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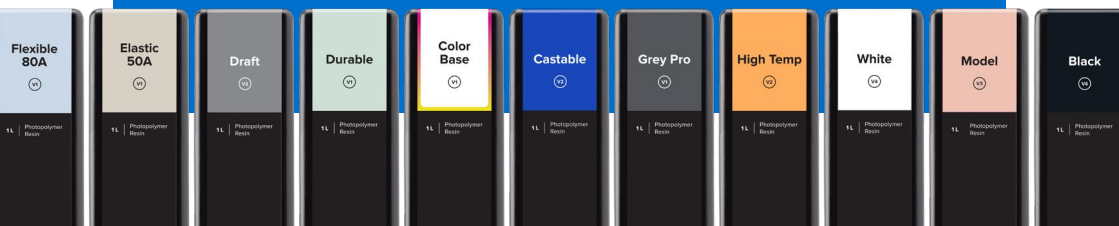
Materials Library

Functional Materials that look the part



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Materials Library

Functional Materials that look the part

ver A.2023

This document is updated quarterly, please check Formlabs.com for the latest product information.

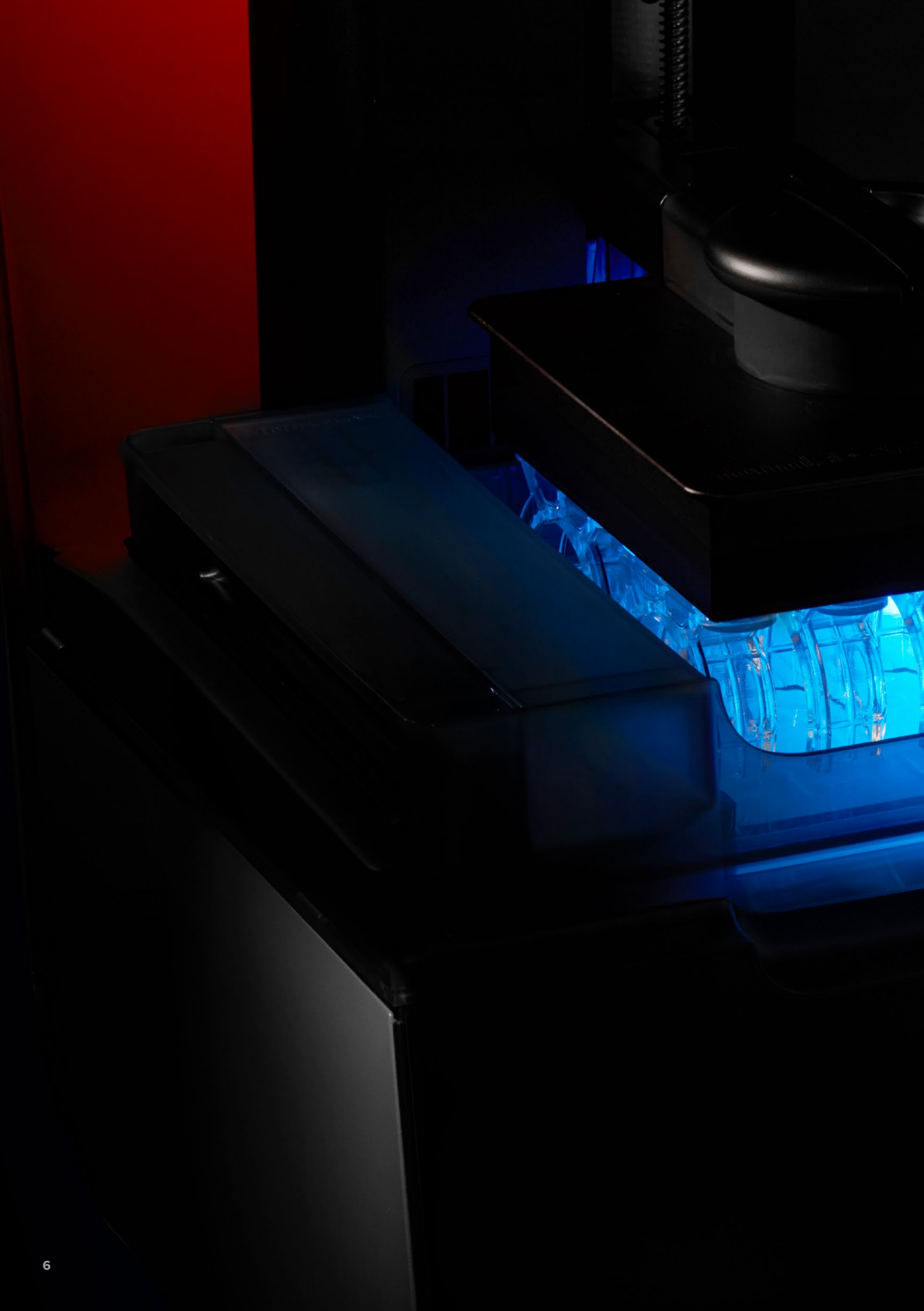
SLA RESIN MATERIAL LIST

SLA RESIN MATERIAL LIST

SLA RESIN MATERIAL LIST

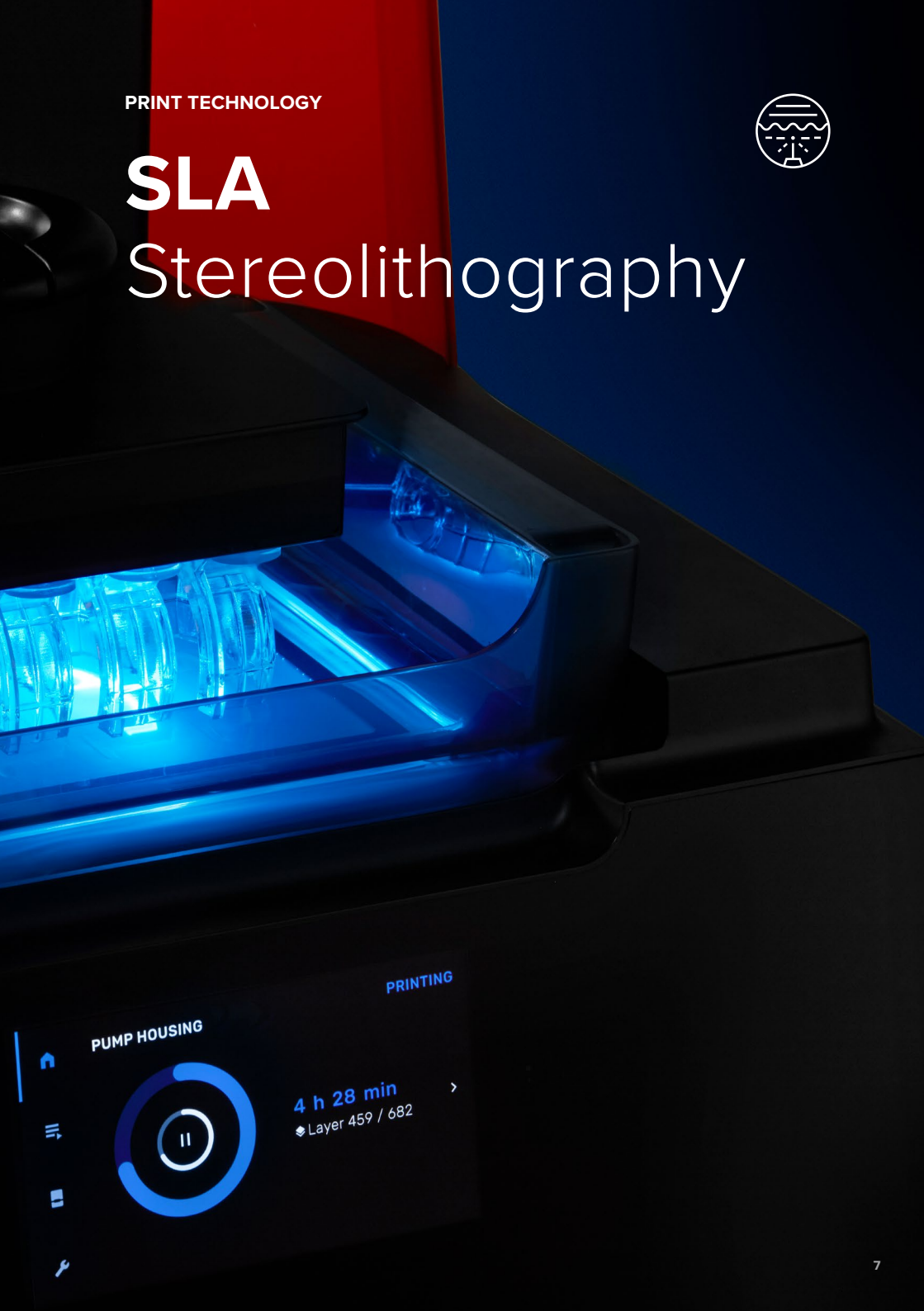
SLA RESIN MATERIAL LIST

SLS POWDER MATERIAL LIST



PRINT TECHNOLOGY

SLA
Stereolithography



formlabs

General Purpose Resins

Materials for High Resolution Models and Rapid Prototyping

High Detail. For demanding applications, our carefully-engineered resins capture the finest features in your model.

Strong and Precise. Our resins create accurate and robust parts, ideal for rapid prototyping, functional testing and product development.

Smooth Surface Finish. Perfectly smooth right out of the printer, parts printed on the Formlabs stereolithography printers have the polish and finish of a final product.

V4 Clear FLGPCL04	V4 Grey FLGPGR04	V2 Draft FLDRGR02	V1 Grey Pro FLPRGR01
V4 White LGPWH04	V4 Black FLGPBL04	V4 Color FLGPCB01	

* May not be available in all regions

Prepared 04 . 09 . 2016

Rev. 01 04 . 09 . 2016

MATERIAL PROPERTIES DATA

Standard Resins

The following material properties are comparable for Clear Resin, White Resin, Grey Resin, Black Resin, and Color Kit.

	METRIC [1]		IMPERIAL [1]		METHOD
	Green [2]	Post-Cured [3]	Green [2]	Post-Cured [3]	
Tensile Properties					
Ultimate Tensile Strength	38 MPa	65 MPa	5510 psi	9380 psi	ASTM D638-14
Tensile Modulus	1.6 GPa	2.8 GPa	234 ksi	402 ksi	ASTM D638-14
Elongation at Break	12%	6%	12%	6%	ASTM D638-14
Flexural Properties					
Flexural Modulus	1.3 GPa	2.2 GPa	181 psi	320 psi	ASTM D 790-15
Impact Properties					
Notched Izod	16 J/m	25 J/m	0.3 ft-lbf/in	0.46 ft-lbf/in	ASTM D256-10
Thermal Properties					
Heat Deflection Temp. @ 1.8 MPa	43 °C	58 °C	109 °F	137 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	50 °C	73 °C	121 °F	134 °F	ASTM D 648-16

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 2, 100 µm, Clear settings, without additional treatments.

