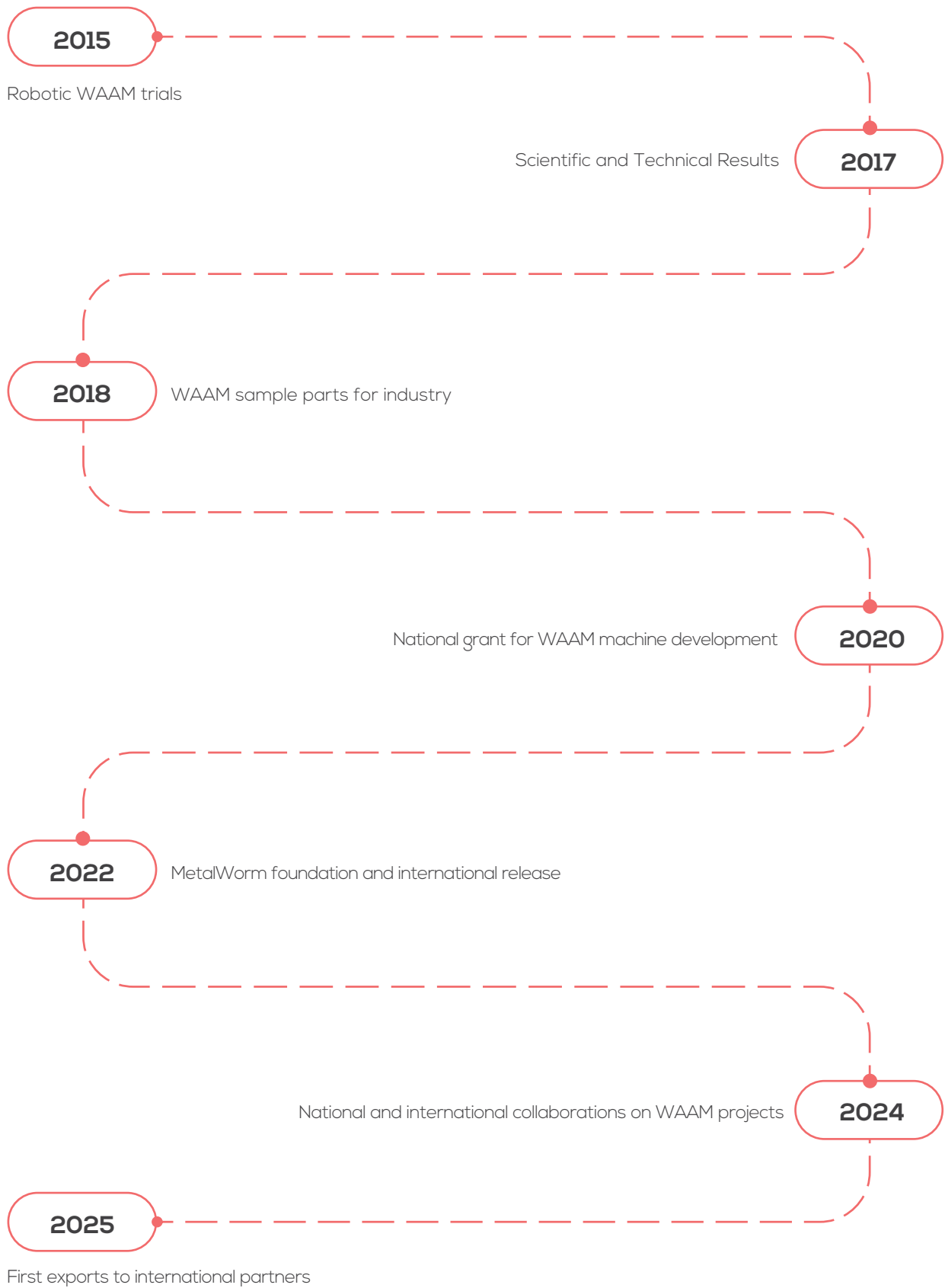
At MetalWorm, our focus is on computer- controlled robotic additive manufacturing technologies. We aim to provide solutions that best meet our clients' needs, with a particular emphasis on the Electric Arc method, which falls under the Direct Energy Deposition (DED) methods.

Vision

Our goal is to offer an additive manufacturing system that decreases processing durations and costs across various sectors, including aerospace, energy, rail systems, construction and maritime. MetalWorm envisions a future where their cutting-edge technology not only revolutionizes the manufacturing industry but also significantly reduces the carbon footprint by minimizing waste and energy consumption in the production process.



MetalWorm Milestone





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A. Ali ŞEN - Chairman

"METALWORM is a global technology pioneer in the WAAM domain, developing proprietary robotic WAAM-DED systems supported by advanced system engineering and in-house software platforms. By integrating adaptive process control, real-time sensing, data-driven monitoring and digital twins into robust robotic architectures, METALWORM delivers end-to-end additive manufacturing solutions that enable industrial manufacturers worldwide to achieve scalable, efficient and high-performance metal production beyond conventional manufacturing limits."

//

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Cihan ŞENSOY - Member of the Board

METALWORM creates sustainable long-term value by combining disciplined project governance with continuously expanding operational experience, strong system integration capabilities and proprietary software development expertise. This holistic approach—spanning mechanical design, automation, control software and process intelligence—ensures that each delivered WAAM system provides not only technical excellence but also strategic and economic value for industrial partners.

//



//

Cem DEŞEN - Member of the Board

As one of the few companies globally that designs and develops dedicated WAAM-DED systems rather than adapting generic platforms, METALWORM positions robotic WAAM-DED technologies as strategic production enablers. Through high-performance hardware, advanced control software and industrially validated architectures, METALWORM delivers reliable, scalable and future-ready additive manufacturing systems to leading manufacturers around the world.

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Prof. Dr. Oğuzhan YILMAZ - CEO / Member of the Board

METALWORM is a technology-driven WAAM system developer, combining deep manufacturing science, advanced system engineering and in-house software development. Supported by a rigorously structured project management framework, the company designs fully customized robotic WAAM-DED solutions—covering hardware, automation and control software—tailored to specific applications and industries. This integrated capability ensures smooth project execution, stable process performance and long-term operational reliability in demanding industrial environments.

//



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Nevzat BOL - Technical Manager

METALWORM advances industrial manufacturing through a disciplined system development methodology that integrates mechanical design, automation, control software and growing operational know-how. By continuously refining both its WAAM-DED hardware platforms and proprietary software tools, METALWORM delivers production-ready systems with high process stability, scalability and repeatability.

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ROBOTIC ADDITIVE MANUFACTURING TECHNOLOGIES

WAAM (Wire Arc Additive Manufacturing)
Laser DED (Laser Directed Energy Deposition)



