PRINTING PROCESS AND MATERIAL GUIDE

Markforged

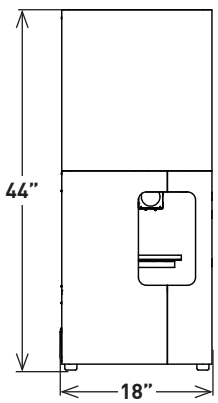
F-PR-5000

METAL X
PRINTER SPECIFICATIONS

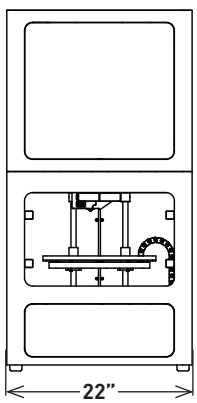
The Metal X is the world's first Atomic Diffusion Additive Manufacturing (ADAM) machine. It's up to 10x less expensive than alternative metal additive manufacturing technologies — and up to a 100x less than traditional fabrication technologies like machining or casting. Affordable, reliable, and easy to use, the Metal X print system gives you everything you need to go from design to fully functional metal parts in under 24 hours.

PRINTER PROPERTIES	**Process**	Atomic Diffusion Additive Manufacturing (ADAM)
	Build Volume	250 x 220 x 200 mm (9.8 x 8.7 x 7.1 in)
	Weight	< 114 kg (250 lbs)
	Machine Footprint	575 x 467 x 1120 mm (22.7 x 18.4 x 44.1 in)
	Power Requirements	100-240VAC, 2400W (20A peak), IEC60320 Type C20
PART PROPERTIES	**Max Part Size**	208 x 183 x 167 mm (8.2 x 7.2 x 6.6 in)
	Max Part Mass	10 kg
	Part Density	> 97%
	Infill	Closed Cell Triangular Infill
SOFTWARE	**Supplied Software**	Markforged Eiger - Cloud Storage, Local Storage, or Fully On-Premise ($5,000 added fee)
	Security	Two Factor Authentication, Org Admin Access, Single Sign On
MATERIALS	**Launch Materials**	17-4 Stainless Steel, 316L Stainless Steel
	Beta Materials	6061 Aluminum, 7075 Aluminum, Inconel (IN) 625, A-2 Tool Steel, D-2 Tool Steel, Titanium Ti6Al4V
	Media Cartridge	Bound Powder
MACHINE COST		**$99,500 SRP**

SIDE VIEW



FRONT VIEW



All specifications approximate and subject to change without notice.

Markforged

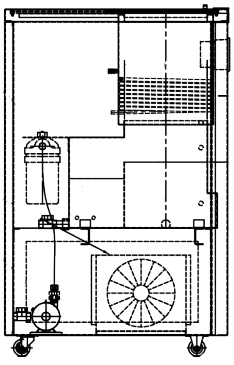
F-PW-0001

WASH-1
DEBINDER SPECIFICATIONS

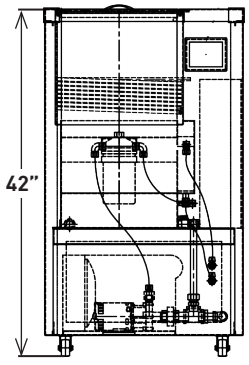
The first step in transforming a printed “green” part into fully dense metal is debinding. The Wash-1 immerses the green part in a specialized fluid which removes the primary binding material, leaving the part semi-porous so the remaining binder can easily burn off during sintering. This debinding step 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 mm x 254 mm x 203 mm (14” x 10” x 8”)
	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
PHYSICAL DIMENSIONS	**External Dimensions**	609 mm x 685 mm x 1067 mm (24” x 27” x 42”)
	Weight	136 kg (300 lbs)
MACHINE COST		**$9,990**

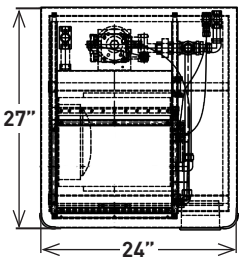
SIDE VIEW



FRONT VIEW



TOP VIEW



All specifications approximate and subject to change without notice.

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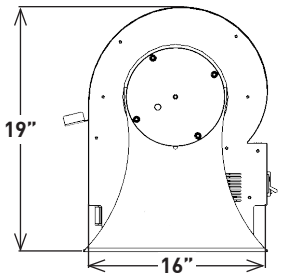
F-SR-0001

SINTER-1
FURNACE SPECIFICATIONS

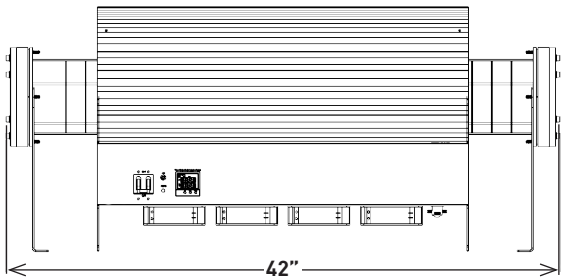
The Markforged Sinter-1 is a high performing, high value furnace - it's affordable, sizable, and reliable. Featuring 4760 cubic cm of working volume, The Sinter-1 effortlessly converts washed parts into their dense final metallic form. Built on 30 years of Metal Injection Molding (MIM) technology, it 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 1-Phase 36A, Recommend Wiring 50A
	Over Temperature	Protection System Included
PHYSICAL DIMENSIONS	**External Dimensions**	1067 mm x 483 mm x 406 mm (42" x 19" x 16")
	Weight	218 kg (500 lbs)
MACHINE COST		**$14,990**

SIDE VIEW



FRONT VIEW



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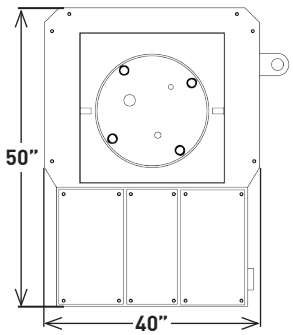
F-SR-0002

SINTER-2
FURNACE SPECIFICATIONS

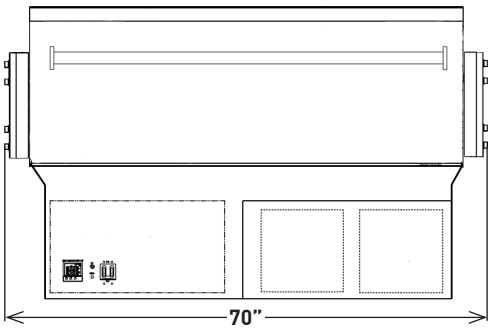
With a huge active hot-zone (22,283 cubic cm), the Sinter-2 accommodates the full build volume of the Metal X. It's the perfect solution for larger parts or batch production This workhorse furnace sinters the full range of commercial grade metals from their washed state into dense metal parts.

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 mm x 1016 mm x 1270 mm (70" x 40" x 50")
	Weight	654 kg (1500 lbs)
MACHINE COST		**$49,990**

SIDE VIEW



FRONT VIEW



All specifications approximate and subject to change without notice.

MATERIAL SPECIFICATIONS

17-4 PH STAINLESS STEEL

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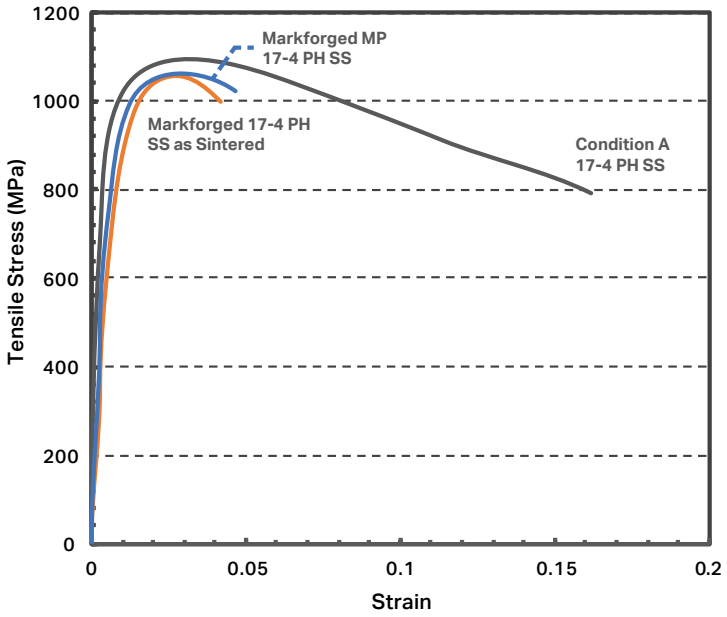
PRELIMINARY DATA: The values stated in this sheet are preliminary — our materials team is working to constantly improve material properties to drive strength up and cost down. We will share updated testing data as we continue to push the boundaries of additive manufacturing.

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



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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.

LINE OVERVIEW

MARKFORGED INDUSTRIAL SERIES

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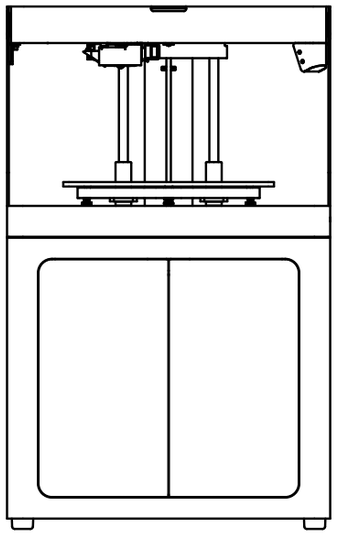
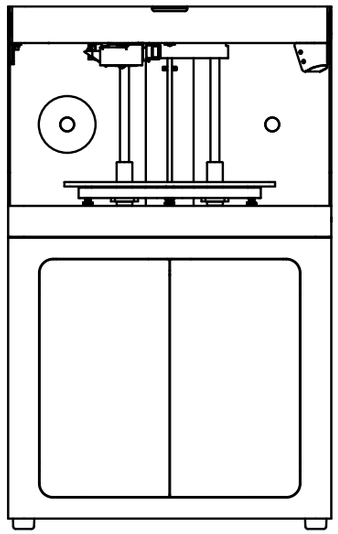
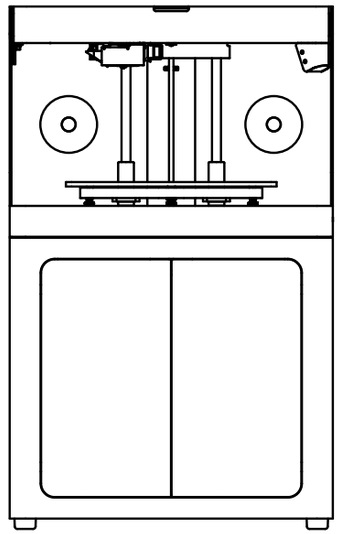
X3 - STRONG