[3] Data was obtained from parts printed using Form 2, 100 µm, Clear settings and post-cured with 1.25 mW/cm^2 of 405 nm LED light for 60 minutes at 60 °C.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	< 1	Mineral oil (Light)	< 1
Acetone	Sample cracked	Mineral oil (Heavy)	< 1
Bleach ~5% NaOCl	< 1	Salt Water (3.5% NaCl)	< 1
Butyl Acetate	< 1	Skydrol 5	1
Diesel Fuel	< 1	Sodium Hydroxide solution (0.025% PH 10)	< 1
Diethyl glycol Monomethyl Ether	1.7	Strong Acid (HCl conc)	Distorted
Hydraulic Oil	< 1	Water	< 1
Hydrogen peroxide (3%)	< 1	Xylene	< 1
Isooctane (aka gasoline)	< 1		
Isopropyl Alcohol	< 1		

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Draft

Draft Resin for Truly Rapid Prototyping

Draft Resin prints up to four times faster than Formlabs standard materials, making it ideal for initial prototypes and rapid iterations to help bring products to market faster. Parts printed with Draft Resin exhibit a smooth grey finish and high accuracy. Use 200 micron settings for fast print speeds, or use 100 micron settings for models with finer details.

Initial prototypes

Rapid design iterations

Live 3D printing demos

High throughput applications

V2 **FLDRGR02** * **May not be available in all regions**

Prepared 10 . 07 . 2020
Rev. 01 10 . 07 . 2020

MATERIAL PROPERTIES DATA

Draft Resin

	METRIC [1]			IMPERIAL [1]			METHOD
	Green [2]	Post-Cured at Room Temperature [3]	Post-Cured at 60 °C [4]	Green [2]	Post-Cured at Room Temperature [3]	Post-Cured at 140 °F [4]	
Tensile Properties							
Ultimate Tensile Strength	24 MPa	36 MPa	52 MPa	3481 psi	5221 psi	7542 psi	ASTM D638-14
Tensile Modulus	0.8 GPa	1.7 GPa	2.3 GPa	122 ksi	247 ksi	334 ksi	ASTM D638-14
Elongation at Break	14%	5%	4%	14%	5%	4%	ASTM D638-14
Flexural Properties							
Flexural Modulus	0.6 GPa	1.8 GPa	2.3 GPa	87 ksi	261 ksi	334 ksi	ASTM D 790-17
Impact Properties							
Notched Izod	26 J/m	29 J/m	26 J/m	0.5 ft-lbf/in	0.5 ft-lbf/in	0.5 ft-lbf/in	ASTM D256-10
Thermal Properties							
Heat Deflection Temp. @ 1.8 MPa	37 °C	44 °C	57 °C	99 °F	111 °F	135 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	43 °C	53 °C	74 °C	109 °F	127 °F	165 °F	ASTM D 648-16

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 3, 200 µm, Draft Resin settings, washed for 5 minutes in Form Wash and air dried without post cure.

[3] Data was obtained from parts printed using a Form 3, 200 micron, Draft Resin settings, and post-cured with Form Cure at room temperature for 5 minutes.

[4] Data was obtained from parts printed using a Form 3, 200 micron, Draft Resin settings, and post-cured with Form Cure at 60 °C for 5 minutes.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.2	Mineral oil (Light)	1.0
Acetone	4.2	Mineral oil (Heavy)	< 1.0
Bleach ~5% NaOCl	0.1	Salt Water (3.5% NaCl)	0.3
Butyl Acetate	0.1	Skydrol 5	0.3
Diesel Fuel	0.1	Sodium Hydroxide solution (0.025% PH 10)	0.3
Diethyl glycol Monomethyl Ether	0.8	Strong Acid (HCl conc)	< 1.0
Hydraulic Oil	< 0.1	Tripropylene glycol monomethyl ether	0.3
Hydrogen peroxide (3%)	0.2	Water	1.0
Isooctane (aka gasoline)	< 1.0	Xylene	1.0
Isopropyl Alcohol	< 1.0		

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Grey Pro

Resin for Versatile Prototyping

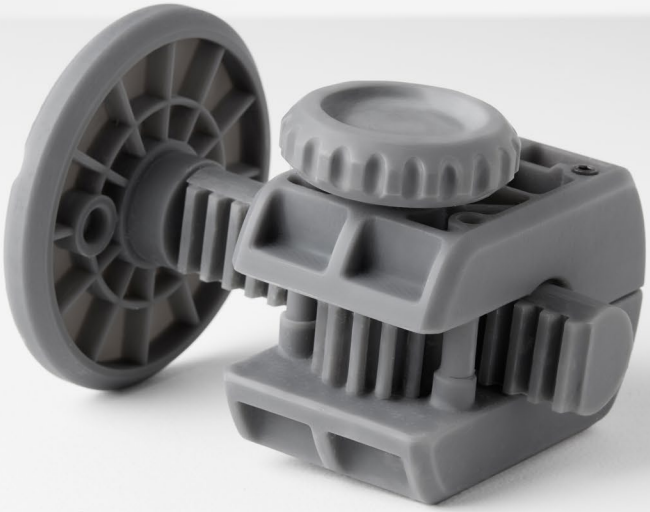
Grey Pro Resin offers high precision, moderate elongation, and low creep. This material is great for concept modeling and functional prototyping, especially for parts that will be handled repeatedly.

Form and fit testing

High quality product prototypes

Mold masters for plastics and silicones

Jigs and fixtures for manufacturing



V1 **FLPRGR01** *** May not be available in all regions**

Prepared 10 . 07 . 2020
Rev. 01 10 . 07 . 2020

MATERIAL PROPERTIES DATA

Grey Pro Resin

	METRIC [1]		IMPERIAL [1]		METHOD
	Green [2]	Post-Cured [3]	Green [2]	Post-Cured [3]	
Tensile Properties					
Ultimate Tensile Strength	35 MPa	61 MPa	5076 psi	8876 psi	ASTM D638-14
Tensile Modulus	1.4 GPa	2.6 GPa	203 ksi	377 ksi	ASTM D638-14
Elongation at Break	33%	13%	33%	13%	ASTM D638-14
Flexural Properties					
Flexural Stress at 5% Strain	39 MPa	86 MPa	5598 psi	12400 psi	ASTM D 790-15
Flexural Modulus	0.94 GPa	2.2 GPa	136 ksi	319 ksi	ASTM D 790-15
Impact Properties					
Notched Izod	Not tested	19 J/m	Not tested	0.35 ft-lbf/in	ASTM D256-10
Thermal Properties					
Heat Deflection Temp. @ 1.8 MPa	Not tested	62 °C	Not tested	144 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	Not tested	78 °C	Not tested	171 °F	ASTM D 648-16
Thermal Expansion (0-150 °C)	Not tested	79 µm/m/°C	Not tested	43 µin/in/°F	ASTM E 831-13

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 2, 100 µm, Grey Pro settings, without additional treatments.

[3] Data was obtained from parts printed using Form 2, 100 µm, Grey Pro settings and post-cured with a Form Cure for 120 minutes at 80 °C.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.8	Isooctane (aka gasoline)	< 0.1
Acetone	11.0	Mineral oil (light)	0.4
Isopropyl Alcohol	1.6	Mineral oil (Heavy)	0.3
Bleach ~5% NaOCl	0.7	Salt Water (3.5% NaCl)	0.6
Butyl Acetate	0.8	Sodium Hydroxide solution (0.025% PH 10)	0.7
Diesel Fuel	< 0.1	Water	0.8
Diethyl glycol Monomethyl Ether	2.4	Xylene	0.4
Hydraulic Oil	0.2	Strong Acid (HCl conc)	8.2
Skydrol 5	0.5	Xylene	0.4
Hydrogen peroxide (3%)	0.8		

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Rigid

Materials for Engineering, Manufacturing, and Product Design

Our library of versatile, reliable Rigid Resins is formulated to help you reduce costs, iterate faster, and bring better experiences to market.

*** Please note that resins may not be available in all regions.**

Rigid 10K

Rigid, strong, industrial-grade parts

Rigid 4000

Stiff, strong, engineering-grade parts

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Rigid 10K

Resin for Rigid, Strong, Industrial-Grade Prototypes

This highly glass-filled resin is the stiffest material in our engineering portfolio. Choose Rigid 10K Resin for precise industrial parts that need to withstand significant load without bending. Rigid 10K Resin has a smooth matte finish and is highly resistant to heat and chemicals.

Short-run injection molds and inserts

Heat resistant and fluid exposed components, jigs, and fixtures

Simulates stiffness of glass and fiber-filled thermoplastics

Aerodynamic test models

V1 **FLRG1001**

* **May not be available in all regions**

Prepared 10 . 07 . 2020

Rev. 04 12 . 12 . 2022

	METRIC				METHOD
	Green	**UV Cure [1]**	**UV + Thermal Cure [2]**	**UV Cure + Media Blast**	
Tensile Properties					
Ultimate Tensile Strength	55 MPa	65 MPa	53 MPa	88 MPa	ASTM D638-14
Tensile Modulus	7.5 GPa	10 GPa	10 GPa	11 GPa	ASTM D638-14
Elongation at Break	2%	1%	1%	1.7%	ASTM D638-14
Flexural Properties					
Flexural Strength	84 MPa	126 MPa	103 MPa	158 MPa	ASTM D 790-15
Flexural Modulus	6 GPa	9 GPa	10 GPa	9.9 GPa	ASTM D 790-15
Impact Properties					
Notched Izod	16 J/m	16 J/m	18 J/m	20 J/m	ASTM D256-10
Unnotched Izod	41 J/m	47 J/m	41 J/m	130 J/m	ASTM D4812-11
Thermal Properties					
Heat Deflection Temp. @ 0.45 MPa	65 °C	163 °C	218 °C	238 °C	ASTM D 648-16
Heat Deflection Temp. @ 1.8 MPa	56 °C	82 °C	110 °C	92 °C	ASTM D 648-16
Thermal Expansion, 0-150 °C	48 µm/m/°C	47 µm/m/°C	46 µm/m/°C	41 µm/m/°C	ASTM E 831-13

	IMPERIAL				METHOD
	Green	**UV Cure [1]**	**UV + Thermal Cure [2]**	**UV Cure + Media Blast**	
Tensile Properties					
Ultimate Tensile Strength	7980 psi	9460 psi	7710 psi	12700 psi	ASTM D638-14
Tensile Modulus	1090 ksi	1480 ksi	1460 ksi	1600 ksi	ASTM D638-14
Elongation at Break	2%	1%	1%	1.70%	ASTM D638-14
Flexural Properties					
Flexural Strength	12200 psi	18200 psi	15000 psi	22900 psi	ASTM D 790-15
Flexural Modulus	905 ksi	1360 ksi	1500 ksi	1440 ksi	ASTM D 790-15
Impact Properties					
Notched Izod	0.3 ft-lbf/in	0.3 ft-lbf/in	0.3 ft-lbf/in	0.37 ft-lbf/in	ASTM D256-10
Unnotched Izod	0.8 ft-lbf/in	0.9 ft-lbf/in	0.7 ft-lbf/in	2.5 ft-lbf/in	ASTM D4812-11
Thermal Properties					
Heat Deflection Temp. @ 0.45 MPa	149 °F	325 °F	424 °F	460 °F	ASTM D 648-16
Heat Deflection Temp. @ 1.8 MPa	133 °F	180 °F	230 °F	198 °F	ASTM D 648-16
Thermal Expansion, 0-150 °C	27 µin/in/°F	26 µin/in/°F	26 µin/in/°F	23 µin/in/°F	ASTM E 831-13

