FDM 3D Printers

SYSTEMS AND MATERIALSOV

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FDM 3D Printers

Advancements in additive manufacturing

FDM (fused deposition modeling) 3D Printers offer unparalleled versatility to turn your CAD files into durable parts. These parts are tough enough to be used as advanced conceptual models, functional prototypes, manufacturing tools and production parts. Engineers can produce a wide variety of products just by loading different files and materials. No traditional machining process can do that.

Strong, reliable and durable materials

FDM technology works with engineering-grade thermoplastics to build strong, long-lasting and dimensionally stable parts with the best accuracy and repeatability of any 3D printing technology. FDM machines make parts with the most commonly used thermoplastics, such as ABS, polycarbonate, a variety of blends, as well as engineered thermoplastics for aerospace, medical, automotive, electronic and other specialty applications. When using 3D printing for validation prototypes and the production of finished goods, using a thermoplastic is all the more important, and it may be the only choice for many applications.

Meet the demands of production

FDM systems are as versatile and durable as the parts they produce. The most advanced FDM 3D Printers boast the largest build envelopes and material capacities in their class, delivering longer, uninterrupted build times, bigger parts and higher production run quantities than other additive manufacturing systems. Plus, they're true production workhorses, delivering the high throughput, duty cycles and utilization rates that make digital manufacturing not only possible, but practical.

Opening the way for new possibilities

FDM 3D Printers can streamline processes from design through manufacturing, reducing costs and eliminating traditional barriers along the way. With FDM, a designer can create an idea, and test it the same day. Industries can cut lead times and costs, products turn out better, and get to market faster. Breakthrough designs, process innovations, just-in-time manufacturing — whatever you can imagine, FDM can make it happen.

See the Results.

Advanced prototypes:
For sprinkler projects at Toro, FDM systems helped reduce product development time by 283 weeks — and saved $500,000.

Advanced manufacturing tools:
At BMW, costs for producing manufacturing tools dropped significantly when engineers started producing tools with FDM systems.

Advanced production parts:
Klock Werks used digital manufacturing to build custom motorcycle parts on their Fortus system, saving nearly $13,000. FDM parts cost less than a quarter of the price to injection mold or cast them.

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FDM Materials

Material		Highlights
	ULTEM™ 1010 resin (polyetherimide)	• Food safety and bio-compatibility certification • Highest heat resistance, chemical resistance and tensile strength • Outstanding strength and thermal stability
	ULTEM 9085 resin (polyetherimide)	• FST (flame, smoke, toxicity)-certified thermoplastic • High heat and chemical resistance; highest flexural strength • Ideal for commercial transportation applications such as airplanes, buses, trains and boats
	PPSF (polyphenylsulfone)	• Mechanically superior material, greatest strength • Ideal for applications in caustic and high heat environments
	ST-130™ (Sacrificial Tooling)	• Designed specifically for hollow composite parts • Fast, hands-free dissolution time • High heat and autoclave pressure resistance
	FDM Nylon 6™ (polyamide 6)	• Combines strength and toughness superior to other thermoplastics • Produces durable parts with a clean finish and high break resistance
	FDM Nylon 12™ (polyamide 12)	• The toughest nylon in additive manufacturing • Excellent for repetitive snap fits, press fit inserts and fatigue-resistance applications • Simple, clean process – free of powders
	PC (polycarbonate)	• Most widely used industrial thermoplastic with superior mechanical properties and heat resistance • Accurate, durable and stable for strong parts, patterns for metal bending and composite work • Great for demanding prototyping needs, tooling and fixtures
	PC-ISO™ (polycarbonate - ISO 10993 USP Class VI biocompatible)	• Biocompatible (ISO 10993 USP Class VI)[1] material • Sterilizable using gamma radiation or ethylene oxide (EtO) sterilization methods • Best fit for applications requiring higher strength and sterilization
	PC-ABS (polycarbonate - acrylonitrile butadiene styrene)	• Superior mechanical properties and heat resistance of PC • Excellent feature definition and surface appeal of ABS • Hands-free support removal with soluble support
	ASA (acrylonitrile styrene acrylate)	• Build UV-stable parts with the best aesthetics of any FDM material • Ideal for production parts for outdoor infrastructure and commercial use, outdoor functional prototyping and automotive parts and accessory prototypes
	ABS-ESD7™ (acrylonitrile butadiene styrene - static dissipative)	• Static-dissipative with target surface resistance of 10^7 ohms (typical range $10^9 – 10^6$ ohms)[2] • Makes great assembly tools for electronic and static-sensitive products • Widely used for functional prototypes of cases, enclosures and packaging
	ABS-M30i™ (acrylonitrile butadiene styrene - ISO 10993 USP Class VI biocompatible)	• Biocompatible (ISO 10993 USP Class VI)[1] material • Sterilizable using gamma radiation or ethylene oxide (EtO) sterilization methods • Best fit for applications requiring good strength and sterilization
	ABSi™ (acrylonitrile butadiene styrene - translucent)	• Translucent material available in natural, red and amber colors • Good blend of mechanical and aesthetic properties • Ideal for automotive design and monitoring fluid movement such as in medical-device prototyping
	ABS-M30™, ABSplus™ (acrylonitrile butadiene styrene)	• Versatile material: good for form, fit and functional applications • Familiar production material for accurate prototyping
	PLA (Polylactic acid)	• Fast printing • Good tensile strength • Economical and user-friendly • Ideal for concept models