X5 - STRONGER



X7 - STRONGEST



FEATURE LIST

Part Ultimate Tensile Strength	36 MPa (1.2x ABS)	590 MPa (19.0x ABS)	700 MPa (22.6x ABS)
Max Flexural Stiffness	2.9 GPa (1.4x ABS)	22 GPa (10.7x ABS)	51 GPa (24.8x ABS)
Material: Plastic	Onyx	Onyx	Onyx
Material: Continuous Fiber	None	Fiberglass	Carbon Fiber, Kevlar, Fiberglass, HSHT Fiberglass
Print Head	1 nozzle	2 nozzle	2 nozzle, hardened for abrasive materials
Laser Operations	Laser Assisted Leveling, Active Print Calibration		Laser Assisted Leveling, In-Process Inspection
Build Volume	330 x 270 x 200 mm (13 x 10.6 x 7.9 in) Volume =17820 cu cm.		
Print Bed	Kinematic Magnetic Coupling, 10um Bed Location Repeatability		
Bed Flatness	Precision ground to 80um Peak to Peak Flatness		
Machine Gantry	Reinforced Hardened Steel, 80um Peak to Peak Flatness		
Laser Specs	Accurate to 1um in Z, 25um in XY		
Live build inspection	Built in camera, photos viewable through eiger		
Adaptive Bed Leveling	Laser Bed Level dynamically adapts for first layers of part based on bed scan		
Electronics and Sensing	High Frequency Motion Control Silent Stepper Motors - Encoder feedback on drive and extruder motor - Full out of material detection		
Weight	46kg (102 lbs)	48kg (106 lbs)	48kg (106 lbs)

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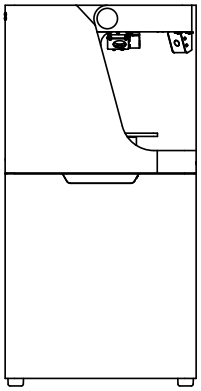
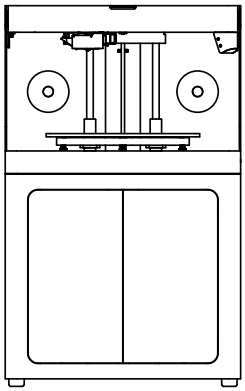
PRICE SHEET

INDUSTRIAL SERIES

Print parts with the strength of Aluminum. Large format, High Precision, and fully instrumented, these printers deliver exceptional accuracy, reliability and repeatability - perfect for manufacturing line Jigs, Jaws, Tools, and Fixtures. Designed for accuracy and built to survive the production floor environment - the X series effortlessly delivers the tools you need to keep your line running.

		X3	X5	X7
PRINTER KIT	Machine	✓	✓	✓
	Laser Assist Bed Level	✓	✓	✓
	In Process Inspection			✓
	3x FFF Quick-Change Nozzle	✓	✓	✓
	3x CFF Quick-Change Nozzle		✓	✓
MATERIALS INCLUDED	Onyx Spool (800 cm^3)	✓	✓	✓
	Fiberglass Spool (50 cm^3)		✓	✓
	Carbon Fiber Spool (50 cm^3)			✓
	Kevlar Spool (50 cm^3)			✓
	HSHT Fiberglass Spool (50 cm^3)			✓
SOFTWARE	Cloud Software	✓	✓	✓
	Premium Software Support	✓	✓	✓
ORDERING DETAILS	SKU	**F-PR-3004**	**F-PR-3005**	**F-PR-3002**
	Machine Cost	**$ 36,990 SRP**	**$ 49,990 SRP**	**$ 69,000 SRP**
	Upgrades	**X5: $16,990 SRP X7: $ 39,990 SRP**	**X7: $ 24,990 SRP**	





Markforged

F-PR-2017

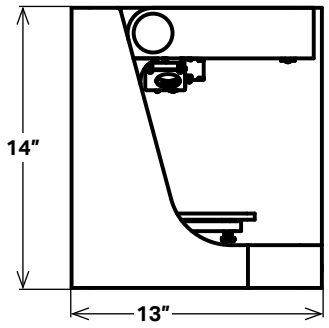
PRINTER SPECIFICATIONS

MARK TWO

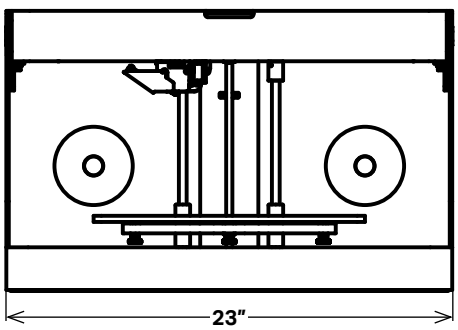
Replace machined aluminum tooling - jigs, jaws and fixtures - with stronger parts for a fraction of the price. The Mark Two combines Markforged's unique continuous carbon fiber reinforcement with workhorse reliability for versatile parts with 23x the strength of ABS, ready same-day for use straight off the printer.

PRINTER PROPERTIES	**Process**	Continuous Fiber Reinforced Plastics
	Build Volume	320 x 132 x 154 mm (12.6 x 5.2 x 6 in)
	Weight	16 kg (35 lbs)
	Machine Footprint	584 x 330 x 355 mm (23 x 13 x 14 in)
	Print Bed	Flat to within 160 um - Kinematic coupling
	Power	100-240VAC, 150W (2A peak)
PART PROPERTIES	**Layer Height**	100um default, 200um maximum
	Ultimate Tensile Strength	700 MPa (22.6x ABS, 19.4x Onyx)
	Max Flexural Stiffness	51 GPa (24.8x ABS, 17.6x Onyx)
	Infill	Closed Cell Infill: Multiple geometries available
SOFTWARE	**Supplied Software**	Markforged Software - Cloud Storage, Local Storage, or Fully On-Premise ($5,000 added fee)
	Security	Two Factor Auth, Org Admin Access, Single Sign On
MATERIALS	**Plastics Available**	Onyx
	Fibers Available	Carbon Fiber, Fiberglass, Kevlar, High Strength/High Temp Fiberglass
MACHINE COST		**$ 13,499 SRP**

SIDE VIEW



FRONT VIEW



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Markforged

F-PR-4001

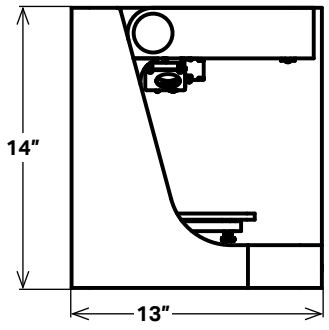
PRINTER SPECIFICATIONS

ONYX PRO

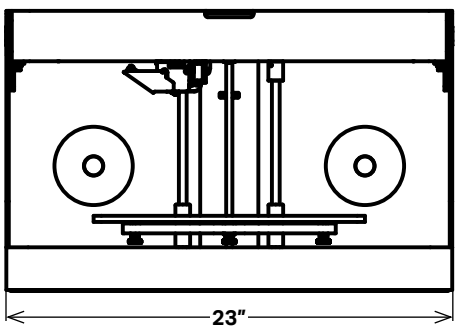
The Onyx Pro features Markforged's unique continuous fiber reinforcement at an affordable price. Built on a durable chassis with precision components, the Onyx Pro prints fiberglass reinforced thermoplastic parts that are 10x as strong as traditional printing plastics.

PRINTER PROPERTIES	**Process**	Continuous Fiber Reinforced Plastics
	Build Volume	320 x 132 x 154 mm (12.6 x 5.2 x 6 in)
	Weight	16 kg (35 lbs)
	Machine Footprint	584 x 330 x 355 mm (23 x 13 x 14 in)
	Print Bed	Flat to within 160 um - Kinematic coupling
	Power	100-240VAC, 150W (2A peak)
	Mark Two Upgrade	Carbon Fiber, HSHT, and Kevlar
PART PROPERTIES	**Layer Height**	100um default, 200um maximum
	Ultimate Tensile Strength	590 MPa (19.0x ABS, 16.4x Onyx)
	Max Flexural Stiffness	22 GPa (10.7x ABS, 7.6x Onyx)
	Infill	Closed Cell Infill: Multiple geometries available
SOFTWARE	**Supplied Software**	Markforged Software - Cloud Storage, Local Storage, or Fully On-Premise ($5,000 added fee)
	Security	Two Factor Auth, Org Admin Access, Single Sign On
MATERIALS	**Plastics Available**	Onyx
	Fibers Available	Fiberglass
MACHINE COST		**$ 6,999 SRP**

SIDE VIEW



FRONT VIEW



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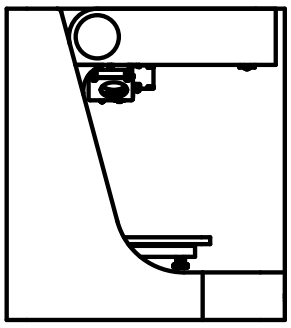
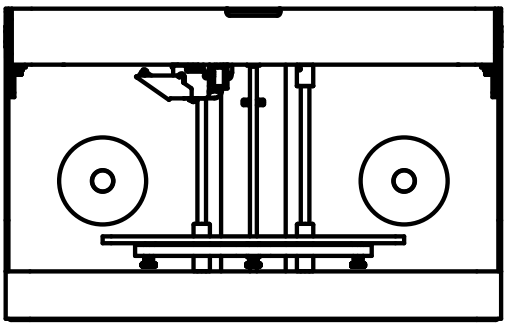
PRICE SHEET

DESKTOP SERIES

The engineering excellence of the Industrial Series in a form factor that fits on your desk. Industrial grade hardware, cloud managed software, and engineering grade materials combine to allow you to print light, strong replacements for machined aluminum tooling. Now, your parts are ready same-day for a fraction of the price.

