M - METAL AM SYSTEMS

ROBOTIC 3D METAL PRINTING

MX3D

www.MX3D.com/systems

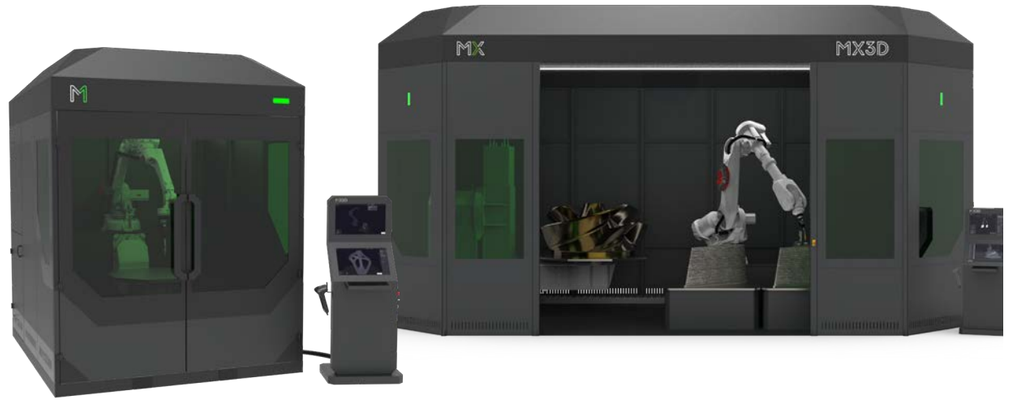
M - METAL AM SYSTEMS

Building on extensive experience with >35,000 kg printed metal, the **MX3D M - Metal AM Systems** ensures quality for Robotic Wire Arc Additive Manufacturing (WAAM).

The M-Systems are **built for WAAM**. It offers a turnkey solution to get started with WAAM fast and print **high-quality, medium-to-large-scale metal parts**. The systems are fully integrated with MetalXL, MX3D's dedicated WAAM-workflow for advanced process control/monitoring. The system is created with quality hardware components from renowned manufacturers.

The systems include an 8-axis industrial robotics system enabling complex prints, a multi-transfer mode GMAW power source for flexible print procedures and a WAAM-dedicated **MetalXL Control System for intelligent automation, real-time print monitoring and closed-loop control**.

MetalXL, our robotic WAAM workflow, is fully integrated into the M - Metal AM Systems thanks to the connected control system and **sensors.** This enables you to get from design to print in one go.



M - BENEFITS

PRINT QUALITY

With our integrated metal alloys/ printing strategies library and dynamic in-process parameters control, we reach excellent material properties on a large range of metal alloys even at a high depostion rate.

PROPRIETARY SOFTWARE

We have developed our own E2E work-flow software (MetalXL), fully dedicated to WAAM technology to achieve high quality and completely integrated with a sensor system to have real-time control.

MANUFACTURING SPEED

The M - Metal AM Systems have a stand-ard deposit rate of 1-7kg per hour. With higher speed, you can reduce lead time, manufacturing time and parts cost much more effectively. With MX3D's custom solutions, higher deposit rates can be achieved.

MATERIAL LIBRARY

Our M - Metal AM Systems allows the production of every weldable alloy, including steels, aluminiums, bronzes and copper-based alloys.

EASY TO USE

Fast operator adaption due to high workflow automation requir-ing only basic engineering skills to operate.

LOW COSTS

With our M - Metal AM Systems, the costs are upto 50% lower CAPEX and >5x cheaper OPEX compared to powder-based and laser-based 3D metal printing.

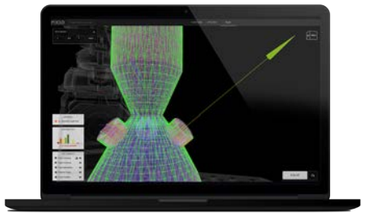
METAL XL

MetalXL is built by MX3D to enable 3D metal printing of medium-to-large-scale metal parts in-house, using robotic WAAM technology.

Its **streamlined end-to-end workflow** allows our users to easily manage the whole printing process from design to print.

It offers diverse features to both print with pre-set metal alloys and process parameters, or customise the entire process to your own needs.

Connected to the **MetalXL Control System**, it provides advanced print monitoring and control in real-time.



MetalXL CAM

WAAM-dedicated CAM including material library and optimised toolpath and infill strategies.