[1] It is the responsibility of the finished device manufacturer to determine the suitability of all the component parts and materials used in their finished products.
[2] Actual surface resistance may range from 109 to 106 ohms, depending upon geometry, build style and finishing techniques.

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FDM 3D Printers

	UPRINT SE PLUS™	STRATASYS F170™	STRATASYS F270™
Build Envelope	203 x 203 x 152 mm (8 x 8 x 6 in)	254 x 254 x 254 mm (10 x 10 x 10 in)	305 x 254 x 305 mm (12 x 10 x 12 in)
System Size/ Weight	**One material bay:** 635 x 660 x 787 mm (25 x 26 x 31 in) 76 kg (168 lbs) **Two material bays:** 635 (w) x 660 (d) x 940 (h) mm (25 x 26 x 37 in) 94 kg (206 lbs)	1626 x 864 x 711 mm (64 x 34 x 28 in) 227 kg (500 lbs) with consumables	1626 x 864 x 711 mm (64 x 34 x 28 in) 227 kg (500 lbs) with consumables
Material Options	ABS*plus*	ABS-M30 ASA PLA	ABS-M30 ASA PLA
Throughput Comparison	1.1 x	1.5 x (standard mode) 3 x (fast-draft mode)	1.5 x (standard mode) 3 x (fast-draft mode)
Achievable Accuracy[1]		Parts are produced within an accuracy of: +/- .200 mm (.008 in), or +/- .002 mm/mm (.002 in/in), whichever is greater.	Parts are produced within an accuracy of: +/- .200 mm (.008 in), or +/- .002 mm/mm (.002 in/in), whichever is greater.
Software	**CatalystEX** Catalyst EX software prepares 3D digital part files (output as an STL) to be manufactured on a uPrint® system by automatically slicing, generating support structures and material extrusion paths in one push of a button. After the part has been processed, it can be combined with other parts and queued on the printer to maximize throughput and utilization. **GrabCAD Print™** GrabCAD Print simplifies the traditional 3D print preparation workflow and provides intelligence around printer usage so your team can get quality prints, faster. Print directly from CAD, organize print queues, monitor material levels and work with detailed views of your model. The tray and slice preview feature supports adjustments before going to print.		

[1]*Accuracy is geometry-dependent. Achievable accuracy specification derived from statistical data at 95% dimensional yield.*