		Onyx One	Onyx Pro	Mark Two
PRINTER KIT	6,505 cm^3 Build Volume	✓	✓	✓
	3x FFF Quick-Change Nozzle	✓	✓	✓
	3x CFF Quick-Change Nozzle		✓	✓
MATERIALS INCLUDED	Onyx Spool (800 cm^3)	✓	✓	✓
	Fiberglass Spool (50 cm^3)		✓	✓
	Carbon Fiber Spool (50 cm^3)			✓
	Kevlar Spool (50 cm^3)			✓
	HSHT Fiberglass Spool (50 cm^3)			✓
SOFTWARE	Markforged Software	✓	✓	✓
	Regular Software Updates	✓	✓	✓
ORDERING DETAILS	SKU	**F-PR-4001**	**F-PR-4002**	**F-PR-2017**
	Machine Cost	**$ 3,499 SRP**	**$ 6,999 SRP**	**$ 13,499 SRP**
	Upgrades	**OP: $ 4,250 SRP M2: $ 11,500 SRP**	**M2: $ 8,000 SRP**	





DATA SHEET

MARKFORGED MATERIAL PROPERTIES

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THERMOPLASTICS	Test Standard	Onyx	Nylon
Tensile Modulus (GPa) Acetone	ASTM D638	1.4	0.94
Tensile Stress at Yield (MPa)	ASTM D638	36	31
Tensile Strain at Yield (%)	ASTM D638	25	27
Tensile Stress at Break (MPa)	ASTM D638	30	54
Tensile Strain at Break (%)	ASTM D638	58	260
Flexural Strength (MPa)	ASTM D790[1]	81	32
Flexural Modulus (GPa)	ASTM D790[1]	2.9	0.84
Heat Deflection Temp (°C)	ASTM D648 B	145	49 (140[2])
Density (g/cm^3)	N/A	1.18	1.1
Izod Impact - notched (J/m)	ASTM D256-10 A	334	1015

TESTING CONDITIONS

Fiber Reinforcement	Unidirectional (0° Plies) reinforcement on all sample plaques tested. Fibers are laid lengthwise along the longest dimension of the sample.[4]
Fiber Tensile Specimens	9.8" x 0.5" x 0.048" (Carbon Fiber), 9.8" x 0.5" x 0.08" (All other fibers)
Plastic Tensile Specimens	ASTM D638 type IV beams
Flexural Specimens	3 pt. bending, 4.5" x 0.4" x 0.12" specimen size
Compressive Specimens	5.5" x 0.5" x 0.085" (Carbon Fiber), 5.5" x 0.5" x 0.12" (Carbon Fiber)
Heat Deflection Conditions	0.45 MPa (Standard ASTM D648 Method B)

ADDITIONAL NOTES

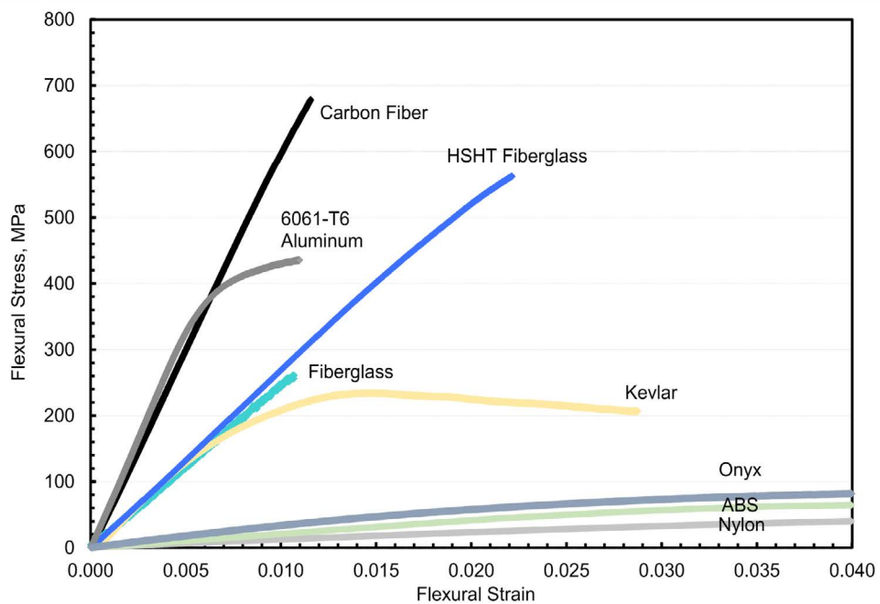
1. Measured by a method similar to ASTM D790
2. HDT of a Nylon beam with <10% HSHT content (fiber added)
3. Two samples measured instead of five
4. Photos to right show Carbon Fiber and Kevlar test samples. Note unidirectional (left to right) reinforcement
5. Fiber tests are plastic-independent (samples with Nylon and Onyx behave the same)

CARBON CFF

KEVLAR CFF

CONTINUOUS FIBERS[5]	Test Standard	Carbon CFF	Kevlar CFF	Fiberglass CFF	HSHT Glass CFF
Tensile Strength (MPa)	ASTM D3039	700	610	590	600
Tensile Modulus (GPa)	ASTM D3039	54	27	21	21
Tensile Strain at Break (%)	ASTM D3039	1.5	2.7	3.8	3.9
Flexural Strength (MPa)	ASTM D790[1]	470	190	210	420
Flexural Modulus (GPa)	ASTM D790[1]	51	26	22	21
Flexural Strain at Break (%)	ASTM D790[1]	1.2	2.1	1.1	2.2
Compressive Strength (MPa)	ASTM D6641	320	97	140	192
Compressive Modulus (MPa)	ASTM D6641	54	28	21	21
Compressive Strain at Break (%)	ASTM D6641	0.7	1.5	n/a	n/a
Heat Deflection Temp (°C)	ASTM D648 B	105	105	105	150
Density (g/cm^3)	N/A	1.4	1.25	1.6	1.6
Izod Impact - notched (J/m)	ASTM D256-10 A	958	1873[2]	2603	3117

STRESS VS STRAIN GRAPH



HP Jet Fusion 580/380 Color and 540/340 3D Printers

Produce functional parts in full color, black or white —with voxel control—in a fraction of the time[1]

The cost-effective HP 3D printer tailored for small/medium-sized product development teams, design firms, and universities.

Now you can prototype and produce with the same technology.

Produce accurate, functional parts with intricate detail

- Produce engineering-grade thermoplastic parts with optimal mechanical properties
- Achieve fine detail and high dimensional accuracy for small features
- Access a wide range of future materials and applications with the HP Multi Jet Fusion Open Platform
- Get accurate and repeatable results

Accelerate your design cycle—create, test, iterate in just hours

- Increase your productivity—produce multiple prototype iterations in the same time it takes to print a single part[1]
- Access convenient in-house automated production with the most compact HP Jet Fusion 3D device
- Get the parts you want when you need them, easily, reliably, and predictably
- Move smoothly from prototyping to final part production with the same HP Multi Jet Fusion platform
- Gain peace of mind—we're here to meet your in-house 3D printing needs with HP's world-class training, support, and services

Create full spectrum color parts with a voxel-control system poised for future innovation

- Produce brilliant, full-color functional parts while maintaining optimal mechanical properties
- Stay ahead with a future-ready technology, configurable for voxel control beyond color

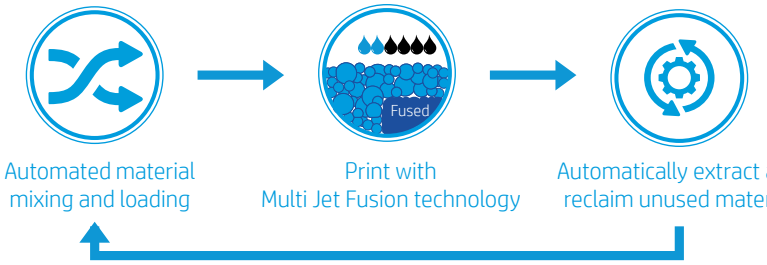
The most compact HP Jet Fusion 3D devices, designed for convenient in-house automated production.

Full color
HP Jet Fusion 580/380 3D Printers
8-agent configurability

Image shows the HP Jet Fusion 580 Color 3D Printing Solution

Black and White
HP Jet Fusion 540/340 3D Printers
4-agent configurability

Fully integrated, compact design.



Technical information

Printable build size 580/540 Printers:	up to 7.5 x 13.1 x 9.8 inches (190 mm x 332 mm x 248 mm)
Printable build size 380/340 Printers:	up to 7.5 x 10 x 9.8 inches (190 mm x 254 mm x 248 mm)
Layer thickness:	0.08mm
Productivity:	Full bucket with 52 parts in about 15 hours, as many as 5 parts in around four hours[1, 2]
Printer dimensions:	Printer dimensions: 61.6 x 37.6 x 59.3 inches (1565mm x 955mm x 1,505mm) Rear module can be temporarily removed to fit through a 36-inch (900mm) door

Materials

Access a wide range of future materials and applications with the HP Multi Jet Fusion Open Platform.

Services

Gain peace of mind—we're here to meet your in-house 3D printing needs with HP's world-class training, support, and services

Data courtesy of FreshFiber

Data courtesy of Phoenix Children's Hospital: Heart of Jemma

Full-color[3] functional parts with engineering-grade thermoplastic

1. Based on internal and third-party testing for HP Jet Fusion 580 and 540 3D Printers, printing time is a fraction of the time of the printing times of comparable plastic fused deposition modeling (FDM), stereolithography (SLA), and material jetting solutions from $20,000 USD to $120,000 USD on market as of June, 2017. Testing variables for the HP Jet Fusion 580 3D Printer: Part quantity: 1 full build chamber of parts from HP Jet Fusion 3D at 10% of packing density versus same number of parts on above-mentioned competitive devices; Part size: 30 cm^3; Layer thickness: .08 mm/0.003 inches. Competitor testing variables are comparable.
2. For HP Jet Fusion 580/540 3D Printers only.
3. For HP Jet Fusion 580/380 3D Printers only.

4AA7-1970ENA, January 2018
This is an HP Indigo digital print.

HP Jet Fusion 3D Printing Solution

Reinventing prototyping and manufacturing

The HP Jet Fusion 3D printing solution reinvents how you prototype and produce functional parts, delivering quality output, up to 10 times faster[1] at half the cost[2]

Superior, consistent part quality

- Get extreme dimensional accuracy and fine detail,[3] thanks to HP's unique Multi-Agent printing process
- Produce truly functional parts with optimal mechanical properties,[4] faster[1]
- Obtain predictable, reliable final printed parts that match your design[5]
- Access new future materials and uncover new applications thanks to the HP Multi Jet Fusion Open Platform

Breakthrough productivity

- Produce more parts per day with continuous printing and fast cooling[1]
- Streamline your workflow with HP's automated materials preparation and post-processing station
- Cleaner experience with an enclosed Processing Station and materials not classified as hazardous[6]
- Rely on HP's world-class Technical Services and Support to maximize uptime and productivity
- Choose your ideal end-to-end solution from a range of printing and processing options

Lowest cost-per-part[2]

- Achieve lowest cost-per-part[2] and reduce operational costs, opening your doors to short-run manufacturing
- Benefit from a competitively-priced 3D printing solution[2]
- Optimize cost and part quality, with cost-efficient materials that offer industry-leading reusability[7]
- Plan production times more accurately and predictably, to increase your overall operational efficiency

For more information, please visit
hp.com/go/JetFusion3Dsolutions

HP Jet Fusion 3D 4200/3200 Printing Solution

SOLUTION

Easy-to-use solution that scales with your business. Integrated **end-to-end process** that delivers both functional prototypes and final parts

Breakthrough speed up to **10 times faster**[1] thanks to **HP's proprietary printing technologies** with 30 million drops per second across each inch of the working area

PRINTER

1 **HP fusing and detailing agents** work with HP Multi Jet Fusion technology and materials to deliver fine details and dimensional accuracy[3]

2 **Accurate thermal control** of every layer enables predictive corrections voxel by voxel for optimal mechanical properties[4]

3 **In-printer quality checks** reported via a touchscreen help minimize errors and enable easy and accurate job progress tracking

SOFTWARE

HP SmartStream 3D Build Manager and Command Centre: complete, easy-to-use in-box software solutions that streamline your workflow from design to final part

SERVICES & SUPPORT

HP Technical Services and Support stand behind your business to maximize your uptime and productivity, with next-business-day onsite support[8] and spare parts availability[9]

HP Jet Fusion 3D 4200/3200 Printer

HP Jet Fusion 3D Processing Station with Fast Cooling[1]

Image may differ from actual product.

