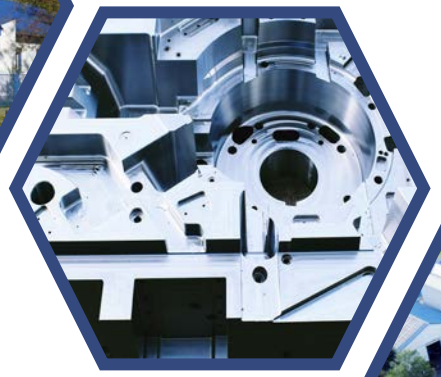


BÜTTNER

PROFESSIONAL PARTNER IN 3D TECHNOLOGY

COMPANY OVERWIEV

- 30 years of experience
- 8,000 m2 production area in Nagyatád and Pécs
- 250 employees
- 3D printing
- Exclusive distribution for MELTIO
- Production of highly complex tool sheets
- Production of tool plates and elements required for plastic injection moulding, aluminum pressure casting and plate forming tools
- CNC milling, drilling, grinding, turning
- Individual production based on customer drawings an
- 80 modern 3- and 5-axis machining centers
- Self-developed company management system

Meltio M450

Turn-key Metal 3D Printer

Designed for industry without the need for industrial infrastructure; reliable, affordable, safe and easy to use metal 3D printer. Ideal for small to medium size part fabrication and multi-metal 3D printing research.

Reliable

The metal 3D printing process is monitored in real time and compensated if required by process control.

Easy to Use

Automatic toolpath generation and material print profiles supplied by Meltio make for a plug and play experience.

Safe

Suitable for any environment thanks to a process built around wire, a sealed chamber and a built-in 3 stage filter.

Affordable

The low capital and running costs of the Meltio M450 make metal 3D printing of conventional parts possible.

Meltio M450 Technical Specifications

Dimensions (W*D*H):
560*600*1400mm

Print Envelope (X*Y*Z):
150*170*425mm

Weight:
250kg

Laser Power:
1200W

Laser Type:
multiple 200W direct diode lasers

Laser Wavelength:
976nm

Process Control:
closed-loop, laser and wire modulation

Power Input:
208/230V single phase or 400V three phase

Power Consumption:
2-5kW peak depending on selected options

Wire Feeds:
up to 2 x K300 spools

Wire Feedstock:
0.8-1.2mm wire diameter

Cooling:
active water-cooled chiller included

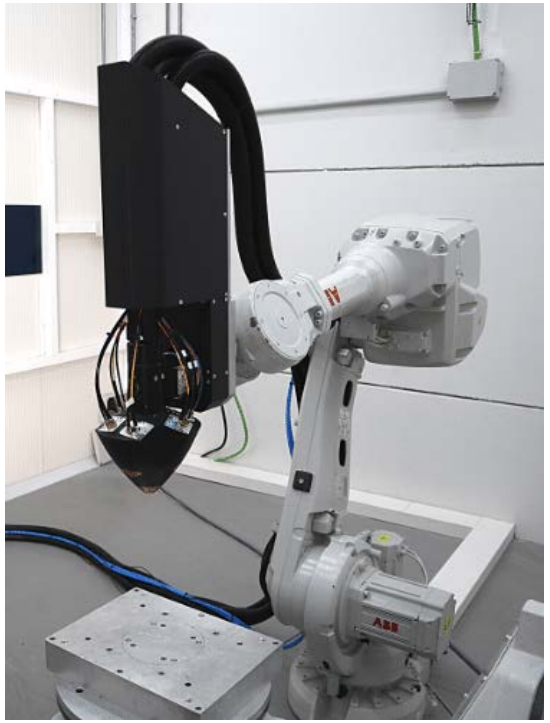
Meltio 3D printing solutions for industrial applications

Meltio M450 3D printer

Standard equipment for 3D printing.

Meltio Engine CNC Integration

For **hybrid manufacturing, repairs** and **feature addition.**



Meltio Engine Robot Integration

For **large, complex parts** and **laser cladding**

Meltio Engine CNC Integration

Hybrid Manufacturing Integration

The most affordable hybrid manufacturing solution, fitting almost any CNC machine in the market. Enable metal 3D printing and machining of complex geometries in a single process step.