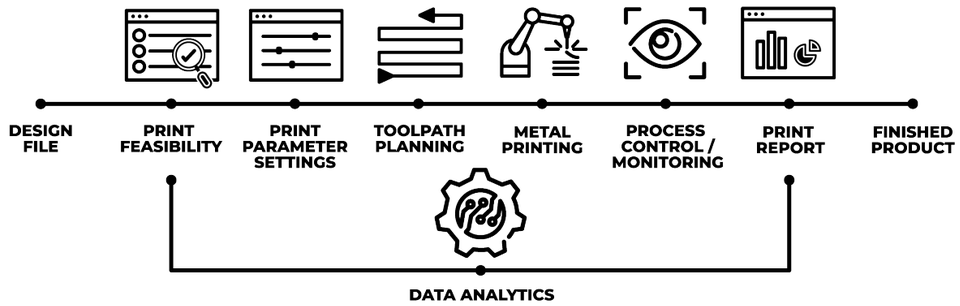
MetalXL LIVE

Real-time and high-resolution data collection of key print process parameters.

MetalXL VIZ

3D visualisation of acquired process data for analytics, tracability and certification.

Dedicated WAAM solution from CAD to print in one go.



METAL XL - CONTROL SYSTEM

PROCESS CONTROL

- Advanced sensors to measure key parameters in real-time directly from the torch.
- Dynamic toolpath streaming that pushes the next layer when passing set parameter levels (e.g. interpass temperature).
- Automated start/stop based on real-time anomaly detection

PROCESS MONITORING

- High-resolution logging and visualisation of key parameters.
- Monitor the printing process live layer-by-layer on the digital twin.
- Live alerts on unexpected print parameter deviations pushed to the operator's preferred device.

PRINT ANALYTICS

- 3D visualisation of logged key parameters during print.
- Detect, filter and analyse deviations during the printing process.
- Visualise the logged data after printing as a 3D point cloud, and compare it to the printed object to optimise the printing parameters.

HIGH-RESOLUTION DATA COLLECTION

- High-resolution welding parameters, including current, voltage, wire feed speed, gas flow, etc.
- Key print process / productivity metrics, including weld time, energy usage, system uptime, etc.
- Advanced dynamic tracking of interpass temperature, layer cooling time and active cooling.

CERTIFICATION

LRQA has qualified MX3D as a certified additive manufacturing facility for robotic wire arc additive manufacturing (Wire-DED). The M - Metal AM System is fundamental to the qualification, including control relating to feedstock, equipment, personnel, process and build control covering multiple metal alloys.

We can support our customers in getting the additive manufacturing facility certification of their own M - Metal AM System, both for standard and custom-configured systems.

LRQA
CERTIFIED

ADDITIVE
MANUFACTURING
FACILITY QUALIFICATION

SHIMODA - USER STORY

The M1 has been installed at the **Shimoda Iron Works Co., Ltd.** factory site in Aioi-City, Hyogo, Japan. The **M1 Metal AM System** acquisition is part of the collaboration agreement between the two companies.