PROCESSING STATION

4 **Automated material mixing and loading systems** help streamline your workflow and reduce labor time

5 No additional room for parts removal needed with **enclosed unpacking and material collection system,** including a laminar hood

6 The **HP Jet Fusion 3D Build Unit**—included within the printer—is moved on for cooling right after job completion allowing a **continuous printing** process and maximizing productivity[1]

7 **The HP Jet Fusion 3D Fast Cooling Module**[1] reduces cooling time resulting in faster[1] time-to-part and more parts ready within the same day

MATERIALS

8 Lowest cost-per-part[2] and minimal powder wastage with **HP 3D High Reusability PA12**—a strong, multi-purpose thermoplastic that optimizes cost and part quality[7]

Accelerated **materials innovation** to drive new, high-performance materials thanks to **HP's Open Platform**

Ordering information

	HP Jet Fusion 3D 4200 printing solution		HP Jet Fusion 3D 3200 printing solution	
Product	M0P44A	HP Jet Fusion 3D 4200 Printer	M0P41A	HP Jet Fusion 3D 3200 Printer
Accessories	M0P49A	HP Jet Fusion 3D Processing Station with Fast Cooling[1]	M0P42A	HP Jet Fusion 3D Processing Station
	M0P45A	HP Jet Fusion 3D Build Unit	M0P45A	HP Jet Fusion 3D Build Unit
Original HP Printheads	F9K08A	HP 3D600 Printhead	F9K08A	HP 3D600 Printhead
Original HP Agents	V1Q60A	HP 3D600 Fusing Agent 3L	V1Q60A	HP 3D600 Fusing Agent 3L
	V1Q61A	HP 3D600 Detailing Agent 3L	V1Q61A	HP 3D600 Detailing Agent 3L
Other supplies	V1Q66A	HP 3D600 Cleaning Roll	V1Q66A	HP 3D600 Cleaning Roll
Original HP 3D materials	V1R10A	HP 3D High Reusability PA12 30L[10] (13 kg)	V1R10A	HP 3D High Reusability PA12 30L[10] (13 kg)
Service and support	U9EK5E	HP Installation and Introduction to Basic Operation	U9EJ8E	HP Installation and Introduction to Basic Operation
	HP Support Contracts (Next Business Day Onsite, Annual)		HP Support Contracts (Next Business Day Onsite, Annual)	
	U9EK4E	HP 3 year HP Next Business Day Onsite Support	U9EJ7E	HP 3 year HP Next Business Day Onsite Support
	U9EK7E	HP Operator Training	U9EK0E	HP Operator Training

Technical specifications[11]

HP Jet Fusion 3D 4200 Printer
HP Jet Fusion 3D 3200 Printer

Printer performance	Technology	HP Multi Jet Fusion technology
	Effective building volume	406 x 305x 406 mm (16 x 12 x 16 in)
	Building speed	**3200 Printer:** 3500 cm³/hr (215 in³/hr)[12] **4200 Printer:** 4500 cm³/hr (275 in³/hr)[13]
	Layer thickness	**3200 Printer:** 0.08 to 0.10 mm (0.003 to 0.004 in) **4200 Printer:** 0.07 to 0.12 mm (0.0025 to 0.005 in)
	Print resolution (x, y)	1200 dpi
Dimensions (w x d x h)	Printer	2178 x 1238 x 1448 mm (85.7 x 48.7 x 57 in)
	Shipping	2300 x 1325 x 1983 mm (91 x 52 x 78 in)
	Operating area	3700 x 3700 mm (146 x 146 in)
Weight	Printer	730 kg (1609 lb)
	Shipping	900 kg (1984 lb)
Network	Gigabit Ethernet (10/100/1000Base-T), supporting the following standards: TCP/IP, DHCP (IPv4 only), TLS/SSL	
Hard disk	2 TB (AES-128 encrypted, FIPS 140, disk wipe DoD 5220M)	
Software	Included software	HP SmartStream 3D Build Manager, HP SmartStream 3D Command Center
	Supported file formats	3mf, stl
	Certified third-party software	Autodesk® Netfabb® Engine for HP, Materialise Magics with Materialise Build Processor for HP Multi Jet Fusion
Power	Consumption	9 to 11 kW (typical)
	Requirements	Input voltage three phase 380 to 415 V (line-to-line), 30 A max, 50/60 Hz / 200 to 240 V (line-to-line), 48 A max, 50/60Hz
Certification	Safety	IEC 60950-1+A1+A2 compliant; United States and Canada (UL listed); EU (LVD and MD compliant, EN60950-1, EN12100-1, EN60204-1, and EN1010)
	Electromagnetic	Compliant with Class A requirements, including: USA (FCC rules), Canada (ICES), EU (EMC Directive), Australia (ACMA), New Zealand (RSM)
	Environmental	REACH
Warranty		One-year Services and Support coverage[14]

HP Jet Fusion Processing Station with Fast Cooling[1]
HP Jet Fusion Processing Station

Features	**Processing Station** (Only compatible with the HP Jet Fusion 3200 Printer)	Automated mixing, sieving, and loading; manual unpacking
	Processing Station with Fast Cooling[1] (Compatible with the HP Jet Fusion 3200 and 4200 Printers)	Automated mixing, sieving, and loading; semi-manual unpacking; fast cooling; external storage tank; compatible with high-capacity material cartridges
Dimensions (w x d x h)	**Processing Station**	1926 x 1245 x 2400 mm (75.8 x 49 x 94.5 in)
	Processing Station with Fast Cooling[1]	3121 x 1571 x 2400 mm (122.9 x 61.9 x 94.5 in)
	Shipping	
	Processing Station	2304 x 1176 x 2180 mm (90.7 x 46.3 x 85.8 in)
	Processing Station with Fast Cooling[1]	3499 x 1176 x 2180 mm (137.8 x 46.3 x 85.8 in)
	Operating area	
	Processing Station	2126 x 2745 mm (83.7 x 108.1 in)
	Processing Station with Fast Cooling[1]	3321 x 3071 mm (130.7 x 120.9 in)
Weight	**Processing station**	450 kg (992 lb)
	Processing station (loaded)	700 kg (1543 lb)
	Processing Station with Fast Cooling[1]	480 kg (1058 lb)
	Processing Station with Fast Cooling[1] (loaded)	810 kg (1786 lb)
	Shipping	
	Processing Station:	600 kg (1323 lb)
	Processing Station with Fast Cooling[1]	620 kg (1367 lb)
Certification	Safety	IEC 60950-1+A1+A2 compliant; United States and Canada (UL listed); EU (LVD and MD compliant, EN60950-1, EN12100-1, EN60204-1, and EN1010)
	Electromagnetic	Compliant with Class A requirements, including: USA (FCC rules), Canada (ICES), EU (EMC Directive), Australia (ACMA), New Zealand (RSM)
	Environmental	REACH
Warranty		One-year Services and Support coverage[14]

Eco Highlights

- Powders or agents and are not classified as hazardous[6]
- Enclosed printing system and automated powder management, including post-processing, for a cleaner and more comfortable environment[6]
- Minimum waste thanks to high reusability of powder[7]
- Take back program for PHs[15]

Find out more about HP sustainable solutions at hp.com/ecosolutions

For more information, please visit
hp.com/go/JetFusion3Dsolutions

Cofinanced Project by Minetur-SETSI TSI-100802-2014-1

1. Fast Cooling enabled by HP Jet Fusion 3D Processing Station with Fast Cooling, available in April 2017. HP Post Processing Station with Fast Cooling accelerates parts cooling time versus recommended manufacturer time by SLS printer solutions from $100,000 USD to $300,000 USD, as tested in April 2016. FDM not applicable. Continuous printing requires an additional HP Jet Fusion 3D Build Unit (standard printer configuration includes one HP Jet Fusion 3D Build Unit). Based on internal testing and simulation, HP Jet Fusion 3D average printing time is up to 10x faster than FDM & SLS printer solutions from $100,000 USD to $300,000 USD on market as of April 2016. Testing variables: Part Quantity-1 full build chamber of parts from HP Jet Fusion 3D at 20% of packing density vs same number of parts on above-mentioned competitive devices; Part Size 30 g; Layer thickness: 0.1 mm/0.004 inches.
2. Based on internal testing and public data, HP Jet Fusion 3D average printing cost-per-part is half the cost of comparable FDM and SLS printer solutions from $100,000 USD to $300,000 USD on market as of April 2016. Cost analysis based on: standard solution configuration price, supplies price, and maintenance costs recommended by manufacturer. Cost criteria: printing 1-2 build chambers per day/ 5 days per week over 1 year of 30-gram parts at 10% packing density using the powder reusability ratio recommended by manufacturer.
3. Based on dimensional accuracy of ±0.2 mm/0.008 inches, measured after sand blasting. See hp.com/go/3Dmaterials for more information on materials specifications.
4. Based on the following mechanical properties: Tensile strength at 50 Mpa (XYZ), Modulus 1900 Mpa (XYZ). ASTM standard tests with PA12 material. See hp.com/go/3Dmaterials for more information on materials specifications.
5. Within allowable margin of error. Based on dimensional accuracy of ±0.2 mm/0.008 inches, measured after sand blasting. See hp.com/go/3Dmaterials for more information on materials specifications.
6. The term "cleaner" does not refer to any indoor air quality requirements and/or consider related air quality regulations or testing that may be applicable. The HP powder and agents do not meet the criteria for classification as hazardous according to Regulation (EC) 1272/2008 as amended.
7. HP Jet Fusion 3D print solution with HP 3D High Reusability PA12 has the highest post-production surplus powder reusability with 80% reusability vs any other powder based 3DP technology using PA12 material. Consistent performance with only 20% powder refresh rate.
8. Within warranty or Care Pack coverage.
9. Next-business-day parts availability in most countries.
10. 30L refers to the materials container size and not the actual materials volume.
11. For latest technical specifications, please visit hp.com/go/3Dprint.
12. Based on 0.08-mm (0.003-in) layer thickness and 10 sec/layer.
13. Based on 0.1-mm (0.004-in) layer thickness and 8 sec/layer.
14. Only available in certain countries and subject to Terms and Conditions of HP Limited Warranty and/or Service Agreement. Please consult with your local sales representatives for further details.
15. Printing supplies eligible for recycling vary by printer. Visit hp.com/recycle to see how to participate and for HP Planet Partners program availability; program may not be available in your area. Where this program is not available, and for other consumables not included in the program, consult your local waste authorities on appropriate disposal.