Hybrid Manufacturing

Create highly complex parts with machining tolerances in the same process.

Retrofitting

Provide new capability to any CNC machine by turning it into an hybrid metal manufacturing system.

Part Repair

Cost-effective component repair, part augmentation and feature addition.

Geometry Freedom

No inherent constraints when the working envelope is only limited by the size of the motion system.

Meltio Engine CNC Technical Specifications

Dimensions (W*D*H):
390*650*1000mm

Print Envelope (X*Y*Z):
Inherent to motion system

Weight:
90kg

Laser Power:
1200W

Laser Wavelength:
976nm

Process Control:
closed-loop, laser and wire modulation

Power Input:
208/230V single phase or 400V three phase

Power Consumption:
2-5kW peak depending on selected options

Laser Type:
multiple 200W direct diode lasers

Wire Feeds:
up to two external wire drums

Wire Feedstock:
0.8-1.2mm wire diameter

Cooling:
active water-cooled chiller included

Minimum requirements for a successful integration of the Meltio Engine with a CNC machine are:

1. Spindle motors can handle the additional weight
2. Deployment mechanism can be mounted without collisions
3. Eight unused M-code controlled relays
4. Ability to add a NO relays to the feed hold
5. Ability to add feed resume/start buttons
6. Laser safety windows can be mounted
7. System can lock all doors and windows

Meltio Engine Robot Integration

Large-scale Metal 3D Printing

The most affordable large scale metal 3D printing solution, the Meltio Engine integrates with any robot arm manufacturer and interface in the market.

High Complexity

Create highly complex parts with machining tolerances in the same process.

Retrofitting

Provide new capability to any CNC machine by turning it into an hybrid metal manufacturing system.

Part Repair

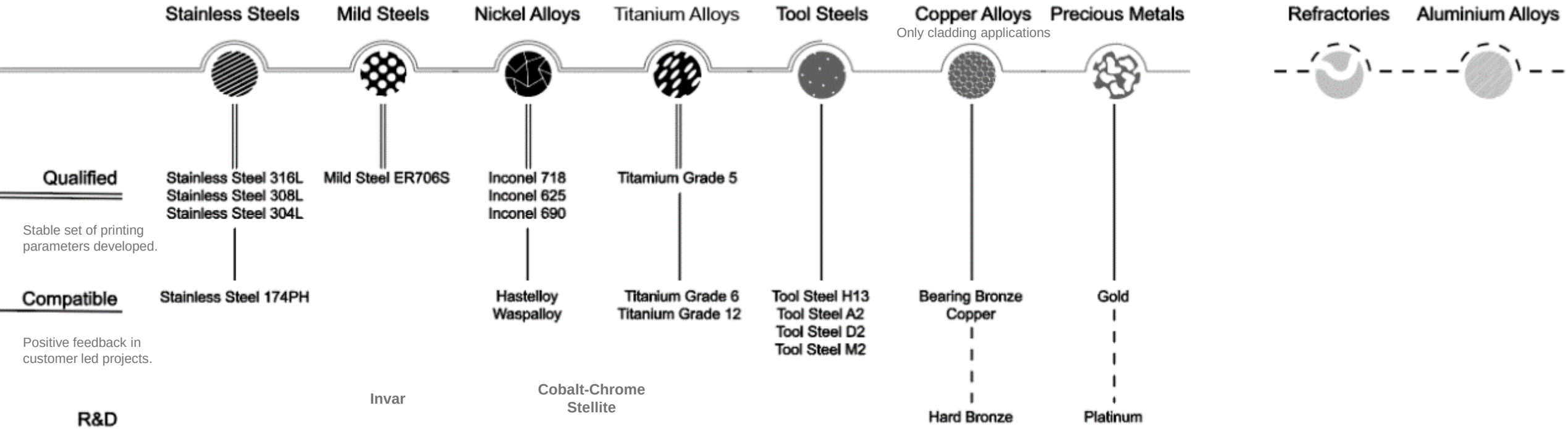
Cost-effective component repair, part augmentation and feature addition.