Toxic Gas Generation

Testing Standard BSS 7239 (comparable to NFPA No. 258)	Maximum allowed concentration per BSS 7239 (ppm)	Flaming Mode (ppm)	Non-Flaming Mode (ppm)
Hydrogen Cyanide (HCN)	150	1	0.5
Carbon Monoxide (CO)	3500	50	10
Nitrous Oxides (NOx)	100	< 2	< 2
Sulfur Dioxide (SO2)	100	< 1	< 1
Hydrogen Fluoride (HF)	200	< 1.5	< 1.5
Hydrogen Chloride (HCl)	500	1	< 1

Smoke Density / Specific Optical Density

Testing Standard	@ 90 sec	@ 4 min	Maximum
ASTM E662 Flaming Mode	2	95	132
ASTM E662 Non-Flaming Mode	0	1	63

Flammability

Testing Standard	Rating
UL 94 Section 7 (3 mm)	HB

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	< 0.1	Isooctane (aka gasoline)	0
Acetone	< 0.1	Mineral oil (light)	0.2
Isopropyl Alcohol	< 0.1	Mineral oil (Heavy)	< 0.1
Bleach ~5% NaOCl	0.1	Salt Water (3.5% NaCl)	0.1
Butyl Acetate	0.1	Sodium Hydroxide solution (0.025% PH 10)	0.1
Diesel Fuel	0.1	Water	< 0.1
Diethyl glycol Monomethyl Ether	0.4	Xylene	< 0.1
Hydraulic Oil	0.2	Strong Acid (HCl conc)	0.2
Skydrol 5	0.6	Tripropylene glycol monomethyl ether	0.4
Hydrogen peroxide (3%)	< 0.1		

All testing specimens were printed using Form 3

[1] Data was obtained from parts printed using Form 3, 100 µm and post-cured with a Form Cure for 60 minutes at 70 °C.

[2] Data was obtained from parts printed using Form 3, 100 µm and post-cured with a Form Cure for 60 minutes at 70 °C and an additional thermal cure at 90 °C for 125 minutes.

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Rigid 4000

Resin for Stiff, Strong, Engineering-Grade Prototypes

Glass-filled Rigid 4000 Resin prints with a smooth, polished finish and is ideal for stiff and strong parts that can withstand minimal deflection. Consider Rigid 4000 Resin for general load-bearing applications.

Mounts and brackets

Jigs and fixtures

Thin-walled parts

Simulates stiffness of PEEK

V1 **FLRGWH01** * **May not be available in all regions**

Prepared 10 . 07 . 2020
Rev. 01 10 . 07 . 2020

MATERIAL PROPERTIES DATA

Rigid 4000 Resin

	METRIC [1]		IMPERIAL [1]		METHOD
	Green [2]	Post-Cured [3]	Green [2]	Post-Cured [3]	
Tensile Properties					
Ultimate Tensile Strength	33 MPa	69 MPa	4786 psi	10007 psi	ASTM D638-14
Tensile Modulus	2.1 GPa	4.1 GPa	305 ksi	595 ksi	ASTM D638-14
Elongation at Break	23%	5.3%	23%	5.3%	ASTM D638-14
Flexural Properties					
Flexural Stress at 5% Strain	43 MPa	105 MPa	6236 psi	15229 psi	ASTM D 790-15
Flexural Modulus	1.4 GPa	3.4 GPa	203 ksi	493 ksi	ASTM D 790-15
Impact Properties					
Notched Izod	16 J/m	23 J/m	0.3 ft-lbf/in	0.43 ft-lbf/in	ASTM D256-10
Thermal Properties					
Heat Deflection Temp. @ 1.8 MPa	41 °C	60 °C	105 °F	140 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	48 °C	77 °C	118 °F	170 °F	ASTM D 648-16
Thermal Expansion (0-150 °C)	64 µm/m/°C	63 µm/m/°C	36 µin/in/°F	35 µin/in/°F	ASTM E 831-13

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 3, 100 µm, Rigid settings, without additional treatments.

[3] Data was obtained from parts printed using Form 3, 100 µm, Rigid settings and post-cured with a Form Cure for 15 minutes at 80 °C.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.8	Isooctane (aka gasoline)	< 0.1
Acetone	3.3	Mineral oil (light)	0.2
Isopropyl Alcohol	0.4	Mineral oil (Heavy)	0.2
Bleach ~5% NaOCl	0.7	Salt Water (3.5% NaCl)	0.7
Butyl Acetate	< 0.1	Sodium Hydroxide solution (0.025% PH 10)	0.7
Diesel Fuel	< 0.1	Water	0.7
Diethyl glycol Monomethyl Ether	1.4	Xylene	< 0.1
Hydraulic Oil	0.2	Strong Acid (HCl conc)	5.3
Skydrol 5	1.1		
Hydrogen peroxide (3%)	0.9		

formlabs

Tough & Durable

Materials for Engineering, Manufacturing, and Product Design

Our library of versatile, reliable Tough & Durable Resins is formulated to help you reduce costs, iterate faster, and bring better experiences to market.

*** Please note that resins may not be available in all regions.**

Tough 2000

Stiff, sturdy, rugged prototyping

Tough 1500

Stiff, pliable, resilient prototyping

Durable

Soft, pliable prototyping material

formlabs

Tough 2000

Resin for Rugged Prototyping

Tough 2000 Resin is the strongest and stiffest material in our functional family of Tough and Durable Resins. Choose Tough 2000 Resin for prototyping strong and sturdy parts that should not bend easily.

Strong and stiff prototypes

Sturdy jigs and fixtures

ABS-like strength and stiffness

V1 **FLTO2001** *** May not be available in all regions**

Prepared 10 . 07 . 2020
Rev. 01 10 . 07 . 2020

MATERIAL PROPERTIES DATA

Tough 2000 Resin

	METRIC [1]		IMPERIAL [1]		METHOD
	Green [2]	Post-Cured [3]	Green [2]	Post-Cured [3]	
Tensile Properties					
Ultimate Tensile Strength	29 MPa	46 MPa	4206 psi	6671 psi	ASTM D638-14
Tensile Modulus	1.2 GPa	2.2 GPa	174 ksi	329 ksi	ASTM D638-14
Elongation at Break	74%	48%	74%	48%	ASTM D638-14
Flexural Properties					
Flexural Strength	17 MPa	65 MPa	2465 psi	9427 psi	ASTM D 790-15
Flexural Modulus	0.45 GPa	1.9 GPa	65 ksi	275 ksi	ASTM D 790-15
Impact Properties					
Notched Izod	79 J/m	40 J/m	1.5 ft-lbf/in	0.75 ft-lbf/in	ASTM D256-10
Unnotched Izod	208 J/m	715 J/m	3.9 ft-lbf/in	13 ft-lbf/in	ASTM D4812-11
Temperature Properties					
Heat Deflection Temp. @ 1.8 MPa	42 °C	53 °C	108 °F	127 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	48 °C	63 °C	118 °F	145 °F	ASTM D 648-16
Thermal Expansion (0-150°C)	107 µm/m/°C	91 µm/m/°C	59 µin/in/°F	50 µin/in/°F	ASTM E 831-13

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 2, 100 µm, Tough 2000 settings, without additional treatments.

[3] Data was obtained from parts printed using Form 2, 100 µm, Tough 2000 settings and post-cured with a Form Cure for 120 minutes at 80 °C.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.7	Isooctane (aka gasoline)	< 0.1
Acetone	18.8	Mineral oil (light)	0.1
Isopropyl Alcohol	3.7	Mineral oil (Heavy)	0.2
Bleach ~5% NaOCl	0.6	Salt Water (3.5% NaCl)	0.6
Butyl Acetate	6.2	Sodium Hydroxide solution (0.025% PH 10)	0.6
Diesel Fuel	0.1	Water	0.6
Diethyl glycol Monomethyl Ether	5.3	Xylene	4.1
Hydraulic Oil	< 0.1	Strong Acid (HCl conc)	3.0
Skydrol 5	0.9		
Hydrogen peroxide (3%)	0.6		

formlabs

Tough 1500

Resin for Resilient Prototyping

Tough 1500 Resin is the most resilient material in our functional family of Tough and Durable Resins. This resin produces stiff and pliable parts that bend and spring back quickly under cyclic loading.

Springy prototypes and assemblies

Snap fit and press fit connectors

Polypropylene-like strength and stiffness

Certified biocompatible for extended skin-contact

V1 **FLTO1501** *** May not be available in all regions**

Prepared 10 . 07 . 2020

Rev. 02 05 . 04 . 2021

MATERIAL PROPERTIES DATA

Tough 1500 Resin

	METRIC [1]		IMPERIAL [1]		METHOD
	Green [2]	Post-Cured [3]	Green [2]	Post-Cured [3]	
Tensile Properties					
Ultimate Tensile Strength	26 MPa	33 MPa	3771 psi	4786 psi	ASTM D638-14
Tensile Modulus	0.94 GPa	1.5 GPa	136 ksi	218 ksi	ASTM D638-14
Elongation at Break	69%	51%	69%	51%	ASTM D638-14
Flexural Properties					
Flexural Strength	15 MPa	39 MPa	2175 psi	5656 psi	ASTM D 790-15
Flexural Modulus	0.44 GPa	1.4 GPa	58 ksi	203 ksi	ASTM D 790-15
Impact Properties					
Notched Izod	72 J/m	67 J/m	1.3 ft-lbf/in	1.2 ft-lbf/in	ASTM D256-10
Unnotched Izod	902 J/m	1387 J/m	17 ft-lbf/in	26 ft-lbf/in	ASTM D4812-11
Thermal Properties					
Heat Deflection Temp. @ 1.8 MPa	34 °C	45 °C	93 °F	113 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	42 °C	52 °C	108 °F	126 °F	ASTM D 648-16
Thermal Expansion (0-150 °C)	114 µm/m/°C	97 µm/m/°C	63 µin/in/°F	54 µin/in/°F	ASTM E 831-13

Tough 1500 Resin has been evaluated as a **skin contacting device** in accordance with ISO 10993-1, and passed the requirements for the following biocompatibility endpoints:

ISO Standard	Description [4,5]
ISO 10993-5	Not Cytotoxic
ISO 10993-10	Not an Irritant
ISO 10993-10	Not a Sensitizer

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 2, 100 µm, Tough 1500 settings, without additional treatments.

