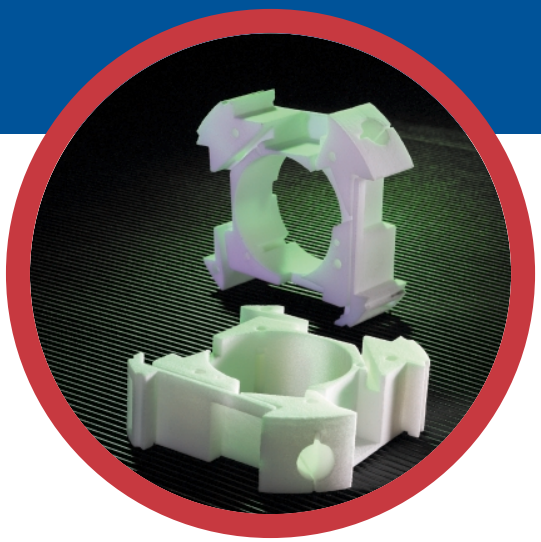
DuraForm™ PA and GF

Materials for SLS® systems

Technology:	Selective Laser Sintering, SLS
Material Class:	Powder; Thermoplastic



Science Cup
Courtesy of NASA Jet Propulsion Lab

Create durable, high-quality, fully testable parts with your SLS® system

DuraForm™ polyamide (PA) and DuraForm™ glass-filled (GF), next-generation nylon materials, were developed specifically for creating rugged engineering thermoplastic parts that withstand aggressive functional testing.

Shorten product testing and development cycles. DuraForm materials trim days, even weeks from your product development times by letting you create high-quality, fully-testable parts in the SLS system, directly from CAD files — no tooling required.

Choose DuraForm PA material for detailed parts and medical applications. DuraForm PA material is ideal for parts with superior surface quality, fine details, and functional features such as living hinges and snap fit connections. Plus DuraForm PA material is USP Level VI certified for brief *in-vivo* exposure; it can be used for modeling and testing surgical devices, and can be sterilized with an autoclave.

Use DuraForm GF material for adverse testing conditions. DuraForm GF material's increased stiffness, heat resistance, and mechanical integrity (relative to PA) make it a perfect material for extreme testing conditions. As an example, a DuraForm material connector with snap fits, hinges and locking cams recently withstood temperatures up to 100°C and an electrical charge of 460 Amps (twice the amperage withstood by the final production part).

Use DuraForm materials for:

- Form, fit/snap-fit, and functional testing
- *In vivo* testing
- Durable patterns for sandcasting & silicone tooling
- Production parts

Benefits

- Durable parts without tooling
- Heat and chemical resistant
- Machinable, weldable, readily-joined — mechanically or with other adhesives
- Excellent surface quality
- High feature definition and detail
- High durability and stability
- USP Level VI certified; sterilized in an autoclave (PA only)

3® SYSTEMS

DuraForm PA & GF Materials Typical Properties for the SLS systems

Powder Properties	Units	Test Method	PA	GF
Density				
Tap	g/cm^3	ASTM D4164	0.59	0.84
Particle Size Average (1)	µm	Laser Diffraction	58	48
Particle Size Range (1)				
90%	µm	Laser Diffraction	25-92	10-96
Specific Gravity				
20°C		ASTM D792	0.97	1.40
Moisture Absorption				
23°C	%	ASTM D570	0.41	0.30

Thermal Properties	Units	Test Method	PA	GF
Melting Point: T_m	°C	DSC	184	185
DTUL, 0.45 MPa				
	°C	ASTM D648	177	175
DTUL, 1.82 MPa	°C	ASTM D648	86	110

Mechanical Properties	Units	Test Method	PA	GF
Tensile Strength	MPa	ASTM D638	44	38.1
Tensile Modulus	MPa	ASTM D638	1600	5910
Tensile Elongation at Break	%	ASTM D638	9	2
Flexural Modulus	MPa	ASTM D790	1285	3300
Impact Strength				
Notched Izod	J/m	ASTM D256	214	96
Unnotched Izod	J/m	ASTM D256	428	101

Surface Finish	Units	PA	GF
Upper Facing			
As Processed, Ra	µm	8.5	6.2
After Finishing, Ra	µm	0.13	1.0

Chemical Resistance

Alkalines, hydrocarbons, fuels & solvents

Electrical Properties	Units	Test Method	PA	GF
Volume Resistivity				
22°C, 50% RH, 500V	ohm x cm	ASTM D257-93	$3.1x10^{14}$	$2.0Ex10^{14}$
Surface Resistivity				
22°C, 50% RH, 500V	ohm x cm	ASTM D257-93	$3.0x10^{14}$	$2.3Ex10^{14}$
Dielectric Constant				
22°C, 50% RV, 5V 1000Hz		D150-95	2.9	3.7
Dielectric Strength				
22°C, 50% RV, in air, 5V V/sec	v/mm	D149-95a	$1.6x10^4$	$1.5Ex10^4$
Comparative Tracking Index	V	D5288-92 and/or IEC Standard 112	585,Tl-Cu <1mm depth	TBD

(1) Results are based upon volume distribution of particles.

Data was generated from the testing of parts produced with the DuraForm materials under typical processing conditions. (New materials processed at 4 watts laser power, 165mm/sec scan speed, 0.1 mm scan spacing, 0.1 mm layer thickness on a Sinterstation® 2500 system. Expected shelf life of this material is at least twelve months, when stored in dry conditions at ambient temperatures. Warranty/Disclaimer: The performance characteristics of these products may vary according to product application, operating conditions, material combined with, or with end use. 3D Systems makes no warranties of any type, express or implied, including, but not limited to, the warranties of merchantability or fitness for a particular use.

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