Large Size

No inherent constraints when the working envelope is only limited by the size of the motion system.

Unlimited Third Party Material Choice

Choose the ideal commodity welding wire for your application



Improved mechanical parameters with Meltio 3D technology

Stainless Steel 316L	Wrought Properties	Cast Properties	Meltio XY Properties	Meltio XZ Properties
Tensile Strength (MPa)	515	550	635 ± 13	650 ± 7
Yield Strength (MPa)	208	260	390 ± 30	380 ± 17
Elongation (%)	40	35	52 ± 3	46 ± 4

Titanium 64	Wrought Properties	Cast Properties	Meltio XY Properties	Meltio XZ Properties
Tensile Strength (MPa)	930	860	950 ± 5	-
Yield Strength (MPa)	860	758	882 ± 5	-
Elongation (%)	>10%	>8%	12 ± 0.5	-

Inconel 718	Wrought Properties	Cast Properties	Meltio XY Properties	Meltio XZ Properties
Tensile Strength (MPa)	1241	802	1308 ± 10	1235 ± 11
Yield Strength (MPa)	1034	758	1128 ± 20	1040 ± 12
Elongation (%)	10	5	6.6 ± 2.1	8.5 ± 0.7

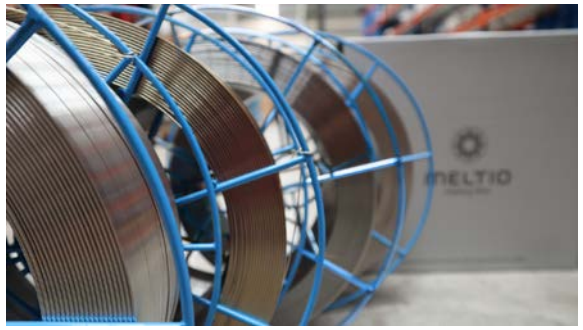
**Visit www.meltio3d.com/materials to download all material datasheets*

Single and Dual Metal 3D Printing

Meltio recommends printing the bulk of the parts with metallic wire.

Single Wire

The bulk of the 3D printing process is built around wire, the safest, cleanest and easiest to work with metal feedstock.



Dual Wire

Combine different metal materials in a single part. The wire switching process is quick, automatic and clean.

Wire and Powder

Create new alloys on the fly, test bi-metallic structures and research metal matrix composites (MMC).

Dual Wire Deposition Head

Coaxial Wire Feed

Can print geometries in any direction. Wire comes through the center of the melt pool thanks to the distributed laser system.

Integrated Wire Feed/s

Critical for high process reliability and unique to Meltio. Short distance from feeder to process is necessary for maximum wire feeding precision.

Distributed Laser System

A total of 1,2kW of laser power distributed across six 200W lasers. It provides an extremely long service life due to low optical densities.

Easy to Service

All wear parts like the wire nozzle and protective optic assembly are very easy and low-cost to replace.

Shield Gas Ring

The head has prevents oxidation through a large nozzle ring with very good gas distribution just a few millimeters from the melt pool.

Integrated Process Control

Sensors monitor the laser fibers and the deposition process. The system will regulate automatically if an irregularity is detected, or put itself on hold in critical conditions.

300mm Tall
200mm Diameter

Dual Wire Material Compatibility

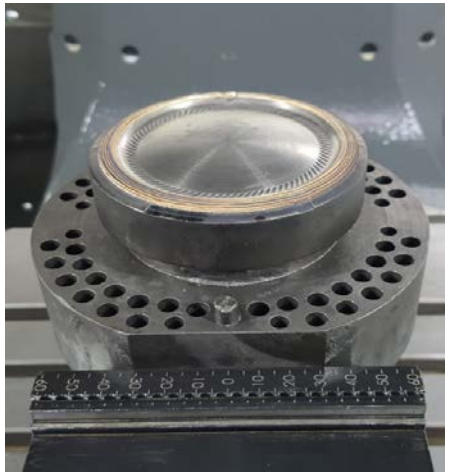
Compatible / In development / Incompatible		Wire 1					
	Material	Stainless Steel	Mild Steel	Tool Steel	Titanium	Inconel	Copper
Wire 2 or Substrate	Stainless Steel						
	Mild Steel						
	Tool Steel						
	Titanium						
	Inconel						
	Copper						