[3] Data was obtained from parts printed using Form 2, 100 µm, Tough 1500 settings and post-cured with a Form Cure for 60 minutes at 70 °C.

[4] ISO 10993 standard testing samples were printed on a Form 3 with 100um Tough 1500 Resin settings, washed in a Form Wash for 20 minutes in ≥99% Isopropyl Alcohol, dried for at least 30 minutes and post-cured at 70°C for 60 minutes in a Form Cure.

[5] Tough 1500 Resin was tested at NAMSA World Headquarters, OH, USA.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic acid (5%)	0.8	Mineral oil (heavy)	< 0.1
Acetone	19.0	Mineral oil (light)	< 0.1
Bleach (5% NaOCl)	0.6	Salt water (3.5% NaCl)	0.7
Butyl acetate	5.0	Skydrol 5	0.5
Diesel	0.1	Sodium Hydroxide solution (0.025% pH=10)	0.7
Diethyl glycol monomethyl ether	5.3	Strong acid (HCl conc)	4.4
Hydraulic oil	0.2	Tripropylene glycol monomethyl ether	0.6
Hydrogen peroxide (3%)	0.7	Water	0.7
Isooctane (aka gasoline)	< 0.1	Xylene	3.2
Isopropyl alcohol	3.2		

formlabs

Durable

Resin for Pliable Prototyping

Durable Resin is the most pliable, impact resistant, and lubricious material in our functional family of Tough and Durable Resins. Choose Durable Resin for squeezable parts and low-friction assemblies.

Squeezable prototypes

Low friction and non-degrading surfaces

Impact resistant jigs

Polyethylene-like strength and stiffness

V2 **FLDUCL02** *** May not be available in all regions**

Prepared 10 . 07 . 2020
Rev. 01 10 . 07 . 2020

MATERIAL PROPERTIES DATA **Durable Resin**

	METRIC [1]		IMPERIAL [1]		METHOD
	Green [2]	Post-Cured [3]	Green [2]	Post-Cured [3]	
Tensile Properties					
Ultimate Tensile Strength	13 MPa	28 MPa	1900 psi	3980 psi	ASTM D638-14
Tensile Modulus	0.24 GPa	1.0 GPa	34 ksi	149 ksi	ASTM D638-14
Elongation at Break	75%	55%	75%	55%	ASTM D638-14
Flexural Properties					
Flexural Strength	1.0 MPa	24 MPa	149 psi	3420 psi	ASTM D 790-15
Flexural Modulus	0.04 GPa	0.66 GPa	5.58 ksi	94.1 ksi	ASTM D 790-15
Impact Properties					
Notched Izod	127 J/m	114 J/m	2.37 ft-lbf/in	2.13 ft-lbf/in	ASTM D256-10
Unnotched Izod	972 J/m	710 J/m	18.2 ft-lbf/in	13.3 ft-lbf/in	ASTM D4812-11
Thermal Properties					
Heat Deflection Temp. @ 0.45 MPa	< 30 °C	41 °C	< 86 °F	105 °F	ASTM D 648-16
Thermal Expansion (0-150°C)	124 µm/m/°C	106 µm/m/°C	69.1 µin/in/°F	59 µin/in/°F	ASTM E 831-13

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 2, 100 µm, Durable settings, without additional treatments.

[3] Data was obtained from parts printed using Form 2, 100 µm, Durable settings and post-cured with a Form Cure for 120 minutes at 60 °C.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	1.3	Isooctane (aka gasoline)	< 1
Acetone	Sample cracked	Mineral oil (light)	< 1
Isopropyl Alcohol	5.1	Mineral oil (Heavy)	< 1
Bleach ~5% NaOCl	< 1	Salt Water (3.5% NaCl)	< 1
Butyl Acetate	7.9	Sodium Hydroxide solution (0.025% PH 10)	< 1
Diesel Fuel	< 1	Water	< 1
Diethyl glycol monomethyl ether	7.8	Xylene	6.5
Hydraulic Oil	< 1	Strong Acid (HCl conc)	Distorted
Skydrol 5	1.3		
Hydrogen peroxide (3%)	1		

formlabs

Flexible & Elastic

Materials for Engineering, Manufacturing, and Product Design

Our library of versatile, reliable Flexible & Elastic Resins is formulated to help you reduce costs, iterate faster, and bring better experiences to market.

*** Please note that resins may not be available in all regions.**

Flexible 80A

Hard flexible parts with slow return

Elastic 50A

Soft flexible parts that spring back

formlabs

Flexible 80A

Resin for Hard Flexible Prototypes

Flexible 80A Resin is the most stiff soft-touch material in our library of Flexible and Elastic Resins, with an 80A Shore durometer to simulate the flexibility of rubber or TPU.

Balancing softness with strength, Flexible 80A Resin can withstand bending, flexing, and compression, even through repeated cycles. This material is well-suited for cushioning, damping, and shock absorption.

Cartilage and ligament anatomy

Seals, gaskets, masks

Handles, grips, overmolds

V1 **FLFL8001**

* **May not be available in all regions**

Prepared 10 . 07 . 2020
Rev. 01 10 . 07 . 2020

MATERIAL PROPERTIES DATA

Flexible 80A Resin

	METRIC [1]		IMPERIAL [1]		METHOD
	Green	Post-Cured [2]	Green	Post-Cured [2]	
Tensile Properties					
Ultimate Tensile Strength [3]	3.7 MPa	8.9 MPa	539 psi	1290 psi	ASTM D 412-06 (A)
Stress at 50% Elongation	1.5 MPa	3.1 MPa	218 psi	433 psi	ASTM D 412-06 (A)
Stress at 100% Elongation	3.5 MPa	6.3 MPa	510 psi	909 psi	ASTM D 412-06 (A)
Elongation at Break	100%	120%	100%	120%	ASTM D 412-06 (A)
Shore Hardness	70A	80A	70A	80A	ASTM 2240
Compression Set (23 °C for 22 hours)	Not Tested	3%	Not Tested	3%	ASTM D 395-03 (B)
Compression Set (70 °C for 22 hours)	Not Tested	5%	Not Tested	5%	ASTM D 395-03 (B)
Tear Strength [4]	11 kN/m	24 kN/m	61 lbf/in	137 lbf/in	ASTM D 624-00
Ross Flex Fatigue at 23 °C	Not Tested	>200,000 cycles	Not Tested	>200,000 cycles	ASTM D1052, (notched), 60° bending, 100 cycles/minute
Ross Flex Fatigue at -10 °C	Not Tested	>50,000 cycles	Not Tested	>50,000 cycles	ASTM D1052, (notched), 60° bending, 100 cycles/minute
Bayshore Resilience	Not Tested	28%	Not Tested	28%	ASTM D2632
Thermal Properties					
Glass transition temperature (Tg)	Not Tested	27 °C	Not Tested	27 °C	DMA

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from parts printed using Form 3, 100 µm, Flexible 80A settings, washed in Form Wash for 10 minutes and post-cured with Form Cure at 60 °C for 10 minutes.

[3] Tensile testing was performed after 3+ hours at 23 °C, using a Die C specimen cut from sheets.

[4] Tear testing was performed after 3+ hours at 23 °C, using a Die C tear specimen directly printed.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.9	Isooctane (aka gasoline)	1.6
Acetone	37.4	Mineral oil (light)	0.1
Isopropyl Alcohol	11.7	Mineral oil (Heavy)	< 0.1
Bleach ~5% NaOCl	0.6	Salt Water (3.5% NaCl)	0.5
Butyl Acetate	51.4	Sodium Hydroxide solution (0.025% PH 10)	0.6
Diesel Fuel	2.3	Water	0.7
Diethyl Glycol Monomethyl Ether	19.3	Xylene	64.1
Hydraulic Oil	1.0	Strong Acid (HCl conc)	28.6
Skydrol 5	10.7	Tripropylene Glycol Methyl Ether (TPM)	13.6
Hydrogen peroxide (3%)	0.7		

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Elastic 50A

Resin for Soft Flexible Parts

Our softest Engineering Resin, this 50A Shore durometer material is suitable for prototyping parts normally produced with silicone. Choose Elastic Resin for parts that will bend, stretch, compress, and hold up to repeated cycles without tearing.

Compliant features for robotics

Wearables and consumer goods prototyping

Medical models and devices

Special effects props and models

V1 **FLELCL01** *** May not be available in all regions**

Prepared 10 . 07 . 2020
Rev. 01 10 . 07 . 2020

	METRIC [1]		IMPERIAL [1]		METHOD
	Green	Post-Cured [2]	Green	Post-Cured [2]	
Tensile Properties					
Ultimate Tensile Strength [3]	1.61 MPa	3.23 MPa	234 psi	468 psi	ASTM D 412-06 (A)
Stress at 50% Elongation	0.92 MPa	0.94 MPa	133 psi	136 psi	ASTM D 412-06 (A)
Stress at 100% Elongation	1.54 MPa	1.59 MPa	233 psi	231 psi	ASTM D 412-06 (A)
Elongation at Break	100%	160%	100%	160%	ASTM D 412-06 (A)
Tear Strength [4]	8.9 kN/m	19.1 kN/m	51 lbf/in	109 lbf/in	ASTM D 624-00
Shore Hardness	40A	50A	40A	50A	ASTM 2240
Compression Set (23 °C for 22 hours)	2%	2%	2%	2%	ASTM D 395-03 (B)
Compression Set (70 °C for 22 hours)	3%	9%	3%	9%	ASTM D 395-03 (B)

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from parts printed using Form 2, 100 µm, Elastic settings, washed in Form Wash for 20 minutes and post-cured with Form Cure at 60 °C for 20 minutes.

[3] Tensile testing was performed after 3+ hours at 23 °C, using a Die C dumbbell and 20 in/min cross head speed.

[4] Tear testing was performed after 3+ hours at 23 °C, using a Die C tear specimen and a 20 in/min cross head speed.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr size gain, %	24 hr weight gain, %	Solvent	24 hr size gain, %	24 hr weight gain, %
Acetic Acid 5%	< 1	2.8	Isooctane (aka gasoline)	< 1	3.5
Acetone	19.3	37.3	Mineral oil (light)	< 1	< 1
Isopropyl Alcohol	13.3	25.6	Mineral oil (Heavy)	< 1	< 1
Bleach ~5% NaOCl	< 1	2	Salt Water (3.5% NaCl)	< 1	1.7
Butyl Acetate	18.2	39.6	Sodium Hydroxide solution (0.025% PH 10)	< 1	2
Diesel Fuel	1.2	4.2	Water	< 1	2.3
Diethyl glycol Monomethyl Ether	12	28.6	Xylene	20.4	46.6
Hydraulic Oil	< 1	2.1	Strong Acid (HCl conc)	14.2	39.4
Skydrol 5	9.9	21.7			
Hydrogen peroxide (3%)	< 1	2.2			

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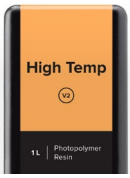
Specialty

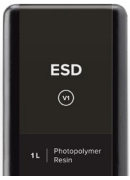
Our family of Specialty Resins features advanced materials with unique properties that expand what's possible with in-house fabrication on our stereolithography 3D printers. These materials may require additional steps, equipment, and experimentation.