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FDM 3D Printers

	STRATASYS F370™	FORTUS 380mc™	FORTUS 450mc™	FORTUS 900mc™
Build Envelope	355 x 254 x 355 mm (14 x 10 x 14 in)	355 x 305 x 305 mm (14 x 12 x 12 in)	406 x 355 x 406 mm (16 x 14 x 16 in)	914 x 610 x 914 mm (36 x 24 x 36 in)
System Size/ Weight	1626 x 864 x 711 mm (64 x 34 x 28 in) 227 kg (500 lbs) with consumables	1270 x 901.7 x 1984 mm (50 x 35.5 x 76.5 in) 601 kg (1325 lbs)	1270 x 901.7 x 1984 mm (50 x 35.5 x 76.5 in) 601 kg (1325 lbs)	2772 x 1683 x 2027 mm (109.1 x 66.3 x 79.8 in) 2869 kg (6325 lbs)
Material Options	ABS-M30 ASA PC-ABS PLA	ABS-M30 ABS-M30i ABS-ESD7 ASA PC-ISO PC PC-ABS FDM Nylon 12	ABS-M30 ABS-M30i ABS-ESD7 ASA PC-ISO PC PC-ABS FDM Nylon 12 ST-130 ULTEM 9085 resin ULTEM 1010 resin	ABS-M30 ABS-M30i ABS-ESD7 ASA PC-ISO PC PC-ABS PPSF FDM Nylon 12 FDM Nylon 6 ST-130 ULTEM 9085 resin ULTEM 1010 resin
Throughput Comparison	1.5 x (standard mode) 3 x (fast-draft mode)	2.0 x	2.0 x	2.1 x
Achievable Accuracy[1]	Parts are produced within an accuracy of: +/- .254 mm (.010 in), or +/- 0.05 mm/mm (.05 in/in), whichever is greater.	Parts are produced within an accuracy of ± .127 mm (± .005 in.) or ± .0015 mm/mm (± .0015 in/in), whichever is greater.	Parts are produced within an accuracy of ± .127 mm (± .005 in.) or ± .0015 mm/mm (± .0015 in/in), whichever is greater.	Parts are produced within an accuracy of: ± .09 mm (.0035 in) or ± .0015 mm/mm (.0015 in/in), whichever is greater.[2]
Software	**Insight™** Insight software prepares 3D digital part files (output as an STL) to be manufactured on an FDM 3D Printer by automatically slicing and generating support structures and material extrusion paths in one push of a button. If necessary, users can override Insight's defaults to manually edit parameters that control the look, strength and precision of parts as well as the time, throughput, expense and efficiency of the FDM process. **Control Center™** Control Center is the software that communicates between the user workstation(s) and the FDM system(s), managing jobs and monitoring the production status of FDM systems. This software application provides the control to maximize efficiency, throughput and utilization while minimizing response time. Control Center is included with Insight software. **GrabCAD Print** GrabCAD Print simplifies the traditional 3D print preparation workflow and provides intelligence around printer usage so your team can get quality prints, faster. Print directly from CAD, organize print queues, monitor material levels and work with detailed views of your model. The tray and slice preview feature supports adjustments before going to print.			

[1]Accuracy is geometry-dependent. Achievable accuracy specification derived from statistical data at 95% dimensional yield. Z part accuracy includes an additional tolerance of -0.000/+slice height.
[2]See Fortus 900mc accuracy study white paper for more information.

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FDM 3D Printers use a variety of engineering-grade thermoplastics to manufacture functional parts direct from digital data. FDM thermoplastics are environmentally stable, so overall shape and part accuracy don't change with ambient conditions over time, unlike the powders in competitive processes. Materials are easy to change on FDM 3D Printers, with no mess or complicated processes. When combined with FDM 3D Printers, FDM thermoplastics give you high-quality thermoplastic parts that are ideal for concept modeling, functional prototyping, manufacturing tools or production parts.

Material:	ULTEM 1010 resin	ULTEM 9085 resin	PPSF	ST-130	FDM Nylon 6
System Availability	Fortus 400mc Fortus 450mc Fortus 900mc	Fortus 400mc Fortus 450mc Fortus 900mc	Fortus 400mc Fortus 900mc	Fortus 450mc Fortus 900mc	Fortus 900mc
Layer Thickness:					
0.013 inch (0.330 mm)	X	X[10]	X[3]	X	X
0.010 inch (0.254 mm)	X	X	X		X
0.007 inch (0.178 mm)					
0.005 inch (0.127 mm)					
Support Structure	Breakaway	Breakaway	Breakaway	Breakaway	Soluble
Available Colors	Natural	Tan Black	Tan	Natural	Black
Tensile Strength (Ultimate)[2]	XY: 11,735 psi (81 MPa) Z: 4,209 psi (29 MPa)	9,950 psi (72 MPa)	8,000 psi (55 MPa)	N/A	XZ: 9,800 psi (67.6 MPa) ZX: 5,300 psi (36.5 MPa)
Tensile Elongation[2]	XY: 3.3% Z: 1.3%	5.8%	3.0%	N/A	38%
Flexural Stress	XY: 20,835 psi (144 MPa) Z: 11,184 psi (77 MPa)	16,200 psi (112 MPa)	15,900 psi (110 MPa)	N/A	No break
IZOD Impact, notched	XY: 0.8 ft-lb/in (41 J/m) Z: 0.4 ft-lb/in (24 J/m)	2.0 ft-lb/in(106 J/m)	1.1 ft-lb/in (59 J/m)	N/A	XY: 2.0 ft-lb/in (106 J/m) ZX: 0.8 ft-lb/in (43 J/m)
Heat Deflection at 264 psi	213°C (415°F)	153°C (307°F)	189°C (372°F)	108°C (226°F)	93°C (199°F)
Unique Properties	Food-safety and bio-compatibility certification	Flame, smoke, toxicity (FST) certified, ULTEM 9085 Aerospace grade available	Highest heat and chemical resistance	Sacrificial tooling	Very high strength and toughness combined