**Laser welding processes such as Meltio have lower heat input and hence are less prone to produce cracks and defects in the part.*

Advanteges of multiple components 3D Meltio printing

Cast Iron Mold
Some cast irons do not allow for the direct deposition of materials such as stainless steel. In these cases an inter-layer with high nickel content can be applied to increase bonding and part strength.

Material 1: Interlayer: Inconel 718
Material 2: Repair: Stainless Steel 316L



Dual Material Pipe
The central pipe carries highly corrosive liquids. The water jacket on the other hand is made directly from lower cost stainless steel which is more than sufficient for water cooling, cutting Inconel use over 66%

Material 1: Inner Part: Inconel 718
Material 2: Main Part: Stainless Steel 316L

Advantages of multiple components 3D Meltio printing

Increase of mechanical resistance: Turbine Fan Blade
Locally increase wear resistance with leading edge from Inconel.

Material 1: Blade: Stainless Steel 316L
Material 2: Leading Edge: Inconel 718

Four Material Drill Bit
As deposited hardness up to 60HRC even within thick layers.
Material 1: Body: Stainless Steel 316L
Material 2: Top: Inconel 718
Material 3: Bits: Tool Steel H11
Material 4: Channels: Copper

Metal AM Technologies

are classified by feedstock and energy source

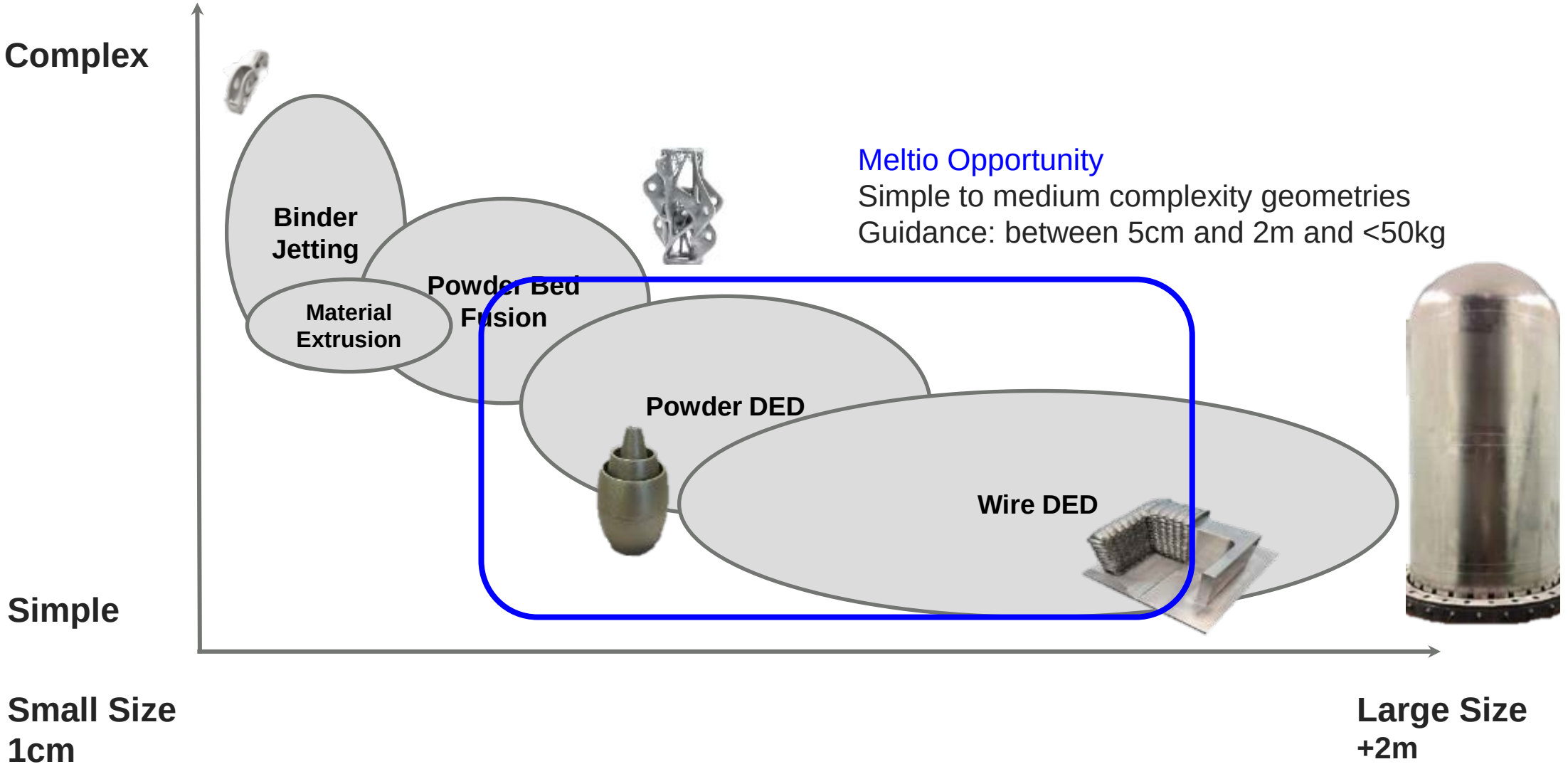
WIRE Welding commodity, cheap, clean and safe	POWDER Most used material in Metal AM, expensive and dangerous to work with	FILAMENT/RODS Proprietary, expensive, easy to use