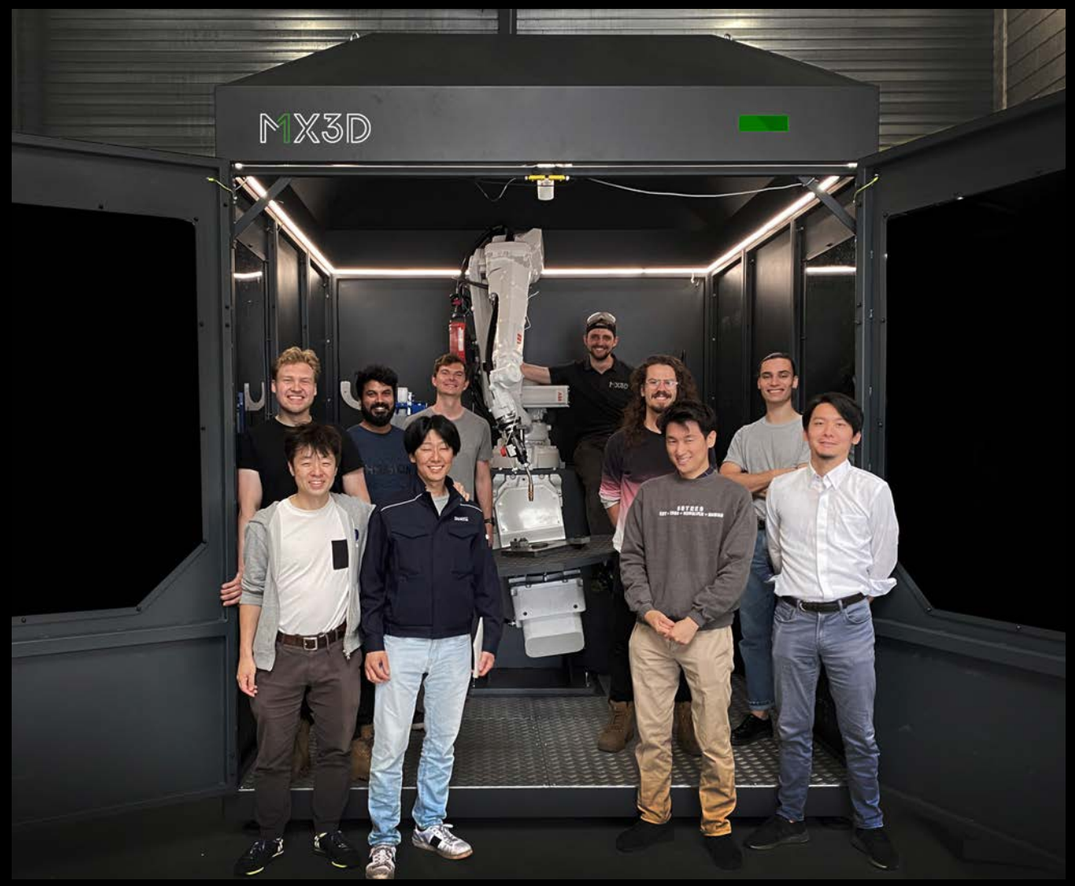
The deployment of the M1 follows a joint project between MX3D and Takenaka Corporation, one of the biggest Japanese construction companies, for the production of duplex **stainless steel structural connectors**. The organic shapes and varied geometries made **Robotic Wire Arc Additive Manufacturing (WAAM)** an optimal choice for manufacturing in a waste-free, fast and cost-effective way. After the successful project, Shimoda decided to invest in the technology and it intends to produce these metal nodes on-site.

"The M1 Metal AM System allows us to start printing optimised parts for various industries including the wind power industry immediately. We were impressed by the ease of use and the quality of the materials. Moreover, this new process is very attractive for us because it will contribute to SDGs by minimising both material and energy loss.

MX3D's M1 makes Shimoda the nr. 1 Wire Arc Additive Manufacturing (WAAM) expert of Japan, a technology that we believe will see a bright future."

Shinji Shimoda, President of Shimoda Iron Works (Japan)

SHIMODA

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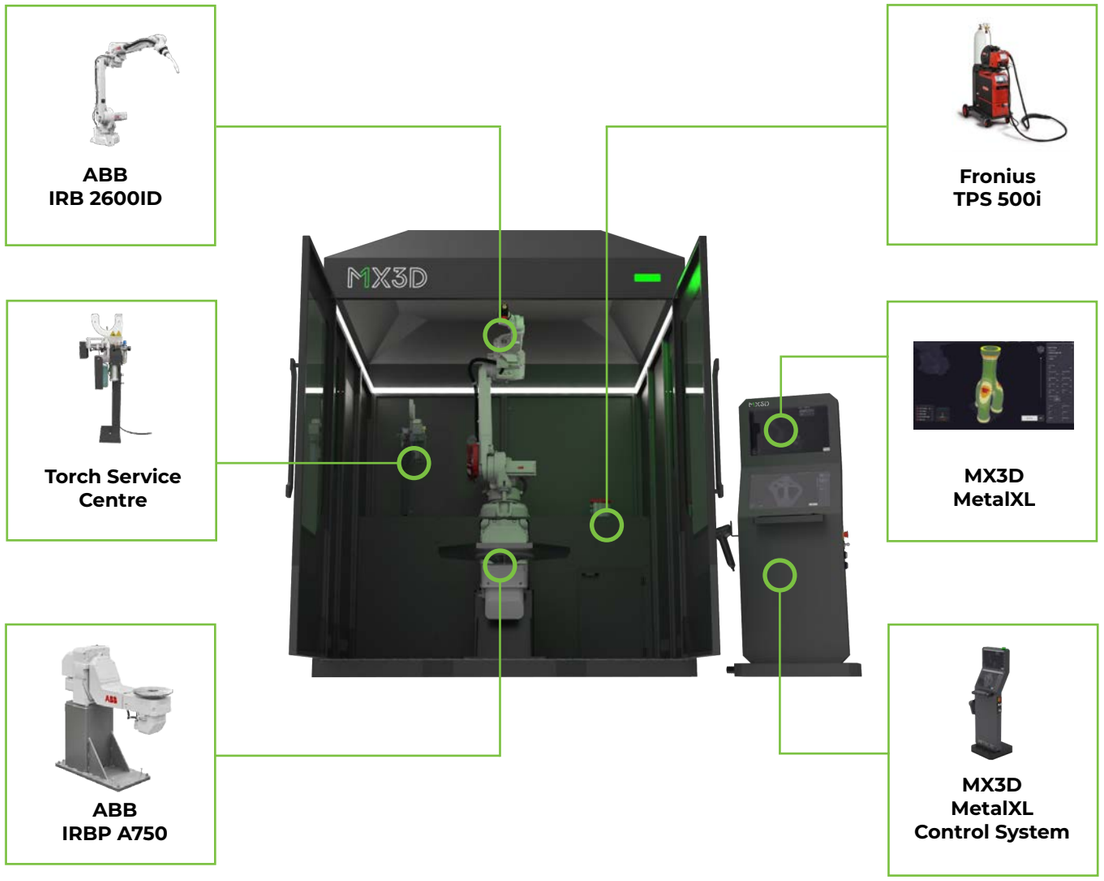
M1 - METAL AM SYSTEM

