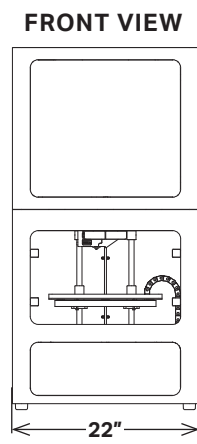
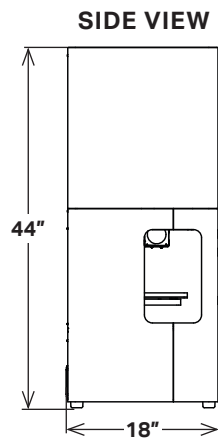


PRINTER SPECIFICATIONS

METAL X

The Metal X is the world's first Atomic Diffusion Additive Manufacturing (ADAM) machine. It's up to 10x less expensive than alternative metal additive manufacturing technologies — and up to a 100x less than traditional fabrication technologies like machining or casting. Affordable, reliable, and easy to use, the Metal X print system gives you everything you need to go from design to fully functional metal parts faster than ever before.

PRINTER PROPERTIES	Process	Atomic Diffusion Additive Manufacturing (ADAM)
	Build Volume	300 x 220 x 180 mm (11.8 x 8.7 x 7.1 in)
	Machine Size	575 x 467 x 1120 mm (22.7 x 18.4 x 44.1 in), 75 kg (160 lbs)
	Print Chamber	Heated
	Print Bed	Heated, Vacuum Sealed Print Sheet, Auto Bed Leveling
	Print System	2 Nozzles — Metal Material and Support Release
	Power Requirements	100-240VAC, 2400W (20A peak), IEC60320 Type C20
PART PROPERTIES	Max Part Size	250 x 183 x 150 mm (9.8 x 7.2 x 5.9 in), 10kg
	Supports	Same Material with Ceramic Release Layer
	Resolution	50 micron - 200 micron
SOFTWARE	Supplied Software	Cloud Storage, Local Storage, or On-Premise (\$5,000 added fee)
	Security	Two Factor Auth, Org Admin Access, Single Sign On
MATERIALS	Launch Material	17-4 PH Stainless Steel
	Beta Materials	Tool Steel (H13, A2, D2) Titanium Ti6Al4V, Inconel (IN) 625, Copper, Aluminum (6061, 7075)
	Media (Spools)	Filament Fed, Bound Powder

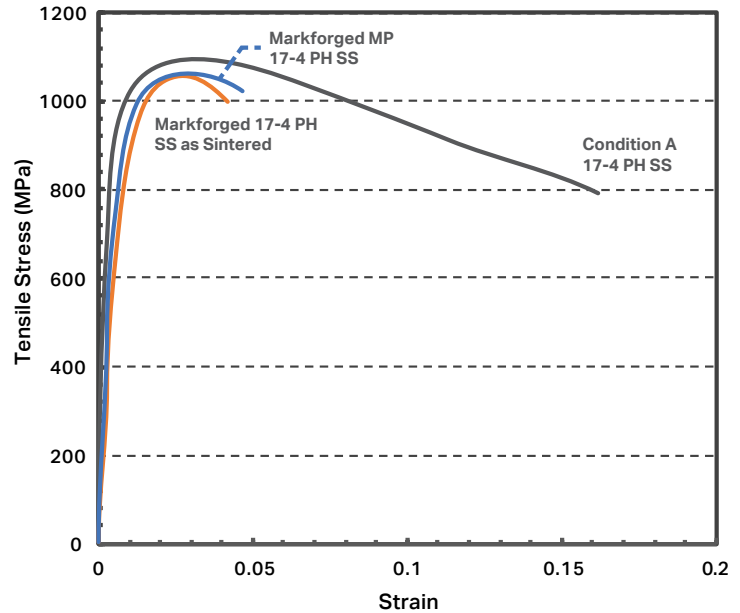


All specifications approximate and subject to change without notice.

17-4 PH STAINLESS STEEL

PRELIMINARY DATA: The values stated in this sheet are preliminary — our materials team is working to constantly improve material properties to drive strength up and cost down. We will share updated testing data as we continue to push the boundaries of additive manufacturing.

COMPOSITION	Amount
Chromium	15-17.5%
Nickel	3-5%
Copper	3-5%
Silicon	1% max
Manganese	1% max
Niobium	0.15-0.45%
Carbon	0.07% max
Phosphorous	0.04% max
Sulfur	0.03% max
Iron	bal



● Markforged

17-4 PH SS printed on the Metal X, washed in the Wash-1, and sintered in the Sinter-1.