*** Please note that resins may not be available in all regions.**



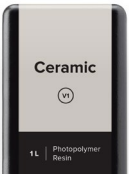
High Temp

High thermal stability



ESD

Rugged ESD-safe material for electronics manufacturing



Ceramic

Experimental ceramic material

formlabs

High Temp

Resin for Heat Resistance

High Temp Resin offers a heat deflection temperature (HDT) of 238 °C @ 0.45 MPa, the highest among Formlabs resins. Use it to print detailed, precise prototypes with high temperature resistance.

Hot air, gas, and fluid flow

Heat resistant mounts, housings, and fixtures

Molds and inserts

V2 **FLHTAM02** *** May not be available in all regions**

Prepared 10 . 07 . 2020
Rev. 01 10 . 07 . 2020

MATERIAL PROPERTIES DATA

High Temp Resin

	METRIC [1]			IMPERIAL [1]			METHOD
	Green [2]	Post-Cured [3]	Post-Cured + additional Thermal Cure [4]	Green [2]	Post-Cured [3]	Post-Cured + additional Thermal Cure [4]	
Tensile Properties							
Ultimate Tensile Strength	21 MPa	58 MPa	49 MPa	3031 psi	8456 psi	7063 psi	ASTM D638-14
Tensile Modulus	0.75 GPa	2.8 GPa	2.8 GPa	109 ksi	399 ksi	406 ksi	ASTM D638-14
Elongation at Break	14%	3.3%	2.3%	14%	3.3%	2.3%	ASTM D638-14
Flexural Properties							
Flexural Strength at Break	24 MPa	95 MPa	97 MPa	3495 psi	13706 psi	14097 psi	ASTM D 790-15
Flexural Modulus	0.7 GPa	2.6 GPa	2.8 GPa	100 ksi	400 ksi	406 ksi	ASTM D 790-15
Impact Properties							
Notched Izod	33 J/m	18 J/m	17 J/m	0.61 ft-lbf/in	0.34 ft-lbf/in	0.32 ft-lbf/in	ASTM D256-10
Thermal Properties							
Heat Deflection Temp. @ 1.8 MPa	44 °C	78 °C	101 °C	111 °F	172 °F	214 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	49 °C	120 °C	238 °C	120 °F	248 °F	460 °F	ASTM D 648-16
Thermal Expansion	118 µm/m/°C	80 µm/m/°C	75 µm/m/°C	41 µin/in/°F	44 µin/in/°F	41 µin/in/°F	ASTM E 831-13

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 2, 100 µm, High Temp settings, washed for 5 minutes in Form Wash and air dried without post cure.

[3] Data was obtained from parts printed using a Form 2, 100 micron, High Temp settings, and post-cured with Form Cure at 60 °C for 60 minutes.

[4] Data was obtained from parts printed using a Form 2, 100 micron, High Temp settings, and post-cured with Form Cure at 80 °C for 120 minutes plus an additional thermal cure in a lab oven at 160 °C for 180 minutes.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr size gain, %	24 hr weight gain, %	Solvent	24 hr size gain, %	24 hr weight gain, %
Acetic Acid 5%	< 1	< 1	Mineral oil (Light)	< 1	< 1
Acetone	< 1	2	Mineral oil (Heavy)	< 1	< 1
Bleach ~5% NaOCl	< 1	< 1	Salt Water (3.5% NaCl)	< 1	< 1
Butyl Acetate	< 1	< 1	Skydrol 5	< 1	1.1
Diesel Fuel	< 1	< 1	Sodium Hydroxide solution (0.025% PH 10)	< 1	< 1
Diethyl glycol Monomethyl Ether	< 1	1	Strong Acid (HCl conc)	1.2	< 1
Hydraulic Oil	< 1	< 1	Tripropylene glycol monomethyl ether	< 1	< 1
Hydrogen peroxide (3%)	< 1	< 1	Water	< 1	< 1
Isooctane (aka gasoline)	< 1	< 1	Xylene	< 1	< 1
Isopropyl Alcohol	< 1	< 1			

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ESD

A rugged ESD-safe material to improve your electronics manufacturing workflows.

Reduce risk and increase manufacturing yield by 3D printing custom tools, jigs, and fixtures with ESD Resin that protect your critical electronics components from static discharge. ESD Resin is a cost-effective solution for producing static-dissipative parts designed to endure use on the factory floor.

Anti-static prototypes and end-use parts

Housings for sensitive electronics

Tooling, jigs, and fixtures for electronics manufacturing

V1 **FLESDS01** * **May not be available in all regions.**

Prepared 12 . 01 . 2021
Rev. 01 12 . 01 . 2021

MATERIAL PROPERTIES DATA

ESD Resin

	METRIC [1, 2]	IMPERIAL [1,2]	METHOD
	Post-Cured	**Post-Cured**	
Mechanical Properties			
Ultimate Tensile Strength	44.2 MPa	6410 psi	ASTM D 638-14
Tensile Modulus	1.937 GPa	280.9 ksi	ASTM D 638-14
Elongation at Break	12%	12%	ASTM D 638-14
Flexural Properties			
Flexural Strength	61 MPa	8860 psi	ASTM D 790-17
Flexural Modulus	1.841 GPa	267 ksi	ASTM D 790-17
Impact Properties			
Notched Izod	26 J/m	0.489 ft-lbs/in	ASTM D 256-10
Unnotched Izod	277 J/m	5.19 ft-lbs/in	ASTM D 4812-11
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	54.2 °C	129.6 °F	ASTM D 648-18
Heat Deflection Temp. @ 0.45 MPa	62.2 °C	143.9 °F	ASTM D 648-18
Thermal Expansion	123.7µm/m/°C	68.7µin/in/°F	ASTM E 813-13
Electrical Properties			
Surface Resistivity	10^5 - 10^8 Ω/sq		ANSI/ESD 11.11 [3]
Volume Resistivity	10^5 - 10^7 Ω-cm		ANSI/ESD 11.11 [3]
Physical Properties			
Density	1.116 g/cm^3	69.67 lbs/ft^3	ASTM D792
Hardness	90 Shore D		ASTM D2240

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data for post-cured samples were measured on Type IV tensile bars printed on a Form 3 printer with 100 µm ESD Resin settings, washed in a Form Wash for 20 minutes in ≥99% Isopropyl Alcohol, and post-cured at 70°C for X 60 minutes in a Form Cure.

[3] ESD Resin was tested at ETS 700 West Park Avenue, Perkasie, PA 18944.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.5	Mineral oil, heavy	0.1
Acetone	13.1	Mineral oil, light	0.1
Bleach ~5% NaOCl	0.5	Salt Water (3.5% NaCl)	0.6
Butyl Acetate	3.8	Skydrol 5	0.5
Diesel Fuel	0.2	Sodium hydroxide solution (0.025% pH = 10)	0.7
Diethyl glycol monomethyl ether	3.6	Strong Acid (HCl Conc)	1.4
Hydraulic Oil	0.2	TPM	0.6
Hydrogen peroxide (3%)	0.6	Water	0.7
Isooctane	< 0.1	Xylene	1.60
Isopropyl Alcohol	2.6		

formlabs

Ceramic

An Experimental Material for Engineering, Art, and Design

Parts 3D printed in silica-filled Ceramic Resin can be fired to create a fully ceramic piece. This experimental Form X material requires more trial and error than other Formlabs products. Please read the usage guide prior to printing.

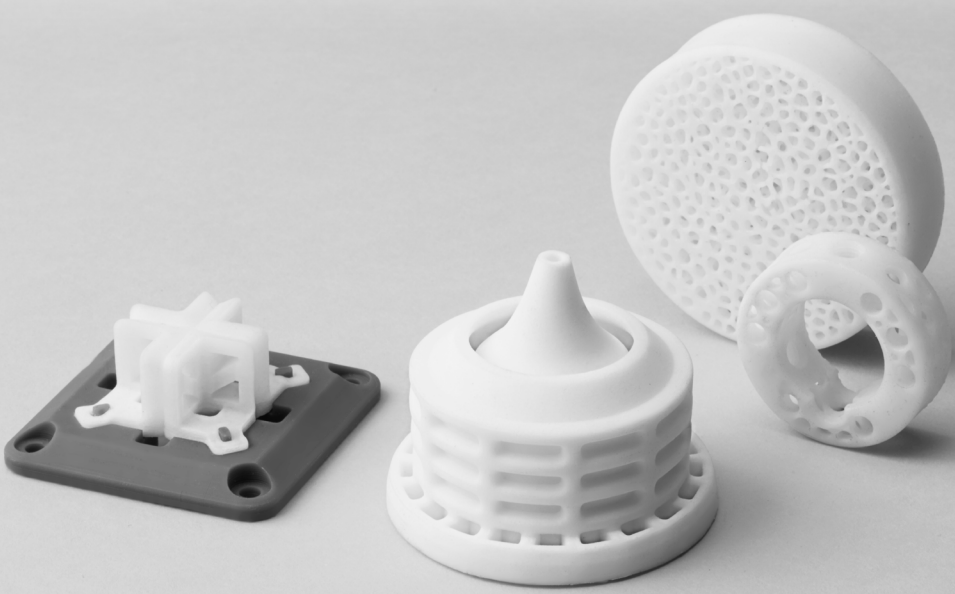
Available only for the Form 2.

Technical experimentation

Research and development

Fine art and sculpture

Jewelry



V1 **FLCEWH01** *** May not be available in all regions**

Prepared 05 . 03 . 2018
Rev. 01 05 . 03 . 2018

	METRIC [1]		IMPERIAL [1]		METHOD
	Green [2]	Fired [3]	Green [2]	Fired [3]	
Tensile Properties					
Ultimate Tensile Strength	5.1 MPa	N/A	740 psi	N/A	ASTM D638-14
Tensile Modulus	1 GPa	5.1 GPa	149 ksi	740 ksi	ASTM D638-14
Elongation	1.4%	N/A	1.4%	N/A	ASTM D638-14
Flexural Properties					
Flexural Stress at Break	10.3 MPa	10.3 MPa	1489 psi	1489 psi	ASTM D790-15e2
Flexural Modulus	995 MPa	N/A	144 ksi	N/A	ASTM D790-15e2
Impact Properties					
Notched Izod	18.4 J/m	N/A	0.35 ft-lb/in	N/A	ASTM D256-10e1
Thermal Properties					
Heat Deflection Temp. @ 1.8 MPa	75 °C	75 °C	155 °F	155 °F	ASTM D648-16, Method B
Heat Deflection Temp. @ 0.45 MPa	> 290 °C	> 290 °C	> 554 °F	> 554 °F	ASTM D648-16, Method B

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 2, 100 µm, Ceramic settings, washed, air dried, and post-cured in Form Cure at 60 °C for 60 minutes.