M1 - CONFIGURATION

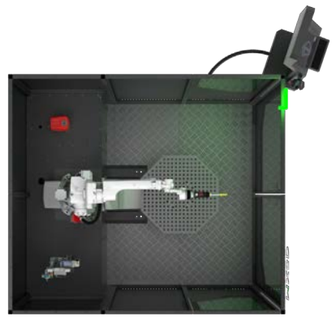


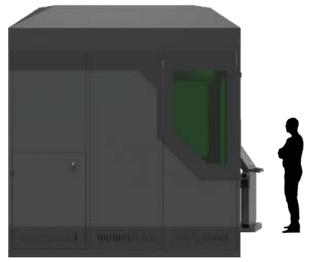
ADVANTAGES

- Equipped with renowned industrial hardware in a ready-to-print setup.
- Print with 8-axis for increased freedom of geometry.
- Multi-transfer mode CMT and MIG/MAG power source.
- Integrated sensors and control system for advanced process control and monitoring.

FULLY INTEGRATED WITH METALXL

- From design, plan your print with the MX3D high-quality MetalXL workflow and push it directly to the robot.
- Track and monitor your print on the MX3D MetalXL Control System.
- Digital twin of the print for optimal parameter assessment and components certification.
- Continuous high-resolution print monitoring with realtime print alerts on your operator's preferred device.





	STANDARD	CONFIGURATION OPTIONS		
ROBOTICS	ABB IRB 2600ID	ABB IRB 1660ID (smaller)	KUKA KR-8	
POSITIONER	ABB IRBP A750	No Positioner	ABB IRBP A500	
POWER SOURCE	Fronius TPS 500i	Fronius Miller	Lincoln Electric Oerlikon	Kemppi ESAB
PRODUCTIVITY PACKAGE	Torch Service Station	Active Cooling*	Advanced Productivity Dashboarding	
WORKFLOW	MetalXL Suite			
CONTROL SYSTEM	MetalXL Control System	3D Scanner* Melt Pool Camera*	Acoustic Emission Sensor Kit* Advanced Thermal Camera*	
MATERIALS	Standard Alloy Library	Titanium WAAM Upgrade*	Specialty Alloy Library*	

*: optional

M1 can be configured with the following brands:

MX3D continuously adds more brands, check www.mx3d.com for latest additions.