[1] 0.005 inch (0.127 mm) layer thickness not available for Fortus 900mc.
[2] See individual material spec sheets for testing details.
[3] 0.013 inch (0.330 mm) layer thickness for PPSF not available on Fortus 900mc.
[4] It is the responsibility of the finished device manufacturer to determine the suitability of all the component parts and materials used in their finished products.
[5] PC can attain 0.005 inch (0.127mm) layer thickness when used with SR-100 soluble support.
[6] Annealed
[7] Actual surface resistance may range from 109 to 106 ohms, depending upon geometry, build style and finishing techniques.
[8] Available only on the Stratays F123 Series
[9] Available only on the Stratasys F370
[10] Available on Fortus 400mc and Fortus 900mc
* Available on Fortus Classic only.
** Mechanical properties are measured on the Fortus systems and may vary with other printers

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FDM Materials

Material:	FDM Nylon 12	PC	PC-ISO	PC-ABS	ASA
System Availability	Fortus 360mc Fortus 380mc Fortus 400mc Fortus 450mc Fortus 900mc	Fortus 360mc Fortus 380mc Fortus 400mc Fortus 450mc Fortus 900mc	Fortus 380mc Fortus 400mc Fortus 450mc Fortus 900mc	Fortus 360mc Fortus 380mc Fortus 400mc Fortus 450mc Fortus 900mc Stratasys F370	Fortus 360mc Fortus 380mc Fortus 400mc Fortus 450mc Fortus 900mc Stratasys F170 Stratasys F270 Stratasys F370
Layer Thickness:					
0.013 inch (0.330 mm)	X	X	X	X	X
0.010 inch (0.254 mm)	X	X	X	X	X
0.007 inch (0.178 mm)	X	X	X	X	X
0.005 inch (0.127 mm)		X[1,5]		X[1]	X[1]
Support Structure	Soluble	Breakaway, Soluble	Breakaway	Soluble	Soluble
Available Colors	■ Black	□ White	□ White ▒ Translucent Natural	■ Black □ White[9]	▒ Ivory ■ Black ■ Dark Gray ■ Light Gray □ White ■ Red ■ Orange ■ Yellow ■ Green ■ Dark Blue
Tensile Strength (Ultimate)[2]	XY: 7,000 psi (48 MPa) Z: 6,400 psi (44 MPa)	8,300 psi (68 MPa)	8,265 psi (57 MPa)	XY: 5,000 psi (34 MPa) Z: 4,000 psi (30 MPa)	XY: 4,750 psi (34 MPa) Z: 4,300 psi (30 MPa)
Tensile Elongation[2]	XY: 30% Z: 5%	4.8%	4.3%	XY: 5.0% Z: 2%	XY: 9% Z: 3%
Flexural Stress	XY: 10,000 psi (69 MPa) Z: 8,600 psi (59 MPa)	15,100 psi (104 MPa)	13,089 psi (90 MPa)	XY: 8,500 psi (59 MPa) Z: 6,000 psi (41 MPa)	XY: 8,720 psi (59 MPa) Z: 6,900 psi (48 MPa)
IZOD Impact, notched	XY: 3.74 ft-lb/in (200 J/m) Z: 75.0 ft-lb/in (75 J/m)	1.0 ft-lb/in (53 J/m)	1.6 ft-lb/in (86 J/m)	4.0 ft-lb/in (235 J/m)	1.2 ft-lb/in (64 J/m)
Heat Deflection at 264 psi	82°C[6] (180°F)[6]	127°C (261°F)	127°C (260°F)	96°C (205°F)	91°C (196°F)
Unique Properties	Fatigue-resistant, high elongation at break	Strong (tension)	ISO 10993 USP Class VI[4]	Strong (impact)	UV stable with the best aesthetics of any FDM material