Directed Energy Deposition				Powder Bed Fusion		Binder Jetting	Material Extrusion
Arc (WAAM)	Electron Beam	wire LMD	Powder LMD	Laser	Electron Beam		

Large Size Simple Geometry ⟷ **Small Size Complex Geometry**

Metal AM Part **Geometries**

Meltio process covers the largest range for size and complexity.



Metal AM **Cost** Comparison

Meltio is the process with the lowest investment, lowest material and energy requirements.

Process	3D Printer and Accessories*	Materials
Arc (WAAM) DED	200k - 1M€	10-100€/kg
Wire LMD	120k – 160k€	10-100€/kg
Powder DED	250k – 2M€	60-200€/kg
PBF Powder Bed Fusion	150k – 2M€	100-500€/kg
Binder Jetting	350k-1M€	100-300€/kg
Material Extrusion	150-250k€	200-400€/kg

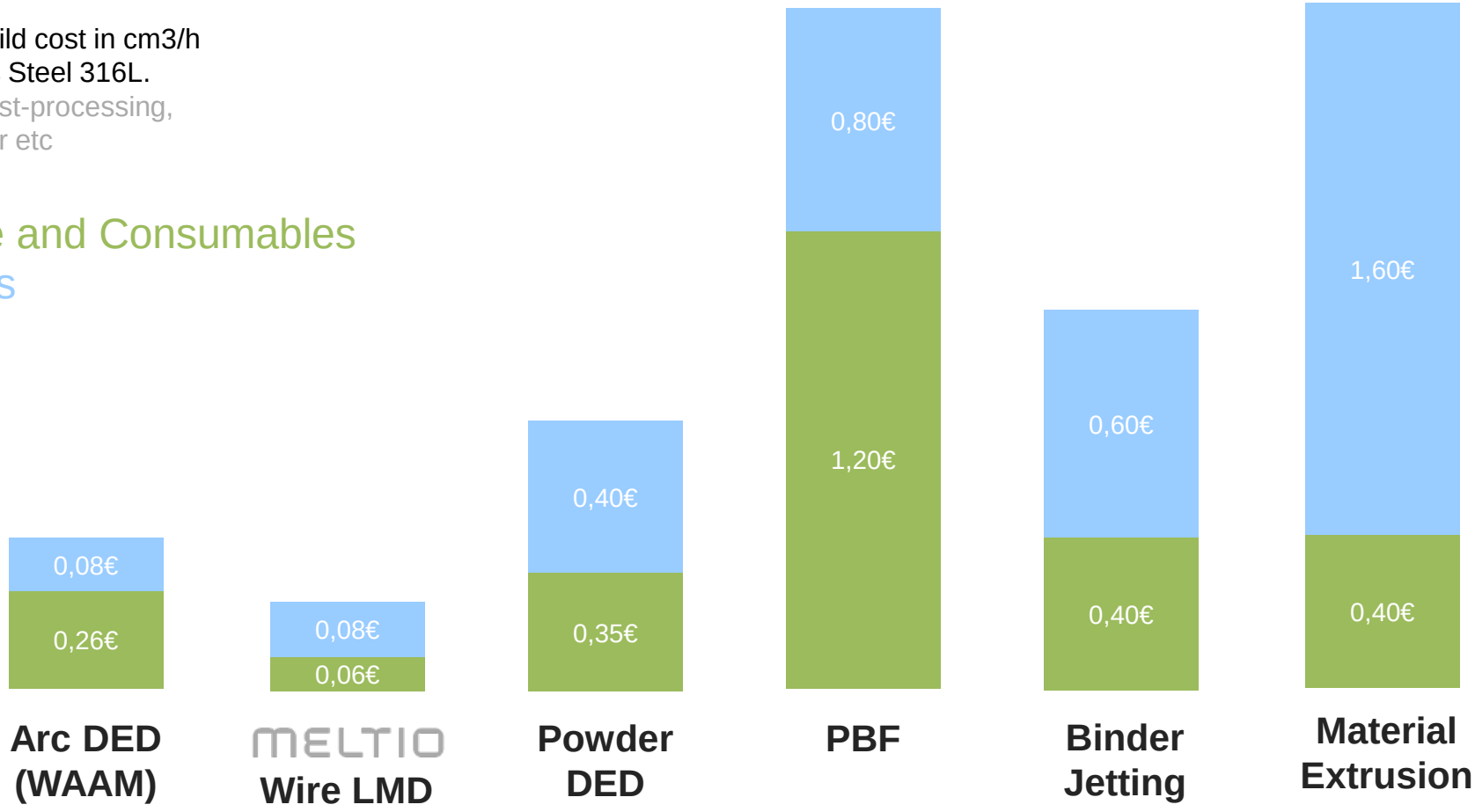
**Considering equipment necessary to get a dense metal component*

Metal AM Cost Comparison

Meltio is the process with the lowest investment, lowest material and energy requirements.

Optimum build cost in cm3/h
for Stainless Steel 316L.
Excludes post-processing,
manual labor etc