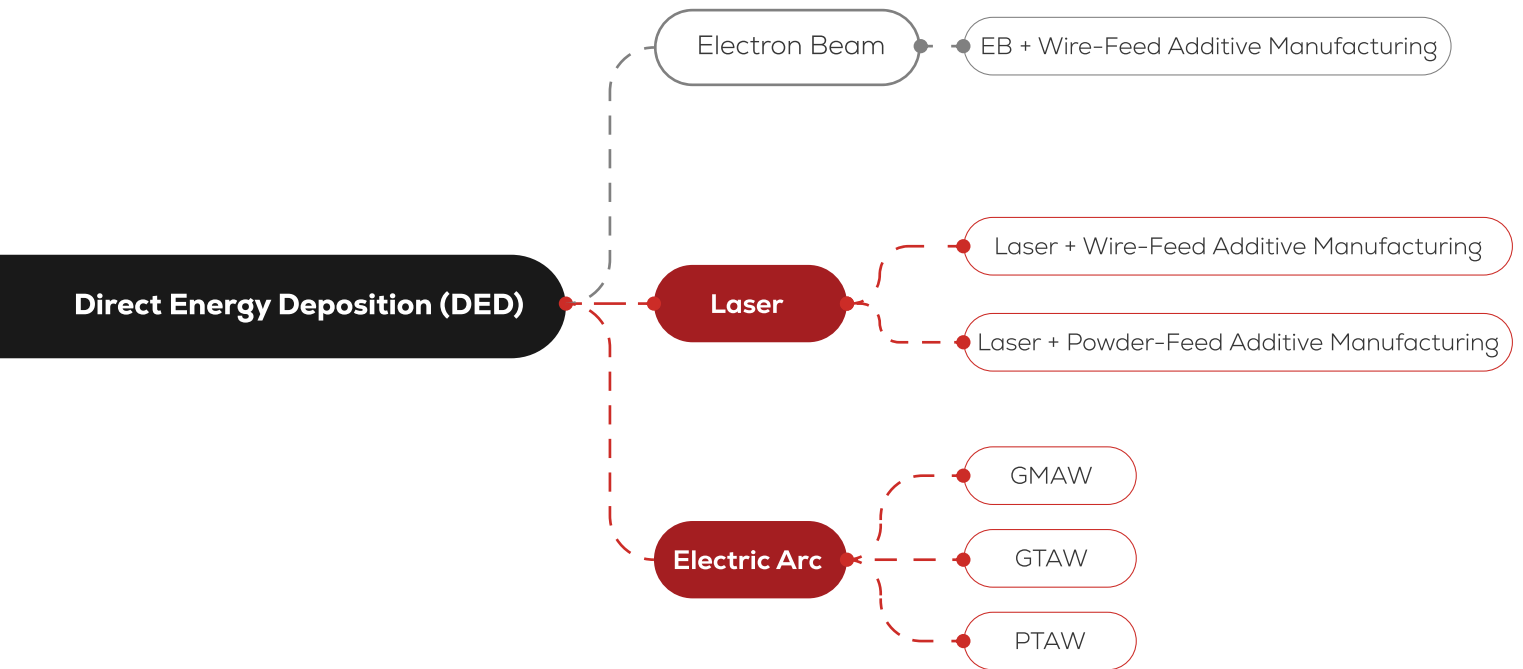
Compact Series

Special Series

Lab Series

**TAILOR MADE, TURNKEY
SYSTEMS**

Print Techniques



DED Processes and Key Features

WAAM
(Electric Arc)
- Based

Gas Metal Arc Welding (GMAW)-based

- Uses a consumable wire electrode
- Suitable for various metals and alloys
- Excellent material deposition rate
- Good for large-scale part production
- Low material waste

Gas Tungsten Arc Welding (GTAW)-based

- Uses a non-consumable tungsten electrode
- Inert gas shielding for reduced contamination
- High precision and quality
- Suitable for thin and delicate components
- Lower deposition rate

Plasma Arc Welding (PTAW)-based

- Uses a high-temperature plasma arc
- Excellent for refractory metals and alloys
- High energy density for robust material fusion
- Ideal for high-temperature applications
- Higher deposition rate

Laser
- Based

Laser + Wire

- Laser heats the wire, depositing material
- Wire acts as a consumable feedstock
- High precision and fine details
- Reduced heat-affected zone (HAZ)
- Low deposition rate

Laser + Powder

- Laser melts and fuses powder material
- Precise deposition Geometries
- Broad material compatibility
- Complex geometries and high resolution
- Perfect solution for repairing

MetalWorm Robotic Toolpath Planning Software

With the MetalWorm Robotic Toolpath Planning Software, you can



Perform toolpath planning easily and quickly without expertise



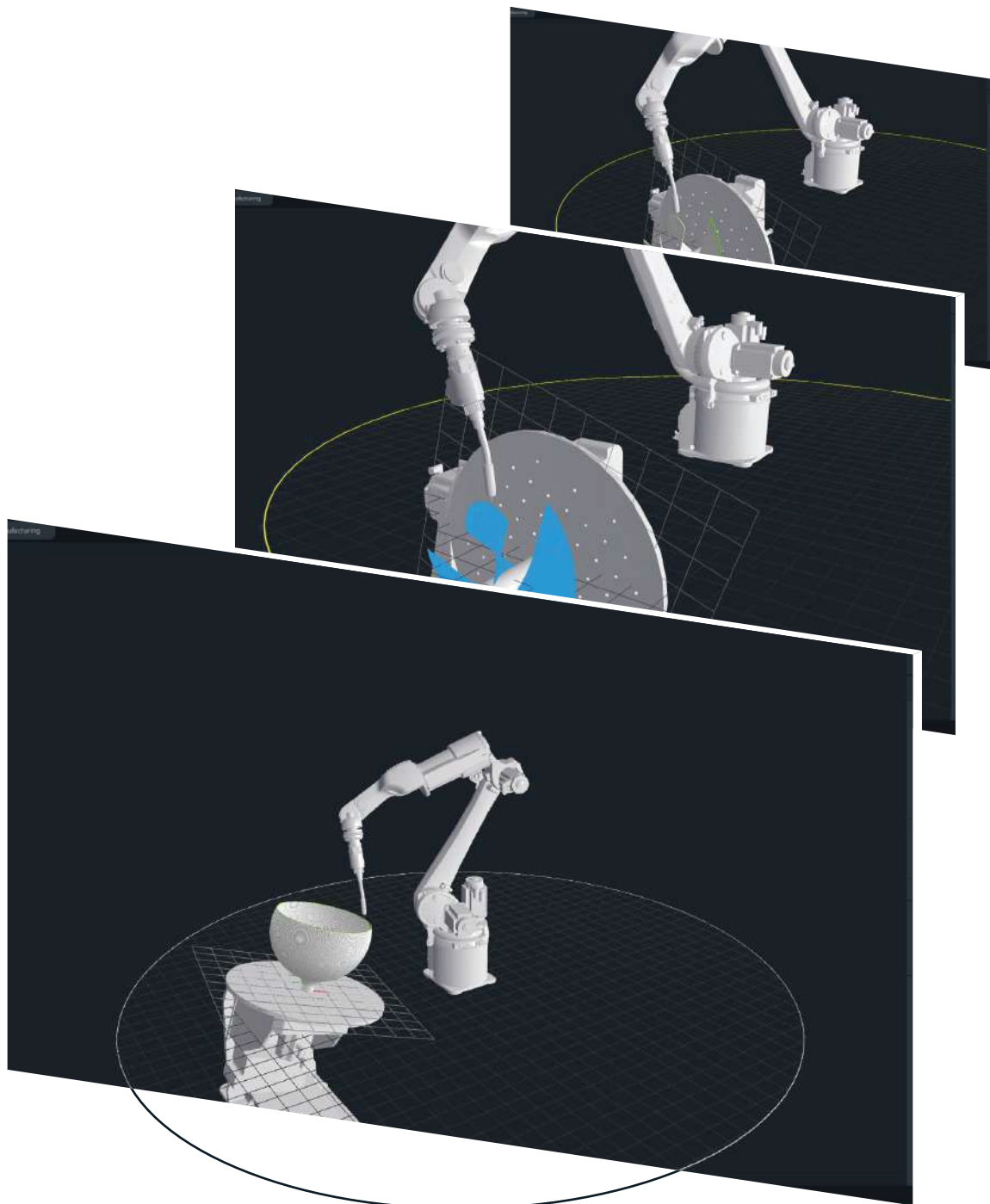
Verify production methodology with simulation



Minimize pre-process preparation time



Check pre-production, consumables requirements and lead time



MetalWorm Robotic Toolpath Planning Software



Toolpath Orientation Adjustment

The toolpath orientation can be built and improved based on the part geometry.



Toolpath Planning by Region

Part performance, weight, and printing capabilities can be enhanced by creating multiple toolpath techniques in distinct regions



Process Parameter Library

Choose among a library of WAAM process parameters that can yield suitable mechanical and metallurgical qualities.



Process Calibration

Various process parameters, including wire feed speed, torch travel speed, current, and voltage, can be adjusted to deposit geometries with the given wall width and height while maximizing deposition efficiency.



Robot & Process Simulation

Execute simulations of part production using robot arms from ABB, Kuka, and Fanuc with resolved external axes kinematics.



Flexible 3D Model Support

Common network-based file formats such as STL, OBJ, 3MF, GLTF, STEP as well as Parasolid are supported.



External Axis Support

Unique interpolation techniques for gantry, slider, and positioner systems in different axes.



Mesh Operations

Isotropic and non-isotropic balance, boolean operations, and automatic repair.



Customize Robot Programs

Use ABB Rapid, Kuka KRL, Fanuc LS, or G Code create bespoke robot programs.



Collision Detection

Detect collisions between static and moving elements before printing.