4AA6-4892ENA, Rev. 1, July 2016
This is an HP Indigo digital print.

HP Jet Fusion 3D 4210 Printing Solution

Accelerate your business' transformation to industrial-scale 3D manufacturing

Unlock 3D manufacturing-scale economics with the HP Jet Fusion 3D 4210 Printing Solution. Start producing engineering-grade parts—now at up to 65% lower cost[1] and up to 10 times faster[2].

Breakthrough economics for production runs[1]

- Achieve up to 65% lower cost-per-part[1]—high-volume 3D production is now truly economically viable
- Discover a world of new high-volume applications, made possible with HP Multi Jet Fusion technology
- Best balance between economics and part quality, with industry-leading surplus powder reusability[3]

Superior[4], consistent part quality

- Get extreme dimensional accuracy and fine detail[4], enabled by HP's unique Multi-Agent printing process
- Produce truly functional parts with optimal mechanical properties[5]—up to 10 times faster[2]
- Predictable and reliable final printed parts that match your design[4]
- Access new future materials and applications with the HP Multi Jet Fusion Open Platform

Breakthrough productivity for manufacturing environments

- Produce more parts per day with minimal intervention, continuous printing, and fast cooling[6]
- Streamline your workflow with HP's automated materials mixing and post-processing station
- Cleaner experience with an enclosed Processing Station and materials not classified as hazardous[7]
- Plan production times more accurately and predictably to help increase your overall operational efficiency

Ordering information

	HP Jet Fusion 3D 4210 Printing Solution	
Printer	2YG73A	HP Jet Fusion 3D 4210 Printer
Accessories	2YG74A	HP Jet Fusion 3D 4210 Processing Station with Fast Cooling[6]
	M0P45B	HP Jet Fusion 3D Build Unit
	M0P54B	HP Jet Fusion 3D External Tank 5 units Bundle
	M0P54C	HP Jet Fusion 3D External Tank Starter kit
Original HP Printheads	F9K08A	HP 3D600 Printhead
	V1Q77A	HP 3D710 Printhead
Original HP Agents	V1Q60A	HP 3D600 3L Fusing Agent
	V1Q61A	HP 3D600 3L Detailing Agent
	V1Q63A	HP 3D700 5L Fusing Agent
	V1Q64A	HP 3D700 5L Detailing Agent
	V1Q78A	HP 3D710 5L Fusing Agent
	V1Q79A	HP 3D710 5L Detailing Agent
Other supplies	V1Q66A	HP 3D600 Cleaning Roll
Original HP 3D materials	V1R10A	HP 3D High Reusability PA 12 30L (13 kg)[8]
	V1R16A	HP 3D High Reusability PA 12 300L (130 kg)[8]
	V1R12A	HP 3D High Reusability PA 11 30L (14 kg)[8]
	V1R18A	HP 3D High Reusability PA 11 300L (140 kg)[8]
	V1R11A	HP 3D High Reusability PA 12 Glass Beads 30L (15 kg)[8]
	V1R22A	HP 3D High Reusability PA 12 Glass Beads 300L (150 kg)[8]
Certified HP 3D materials	EVNV1R14A	VESTOSINT® 3D Z2773 PA 12 30L/14 kg Material
	EVNV1R17A	VESTOSINT® 3D Z2773 PA 12 300L/140 kg Material
HP 3D Services	U9EJ8E	HP Installation w/Introduction to Basic Operation Service for HP Jet Fusion 3D Printer
	U9EL9E	HP Installation w/Introduction to Basic Operation SVC for HP Jet Fusion 3D Processing Station with FC
	U9HQ4E	Ramp up Care Pack for HP Jet Fusion 3D Solution
	1MZ23B	HP 3D Printer Initial Maintenance Kit
	1MZ24A	HP 3D Printer Yearly Maintenance Kit
	1MZ25B	HP 3D Post Processing Maintenance Kit
	U9EK7E	HP Advanced Operation Training Service for Jet Fusion 3D Printer (HP Training Center)
	U9VP8E	HP 3 year NBD* Onsite Hardware Support with DMR** HP 3 year NBD* Onsite Hardware Support with DMR**
	U9EQ8E	HP 3 year NBD* Onsite Build Unit Support
	U9EM5E	HP 3 year NBD* Onsite Support for Processing Station with Fast Cooling
	U9VQ3E	HP 3 year Shared HW Support, Parts NBD* with DMR** and 2 onsite visits for Printer
	U9UA2E	HP 3 year Shared Hardware Support, Parts NBD* and 2 onsite visits for Build Unit
	U9UA7E	HP 3 year Shared Hardware Support, Parts NBD* and 2 onsite visits for Processing Station with FC
	U9UB1E	HP Train to Maintain Service for Jet Fusion 3D Printer
	2UL67A	HP Uptime Kit for Jet Fusion 3D Printer
	2UL69A	HP Uptime Kit for Jet Fusion 3D Processing Station
	2UL68A	HP Uptime Kit for Jet Fusion 3D Build Unit

Technical specifications

HP Jet Fusion 3D 4210 Printer

Printer performance	Technology	HP Multi Jet Fusion technology
	Effective building volume	380 x 284 x 380 mm (15 x 11.2 x 15 in)
	Building speed	4500 cm³/hr (274 in³/hr)[9]
	Layer thickness	0.07 to 0.08 mm (0.0027 to 0.0031 in)
	Print resolution (x, y)	1200 dpi
Dimensions (w x d x h)	Printer	2210 x 1200 x 1448 mm (87 x 47 x 57 in)
	Shipping	2300 x 1325 x 2068 mm (91 x 52 x 81 in)
	Operating area	3700 x 3700 x 2500 mm (146 x 146 x 99 in)
Weight	Printer	750 kg (1653 lb)
	Shipping	945 kg (2083 lb)
Network[10]	Gigabit Ethernet (10/100/1000Base-T), supporting the following standards: TCP/IP, DHCP (IPv4 only), TLS/SSL	
Hard disk	2 TB (AES-128 encrypted, FIPS 140, disk wipe DoD 5220M)	
Software	Included software	HP SmartStream 3D Build Manager, HP SmartStream 3D Command Center
	Supported file formats	3mf, stl
	Certified third-party software	Autodesk® Netfabb® Engine for HP, Materialise Magics with Materialise Build Processor for HP Multi Jet Fusion, Siemens NX AM for HP Multi Jet Fusion
Power	Consumption	9 to 11 kW (typical)
	Requirements	Input voltage three phase 380-415 V (line-to-line), 30 A max, 50/60 Hz / 200-240 V (line-to-line), 48 A max, 50/60Hz
Certification	Safety	IEC 60950-1+A1+A2 compliant; United States and Canada (UL listed); EU (LVD and MD compliant, EN60950-1, EN12100-1, EN60204-1, and EN1010)
	Electromagnetic	Compliant with Class A requirements, including: USA (FCC rules), Canada (ICES), EU (EMC Directive), Australia (ACMA), New Zealand (RSM)
	Environmental	REACH
Warranty & Service coverage included	One-year limited hardware warranty	

HP Jet Fusion 4210 Processing Station with Fast Cooling[6]

Features	Automated mixing, sieving, and loading; semi-manual unpacking; fast cooling; external storage tank; compatible with high-capacity material cartridges	
Dimensions (w x d x h)	Processing Station with Fast Cooling[6]	3121 x 1571 x 2400 mm (122.9 x 61.9 x 94.5 in)
	Shipping	3499 x 1176 x 2180 mm (137.8 x 46.3 x 85.8 in)
	Operating area	3321 x 3071 x 2500 mm (130.7 x 120.9 x 99 in)
Weight	Processing Station with Fast Cooling[6]	480 kg (1058 lb)
	Loaded	810 kg (1786 lb)
	Shipping	620 kg (1367 lb)
Power	Consumption	2.6 kW (typical)
	Requirements	Input voltage single phase 200-240 V (line-to-line), 19 A max, 50/60Hz or 220 -240 V (line-to-neutral), 14 A max, 50Hz
Certification	Safety	UL 2011, UL508A, NFPA, C22.2 NO. 13-14 compliant; United States and Canada (UL listed); EU (MD compliant, EN 60204-1, EN 12100-1 and EN 1010)
	Electromagnetic	Compliant with Class A requirements, including: USA (FCC rules), Canada (ICES), EU (EMC Directive), Australia (ACMA), New Zealand (RSM)
	Environmental	REACH
Warranty & Service coverage included	One-year limited hardware warranty	

Eco Highlights

- Powders or agents are not classified as hazardous[7]
- Cleaner, more comfortable workplace—enclosed printing system, and automatic powder management[7]
- Minimizes waste due to industry-leading reusability of powder[3]
- Take-back program for printheads[11]