● Markforged Mass Production

17-4 PH SS Printed on the Metal X and sent to a production MIM facility for washing and sintering.

● Wrought

Condition A Wrought 17-4 PH SS purchased from McMaster Carr.

MECHANICAL PROPERTIES	Standard	Markforged	MF MP	Wrought
Ultimate Tensile Strength	ASTM E8	1050 MPa	1050 MPa	1090 MPa
0.2% Yield Strength	ASTM E8	750 MPa	800 MPa	900 MPa
Elongation at Break	ASTM E8	4-6%	4-6%	16%
Tensile Modulus	ASTM E8	125 GPa	135 GPa	175 GPa
Hardness	ASTM E18	35 HRC	35 HRC	35 HRC
Corrosion	ASTM F1089	Pass	Pass	Pass
Relative Density	—	≥ 96%	98%	100%

DESIGN CONSTRAINTS

	Dimension
Minimum Part Dimensions	3 mm x 3 mm x 1.6 mm
Minimum Part Width	3 mm (0.118")
Minimum Emboss/Engrave Width	1.8 mm / 0.33 mm
Minimum Post/Hole Diameter	3.5 mm / 1 mm
Maximum Unsupported Overhang	45°
Minimum Thread Size	M3 (1/8")

Composition data were provided by an accredited 3rd party test facility. Mechanical Properties and Design Constraints were tested and verified internally by Markforged. Data is preliminary and will be updated with 3rd party data.

Part and material performance will vary based on build orientation and infill. "As sintered" parts are in the solution annealed condition (condition a). For most applications, mechanical properties can be optimized with heat treatment. Some parts may require redesign for printing and sintering.

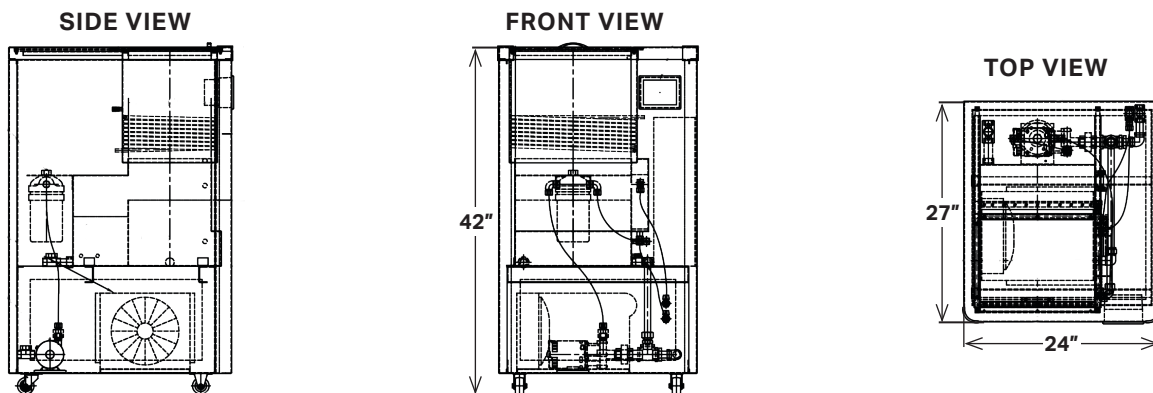
Material data is preliminary and subject to change without notice.

DEBINDER SPECIFICATIONS

WASH-1

The first step in transforming a printed “green” part into fully dense metal is debinding. The Wash-1 immerses the green part in a specialized fluid which removes the primary binding material, leaving the part semi-porous so the remaining binder can easily burn off during sintering. This debinding step purifies the final metal part and helps keep your sintering furnace clean.

DEBINDER PROPERTIES	Materials Supported	All Metals
	Fluid	Opteon Sion
	Controller	Integrated Control System
	Workholding	Stainless Steel Basket
	Washing Size	356 x 254 x 203 mm (14 x 10 x 8 in)
	Washing Volume	18,356 cubic cm (1120 cubic in)
SAFETY & INSTALLATION	Environmental Req.	External Exhaust
	Safety Control	Low Fluid Shutoff Control High Vapor Pressure Shutoff Control
	Regulatory	Refer to MSDS
	Emissions	Low Emission Design to Conserve Solvent
	Power	120/240 VAC Single Phase, 15A/1650W Peak Draw
PHYSICAL DIMENSIONS	External Dimensions	609 x 685 x 1067 mm (24 x 27 x 42 in)
	Weight	136 kg (300 lbs)