Multi-axis Toolpath Planning

Different toolpath techniques, including multi-planar slicing, non-planar, angular, b-spline, radial, conical and rotational surfaces, can be created.



Process Traceability

Log, keep track of and document the entire printing process.

MetalWorm Diagnostic - Real-Time Process Monitoring Software

Data Collection



Collects sensor and process data in real time and saves them in local database.

Process and Sensors Data



Makes process-oriented calculations by using process and sensor data such as welding current, welding voltage, wire feed speed, torch travel speed, gas flow rate, temperature, humidity and oxygen.

Real Time Graphs



Increases the traceability of the process with real time graphics.

Data Export



Exports data for further analysis.

Audio and Visual Alerts



Gives audible and visual warnings depending on the deviations in the process parameters and user limits. All realized alerts are saved in the log.

Manufacturing Report



Provides an interactive report for each of your production woks, including vision on production quality and large amounts of process data.

Event Log



Keeps a comprehensive log of events, including alarms, errors and warnings that occur in the system.

System Management



Provides easy access to the status of cell, robotic system and safety equipment can be monitored.

Integrated CCTV Monitoring



Records the process with various angles placed in the robotic system.

Integrated ERP/MES



Integraes with existing ERP/MES systems, everything is recorded and made accessible to your organization for full traceability.

System Errors and Warnings



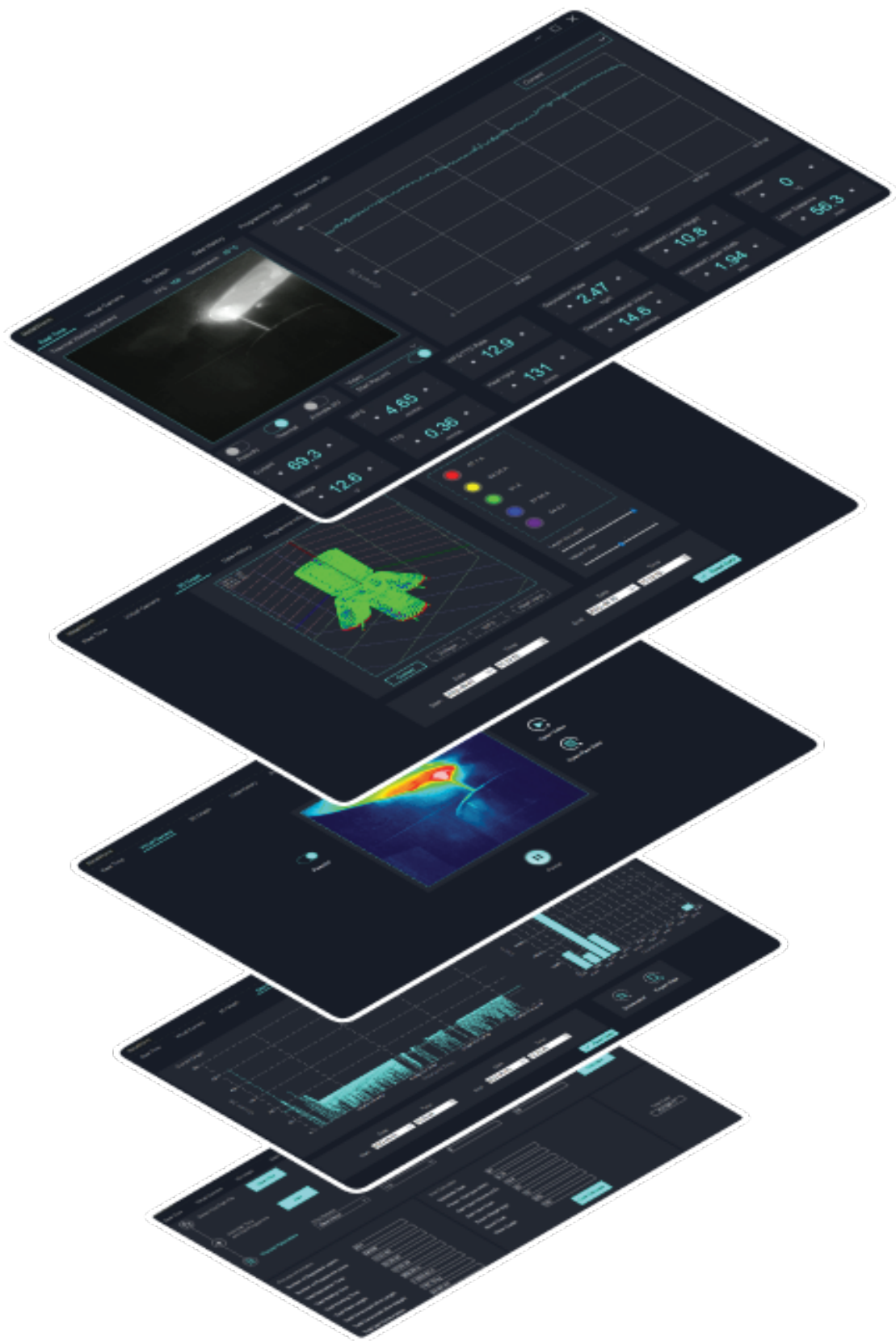
Informs the operator of system warnings and errors. The relevant error codes of the welding robot system are displayed on the instrument panel to ensure fast continuation.

3D Graphs



Offers 3D graphics during and after part production and creates a 3D color map of the collected data.

MetalWorm Diagnostic - Real-Time Process Monitoring Software

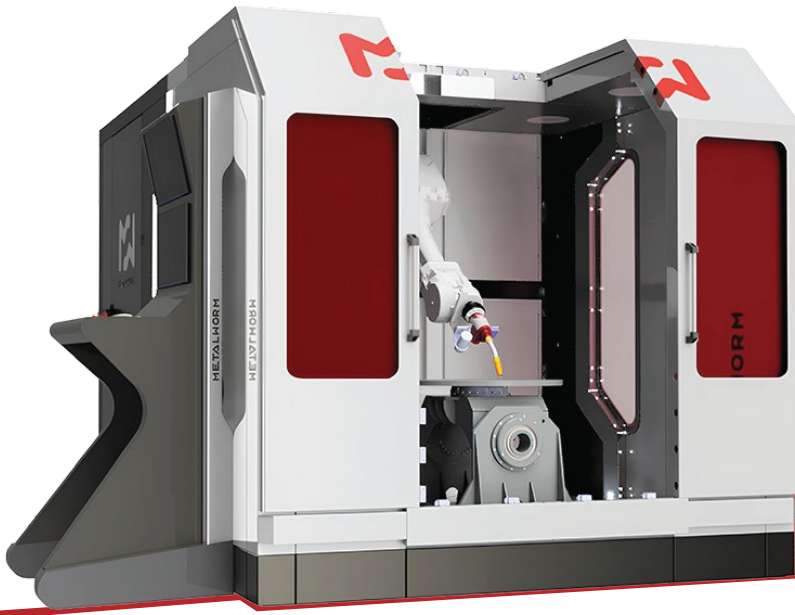


We develop software solutions that make it easy to use the full power of robotic additive manufacturing.

01 Compact Systems

Discover MetalWorm's robotic cell, designed specifically for additive manufacturing. The plug-and-play, user-friendly, and integrated components and technologies of the compact systems are all designed in a single cell.