[3] Data was obtained from fired parts, printed using Form 2, 100 µm, Ceramic settings, which were washed, dried and post-cured in Form Cure at 60 °C for 60 minutes. Parts had been printed with a pre-applied scale factor and fired using an 30 hr schedule to a maximum firing temperature of 1275 °C as laid out in the Formlabs usage guide.

formlabs

Polyurethane

Materials for Engineering, Manufacturing, and Product Design

Our library of versatile, reliable polyurethane resins is formulated to help you reduce costs, iterate faster, and bring better experiences to market.

*** Please note that resins may not be available in all regions.**

PU Rigid 1000
Stiff, Sturdy, and Unyielding Polyurethane Parts

PU Rigid 650
Impact Resistant and Pliable Polyurethane Parts

Rebound
Highly resilient end-use TPU material

formlabs

PU Rigid 1000

For Stiff, Sturdy, and Unyielding Polyurethane Parts

PU Rigid 1000 Resin is a semi-rigid and tough polyurethane material that can handle high impacts and harsh environments repeatedly.

Protective casings, housings, and enclosures

Static jigs and fixtures undergoing high-stress

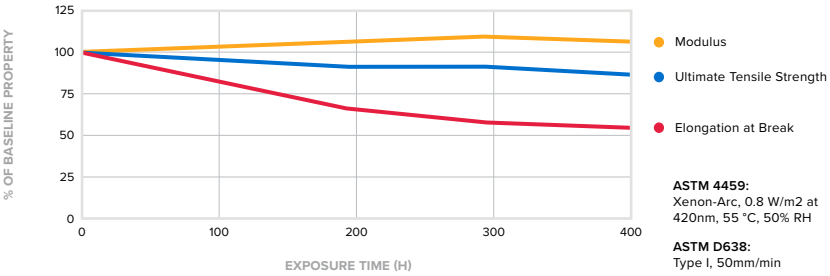
Sturdy consumer products

V1 **FLPU1001** *** May not be available in all regions**

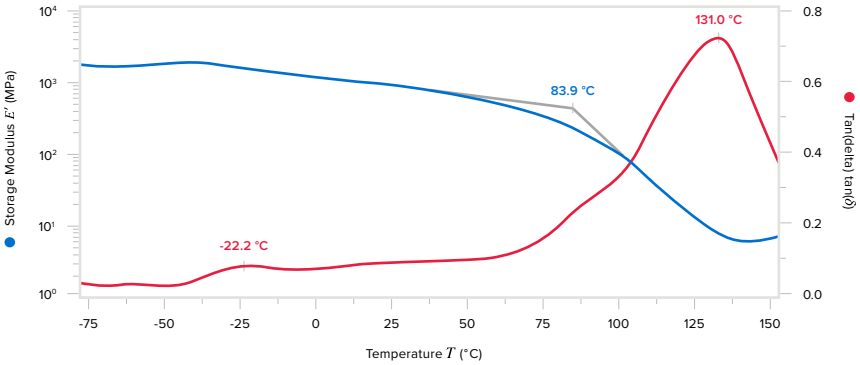
Prepared 04 . 28 . 2022
Rev. 01 04 . 28 . 2022

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured [2]	Post-Cured [2]	
Tensile Properties			
Ultimate Tensile Strength	35 ± 3.5 MPa	5 ± 0.5 ksi	ASTM D638
Young's Modulus	0.92 ± 0.09 GPa	133 ± 13 ksi	ASTM D638
Elongation at Break	80 ± 8%	80 ± 8%	ASTM D638
Flexural Properties			
Flexural Strength	32 ± 1.6 MPa	4.6 ± 0.2 ksi	ASTM D 790-15
Flexural Modulus	0.75 ± 0.03 GPa	109 ± 4.4 ksi	ASTM D 790-15
Ross Flexing Fatigue (unnotched)	> 50,000 cycles (PASS-no crack propagation)		ASTM D 1052 (23 °C)
Impact Properties			
Notched Izod	170 J/m	3.18 ft-lbs/in	ASTM D 256-10
Charpy Impact Test (Notched)	23 kJ/m^2	11 $ft\text{-}lbs/in^2$	ISO 179-1:2010(E)
Tabor Abrasion	177 mm^3	0.01 in^3	ISO 4649 (40rpm, 10N load)
Physical Properties			
Hardness	74D		ASTM D 2240
Density (solid)	1.16 g/cm^3	72.42 lb/ft^3	ASTM D 792-20
Viscosity (@ 25 °C)	1193 cP		
Viscosity (@ 35 °C)	567 cP		
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	64 °C	147 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	79 °C	174 °F	ASTM D 648-16
Thermal Expansion	142 µm/m/°C	78.9 µin/in/°F	ASTM E 813-13
Glass Transition Temperature (Tg1)	-22 °C	-8 °F	DMA*
Glass Transition Temperature (Tg2)	131 °C	268 °F	DMA*
Electrical Properties			
Dielectric Strength	1.8 x 10^7 V/m	460 V/mil	ASTM D149-20
Dielectric Constant	3.9		ASTM D 150, 0.5 MHz
Dielectric Constant	4.3		ASTM D 150, 1.0 MHz
Dissipation Factor	0.077		ASTM D 150, 0.5 MHz
Dissipation Factor	0.081		ASTM D 150, 1.0 MHz
Volume resistivity	6.5 x 10^{11} ohm-cm	2.56 x 10^{11} ohm-in	ASTM D257-14
Flammability Properties			
Flammability rating	HB		UL 94
Smoke Density	(D s 1.5) = 31 (PASS) (D s 4.0) = 244 (FAIL)		ASTM E662-21
Automotive Specific Testing			
Volatile Organic Compounds	199 µg/g	0.03 oz/lb	VOC VDA 278
Fogging	3.2 mg	1.1 x 10^{-4} oz	DIN 75201, Method B

Accelerated Aging



Dynamic mechanical analysis (DMA) is used to study the viscoelastic behavior of materials. Below is the DMA thermogram for PU Rigid 1000. Storage modulus and tan(delta) are plotted as function of temperature. Two glass transition temperatures are observed for PU Rigid 1000, which are -22.2°C and +131.0°C. A drop in storage modulus, indicating softening, is observed around 80°C.



PU R1000 Resin has been evaluated as a **skin contacting device** in accordance with ISO 10993-1, and passed the requirements for the following biocompatibility endpoints:

ISO Standard	Description [3, 4]
EN ISO 10993-5	Not cytotoxic
EN ISO 10993-10	Not an irritant
EN ISO 10993-10	Not a sensitizer

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.4	Isopropyl Alcohol	1.7
Acetone	11.0	Castor Oil	< 0.1
Bleach ~5% NaOCl	0.3	Mineral oil, light	< 0.1
Butyl Acetate	3.5	Propylene Glycol Diacetate	0.1
Dichloromethane	95.9	Salt Water (3.5% NaCl)	0.2
Diesel Fuel	< 0.1	Skydrol 500B-4	0.2
Diethyl glycol monomethyl ether	3.5	Sodium hydroxide solution (0.025% pH = 10)	0.3
Gasoline	< 0.1	Strong Acid (HCl Conc)	-1.1
Hexane	< 0.1	Water	0.2
Hydraulic Oil	< 0.1	Xylene	2.7
Hydrogen peroxide (3%)	0.3		

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data for post-cured samples were measured on Type I tensile bars printed on a Form 2 printer with 100 µm PU R1000 Resin settings, washed in a Form Wash for 2 minutes in ≥99% PGDA, and post-cured.

[3] ISO 10993 standard testing samples were printed on a Form 3 with 100um PU Rigid 1000 Resin settings, washed in a Form Wash for 5 minutes in ≥99% PGDA, dried for at least 24 hours and post-cured at 46°C and 70%RH for 3 days in an oven.

[4] PU R1000 Resin was tested at NAMSA World Headquarters, OH, USA.

formlabs

PU Rigid 650

For Impact Resistant and Semi-Stiff Polyurethane Parts

PU Rigid 650 Resin is a tough and pliable polyurethane material that can withstand extreme impacts while maintaining true shape long-term.

Impact-resistant components

Pliable mechanical connectors

Shock-absorbing bumpers and dampeners

Noise-dampening components

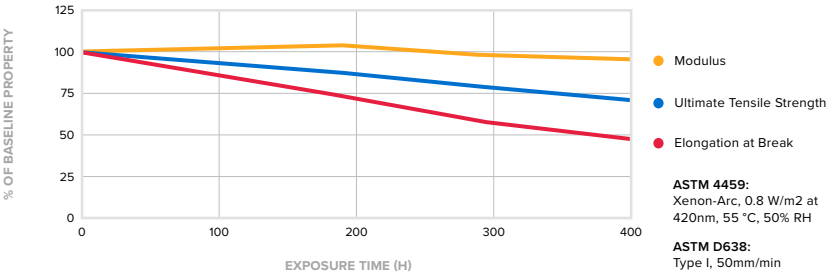
V1 **FLPU6501** *** May not be available in all regions**