TECHNICAL SPECIFICATIONS
MX3D | M1 METAL AM SYSTEM

SYSTEM	System Footprint (wxdxh)	mm	2600mm (w) x 3000mm (d) x 3300mm (h)
	Access Door (wxh)	mm	2435mm (w) x 2500mm (h)
	Weight with Max. Part Weight	t	3.5
	Weight without Part	t	2.75
	Air Volume	m^3	5.2 (min) - 20.1 (max)
PRINT	Max. Print Volume (wxdxh)	mm	2200mm (w) x 1400mm (d) x 1700mm (h)
	Max. Table Payload	kg	750
	Max. Print Payload	kg	500
	Size Build Plate (wxdxh)	mm	1000mm x 1000mm x 38mm hardened steel octogonal shape / interchangeable
	Weight Build Plate	kg	250
	Clamping Thread Size	M	16
ROBOTICS	Robotic Axis	#	8
	Robot Accuracy	mm	max 0.5 (positional accuracy), max 0.02 (positional repeatability), max 0.3 (path repeatability)
	Robot Motion Speed	°/s	175 (J1-3), 360 (J4-5), 500 (J6), 90 (J7), and 150 (J8)
	Robot Motion Range	°	+180 to -180 (J1), +155 to -95 (J2), +75 to -180 (J3), +75 to -180 (J4), +175 to -175 (J5) and +120 to -120 (J6)
	Rotation Range Build Table	°	-360 to +360, up to infinite rotation neg/pos
	Swiveling Range Build Table	°	-180 to +180 (J8)
WELDING	Welding Transfer Modes	GMAW	MIG/MAG + CMT
	Input Voltage	V	3 x 380V (EU, country-specific voltage possible)
	Max. Input Current	A	3 x 380v --> 38.8A || 3 x 400v --> 37.5A
	Welding Current / Duty Cycle	A/%	10min/40°C: 500A / 40%, 430A / 60%, 360A / 100%
WORKFLOW	Control	OS	MX3D MetalXL-license
	Data/Signal Processing	fs	5,000+
	Interface	Inch	2x 21.5" Touch Screens + MetalXL (online/remote)
	CAD File Format	Format	.stl
LOCAL REQUIREMENTS	Power Connection	V	3 x 380 (EU), 3 x 400 (EU) or 3 x 460 (outside EU)
	Main Fuse Protection	A	3 x 40A slow blow
	Compressed Air	MPa	0.8 MPa / 8
	Floor Loading	kN/m^2	5.7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MX - METAL AM SYSTEM

For companies that want to print larger metal parts in-house, MX3D has recently launched the **MX Metal AM System**. The MX is a new turnkey robotic metal AM System for printing qualified metal parts fully tailored to customers' requests.

The MX Metal AM System includes an enlarged 8-axis heavy-duty industrial robot, high productivity power source and automation tools, all fully integrated with MX3D's MetalXL end-to-end workflow software and control system. It prints on multiple adjustable built plates simultaneously enabling autonomous 24/7 printing of qualified metal parts, where parts can weigh 5+ tons and measure up to 6 x 2 x 4 meters.

The MX-Metal AM System is fully customizable to print your large-scale metal parts. Utilizing renowned hardware from ABB, KUKA and Fronius, customers have a wide range of hardware options to configure the perfect system for printing large, heavy and customer metal components. The 8-axis robotic system can be fully optimized on reach, payload, force and accuracy, all fully integrated and automated by our MetalXL workflow platform and control system for flexible, controlled and advanced robotic 3D metal printing.

Due to its high level of robotic flexibility, automated productivity tools and integrated sensors system, the extended and heavy-duty MX Metal AM System runs autonomous 3D metal printing at an even faster speed, higher quality and larger volumes.

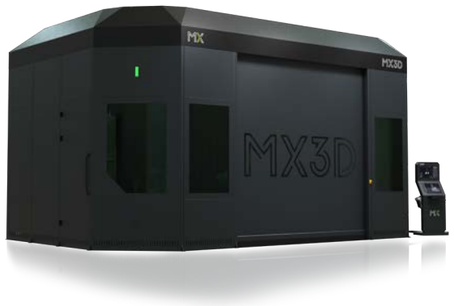
MX - CONFIGURATION

ADVANTAGES

- Enlarged robotic setup fully customizable to print your desired large-scale metal parts.
- Fully optimized extended 8-axis heavy-duty industrial robot to print up to 5+ tons and >2m in each dimension.
- Heavy-duty cycle power sources to achieve high print speed at 1-10 kg/hr, configurable for multi-alloy printing.
- Integrated productivity tools, advanced sensors and a control system to drive high print quality at high speed and control.

FULLY INTEGRATED WITH METALXL

- Full end-to-end workflow from design to print in one go, for various geometries on multiple build plates at high speed.
- Digital twin of the print for parameter optimization and component qualification.
- Add advanced sensors to expand monitoring and advance the closed-loop control system.
- Full traceability of the print process at high resolution in real-time complementary to components certification.