MHTTN1000



Dimensions (WxDxH)

2.4m×4.5m×2.75m

Build Volume

Ø0.7m×0.7m

Number of Axes

6+2

Number of Stations

1

Industrial Robot*

ABB-IRB2600ID-15/1.85

System Components

Two-Axis Compact Skyhook Positioner

Positioner Payload

1000 kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

Dimensions (WxDxH)

2.4m×4.5m×2.75m

Build Volume

1m×0.5m×0.7m

Number of Axes

6+1

Number of Stations

1

Industrial Robot*

ABB-IRB2600ID-15/1.85

System Components

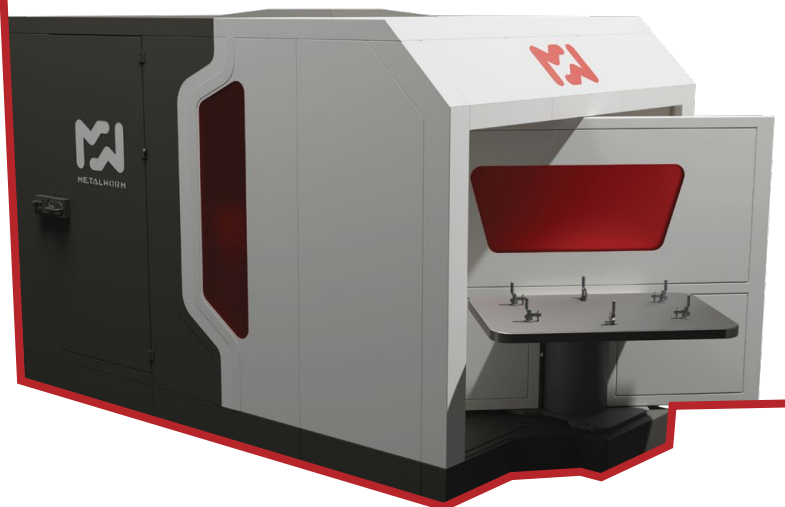
Two Station Rotary Positioner

Positioner Payload

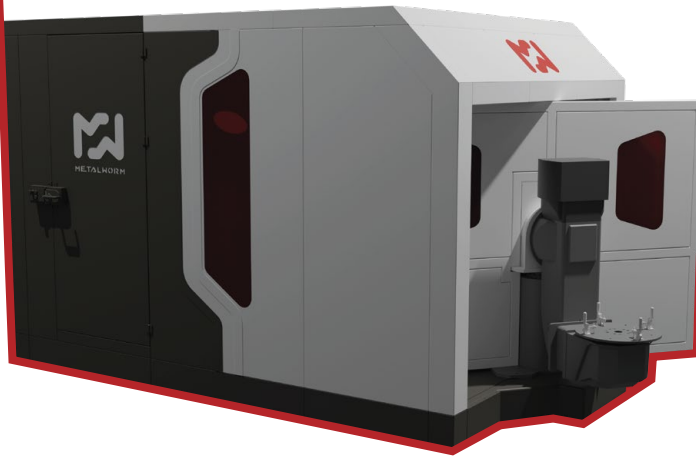
500 kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

MHTTN500RP



MHTTN500DS



*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

Dimensions (W×D×H)

2.4m×4.5m×2.75m

The Greatest Producible Component's Size (X-Y-Z)

Ø0.7m×0.7m

Number of Axes

6+5

Number of Stations

2

Industrial Robot*

ABB-IRB2600ID-15/1.85

System Components

Double Skyhook

Positioner Payload

500 kg

It provides simultaneously production of the parts in 2 distinct stations.

Dimensions (W×D×H)

2.6m×4.5m×2.75m

The Greatest Producible Component's Size (X-Y-Z)

Ø0.7m×0.7m

Power Source

MIG/MAG/TIG

Number of Axes

6+3

Number of Stations

2

Industrial Robot*

ABB-IRB2600ID-15/1.85

System Components

THDZ Positioner

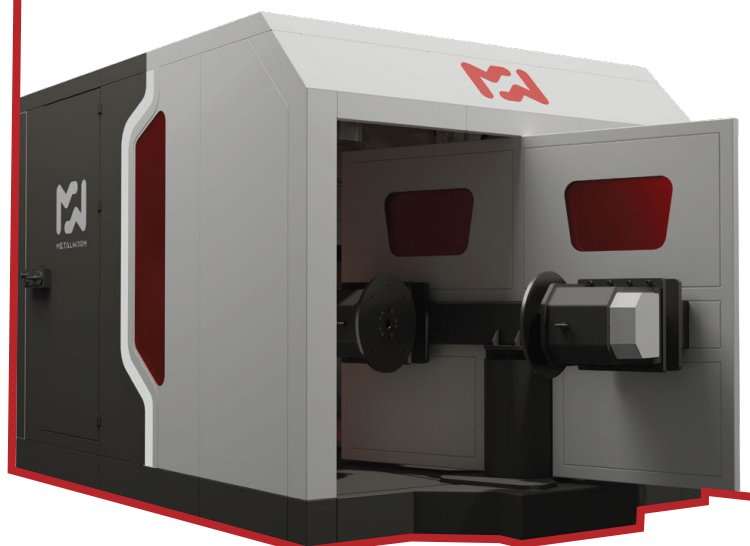
Positioner Payload

500 kg

It provides simultaneously production of the parts in 2 distinct stations.

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

MHTTN500THDZ



02 LAB Systems

It provides robotic solutions for the manufacturing of larger parts for various industries and requirements.

MWLAB



Dimensions (W×D×H)

1.8m×0.8m×2.05m

Build Volume

500×500×500mm

Number of Axes

6

Number of Stations

1

Industrial Robot*

ABB - IRB 1300-II/0.9

System Components

Build Plate

Positioner Payload

250 Kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

Dimensions (W×D×H)

2m×1.2m×2.4m

Build Volume

Ø500×500mm

Number of Axes

6+2

Number of Stations

1

Industrial Robot*

ABB-IRB 1300-II/0.9

System Components

Skyhook

Positioner Payload

250 Kg

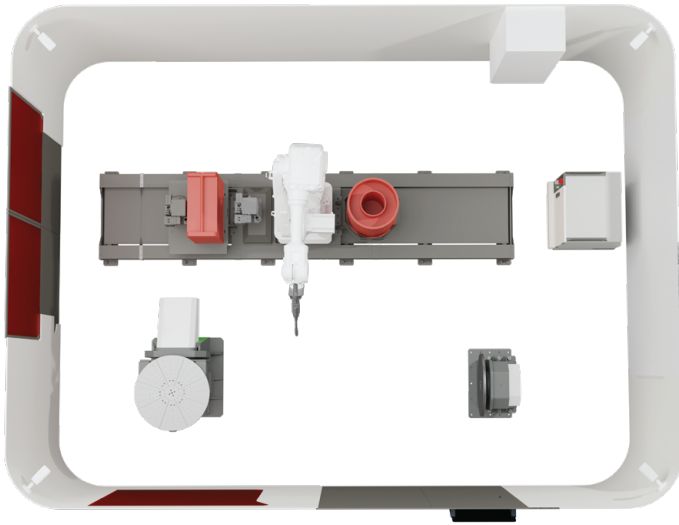
*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

MWLABS



03 Special Systems

MW1000S+CS



Dimensions (WxDxH)

5m×8m×3m

Build Volume

Ø1m×1m

Number of Axes

6+1+2

Number of Stations

1

Industrial Robot*

ABB-IRB2600ID-15/1.85

System Components

Slider, 2 Axis Compact Skyhook, and Tail Side

Positioner Payload

1000 kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

MW2000S

Dimensions (WxDxH)

2.8m×6.2m×3.35m

Build Volume

Ø1.5m×2m

Number of Axes

6+2

Number of Stations

1

Industrial Robot*

ABB-IRB4600-20/2.5

System Components

Two-Axis Skyhook Positioner

Positioner Payload

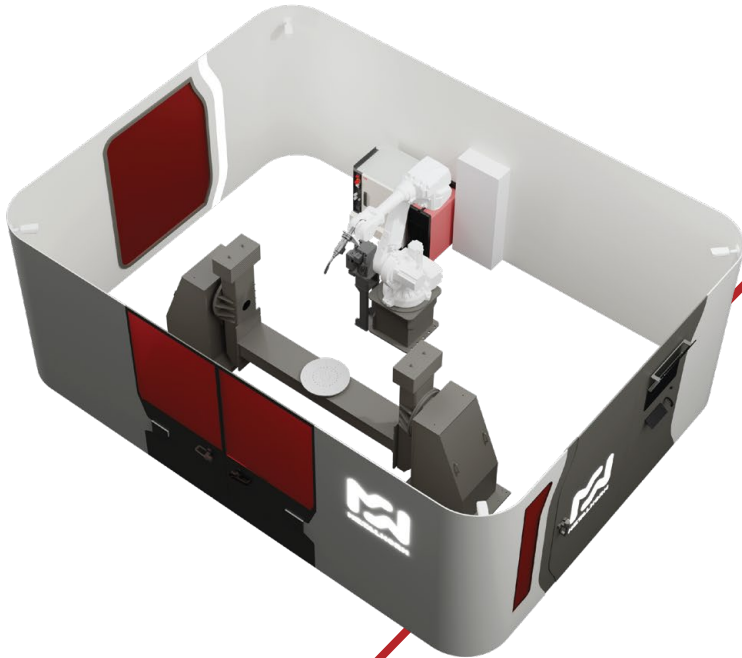
2000 Kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.