[1] 0.005 inch (0.127 mm) layer thickness not available for Fortus 900mc.
[2] See individual material spec sheets for testing details.
[3] 0.013 inch (0.330 mm) layer thickness for PPSF not available on Fortus 900mc.
[4] It is the responsibility of the finished device manufacturer to determine the suitability of all the component parts and materials used in their finished products.
[5] PC can attain 0.005 inch (0.127mm) layer thickness when used with SR-100 soluble support.
[6] Annealed
[7] Actual surface resistance may range from 109 to 106 ohms, depending upon geometry, build style and finishing techniques.
[8] Available only on the Stratays F123 Series
[9] Available only on the Stratasys F370
* Available on Fortus Classic only.
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FDM Materials

Material:	ABS-ESD7	ABS-M30i	ABSi	ABS-M30**	ABS*plus*	PLA
System Availability	Fortus 380mc Fortus 400mc Fortus 450mc Fortus 900mc	Fortus 380mc Fortus 400mc Fortus 450mc Fortus 900mc	Fortus 400mc™	Fortus 360mc™ Fortus 380mc Fortus 400mc Fortus 450mc Fortus 900mc Stratasys F170 Stratasys F270 Stratasys F370	uPrint SE Plus	Stratasys F170 Stratasys F270 Stratasys F370
Layer Thickness:						
0.013 inch (0.330 mm)		X	X	X	X	
0.010 inch (0.254 mm)	X	X	X	X	X	X
0.007 inch (0.178 mm)	X	X	X	X	X	
0.005 inch (0.127 mm)		X[1]	X[1]	X[1]		
Support Structure	Soluble	Soluble	Soluble	Soluble	Soluble	Breakaway
Available Colors	Black	Ivory	Translucent Natural Translucent Amber Translucent Red	Ivory White Black Dark Gray Red Blue Orange[8] Yellow[8] Green[8] Custom Colors	Ivory White Black Dark Grey Red Blue Olive Green Nectarine Fluorescent Yellow	Black White Light Gray Medium Gray Red Blue Natural Translucent Red Translucent Blue Translucent Yellow Translucent Green Translucent
Tensile Strength (Ultimate)[2]	5,200 psi (36 MPa)	XY: 4,650 psi (32 MPa) Z: 4,050 psi (28 MPa)	5,400 psi (37 MPa)	XY: 4,650 psi (32 MPa) Z: 4,050 psi (28 MPa)	4,700 psi (33 MPa)	6,990 psi (48 MPa)
Tensile Elongation[2]	3.0%	XY: 7% Z: 2%	4.4%	XY: 7.0% Z: 2%	6%	2.5%
Flexural Stress	8,800 psi (61 MPa)	XY: 8,700 psi (60 MPa) Z: 7,000 psi (48 MPa)	8,980 psi (62 MPa)	XY: 8,700 psi (60 MPa) Z: 7,000 psi (48 MPa)	XY: 8,450 psi (56 MPa) Z: 5,050 psi (35 MPa)	12,190 psi (84 mPa)
IZOD Impact, notched	0.5 ft-lb/in (28 J/m)	2.4 ft-lb/in (128 J/m)	1.8 ft-lb/in (96 J/m)	2.4 ft-lb/in (128 J/m)	2.0 ft-lb/in (106 J/m)	0.5 ft-lb/in (26.7 J/m)
Heat Deflection at 264 psi	82°C (180°F)	82°C (180°F)	73°C (163°F)	82°C (180°F)	82°C (180°F)	51°C (124°F)
Unique Properties	Static-dissipative, target surface resistance of 107 ohms[7]	ISO 10993 USP Class VI[4]	Translucent material	Variety of color options	Variety of color options	Low cost, fast-draft printing

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[2] See individual material spec sheets for testing details.
[3] 0.013 inch (0.330 mm) layer thickness for PPSF not available on Fortus 900mc.
[4] It is the responsibility of the finished device manufacturer to determine the suitability of all the component parts and materials used in their finished products.
[5] PC can attain 0.005 inch (0.127mm) layer thickness when used with SR-100 soluble support.
[6] Annealed
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