Prepared 05 . 03 . 2022

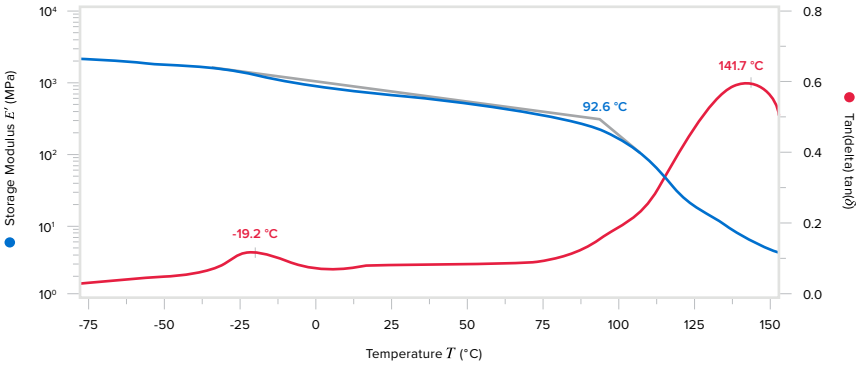
Rev. 01 05 . 03 . 2022

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured [2]	**Post-Cured [2]**	
Tensile Properties			
Ultimate Tensile Strength	34 ± 3.4 MPa	5 ± 0.5 ksi	ASTM D638
Young's Modulus	0.67 ± 0.06 GPa	97 ± 9 ksi	ASTM D638
Elongation at Break	170 ± 17 %	170 ± 17 %	ASTM D638
Flexural Properties			
Flexural Strength	22 ± 1.1 MPa	3.2 ± 0.2 ksi	ASTM D 790-15
Flexural Modulus	0.57 ± 0.03 GPa	83 ± 4 ksi	ASTM D 790-15
Ross Flexing Fatigue (unnotched)	> 50,000 cycles (PASS-no crack propagation)		ASTM D 1052 (-10 °C)
Ross Flexing Fatigue (unnotched)	> 50,000 cycles (PASS-no crack propagation)		ASTM D 1052 (23 °C)
Impact Properties			
Notched Izod	375 J/m	7.0 ft-lbs/in	ASTM D 256-10
Charpy Impact Test (Notched)	44 kJ/m^2	21 $ft\text{-}lbs/in^2$	ISO 179-1:2010(E)
Tabor Abrasion	101 mm^3	6.2 x 10-3 in^3	ISO 4649 (40rpm, 10N load)
Physical Properties			
Hardness	64D		ASTM D 2240
Density (solid)	1.16 g/cm^3	72.42 lb/ft^3	ASTM D 792-20
Viscosity (@ 25 °C)	1070 cP		
Viscosity (@ 35 °C)	519 cP		
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	59 °C	138 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	82 °C	179 °F	ASTM D 648-16
Thermal Expansion	130.4 µm/m/°C	72.4 µin/in/°F	ASTM E 813-13
Glass Transition Temperature (Tg1)	-19 °C	-2 °F	DMA*
Glass Transition Temperature (Tg2)	142 °C	286 °F	DMA*
Electrical Properties			
Dielectric Strength	1.8 x 10^7 V/m	460 V/mil	ASTM D149-20
Dielectric Constant	4.3		ASTM D 150, 0.5 MHz
Dielectric Constant	4.7		ASTM D 150, 1.0 MHz
Dissipation Factor	0.088		ASTM D 150, 0.5 MHz
Dissipation Factor	0.088		ASTM D 150, 1.0 MHz
Volume resistivity	4.7x 10^{11} ohm-cm	1.9 x 10^{11} ohm-in	ASTM D257-14
Flammability Properties			
Flammability rating	HB		UL 94
Smoke Density	(D s 1.5) = 15 (PASS) (D s 4.0) = 262 (FAIL)		ASTM E662-21
Automotive Specific Testing			
Volatile Organic Compounds	444 µg/g	0.07 oz/lb	VOC VDA 278
Fogging	10.7 mg	3.8 x 10^{-4} oz	DIN 75201, Method B

Accelerated Aging



Dynamic mechanical analysis (DMA) is used to study the viscoelastic behavior of materials. Below is the DMA thermogram for PU Rigid 650. Storage modulus and tan(delta) are plotted as function of temperature. Two glass transition temperatures are observed for PU Rigid 1000, which are -19.2°C and +141.7°C. A drop in storage modulus, indicating softening, is observed around 90°C.



PU Rigid 650 Resin has been evaluated as a **skin contacting device** in accordance with ISO 10993-1, and passed the requirements for the following biocompatibility endpoints:

ISO Standard	Description [3, 4]
EN ISO 10993-5	Not cytotoxic
EN ISO 10993-10	Not an irritant
EN ISO 10993-10	Not a sensitizer

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.4	Isopropyl Alcohol	1.3
Acetone	8.9	Castor Oil	< 0.1
Bleach ~5% NaOCl	< 0.1	Mineral oil, light	< 0.1
Butyl Acetate	2.6	Propylene Glycol Diacetate	0.7
Dichloromethane	116.1	Salt Water (3.5% NaCl)	0.3
Diesel Fuel	< 0.1	Skydrol 500B-4	0.1
Diethyl glycol monomethyl ether	2.7	Sodium hydroxide solution (0.025% pH = 10)	0.2
Gasoline	< 0.1	Strong Acid (HCl Conc)	-3.0
Hexane	< 0.1	Water	0.3
Hydraulic Oil	< 0.1	Xylene	2.0
Hydrogen peroxide (3%)	0.2		

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data for post-cured samples were measured on Type IV tensile bars printed on a Form 2 printer with 100 µm PU Rigid 650 Resin settings, washed in a Form Wash for 2 minutes in ≥99% PGDA, and post-cured.

[3] ISO 10993 standard testing samples were printed on a Form 3 with 100um PU Rigid 650 Resin settings, washed in PGDA for 5 minutes, dried for at least 24 hours and cured at 46°C at 70% RH for 3 day in an oven.

[4] PU Rigid 650 Resin was tested at NAMSA World Headquarters, OH, USA.

formlabs

Rebound

Production-Ready Elastic 3D Printing Material Resin

With five times the tear strength, three times the tensile strength, and two times the elongation of other production-grade elastomeric materials on the market, Rebound Resin is perfect for 3D printing springy, resilient parts.

End-use production

Gaskets, seals, and grommets

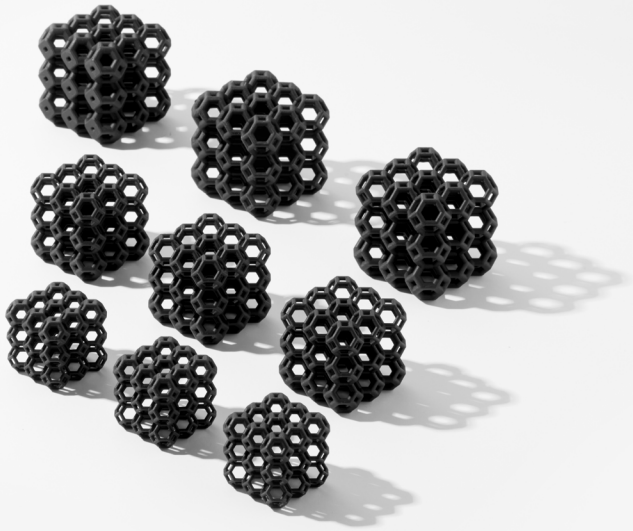
Compliant robotics

Custom cases

Handles, grips, and overmolds

Complex geometries

This material is available exclusively through partnership with Formlabs and requires a minimum quantity commitment to get started. After you contact us, you'll have the opportunity to request a standard sample, purchase a run of custom samples to evaluate, and finally, buy a turnkey package of the equipment needed to print in Rebound Resin at your facility.



V1 **FLRBBL01** *** May not be available in all regions**

Prepared 03 . 18 . 2020
Rev. 01 03 . 18 . 2020

MATERIAL PROPERTIES DATA

Rebound Resin

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured	**Post-Cured**	
Tensile Properties			
Ultimate Tensile Strength	22 MPa	3,391 psi	ASTM D 412-06 (A)
Modulus at 50% Elongation	3.46 MPa	501.83 psi	ASTM D 412-06 (A)
Elongation at Break	300%	300%	ASTM D 412-06 (A)
Compression set at 25 °C for 22 hrs	16%	16%	ASTM D 395-03 (B)
Compression set at 70 °C for 22 hrs	40%	40%	ASTM D 395-03 (B)
Tear Strength	110 kN/m	628 lbf/in	ASTM D 624-00
Hardness, Shore A	86A	86A	ASTM D 2633
Bayshore Rebound Resilience	57%	57%	ASTM D 2633
Abrasion	101 mm^3	101 mm^3	ISO 4649, 40 rpm, 10 N load
Ross Flexing Fatigue (23 °C)	> 50,000 cycles (no crack propagation)	> 50,000 cycles (no crack propagation)	ASTM D1052, (notched), 23 °C, 60 degree bending, 100 cycles/minute
Ross Flexing Fatigue (-10 °C)	> 50,000 cycles (no crack propagation)	> 50,000 cycles (no crack propagation)	ASTM D1052, (notched), -10 °C, 60 degree bending, 100 cycles/minute
Dielectric Properties			
Dielectric Constant	7.7	7.7	ASTM D150, 1MHz
Dissipation Factor	0.069	0.069	ASTM D150, 1MHz
Thermal Properties			
Glass Transition Temperate	-50 °C	-58 °F	DSC

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

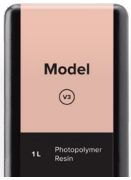
Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Water	9	Dichloromethane	367
Salt Water	7	Propylene Glycol Diacetate	9
Isopropyl Alcohol	8	Diethylene Glycol Monomethyl Ether	16
Acetone	37	Mineral Oil (Light)	< 1.0
Hexane	1	Castor Oil	< 1.0
Butyl Acetate	26	Hydraulic Oil	< 1.0

Dental

High-Accuracy Materials for Dental Labs and Practices

Our library of Dental Resins enables dental practices and labs to rapidly manufacture a range of dental products in-house, from biocompatible surgical guides and splints to fixed prosthetic and clear aligner models.

*** Please note that resins may not be available in all regions.**



Model

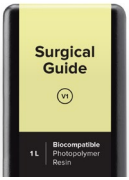
Stone-colored models

Draft

Fast-printing models

Castable Wax

Castable and pressable restorations



Surgical Guide

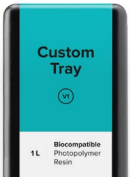
Implant guides

IBT

Indirect bonding trays

Dental LT Clear V2

Occlusal splints



Custom Tray

Custom impression trays

Temporary CB

Temporary crowns, bridges, inlays, onlays, and veneers

VITA CLASSICAL SHADES: A2, A3, B1, C2, BL

Permanent Crown

Permanent crowns, inlays, onlays, and veneers

VITA CLASSICAL SHADES: A2, A3, B1, C2

Denture Base & Teeth

Long term, temporary, and try-in dentures

Soft Tissue (Starter Pack)

Gingiva masks

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Model

A fast-printing material for production of high-accuracy restorative models

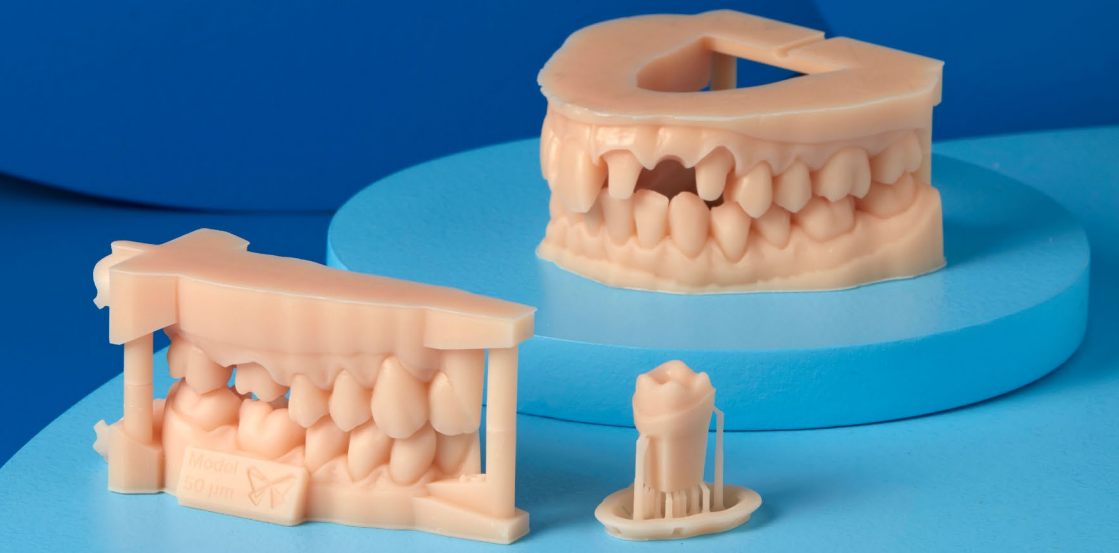
Model Resin was developed to meet the precision, reliability, and throughput requirements of restorative dentistry. Print accurate models and dies with crisp margins and contacts, delivering high-quality results on fast-paced timelines.