It provides robotic solutions for the manufacturing of larger parts for various industries and requirements.

MW1000DC



Dimensions (W×D×H)

5m×8m×3m

Build Volume

Ø2m×1m

Number of Axes

6+2

Number of Stations

1

Industrial Robot*

ABB-IRB4600-20/2.5

System Components

Drop Center Positioners

Positioner Payload

1000 kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

Dimensions (W×D×H)

5m×8m×5m

Build Volume

Ø2m×4m

Number of Axes

6+1+1

Number of Stations

1

Industrial Robot*

ABB- IRB4600-20/2.5

System Components

Z Axis and 1 Axis Rotary Positioner

Positioner Payload

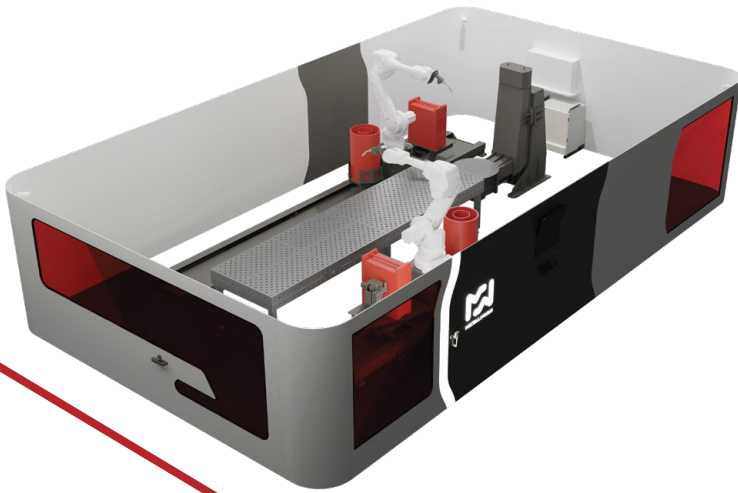
2500 kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

MW2500ZGRP



MW5000DS+SH



Dimensions (W×D×H)

7m×12m×3m

Build Volume

On Positioner: Ø1.5m×2m On Table: 1m×5m×2m

Number of Axes

2×(6 + 1) + 2

Number of Stations

2

Industrial Robot*

ABB-IRB2600ID-8/2.0

System Components

Slider, 2 Axis Skyhook, and Table

Positioner Payload

2000 kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

Dimensions (W×D×H)

8m×8m×5.8m

Build Volume

Ø2.6m×2.8m

Number of Axes

6 + 5

Number of Stations

1

Industrial Robot*

ABB-IRB2600ID-15/1.85

System Components

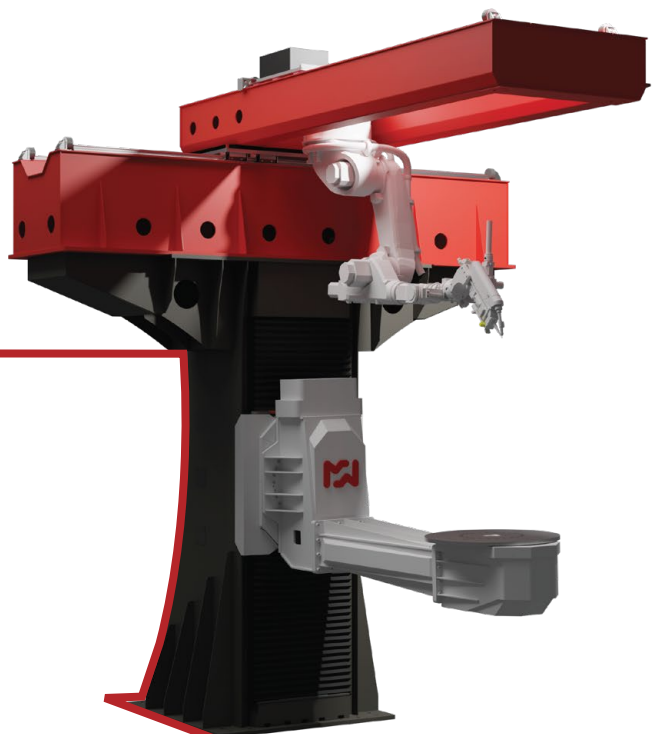
Hybrid Gantry

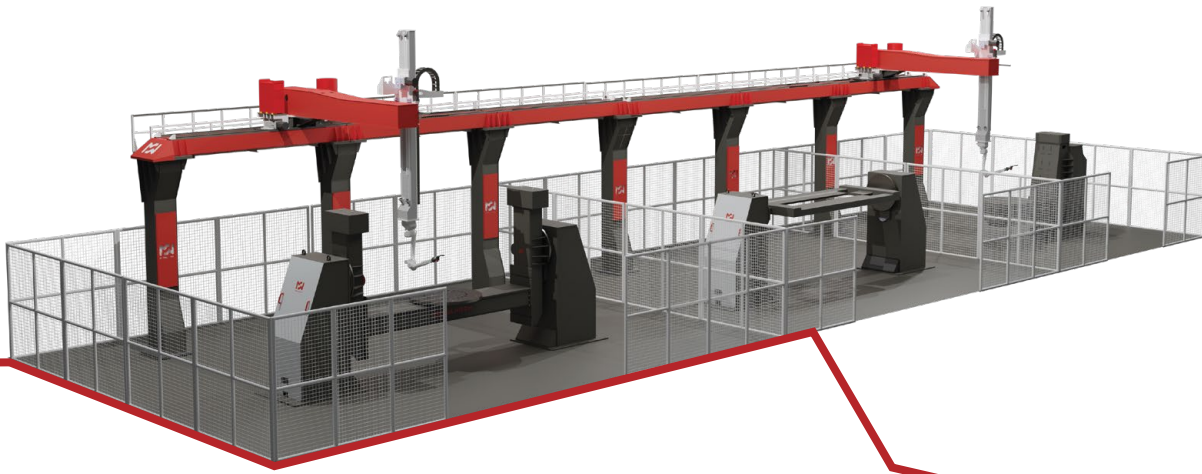
Positioner Payload

5000 kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

Hybrid Gantry Robotic WAAM System





Multi Station Flexible Gantry Robotic WAAM System

Dimensions (WxDxH)

35x10.8x9m

Manufacturing Volume (X,Y,Z)

Station-1: Drop Center - Up to Ø2.6x3.5m

Station-2: TH Positioner - Up to 2.5x5m

Station-3: Skyhook - Up to Ø3x3.5m

Number of Axes

2x(6+3) + 2 + 1 + 2

Number of Stations

3

Industrial Robot*

ABB-IRB2600ID-15/1.85

System Components

Gantry, Drop Center, TH Positioner, Skyhook

Positioner Payload

Station-1: Drop Center - Up to 10.000 kg

Station-2: TH Positioner - Up to 20.000 kg

Station-3: Skyhook - Up to 5.000 kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.



Multi Station Flexible Robotic WAAM System

Dimensions (WxDxH)

28.5x8x8.4m

Manufacturing Volume (X,Y,Z)

Station-1: Drop Center - Up to Ø2.6x2m

Station-2: TH Positioner - Up to 2.5x5m

Station-3: Skyhook - Up to Ø3x2m

Number of Axes

2x(6+3) + 2 + 1 + 2

Number of Stations

3

Industrial Robot*

ABB-IRB2600ID-15/1.85

System Components

Slider, C Column, Drop Center, TH Positioner, Skyhook

Positioner Payload

Station-1: Drop Center - Up to 10.000 kg

Station-2: TH Positioner - Up to 20.000 kg

Station-3: Skyhook - Up to 5.000 kg

*The robot brand and system model may change depending on the industry and area of use. Our systems can be integrated by KUKA, FANUC, and ABB robots.

MetalWorm Capabilities

Standards and Options

04 Custom Systems

Give us a call and we'll design a unique solution for you if none of these solutions still don't fit your needs.