Machine and Consumables
Materials

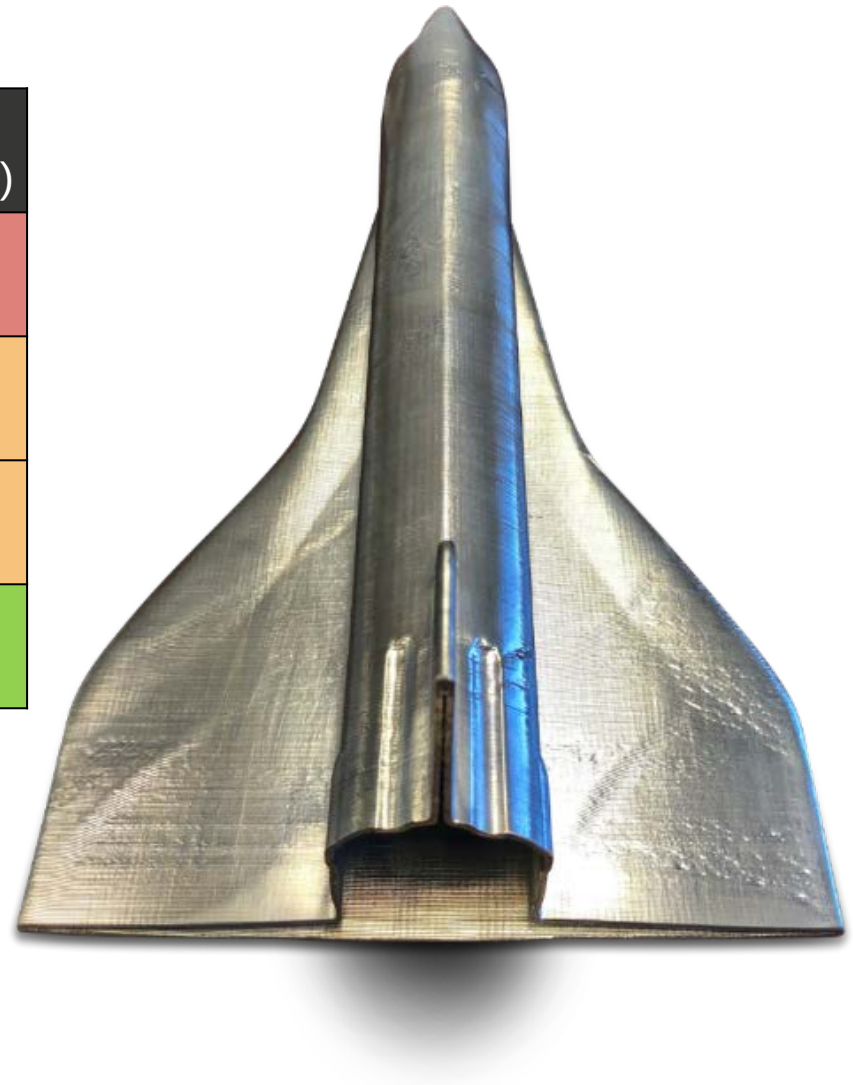


AMPOWER

Technology comparison study developed for Meltio by AMPOWER

Metal AM Surface Roughness

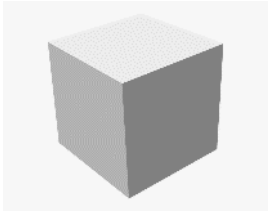
Process	Layer Thickness µm	Raw surface roughness Ra (µm)
Arc (WAAM) **DED**	1000 - 3000	200-500
Wire LMD	400 - 1200	50 - 120
Powder **DED**	200 - 2000	20 -100
PBF **Powder Bed Fusion**	20 -100	5 - 20



Metal AM **Start to Part Time 2021**

MELTIO

Meltio is the most balanced process in terms of time to part and resolution, whilst keeping excellent mechanical properties, the most attractive capital and operations cost, and convenient user experience.



Cube 5x5cm, 1kg, SS 316L

Process	Build Rate	Batch Size	File Preparation	Machine Set-up	3D Print	Post-processing	Start to Part*
Arc (WAAM) DED	3kg/h	1	easy 5min	easy 10min	20min	remove buildplate 30min	~1h
MELTIO **Wire LMD**	0.8kg/h	1	easy 5min	easy 10min	1.5h	remove buildplate 30min	~2h
Powder DED**	0.2kg/h	1	easy 5min	hard (cleanup) 1h	6h	remove buildplate 2h	~7h
PBF* Powder Bed Fusion**	0.1kg/h	4	medium 30min	hard (cleanup) 1h	12h	remove buildplate, clean powder, heat treatment 5h	~18h
Binder Jetting	0.5kg/h	2-10	medium 30min	hard (cleanup) 1h	3h	72h debinding 24h oven	~4 Days
Material Extrusion	0.05kg/h	1	easy 5min	easy 5min	12h	72h debinding 24h oven	~5 Days

The Benefits of a Wire Based Process

Meltio started as a powder and wire 3D printing technology provider, however, after 2 years in operation 99% of our customer base and R&D work is around improving the laser wire process due to its obvious benefits towards industrial adoption.

0% Material Waste

Meltio's multi-laser metal deposition process enables the wire to enter the meltpool coaxially effectively using 100% of the material, powder based DED processes have 30-50% material waste which cannot be recycled.