CONFIGURATION OPTIONS

ROBOTICS	ABB IRB 5600-series ABB IRB 6600-series - for extended reach ABB IRB 6700-series - for higher payload	KUKA KR Quantec series KUKA KR Fortec series - for extended reach KUKA KR Titan - for higher payload	
POSITIONER	ABB IRBP-iA 2-axis 1000kg ABB IRBP-iA 2-axis 2000kg ABB IRBP-iA 2-axis 4000kg	KUKA KP2-SV HW 2-axis 1100kg KUKA KP2-SV HW 2-axis 2600kg KUKA KP2-SV HW 2-axis 5000kg	Custom Positioner (for special higher payload or larger print dimensions)
POWER SOURCES	Fronius TPS/i CMT High Duty-Cycle - for higher productivity Fronius TPS/i Twin Wire Push - for higher deposition rate Fronius TPS/i Dual Torch Push - for multi-material printing	Other Welding Brands*	
PRODUCTIVITY PACKAGES	Torch Service Station	Active Cooling*	Advanced Productivity Dashboarding
WORKFLOW	MetalXL Suite		
CONTROL SYSTEM	MetalXL Control System	3D Scanner* Melt Pool Camera*	Acoustic Emission Sensor Kit* Advanced Thermal Camera*
MATERIALS	Standard Alloy Library	Titanium WAAM Upgrade*	Specialty Alloy Library*

*: optional

MX can be configured with the following brands:

MX3D continuously adds more brands, check www.mx3d.com for latest additions.

TECHNICAL SPECIFICATIONS

MX3D | MX METAL AM SYSTEM

SYSTEM	System Footprint (wxdxh)	mm	9300mm (w) x 5300mm (d) x 4900mm (h)
	Access Door (wxh)	mm	3900mm (w) x 4000mm (h)
	Weight Net	t	8.3t
	Volume	m^3	240
PRINT 1 LARGE	Max. Print Volume (wxdxh)	mm	6000mm (w) x 1500mm (d) x 3600mm (h)
	Size Build Plate (wxdxh)	mm	6000mm x 1500mm x 38mm - hardened steel
	Max. Build Plates	#	6000mm x 1500mm
	Weight Build Plate	kg	750
	Clamping Thread Size	M	16
PRINT 2 COMPLEX	Max. Print Volume (wxdxh)	mm	2000mm (w) x 2000mm (d) x 3600mm (h) - octagonal shape / interchangeable
	Size Build Plate (wxdxh)	mm	2000mm (w) x 2000mm (d) x 40mm (h) - octagonal shape / interchangeable
	Max. Table Payload (incl. build plate)	kg	2000
	Max. Print Payload	kg	Up to 2000
	Weight Build Plate	kg	500
	Clamping Thread Size	M	16
ROBOTICS	Robotic Axis	#	8
	Robot Accuracy	mm	max 0.05 (positional accuracy), max 1.6 (path repeatability)
	Robot Motion Speed	°/s	100 (J1), 90(J1-2),170 (J4),120 (J5),190 (J6),
	Robot Motion Range	°	+220 to -220 (J1), +85 to -65 (J2), +70 to -180 (J3), +300 to -300 (J4), +130 to -130 (J5) and +360 to -360 (J6)
	Rotation Range Build Table	°	-360 to +360, up to infinite rotation in both directions (J7)
	Swiveling Range Build Table	°	-180 to +180 (J8)
WELDING	Welding Transfer Modes	GMAW	MIG/MAG + CMT
	Input Voltage	V	3 x 380V (EU, country-specific voltage possible)
	Max. Input Current	A	45A - before transformer
	Welding Current / Duty Cycle	A/%	10min/40°C: 600A / 40%, 520A / 60%, 430A / 100%
WORKFLOW	Control	OS	MX3D MetalXL-license
	Data/Signal Processing	fs	5,000+
	Interface	Inch	2x 21.5” Touch Screens + MetalXL (online/remote)
	CAD File Format	Format	.stl
LOCAL REQUIREMENTS	Power Connection	V	440V
	Main Fuse Protection	A	3 x 63A slow blow
	Compressed Air	MPa	0.8 MPa / 8 bars
	Compressed Air Flow	l/s	15
	Floor Loading	kN/m^2	Depends on weight of the largest desired print. Calculation: (max. print weigh in kg * 9.80) / 5 (weight / surface)=Kn/m^2

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