MetalWorm Capability - Product Options

The unique process solutions of MetalWorm applied to all other systems come responsivitiy

Sensor	Standard	Advanced
Pyrometer	Available	Available
Laser Distance Sensor	Unavailable	Available
In-Cell Humidity Sensor	Unavailable	Available
In-Cell Temperature Sensor	Unavailable	Optional
In-Cell Oxygen Sensor	Unavailable	Available
Gas Flow Meter	Unavailable	Available
Thermal Welding Camera	Unavailable	Available
Welding Camera (HDR)	Unavailable	Optional
Thermal Camera (IR)	Unavailable	Optional
Microphone	Unavailable	Optional
3D Camera	Unavailable	Optional
Laser Profiler	Unavailable	Optional
Welding Current and Voltage Sensor	Unavailable	Optional

	Standard	Advanced
Power Source	MIG/MAG/TIG/ Plasma/Laser*	MIG/MAG/TIG/ Plasma/Laser*
Torch Cleaning	Available	Available
In-Cell Lighting System	Available	Available
Industrial Safety Equipment	Available	Available
CCTV	Available	Available

MetalWorm Add-On	Standard	Advanced
Active Cooling Technology	Optional	Optional
In-situ Heating Technology	Optional	Optional
Vibration Technology	Optional	Optional

MetalWorm Options	Standard	Advanced
Gas Filter	Optional	Optional
Fixture/Clamp	Optional	Optional
Transfer the Manufactured Part out of the Cell - Crane	Optional	Optional
Transfer the Manufactured Part out of the Cell - Trolley	Optional	Optional

MetalWorm Software	Standard	Advanced
Offline Programme	Available	Available
Diagnostic	Available	Available
Machine Vision	Unavailable	Available
Control	Unavailable	Available
Anomaly Detection	Unavailable	Available

Acceptable Materials Properties

Process Specific Library

Optimized Parameters for Various Materials

Materials





“Choose materials that have the structural potential to sustain and bear the building loads”

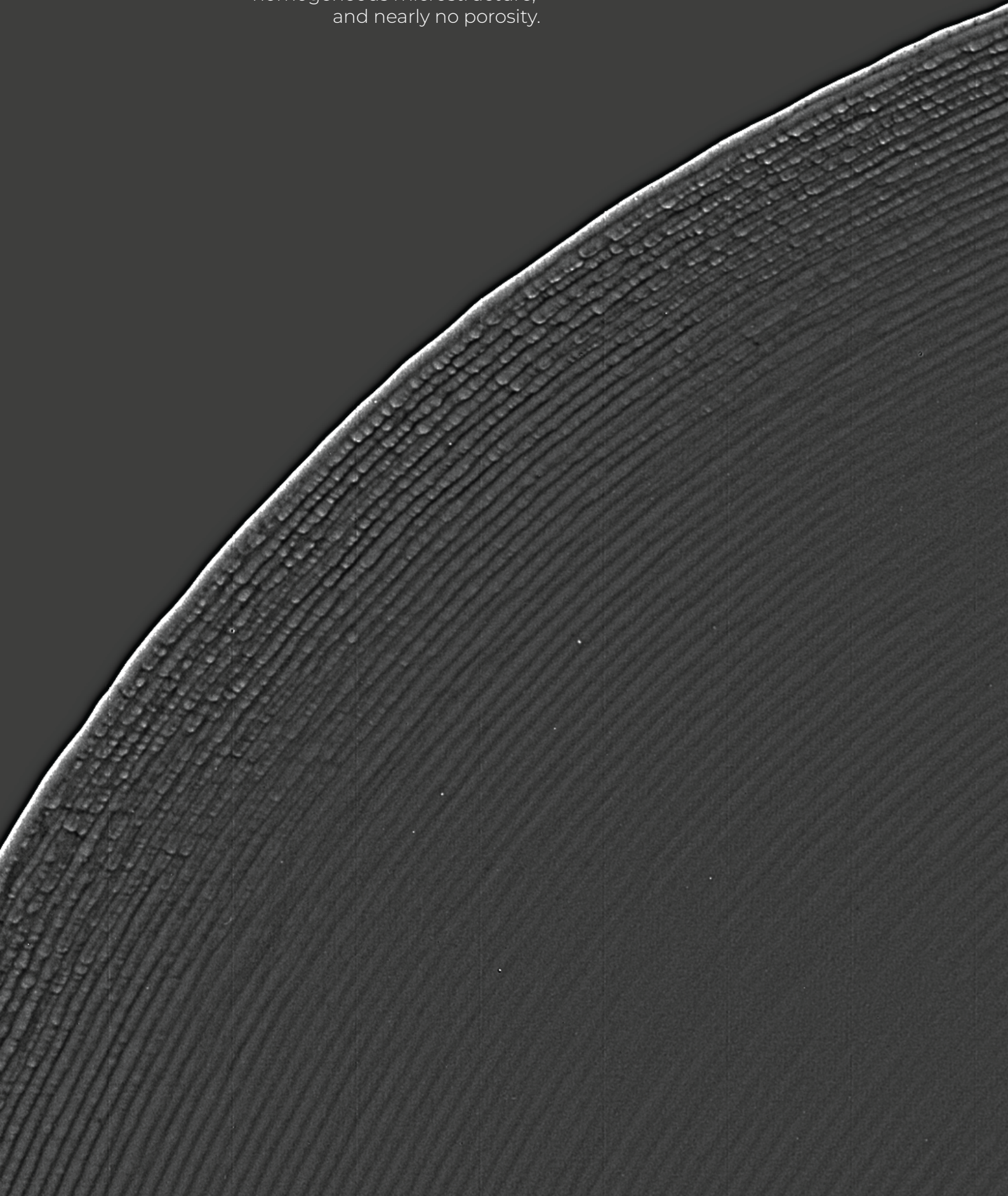
MetalWorm Solutions can be used to build parts utilizing a variety of metals and alloys. A number of materials have been used, and the relevant mechanical properties have been shared in the process library. MetalWorm team continues its research on new materials and will soon release the process specifications for all capable materials.

Our approach and integrated technologies at MetalWorm are particularly adaptable to practically any material, which results in excellent mechanical qualities of WAAM manufactured components.

A good material is one that has:

- No microstructural defects such as porosity
- Isotropic mechanical characteristics
- Homogeneous microstructure

The materials utilized by
MetalWorm's WAAM method
provide comparable and
isotropic mechanical properties,
homogeneous microstructure,
and nearly no porosity.



WAAM Material Capabilities

Aluminium Alloys | **ER2319, ER4043, ER5087, ER5183,
ER5356, ER6061, ER6063, ER7075**

Steel Alloys | **ER70, ER80, ER90, ER110, ER120**

Stainless Steel Alloys | **ER304L, ER307L, ER316L, ER630L,
ER2209, ER2594**

Titanium Grades | **Ti6Al4V Grade 5**

Copper Alloys | **CuAl8Ni6**

Nickel Alloys | **Inconel 625, Inconel 718, Invar 36**

**Revolutionizing Industry,
Reshaping Sustainability**



ER70S-6 G42 4 M21 3Si1



Wire

Key Features

Excellent ductility	Low cost	High toughness	Machinability
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Applications

General fabrications	Automotive	Pipes	Structural steel	Carbon steel plate	Sheet metal applications
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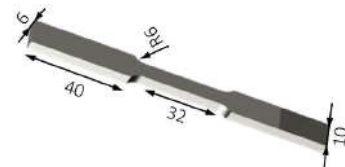
Chemical Composition

Component	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	V	Fe
Weight Percent (we%)	0.13	0.7	1.16	0.0103	0.025	0.025	0.01	0.03	0.1	0.002	Bal

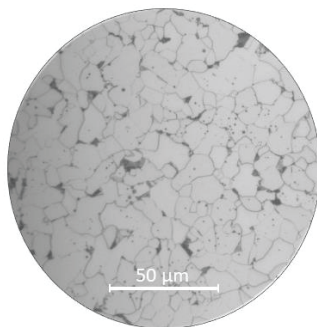


Mechanical Properties

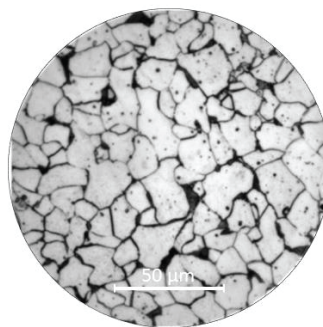
Material	Tensile Strength (MPa)	Yield Strength (MPa)	Elongation (%)	Hardness (HV)	Hardness (HB)
MetalWorm WAAM ER70S-6	486 @ LD [2] 480 @ ND[3]	357 @ LD 356 @ ND	38 @ LD 33 @ ND	170	160
ASTM A285 Grade C [4]	360-515	205	23-27	N/A	N/A



Microstructure



WAAM ER70S-6 @ MetalWorm



Reference ST-37 steel alloy

The microstructure of WAAM fabricated ER70S-6 is typical microstructure of low carbon steel. The dominant microstructure is equiaxed primary ferrite grains which are bonded within the secondary phase of lamellar pearlite phases.