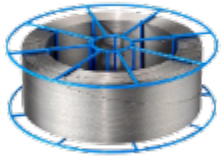
Up to 10x Lower Cost

Wire feedstock is a welding commodity and unlike powder it is available from 5€/kg. In some alloys the price difference is up to an order of magnitude.

Up to 4x Productivity

Thanks to its higher material efficiency the wire-laser DED process is faster whilst requiring lower laser power compared to powder DED processes.

Wire vs Powder: User Experience



	Wire	Powder
PPE	Not required	Mask, Suit and Gloves
Storage Risk	None	Flammability and Inhalation
Shelf Life	Keep in dry environment	Very prone to absorb moisture, must be stored in a vacuum
Machine Clean Up	Not required	At least one hour with special ATEX vacuum cleaner
Material Change	2 minutes, with no cross contamination	From one to a few hours, with high risk of material cross contamination
Facility Requirements	No inherent requirements specific to wire usage	Dedicated infrastructure, safety equipment and procedures to manage risks.

Wire vs Powder: Print Speed

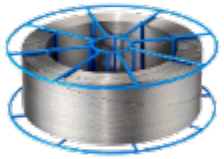
Powder based processes compromise user experience and print speed for better surface resolution. Meltio presents the perfect balance between speed and surface finish

Process	Feedstock	Deposition	Layer Thickness
Arc DED (WAAM)	Wire	1-5kg/h	1-6mm
MELTIO LMD	Wire	0.2-0.8kg/h	0.4-1.2mm
Powder LMD	Powder	0.2kg/h	0.2-2mm
PBF Powder Bed Fusion* **	Powder	0.1kg/h	0.02-0.2mm
Binder Jetting	Powder	0.5kg/h	0.02-0.2mm

Wire vs Powder: Feedstock Cost

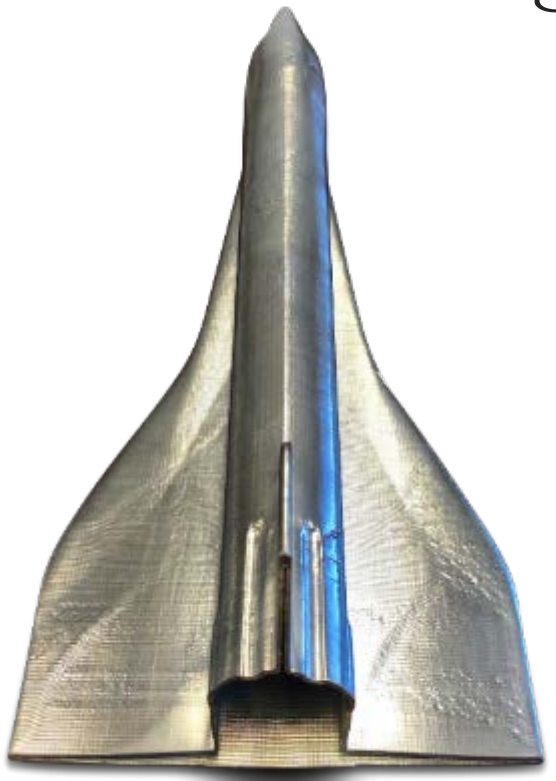
MELTIO

Powder is typically 3-4x more expensive, in commodity materials such as steels up to 10x



Material	Wire ($/kg)	Powder ($/kg)
Stainless Steel 316L	from 5, typically 10	40-100
Stainless Steel 308	from 5, typically 10	40-100
Mild Steel SG2	from 3, typically 5	40-100
Tool Steel H13	35	75-120
Inconel 625	70	200-250
Inconel 718	72	200-250
Titanium Ti-6Al-4V	from 100	300-350

Benefits of Meltio's Wire-Laser (W-LMD) Technology



Achieves very smooth surfaces

Can be used to print large, medium and small parts

Only 1.5mm extra stock is required in critical areas

THANK YOU FOR YOUR ATTENTION!

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