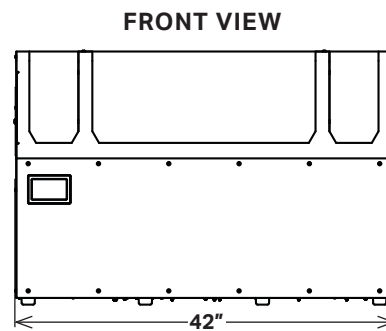
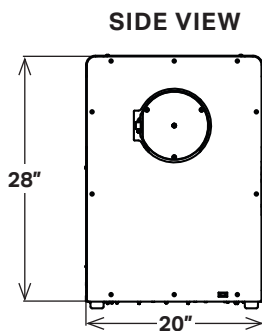
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FURNACE SPECIFICATIONS

SINTER-1

The Markforged Sinter-1 is a high performing, high value furnace - it's affordable, sizable, and reliable. Featuring 4760 cubic cm of working volume, The Sinter-1 effortlessly converts washed parts into their dense final metallic form. Built on 30 years of Metal Injection Molding (MIM) technology, it is ideal for sintering medium sized parts and small batch production.

FURNACE PROPERTIES	Materials Supported	All Commercial Grade Metals Including: Stainless Steel, Tool Steel, Inconel, Aluminum, & Titanium
	Heating Element	Kanthal
	Controller	Pre-Programmed Automatic Cycling
	Peak Temperature	1300° C
	Sintering Capacity	Cylindrical - 141 mm ID x 305 mm L (5.55" ID x 12" L)
	Sintering Volume	4760 cubic cm (290 cubic in)
	Gas Types	Nitrogen, Argon, and Forming Gases
	Retort	High Purity Refractory Retort (Carbon Free)
	Sintering Surface	Ceramic
SAFETY & INSTALLATION	Environmental Req.	External Exhaust (100 CFM)
	Power	208-250 V Single Phase 36A, Recommend Wiring 50A
	Over Temperature	Protection System Included
PHYSICAL DIMENSIONS	External Dimensions	1067 x 505 x 720 mm (42 x 20 x 28 in)
	Weight	136 kg (300 lbs)



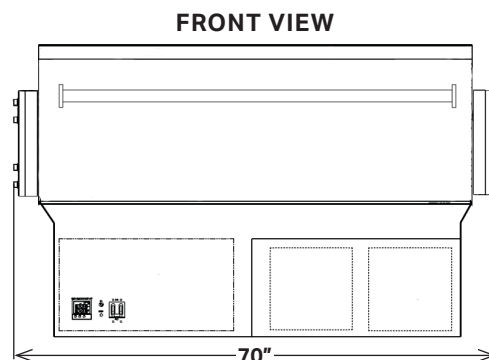
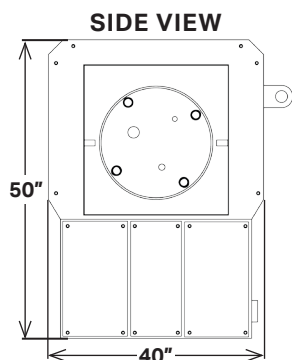
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FURNACE SPECIFICATIONS

SINTER-2

With a huge active hot-zone (22,283 cubic cm), the Sinter-2 accommodates the full build volume of the Metal X. It's the perfect solution for larger parts or batch production. This workhorse furnace sinters the full range of commercial grade metals from their washed state into dense metal parts.

FURNACE PROPERTIES	Materials Supported	All Commercial Grade Metals Including: Stainless Steel, Tool Steel, Inconel, Aluminum, & Titanium
	Heating Element	Kanthal
	Controller	Pre-Programmed Automatic Cycling
	Peak Temperature	1300° C
	Sintering Capacity	Cylindrical - 305 mm ID x 305 mm L (12" ID x 12" L)
	Sintering Volume	22,283 cubic cm (1,360 cubic in)
	Gas Types	Nitrogen, Argon, and Forming Gases
	Retort	High Purity Refractory Retort (Carbon Free)
	Sintering Surface	Ceramic
SAFETY & INSTALLATION	Environmental Req.	External Exhaust (100 CFM)
	Power	208 3-Phase, 100A Recommended
	Over Temperature	Protection System Included
PHYSICAL DIMENSIONS	External Dimensions	1778 x 1016 x 1270 mm (70 x 40 x 50 in)
	Weight	654 kg (1500 lbs)



All specifications approximate and subject to change without notice.