[1] Tensile tests were carried out at room temperature, according to ASTM E8 standard with thickness of 6mm and loading speed of 0.25mm/s.
 [2] LD corresponds to longitudinal or deposition direction.
 [3] ND corresponds to normal or building direction.
 [4] The data are taken from Masteel UK Limited, <https://masteel.co.uk/astm-a285/>

ER5356

DIN 3.3536, EN ISO 18273
S Al 5356 (AlMg5Cr(A))



Wire

Key Features

Medium strength	High ductility	Excellent corrosion resistance	Good feedability
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Applications

Structural materials in marine	Automotive	Aircraft	Cryogenic application
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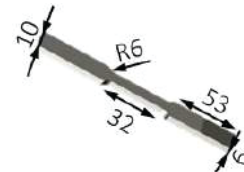
Chemical Composition

Component	Si	Fe	Cu	Mn	Mg	Cr	Zn	Ti	Al
Weight Percent (we%)	0.05	0.1	0.001	0.1	4.75	0.1	0.003	0.1	Bal

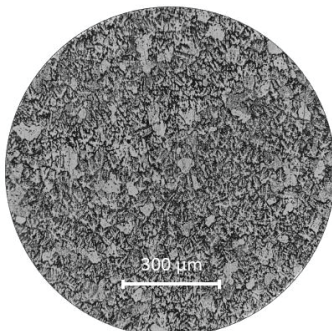


Mechanical Properties

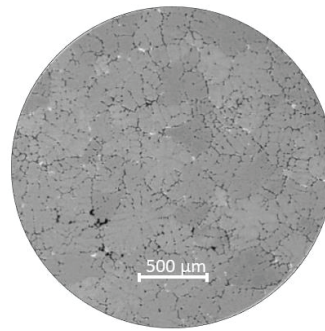
Material	Tensile Strength (MPa)	Yield Strength (MPa)	Elongation (%)	Hardness (HV)	Hardness (HB)
MetalWorm WAAM ER5356	299 @ LD [2] 295 @ ND[3]	195 @ LD 200 @ ND	30 @ LD 18 @ ND	86	82
As-fabricated 5019 aluminum [4]	280	130	16	N/A	N/A



Microstructure



WAAM ER5356 @ MetalWorm



Reference 5019 Aluminum alloy [5]

The microstructure of WAAM fabricated ER5356 is similar to the microstructure of 5019 aluminum alloy. The microstructure consists of columnar, planar, dendritic, and equiaxed grains. Different grain morphologies are effected by various cooling rates in different region of WAAM fabricated ER5356 aluminum alloy.

[1] Tensile tests were carried out at room temperature, according to ASTM E8 standard with thickness of 6mm and loading speed of 0.25mm/s.

[2] LD corresponds to longitudinal or deposition direction.

[3] ND corresponds to normal or building direction.

[4] The data correspond to 5019 aluminum and are taken from: <https://www.makeitfrom.com/material-properties/5019-F-Aluminum>

[5] The image is taken from: [doi:10.4028/www.scientific.net/KEM.682.10](https://doi.org/10.4028/www.scientific.net/KEM.682.10)

ER4043

DIN 3.2245, EN ISO 18273 S Al 4043 (AlSi5)



Wire

Key Features

Excellent machinability	Excellent formability	Good strength	Good corrosion resistance properties
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Applications

Bicycle Trucks	Automotive	Trailers
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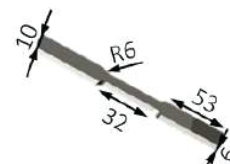
Chemical Composition

Component	Si	Fe	Cu	Mn	Mg	Cr	Zn	Al
Weight Percent (we%)	5	0.1	0.001	0.05	0.03	0.001	0.003	Bal

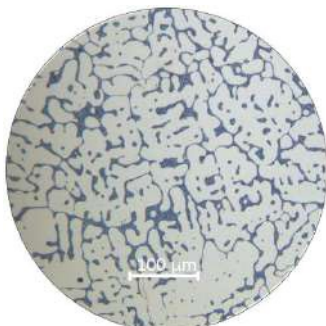


Mechanical Properties

Material	Tensile Strength (MPa)	Yield Strength (MPa)	Elongation (%)	Hardness (HV)	Hardness (HB)
MetalWorm WAAMER4043	152@ LD [2] 157@ ND[3]	93 @ LD 94 @ ND	19 @ LD 23 @ ND	45	39
As cast Al-Si alloy [4]	127	120	10.7	N/A	N/A



Microstructure



WAAM ER4043 @ MetalWorm



As cast Al-Si alloy [5]

The microstructure of WAAM fabricated ER4043 is typical microstructure of Al-Si alloy. The dominant microstructure consists of primary aluminium dendrite (α -Al) structure embedded in Al-Si eutectic.

[1] Tensile tests were carried out at room temperature, according to ASTM E8 standard with thickness of 6 mm and loading speed of 0.25 mm/s.
 [2] LD corresponds to longitudinal or deposition direction.
 [3] ND corresponds to normal or building direction.
 [4] The data are taken from: doi:10.3390/ma10070786
 [5] The image is taken from: doi:10.3390/ma10070786

ER316LSI

Stainless Steel
G19123LSi



Wire

Key Features

High resistance	Heat resistance	Superior corrosion resistance	Fabrication ease
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Applications

Marine	Medical Implants	Food Industry	Heat exchanger	Architectural application
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Chemical Composition

Component	C	Si	Mn	P	S	Cr	Ni	Mo	Fe
Weight Percent (wt.%)	0.02	0.7	1.9	0.045	0.015	18.5	0.09	2.5	2.5

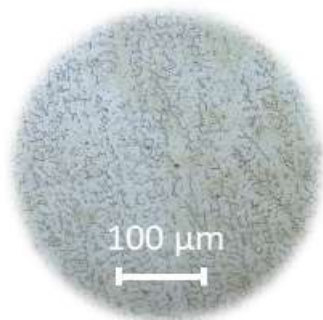


Mechanical Properties

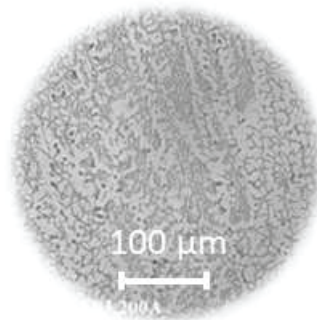
Material	Tensile Strength (MPa)	Yield Strength (MPa)	Elongation (%)	Hardness (HV)	Hardness (HB)
MetalWorm WAAM 316L Stainless Steel	588 @ LD [2] 625 @ ND [3]	410 @ LD 412 @ ND	33 @ LD 33 @ ND	184	174
AISI 316L Stainless Steel	485	220	45	N/A	N/A



Microstructure



WAAM 316L Stainless Steel @ MetalWorm



Reference AISI316L Stainless Steel [5]

The microstructure of WAAM fabricated 316L stainless steel consists of austenitic matrix and delta ferrite in the interdendritic spaces.