Find out more about HP sustainable solutions at hp.com/ecosolutions

For more information, please visit hp.com/go/JetFusion3Dsolutions

Cofinanced Project by Minetur-SETSI TSI-100802-2014-1

1. Based on internal testing and public data, HP Jet Fusion 3D 4210 Printing Solution average printing cost-per-part is 65% lower versus the average cost of comparable fused deposition modeling (FDM) and selective laser sintering (SLS) printer solutions from $100,000 USD to $300,000 USD on market as of April, 2016 and is 50% lower versus the average cost of comparable SLS printer solutions for $300,000 USD to $450,000 USD. Cost analysis based on: standard solution configuration price, supplies price, and maintenance costs recommended by manufacturer. Cost criteria: printing 1.4 full build chambers of parts per day/5 days per week over 1 year of 30-gram parts at 10% packing density on fast print mode using HP 3D High Reusability PA 12 material, and the powder reusability ratio recommended by manufacturer.
2. Based on internal testing and simulation, HP Jet Fusion 3D average printing time is up to 10 times faster than average printing time of comparable fused deposition modeling (FDM) and selective laser sintering (SLS) printer solutions from $100,000 USD to $300,000 USD on market as of April, 2016. Testing variables: Part quantity: 1.4 full build chamber of parts from HP Jet Fusion 3D at 20% of packing density on fast print mode vs same number of parts on above-mentioned competitive devices; Part size: 30 grams; Layer thickness: 0.08 mm/0.0031 inches.
3. Industry-leading surplus powder reusability based on using HP 3D High Reusability PA 12 at recommended packing densities and compared to selective laser sintering (SLS) technology, offers excellent reusability without sacrificing mechanical performance. Tested according to ASTM D638 and MFI test using HDT at different loads with a 3D scanner for dimensional stability. Testing monitored using statistical process controls. Liters refers to the materials container size and not the actual materials volume. Materials are measured in kilograms.
4. Based on HP's unique Multi-Agent printing process. Extreme dimensional accuracy and fine detail within allowable margin of error. Based on dimensional accuracy of ±0.2 mm/0.008 inches using HP 3D High Reusability PA 12 material, measured after sandblasting. See hp.com/go/3Dmaterials for more information on materials specifications.
5. Based on the following mechanical properties: Tensile strength at 48 MPa (XYZ), Modulus at 1700 -1800 MPa (XYZ). ASTM standard tests with HP 3D High Reusability PA 12 material. See hp.com/go/3Dmaterials for more information on materials specifications.
6. Fast Cooling is enabled by HP Jet Fusion 3D Processing Station with Fast Cooling. HP Jet Fusion 3D Processing Station with Fast Cooling accelerates parts cooling time vs recommended manufacturer time of selective laser sintering (SLS) printer solutions from $100,000 USD to $450,000 USD, as tested in April, 2016. Fused deposition modeling (FDM) not applicable. Continuous printing requires an additional HP Jet Fusion 3D Build Unit (standard printer configuration includes one HP Jet Fusion 3D Build Unit).
7. Compared to manual print retrieval process used by other powder-based technologies. The term "cleaner" does not refer to any indoor air quality requirements and/or consider related air quality regulations or testing that may be applicable. The HP powder and agents do not meet the criteria for classification as hazardous according to Regulation (EC) 1272/2008 as amended.
8. Liters refers to the materials container size and not the actual materials volume. Materials are measured in kilograms.
9. Based on 0.08-mm (0.003-in) layer thickness and 7,9 sec/layer.
10. The HP Jet Fusion 3D Printing Solution should be connected to the HP Cloud in order to enable the correct functioning of the printer and to offer better support.
11. Printing supplies eligible for recycling vary by printer. Visit hp.com/recycle to see how to participate and for HP Planet Partners program availability; program may not be available in your area. Where this program is not available, and for other consumables not included in the program, consult your local waste authorities on appropriate disposal.

4AA7-1532ENA, November 2017

This is an HP Indigo digital print.

HP 3D printing materials

Data courtesy of Vizua Heart of Bernard Werber and Invent Medical

1 Breaking down barriers to 3D printing adoption through materials innovation

Leading the charge into a new era of digital manufacturing, HP 3D printing solutions are providing new opportunities for businesses and industries. HP Multi Jet Fusion Technology disrupts the status quo with a solution that can transform part properties voxel by voxel—enabling a future of limitless applications, materials, and colors. Imagine a future where we can produce "Smart Parts" with embedded electronics and integrated traceability and intelligence. Materials innovation is at the heart of making this vision a reality.

To help your business get ready for a future era of digital manufacturing, HP is working hard to enable new materials innovations that break down some of the traditional barriers to 3D printing adoption—cost, quality, performance, and diversity. We're doing this through a growing portfolio of HP-branded powders and an open platform model that encourages third-party collaboration and materials expansion.

HP 3D printing materials—providing optimal output quality and high reusability at a low cost per part

In addition to our flagship material, HP 3D High Reusability PA 12, HP is growing its portfolio of thermoplastics. New powders, such as HP 3D High Reusability PA 12 Glass Beads and HP 3D High Reusability PA 11, deliver optimal mechanical properties. Engineered for HP Multi Jet Fusion technology, these materials test the limits of functional part creation, optimizing cost and part quality, while also delivering high[3] and, in many cases, industry-leading reusability[4] at the lowest cost per part.[1]

HP 3D High Reusability PA 12—ideal for producing strong, quality parts at the lowest cost per part[1]

Produce strong, functional, detailed complex parts

- Robust thermoplastic produces high-density parts with balanced property profiles and strong structures
- Provides excellent chemical resistance to oils, greases, aliphatic hydrocarbons, and alkalies[5]
- Ideal for complex assemblies, housings, enclosures, and watertight applications
- Biocompatibility certifications—meets USP Class I-VI and US FDA guidance for Intact Skin Surface Devices[6]

Quality at the lowest cost per part[1]

- Achieve the lowest cost per part[1] and reduce your total cost of ownership[7]
- Minimize waste—reuse surplus powder batch after batch and get functional parts, no throwing away anymore[4]
- Get consistent performance while achieving 80% surplus powder reusability[8]
- Optimize cost and part quality—cost-efficient material with industry-leading surplus powder reusability[4]

Engineered for HP Multi Jet Fusion technology

- Designed for production of functional parts across a variety of industries
- Provides the best balance between performance and reusability[9]
- Achieves watertight properties without any additional post-processing
- Engineered to produce final parts and functional prototypes with fine detail and dimensional accuracy

Recognized certifications provide reassurance

HP 3D High Reusability PA 12 is compliant with a number of important certifications that help provide reassurance that parts produced with this thermoplastic material adhere to health and safety related restrictions.

Biocompatability[6]

HP 3D High Reusability PA 12, along with HP 3D600/3D700 Fusing and Detailing Agents, have met the requirements of USP Class I-VI and US FDA's guidance for Intact Skin Surface Devices. This conclusion is based on the following tests and guidelines used:

1. USP Class I-VI including irritation, acute systemic toxicity, and implantation
2. Cytotoxicity—ISO 10993-5, Biological evaluation of medical devices – part 5: Tests for in vitro cytotoxicity, and
3. Sensitization—ISO 10993-10, Biological evaluation of medical devices – Part 10: Tests for irritation and skin sensitization

For certificate, see hp.com/go/biocompatibilitycertificate/PA12.

REACH

HP 3D High Reusability PA 12 is REACH compliant. REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals) is a regulation of the European Union, adopted to improve the protection of human health and the environment from risks that can be posed by chemicals.
For certificate, see hp.com/go/RoHS_REACH_Certificate/PA12.

RoHS

HP 3D High Reusability PA 12 is RoHS compliant. The RoHS directive is intended to restrict certain dangerous substances commonly used in electrical and electronic equipment. Any RoHS compliant component is tested for the presence of Lead (Pb), Cadmium (Cd), Mercury (Hg), Hexavalent chromium (Hex-Cr), Polybrominated biphenyls (PBB), and Polybrominated diphenyl ethers (PBDE).
For certificate, see hp.com/go/RoHS_REACH_Certificate/PA12.

PAHs (EU REACH)

Parts printed on an HP 3D printer using HP 3D600/700 Agents and HP 3D HR PA 12 were tested for PAHs. No PAHs stated below were detected above the detection limit of 1 ppb using GC/MS.

- Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthrene, Pyrene, Benzo[c]phenanthrene, Benzo[a]anthracene, Chrysene, Benzo[b] fluoranthene, Benzo[k]fluoranthene, Benzo[j]fluoranthene, Benzo[a]pyrene, Benzo[e]pyrene, 3-Methylcholanthrene, Dibenzo[a,h]anthracene, Indeno[1,2,3-cd]pyrene, Benzo[g,h,i]perylene.

For certificate, see hp.com/go/PAHs_Certificate/PA12.

HP 3D High Reusability PA 12 Glass Beads—ideal for producing stiff, low-cost, quality parts

Produce stiff, functional parts

- 40% glass bead filled thermoplastic material with both optimal mechanical properties and high reusability[3]
- Provides dimensional stability along with repeatability[2]
- Ideal for applications requiring high stiffness like enclosures and housings, fixtures and tooling

Quality at a low cost per part

- Produce at a low cost per part and reduce your total cost of ownership[7]
- Less waste—reuse surplus powder batch after batch and get functional parts, no throwing away anymore[4]
- Get consistent performance while achieving 70% surplus powder reusability[10]
- Optimize cost and part quality—cost-efficient material with high surplus powder reusability[3]

Engineered for HP Multi Jet Fusion technology

- Designed for production of functional parts across a variety of industries
- Provides the best balance between performance and reusability[11]
- Engineered to produce common glass bead applications with detail and dimensional accuracy

HP 3D High Reusability PA 11—ideal for producing ductile,[2] quality parts at the lowest cost per part[1]

Produce strong, ductile,[2] functional parts

- Thermoplastic material delivering optimal mechanical properties
- Renewable raw material from vegetable castor oil (reduced environmental impact)[12]
- Provides excellent chemical resistance[5] and enhanced elongation-at-break[2]
- Impact resistance and ductility[2] for prostheses, insoles, sports goods, snap fits, living hinges, and more

Quality at the lowest cost per part[1]

- Achieve the lowest cost per part[1] and reduce your total cost of ownership[7]
- Minimize waste—reuse surplus powder batch after batch and get functional parts, no throwing away anymore[4]
- Get consistent performance while achieving 70% surplus powder reusability[13]
- Optimize cost and part quality—cost-efficient material with industry-leading surplus powder reusability[4]

Engineered for HP Multi Jet Fusion technology

- Designed for production of functional and final parts across a variety of industries
- Provides the best balance between performance and reusability[14]
- Easy-to-process material enables high productivity, less waste, and lower cost[15]
- Engineered to reliably produce final parts and functional prototypes with fine detail, dimensional accuracy

2 Accelerating materials innovation through the HP Multi Jet Fusion Open Platform

HP's unique Open Platform approach is fostering widespread adoption of 3D printing by expanding the availability of new materials to address a broader set of applications, lowering materials costs, driving performance improvements, and creating new possibilities for part properties that address specific industry needs.

HP Multi Jet Fusion is fast becoming the printing platform of choice to accelerate technology, materials, and software innovation. We're working diligently on our own and with others to:

- Spearhead the widespread adoption of 3D printing across industries
- Enable new 3D printing materials that combine lower costs with enhanced properties
- Facilitate the development of never-before-seen 3D printing materials and new software to expand applications
- Support the transformation from traditional manufacturing to a future of digital manufacturing
- Drive software innovation and standards such as 3MF, an improved 3D printing file format, through collaboration with partners

HP Open Platform encourages collaboration and advancement

HP 3D Materials Certification Program
The certification program provides an opportunity and pathway for third-party vendors to develop materials compatible with HP Jet Fusion 3D printing solutions. The certification process reassures customers that third-party powders work effectively and reliably with HP Multi Jet Fusion technology.