[1] Tensile tests were carried out at room temperature, according to ASTM E8 standard with thickness of 6 mm and loading speed of 0.25 mm/s.
 [2] LD corresponds to longitudinal or deposition direction.
 [3] ND corresponds to normal or building direction.
 [4] The data are taken from: <https://doi.org/10.1016/j.jmrt.2022.08.074>
 [5] The image is taken from: <https://doi.org/10.1016/j.jmrt.2019.11.004>



Transforming manufacturing with MetalWorm

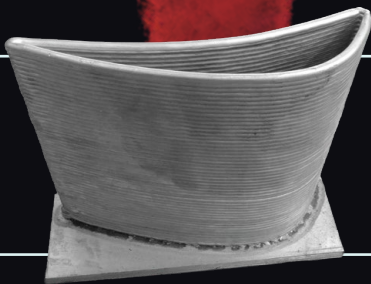


Samples



Helix-Steel Alloy ER70S-6

Size	Weight	Print Time
Ø95x275mm	1kg	2h 27m



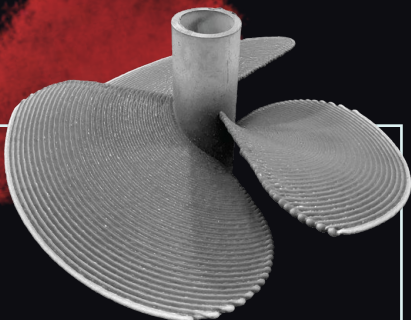
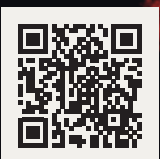
Airfoil-Aluminum Alloy ER5356

Size	Weight	Print Time
250x100x200mm	1.46kg	1h 46m



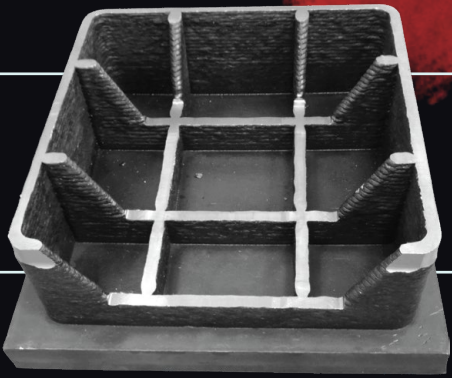
Connector-Steel Alloy ER70S-6

Size	Weight	Print Time
Ø435x300mm	51.39kg	48h 20m



Propeller-Stainless Steel ER316LSi

Size	Weight	Print Time
Ø380x80mm	3.8kg	11h 57m



Landing Gear Part-Steel Alloy ER70S-6

Size	Weight	Print Time
300x300mm	39kg	12h 43m



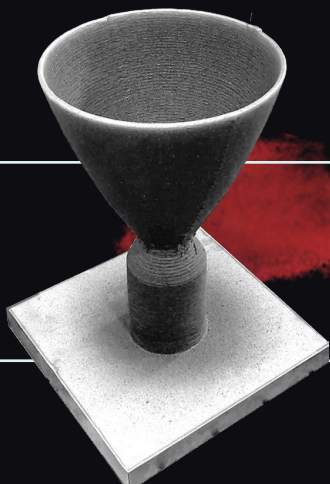
COCOON- Steel Alloy ER70S-6

Size	Weight	Print Time
Ø300x1000mm	40kg	38h 0m



Dome Shape Composite Mold-Invar 36

Size	Weight	Print Time
395mmx215mmx21mm	35.5kg	18h 24m



Rocket Nozzle-Stainless Steel ER316LSi

Size	Weight	Print Time
Ø250x400mm	14kg	10h 59m





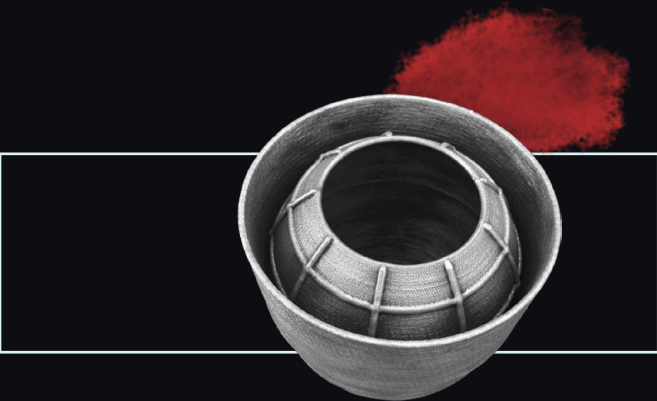
Pressure Vessel-Stainless Steel ER316LSi

Size	Weight	Print Time
Ø300x495mm	5.5kg	8h 30m



Valve-Stainless Steel ER316LSi

Size	Weight	Print Time
Ø360x420x15mm	70.5kg	48h 41m



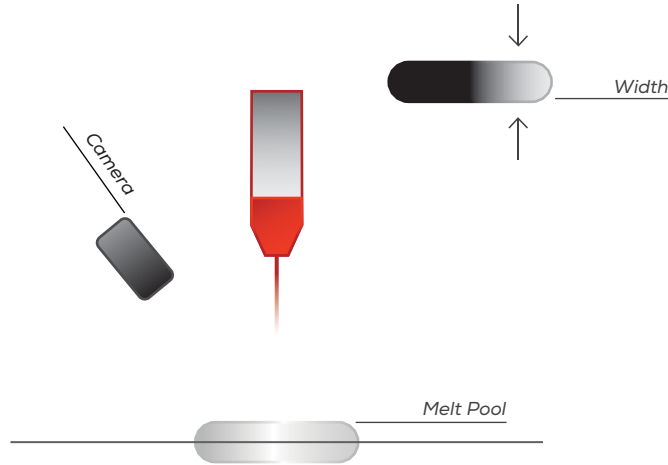
Double surface - Aluminum Alloy ER5356

Size	Weight	Print Time
Ø496x530mmx11.2mm	38kg	72h 44m

MetalWorm Control - In-Situ Process Control Software

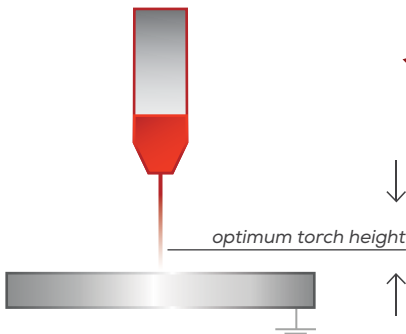
Thermal Monitoring and Control

Controls the torch travel speed based on melt pool width and temperature distribution.



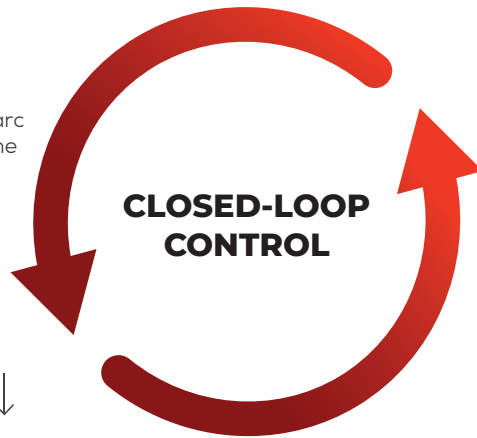
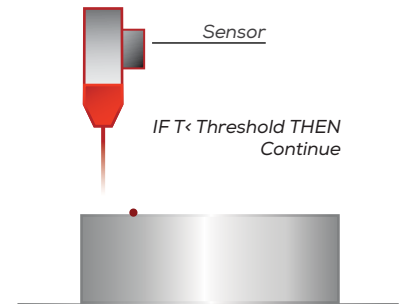
Arc Voltage Control

During the procedure, the height difference between the torch and part is detected by the arc voltage control software, which then permits the robot to operate at the modified height.



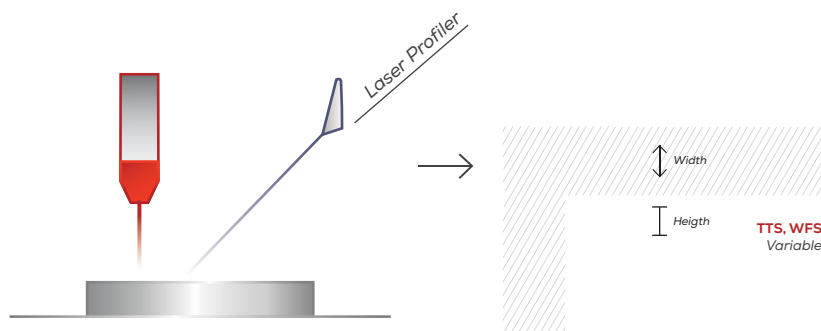
Temperature Control

The operation continues automatically after the predetermined temperature setting is reached.



Real Time Geometry Control

Utilizing sensor such as a 3D camera, Laser Profiler, profilometer, and interferometer, it evaluates the layer that has been generated during production and modifies the toolpath for the following layer as necessary.




METALWORM



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Industries