Joining the HP 3D Materials Certification Program enables material innovation partners to help expand 3D printing materials to address a broader set of applications—driving performance improvements and new possibilities for part properties that address specific industry needs—and making new applications possible.

HP is inviting partners to innovate in materials for specific customer/application needs for both broader market availability and exclusive customer needs. Material partners interested in engaging with HP are invited to:

1. Go to hp.com/go/3DPrint.
2. Click on the Contact us button and complete the "Connect with us" form.
3. Once the "Connect with us" form is submitted, the interested partner will receive a Questionnaire, internally known as the "Materials PQD," that helps us better understand partner needs and expectations.
4. The materials team receives the Questionnaire, evaluates possible areas of collaboration, and always contacts the potential partner to clarify next steps.

HP Open Platform certified materials
HP is committed to expanding our portfolio of materials certified for HP 3D Jet Fusion printers. Evonik's VESTOSINT® 3D Z2773 PA 12 is the first certified material. We're also working with a variety of other third-party vendors to increase the materials and application options available.

Certified for HP Jet Fusion 3D printers

VESTOSINT® 3D Z2773 PA 12 30L (14 kg) is a modified polyamide-based powder that is produced at Evonik's Marl site in Germany using the company's own special process. The powders are certified for the HP Jet Fusion 3D printer.[16]

Active partnerships
We're working with the following industry-leading materials companies to better address 3D printing needs across industries. Together with our growing network of materials innovation partners, we're enabling performance improvements and new possibilities for part properties.

> "Four or five materials is not going to cut it. We need thousands of materials. This is where the open materials platform was born. There's no way we have the resources to do that. Materials companies have been doing it for years and years."
>
> Dr. Tim Weber, Head of the HP 3D Open Platform Materials and Applications Lab

ARKEMA

"By enabling us to directly develop 3D printing materials leveraging the HP Multi Jet Fusion Open Materials Platform, Arkema believes that we will be able to develop user-specific materials and uncover new applications for our customers and industry leaders. This great concept will accelerate the adoption of 3D printing and unlock its full potential. As a global designer of innovative, environmentally responsible Technical Polymer solutions for a wide variety of markets, Arkema is excited to collaborate with HP to change the way products are designed and produced and lead the way for the next industrial revolution."

Adrien Lapeyre
Global Market Manager — Technical Polymers Powders

Arkema

BASF
We create chemistry

"BASF has one of the broadest 3D Material portfolios in the chemical industry, and therefore, we are proud to join the HP Multi Jet Fusion Open Platform. BASF is a founding member of this Open Platform, and with our experience, knowledge of customer needs and applications, we are motivated to collaborate. The HP Open Platform is a great foundation to develop new materials and enable economies of scale, making materials more affordable and enabling not only prototyping but unlocking the potential of 3D printing for production."

Dietmar Geiser
Senior Manager 3D-Printing Strategy & Planning

BASF New Business GmbH

EVONIK

"Evonik is developing new materials leveraging the HP Multi Jet Fusion Open Materials Platform. Evonik believes that HP's Open Materials program provides a unique opportunity to expand the adoption of 3D printing and creates a new platform to drive materials innovation through development of materials specifically suited for this process. HP's new Multi Jet Fusion technology has the capabilities to create new applications for the 3D printing market by allowing us to develop new materials for the future."

Dr. Matthias Kottenhahn
Sr. VP & GM, High Performance Polymers

Evonik Resource Efficiency GmbH

Henkel

"The partnership between HP and Henkel is backed by strong market leadership, a legacy of innovation and an aligned commitment to additive manufacturing. With our broad material portfolio and customer base across diverse industries, Henkel is able to champion custom 3D solutions across various functional applications. This, combined with HP's vision for open materials innovation, enables us to develop materials and applications once thought impossible."

Michael Todd
Corporate Senior Vice President and Global Head of Innovation and New Business Development

Henkel Adhesive Technologies

Lehmann&Voss&Co.

"Lehmann&Voss&Co. believes HP's Open Materials platform is a great concept and that with this approach HP can fulfill market needs that have so far limited the 3D printing market expansion. This platform will drive 3D adoption and will provide an on-ramp to companies to drive materials innovation using HP Multi Jet Fusion technology. Lehmann&Voss&Co. plans to collaborate with HP and looks forward to introducing a new material on this platform."

Dr. Marcus Rechberger
Market Development LUVOSINT©

Lehmann&Voss&Co.

SIGMADESIGN

Materials Development Kit for HP Jet Fusion 3D Printers made by Sigma Design to accelerate materials innovation.

New HP Open Platform Materials Partners:

dressler group

Lubrizol

Hands-on materials advancement
HP offers tools and resources that encourage and support third-party materials innovation and development.

Jumpstart the development process with the Material Development Kit (MDK)—Developed by HP and **SIGMA**DESIGN, the industry's first MDK helps materials suppliers more effectively—and successfully—develop their first powder materials for the HP Multi Jet Fusion platform. The MDK enables companies interested in certifying their materials to quickly test 3D powder spreadability and compatibility with HP Multi Jet Fusion 3D printers prior to submitting the materials to HP for testing.

SIGMADESIGN

The Vision System Accessory works in conjunction with the MDK and facilitates the testing of new materials under development. It allows material suppliers to easily assess and quantify new material properties by automating the test coupon analysis.

"HP is leading the evolution of 3D printing from prototyping to production and **SIGMA**DESIGN understands how important each step of the manufacturing process is in this journey. Materials are at the center of successful manufacturing, and the combination of HP's Open Platform and the ability to enable voxel-level control will help expedite the digital transformation of this multi-trillion dollar market.

Many companies, both large and small, do not have the internal capabilities to execute their 3D printing vision as quickly or as broadly as they'd like. We are proud to provide world-class foundational tools such as the MDK and in-depth design expertise for organizations ready to innovate using HP Multi Jet Fusion technology right now."

Bill Huseby
President and CEO, **SIGMA**DESIGN

HP 3D Open Platform Materials and Applications Lab—As part of our commitment to the evolution and widespread adoption of 3D printing, we're inviting materials companies to work in a collaborative lab environment. Located in Corvallis, Oregon, the new HP 3D Open Platform Materials and Applications Lab is the world's first state-of-the-art lab helping companies develop, test, certify, and deliver the next generation of materials and applications for HP 3D printing.

This 3,500 square-foot facility offers 3D partners a range of equipment and in-house expertise to jumpstart and accelerate materials innovation and the development of new applications. This is critical to quickening the evolution and adoption of 3D printing technologies.

"We are convening the world's leading materials companies and empowering them to disrupt and innovate."

Dr. Tim Weber
Head of the HP 3D Open Platform Materials and Applications Lab

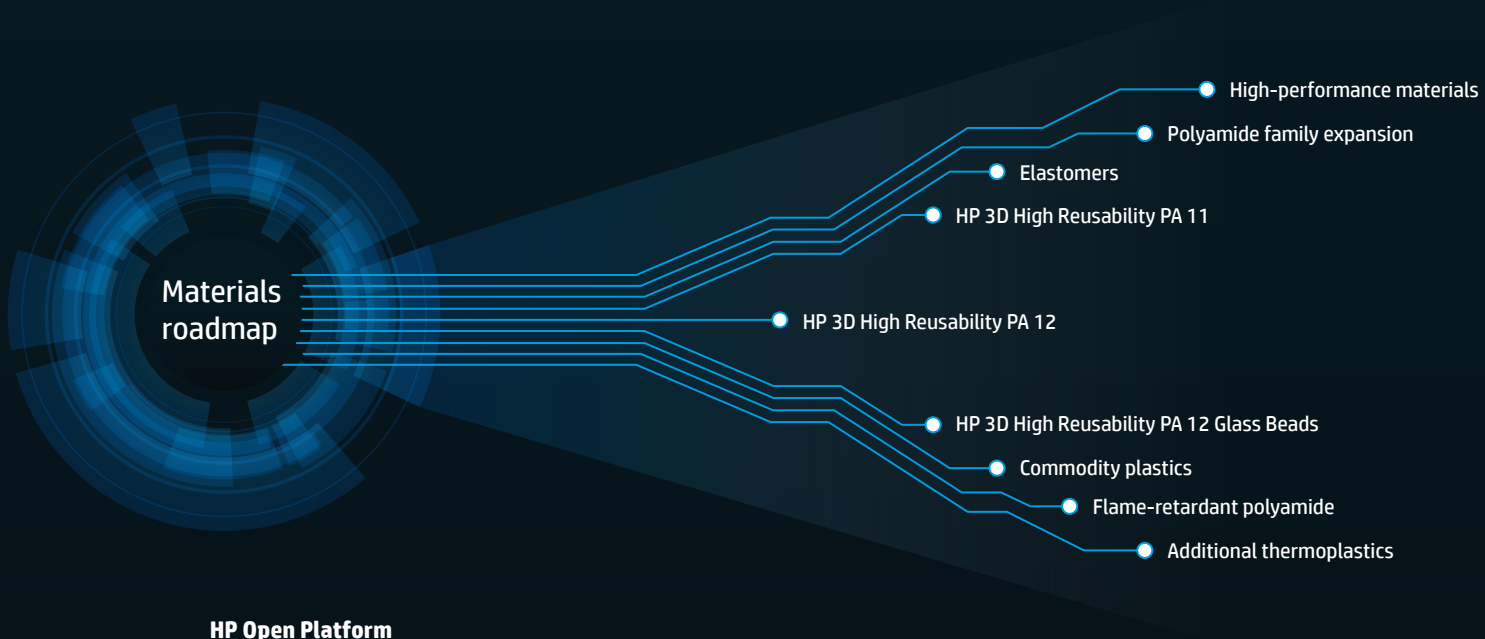
Technical Guideline for Material Development with HP 3D Open Materials Platform—Access to comprehensive technical guidelines for suppliers who are interested in developing suitable materials for HP Multi Jet Fusion technology through the HP Open Materials Platform. Learn more at hp.com/go/guidelinematerialdevelopment.

3 HP Multi Jet Fusion portfolio

Portfolio roadmap

HP plans to continue expanding the palette of material offerings even further—delivering a wider family of thermoplastics, including those with flame-retardant properties. And we're exploring new materials, such as elastomers, polyamides, commodity plastics, and high-performance materials. The HP Multi Jet Fusion Open Platform is a critical force in the process of accelerating materials innovation. By working together, we can enable a future where even not-yet-imagined applications become possible.

HP 3D materials portfolio roadmap



HP Open Platform

Bringing down the barriers to advance widespread 3D printing adoption across industries through materials innovation

Materials performance summary

Mechanical properties

Measurement	HP 3D HR PA12[18]	HP 3D HR PA12 GB[19]	HP 3D HR PA11[20]	VESTOSINT© 3D Z2773 PA 12
Tensile strength, max load[17], XY	48 MPa/6960 psi	30 MPa/4350 psi	50 MPa/7250 psi	48 MPa/6960 psi
Tensile modulus[17], XY	1700 MPa/247 ksi	2800 MPa/406 ksi	1800 MPa/261 ksi	1700 MPa/247 ksi
Elongation at break[17], XY	20%	6.5%	50%	20%
Izod impact notched (@ 3.2 mm, 23 ºC), XYZ	3.5 kJ/m²	2.7 kJ/m²	6 kJ/m²	-
Heat deflection temperature (@ 0.45 MPa, 66 psi) - Z	175 ºC/347 ºF	173 ºC/344 ºF	183 ºC/361 ºF	-
Heat deflection temperature (@ 1.82 MPa, 264 psi) - Z	106 ºC/223 ºF	121 ºC/250 ºF	50 ºC/122 ºF	-
Refresh ratio for stable performance	20%	30%	30%	50%
Applications examples				

Multi Jet Fusion Materials Portfolio selection guide

Usages and Properties	HP 3D HR PA12	HP 3D HR PA12 GB	HP 3D HR PA11	VESTOSINT© 3D Z2773 PA 12
Visual aids & presentation models	●	●	●	●
Functional prototyping	●	●	●	●
End-use parts	●	●	●	●
Dimensional stability	●	●	●	●
Functional rigid part (higher stiffness)	●	●	●	●
Flexible part (higher elongation at break)	●	●	●	●
Impact	●	●	●	●
HDT (heat deflection tempeature)	●	●	●	●
Medical bio-compatible (USP Class I-VI and US FDA guidance for Inact Skin Surface Devices)	●	●	●	●
Look and feel	●	●	●	●
Refresh ratio for stable performance/TCO	●	●	●	●

●	Excellent
●	Good
●	Fair
●	Not Recommended
●	On testing process

Ordering information

Material	HP Jet Fusion 3D 4210 Printing Solution	HP Jet Fusion 3D 4200 Printing Solution	HP Jet Fusion 3D 3200 Printing Solution
V1R10A—HP 3D High Reusability PA 12 30L (13 Kg)	Yes	Yes	Yes
V1R16A—HP 3D High Reusability PA 12 300L (130 Kg)	Yes	Yes	No
V1R12A—HP 3D High Reusability PA 11 30L (14 Kg)	Yes	Yes	Yes
V1R18A—HP 3D High Reusability PA 11 300L (140 Kg)	Yes	Yes	No
V1R11A—HP 3D High Reusability PA 12 Glass Beads 30L (15 Kg)	Yes	Yes	Yes
V1R22A—HP 3D High Reusability PA 12 Glass Beads 300L (150 Kg)	Yes	Yes	No
EVNV1R14A—VESTOSINT© 3D Z2773 PA 12 30L (14 Kg) Certified for HP Jet Fusion 3D printers	Yes	Yes	Yes
EVNV1R17A—VESTOSINT© 3D Z2773 PA 12 300L (140 Kg) Certified for HP Jet Fusion 3D printers	Yes	Yes	No

Note: Liters refers to the materials container size and not the actual materials volume. Materials are measured in kilograms.

Eco Highlights

- Powders or agents are not classified as hazardous[21]
- Cleaner, more comfortable workplace—enclosed printing system, and automatic powder management[22]
- Minimizes waste due to industry-leading reusability of powder[23]

Find out more about HP sustainable solutions at hp.com/go/ecosolutions

Data courtesy of Invent Medical

For more information, please visit
hp.com/go/3DMaterials

1. Based on internal testing and public data, HP Jet Fusion 3D printing solution average printing cost per part is half the cost of comparable fused deposition modeling (FDM) and selective laser sintering (SLS) printer solutions from $100,000 USD to $300,000 USD, when averaged together and not taken individually, in market as of April 2016. Cost analysis based on: standard solution configuration price, supplies price, and maintenance costs recommended by the manufacturer. Cost criteria: printing 1-2 buckets per day/5 days per week over 1 year of 30-gram parts at 10% packing density using the powder reusability ratio recommended by the manufacturer.
2. Testing according to ASTM D638, ASTM D256, and ASTM D648 using HDT at different loads with a 3D scanner for dimensional stability. Testing monitored using statistical process controls.
3. Based on using recommended packing densities, offers high reusability of surplus powder. Liters refers to the materials container size and not the actual materials volume. Materials are measured in kilograms.
4. Based on using recommended packing densities and compared to selective laser sintering (SLS) technology, offers excellent reusability without sacrificing mechanical performance. Tested according to ASTM D638 and MFI test using HDT at different loads with a 3D scanner for dimensional stability. Testing monitored using statistical process controls. Liters refers to the materials container size and not the actual materials volume. Materials are measured in kilograms.
5. Tested with diluted alkalies, concentrated alkalies, chlorine salts, alcohol, ester, ethers, ketones, aliphatic hydrocarbons, unleaded petrol, motor oil, aromatic hydrocarbons, toluene, and DOT 3 brake fluid.
6. Based on HP internal testing, June 2017, HP 3D600 Fusing and Detailing Agents and HP 3D High Reusability PA 12 powder meet USP Class I-VI and US FDA's guidance for Intact Skin Surface Devices. Tested according to USP Class I-VI including irritation, acute systemic toxicity, and implantation; cytotoxicity per ISO 10993-5, Biological evaluation of medical devices–part 5: Tests for in vitro cytotoxicity; and sensitization per ISO 10993-10, Biological evaluation of medical devices–Part 10: Tests for irritation and skin sensitization. It is the responsibility of the customer to determine that its use of the fusing and detailing agents and powder is safe and technically suitable to the intended applications and consistent with the relevant regulatory requirements (including FDA requirements) applicable to the customer's final product. For more information, see hp.com/go/biocompatibilitycertificate/PA12.
7. Compared to selective laser sintering (SLS) and fused deposition modeling (FDM) technologies, HP Multi Jet Fusion technology can reduce the overall energy requirements needed to attain full fusing and reduce the system requirements for large, vacuum-sealed ovens. In addition, HP Multi Jet Fusion technology uses less heating power than SLS systems for better material properties and material reuse rates, minimizing waste.
8. HP Jet Fusion 3D printing solutions using HP 3D High Reusability PA 12 provide 80% post-production surplus powder reusability, producing functional parts batch after batch. For testing, material is aged in real printing conditions and powder is tracked by generations (worst case for recyclability). Parts are then made from each generation and tested for mechanical properties and accuracy.
9. Compared to selective laser sintering (SLS) technology. Tested according to ASTM D638 and MFI test.
10. HP Jet Fusion 3D printing solutions using HP 3D High Reusability PA 12 Glass Beads provide 70% post-production surplus powder reusability, producing functional parts batch after batch. For testing, material is aged in real printing conditions and powder is tracked by generations (worst case for recyclability). Parts are then made from each generation and tested for mechanical properties and accuracy.
11. Compared to selective laser sintering (SLS) technology. Based on running a scan on the 3D printing part to measure and compare with the original STL file (using GOM software). For testing, material is aged in real printing conditions and powder is tracked by generations (worst case for recyclability). Parts are then made from each generation and tested for mechanical properties and accuracy.
12. HP 3D High Reusability PA 11 powder is made with 100% renewable carbon content derived from castor plants grown without GMOs in arid areas that do not compete with food crops. HP 3D High Reusability PA 11 is made using renewable sources, and may be made together with certain non-renewable sources. A renewable resource is a natural organic resource that can be renewed at the same speed in which it is consumed. Renewable stands for the number of carbon atoms in the chain coming from renewable sources (in this case, castor seeds) according to ASTM D6866.
13. HP Jet Fusion 3D printing solutions using HP 3D High Reusability PA 11 provide 70% post-production surplus powder reusability, producing functional parts batch after batch. For testing, material is aged in real printing conditions and powder is tracked by generations (worst case for recyclability). Parts are then made from each generation and tested for mechanical properties and accuracy.
14. Compared to selective laser sintering (SLS) technology. Providing an elongation at break XY of 50% with 80% post-production surplus power reusability according to the ASTM D638 test method. For testing, material is aged in real printing conditions and powder is tracked by generations (worst case for recyclability). Parts are then made from each generation and tested for mechanical properties and accuracy.
15. Easier to process than standard HP 3D High Reusability PA12, providing proper fusing along with good spreadability and compatibility due to its small particle size.
16. The only terms and conditions governing the sale of HP 3D printer solutions are those set forth in a written sales agreement. The only warranties for HP products and services are set forth in the express warranty statements for such products and services. Nothing herein should be construed as constituting an additional warranty or additional binding terms and conditions. HP shall not be liable for technical or editorial errors or omissions contained herein and the information herein is subject to change without notice. The Certified for HP Jet Fusion 3D Materials have not been designed, manufactured, or tested by HP for compliance with legal requirements and recipients are responsible for making their own determination as to the suitability of VESTOSINT® 3D Z2773 for their purposes, including but not limited as regards direct or indirect food contact applications.
17. Test results realized under the ASTM D638, specimens type V.
18. The following technical information should be considered representative of averages or typical values and should not be used for specification purposes. These values refer to a balanced print mode with FW BD5.
19. The following technical information should be considered representative of averages or typical values and should not be used for specification purposes. These values refer to a balanced print mode with FW BD6.1.
20. The following technical information obtained (November 2017) may change and is representative of averages or typical values of the testing date and should not be used for specification purposes. These values refer to a balanced print mode with FW BD6.1.
21. The HP powder and agents do not meet the criteria for classification as hazardous according to Regulation (EC) 1272/2008 as amended.
22. Compared to manual print retrieval process used by other powder-based technologies. The term "cleaner" does not refer to any indoor air quality requirements and/or consider related air quality regulations or testing that may be applicable.
23. Compared to PA 12 and PA 11 materials available as of June, 2017. HP Jet Fusion 3D printing solutions using HP 3D High Reusability PA 12 provide 80% post-production surplus powder reusability and HP Jet Fusion 3D printing solutions using HP 3D High Reusability PA 11 provide 70% post-production surplus powder reusability, producing functional parts batch after batch.

4AA7-1533ENE, November 2017

This is an HP Indigo digital print.