Crown and bridge models

Implant analog models

Orthodontic models

Diagnostic models



V3 **FLDMBE03** * May not be available in all regions

Prepared 11 . 09 . 2021

Rev. 01 11 . 09 . 2021

MATERIAL PROPERTIES DATA **Model Resin**

	METRIC [1]		IMPERIAL [1]		METHOD
	Green [2]	Post-Cured [3]	Green [2]	Post-Cured [3]	
Mechanical Properties					
Ultimate Tensile Strength	27 MPa	48 MPa	3970 psi	6990 psi	ASTM D 638-14
Tensile Modulus	1.1 GPa	2.3 GPa	160 ksi	331 ksi	ASTM D 638-14
Elongation at Break	14%	4.8%	14%	4.8%	ASTM D 638-14
Flexural Properties					
Flexural Strength	25 MPa	85 MPa	3640 psi	12300 psi	ASTM D 790-15
Flexural Modulus	0.67 GPa	2.2 GPa	97 ksi	320 ksi	ASTM D 790-15
Impact Properties					
Notched Izod	23 J/m	24 J/m	0.43 ft-lbs/in	0.45 ft-lbs/in	ASTM D 256-10
Unnotched Izod	300 J/m	325 J/m	5.6 ft-lbs/in	6.1 ft-lbs/in	ASTM D 4812-19
Thermal Properties					
Heat Deflection Temp. @ 1.8 MPa	41 °C	56 °C	104 °F	133 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	47 °C	75 °C	117 °F	167 °F	ASTM D 648-16
Thermal Expansion	108 µm/m/°C	76 µm/m/°C	60 µin/in/°F	43 µin/in/°F	ASTM E 813-13

[1] Material properties may vary based on part geometry, print orientation, print settings, and temperature.

[2] Data for green samples were measured on Type IV tensile bars printed on a Form 3 printer with 100 µm Model Resin settings and washed in a Form Wash for 10 minutes in ≥99% Isopropyl Alcohol.

[3] Data for post-cured samples were measured on Type IV tensile bars printed on a Form 3 printer with 100 µm Model Resin settings, washed in a Form Wash for 10 minutes in ≥99% Isopropyl Alcohol, and post-cured at 60°C for 5 minutes in a Form Cure.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.2	Mineral oil, heavy	0.2
Acetone	0.9	Mineral oil, light	0.2
Bleach ~5% NaOCl	0.1	Salt Water (3.5% NaCl)	0.2
Butyl Acetate	< 0.1	Skydrol 5	0.4
Diesel Fuel	0.1	Sodium hydroxide solution (0.025% pH = 10)	0.2
Diethyl glycol monomethyl ether	< 0.1	Strong Acid (HCl Conc)	< 0.1
Hydraulic Oil	0.1	TPM	0.2
Hydrogen peroxide (3%)	0.1	Water	0.2
Isooctane	< 0.1	Xylene	< 0.1
Isopropyl Alcohol	< 0.1		

formlabs | dental

Draft

A cutting-edge material designed to print accurate orthodontic models — fast

Draft Resin is our fastest printing material, capable of printing a dental model in under 20 minutes. This highly accurate resin prints with a smooth surface finish, making Draft Resin the ideal material for aligner and retainer production. Use 200 micron settings for fastest print speeds and same day appliances, or use 100 micron settings for more detailed models.

Rapid model production

Orthodontic models

V2 **FLDRGR02** *** May not be available in all regions**

Prepared 10 . 07 . 2020
Rev. 01 10 . 07 . 2020

MATERIAL PROPERTIES DATA

Draft Resin

	METRIC [1]			IMPERIAL [1]			METHOD
	Green [2]	Post-Cured at Room Temperature [3]	Post-Cured at 60 °C [4]	Green [2]	Post-Cured at Room Temperature [3]	Post-Cured at 140 °F [4]	
Tensile Properties							
Ultimate Tensile Strength	24 MPa	36 MPa	52 MPa	3481 psi	5221 psi	7542 psi	ASTM D638-14
Tensile Modulus	0.8 GPa	1.7 GPa	2.3 GPa	122 ksi	247 ksi	334 ksi	ASTM D638-14
Elongation at Break	14%	5%	4%	14%	5%	4%	ASTM D638-14
Flexural Properties							
Flexural Modulus	0.6 GPa	1.8 GPa	2.3 GPa	87 ksi	261 ksi	334 ksi	ASTM D 790-17
Impact Properties							
Notched Izod	26 J/m	29 J/m	26 J/m	0.5 ft-lbf/in	0.5 ft-lbf/in	0.5 ft-lbf/in	ASTM D256-10
Thermal Properties							
Heat Deflection Temp. @ 1.8 MPa	37 °C	44 °C	57 °C	99 °F	111 °F	135 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	43 °C	53 °C	74 °C	109 °F	127 °F	165 °F	ASTM D 648-16

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from green parts, printed using Form 3, 200 µm, Draft Resin settings, washed for 5 minutes in Form Wash and air dried without post cure.

[3] Data was obtained from parts printed using a Form 3, 200 micron, Draft Resin settings, and post-cured with Form Cure at room temperature for 5 minutes.

[4] Data was obtained from parts printed using a Form 3, 200 micron, Draft Resin settings, and post-cured with Form Cure at 60 °C for 5 minutes.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.2	Mineral oil (Light)	< 1.0
Acetone	4.2	Mineral oil (Heavy)	< 1.0
Bleach ~5% NaOCl	0.1	Salt Water (3.5% NaCl)	0.3
Butyl Acetate	0.1	Skydrol 5	0.3
Diesel Fuel	0.1	Sodium Hydroxide solution (0.025% PH 10)	0.3
Diethyl glycol Monomethyl Ether	0.8	Strong Acid (HCl conc)	< 1.0
Hydraulic Oil	< 0.1	Tripropylene glycol monomethyl ether	0.3
Hydrogen peroxide (3%)	0.2	Water	< 1.0
Isooctane (aka gasoline)	< 1.0	Xylene	< 1.0
Isopropyl Alcohol	< 1.0		

Castable Wax

A highly accurate material for casting and pressing crowns, bridges, and RPD frameworks

Tested at length by dental technicians, Castable Wax Resin provides accurate, sealed margins and contains 20% wax for reliable casting with clean burnout. Printed patterns are strong enough to handle with no post-cure required, allowing for a faster, simpler workflow.

Patterns for casting and pressing

Crowns

Removable partial denture frameworks

Bridges

V1 **FLCWPU01** *** May not be available in all regions**

Prepared 10 . 02 . 2017
Rev. **01** 10 . 02 . 2017

	METRIC [1]	IMPERIAL [1]	METHOD
	Green [2]	**Green [2]**	
Tensile Properties			
Ultimate Tensile Strength	12 MPa	1680 psi	ASTM D 638-10
Tensile Modulus	220 MPa	32 ksi	ASTM D 638-10
Elongation at Break	13%	13%	ASTM D 638-10
Burnout Properties			
Temp @ 5% Mass Loss	249 °C	480 °C	
Ash Content (TGA)	0.0 - 0.1%	0.0 - 0.1%	

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from parts printed using Form 2, Castable 50 µm Fine Detail settings and washed without post-cure.

Surgical Guide

A premium-quality material for printing surgical implant guides

Surgical Guide Resin is designed to print at 100 micron and 50 micron layer line resolutions on Formlabs SLA printers to produce dimensionally accurate dental implant guides and templates.

Surgical guides

Pilot drill guides

Device sizing templates

Drilling templates

V1 **FLSGAM01** *** Regional availability may vary.**

Prepared 11 . 04 . 2019

Rev. **02** 21 . 07 . 2021

	Post-Cured [1, 2]	Method
Elongation	12%	ASTM D638
Flexural Strength	> 102 MPa	ASTM D790
Flexural Modulus	> 2400 MPa	ASTM D790

Sterilization Compatibility	
E-beam	35 kGy E-beam radiation
Ethylene Oxide	100% Ethylene oxide at 55 °C for 180 minutes
Gamma	29.4 - 31.2 kGy gamma radiation
Steam Sterilization	Autoclave at 134 °C for 20 minutes Autoclave at 121 °C for 30 minutes

For more details on sterilization compatibilities, visit formlabs.com

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

Surgical Guide Resin is a Class I Medical Device as defined in Article 2 of the Medical Device Regulation 2017/74 (MDR) in the EU and in Section 201(h) of the Federal Food Drug & Cosmetic (FD&C) Act.

Surgical Guide Resin has been evaluated in accordance with ISO 10993-1, Biological evaluation of medical devices - Part 1: Evaluation and testing within a risk management process, and ISO 7405, Dentistry - Evaluation of biocompatibility of medical devices used in dentistry, and passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3]
EN ISO 10993-5	Not cytotoxic
EN ISO 10993-10	Not an irritant
EN ISO 10993-10	Not a sensitizer

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	Description
EN ISO 13485	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971	Medical Devices – Application of Risk Management to Medical Devices

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data for post-cured samples were measured on Type IV tensile bars printed on a Form 2 printer with 100 µm Surgical Guide Resin settings, washed in a Form Wash for 20 minutes in ≥99% Isopropyl Alcohol, and post-cured at 60°C for 30 minutes in a Form Cure.

[3] Surgical Guide Resin was tested at NAMSA World Headquarters, OH, USA.

formlabs | dental

IBT Resin

A flexible material that enables efficient, accurate orthodontic bracket placement

Use IBT Resin to 3D print indirect bonding trays for a cost-effective, rapid dental bracket placement process for high quality orthodontics. IBT Resin prints full arch and quadrant bracket transfer trays quickly using 100 micron layer heights, reducing labor time and enabling higher throughput.

Indirect Bonding Trays

V1 **FLIBCL01**

*** Regional availability may vary.**

Prepared 14 . 01 . 2021
Rev. **02** 21 . 07 . 2021

	Post-Cured [1,2]	Method
Ultimate Tensile Strength	≥ 5 MPa	ASTM D638
Young's Modulus	> 16 MPa	ASTM D638
Elongation	> 25%	ASTM D638
Hardness Shore A	< 90A	ASTM D2240

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

IBT Resin is a Class I Medical Device as defined in Article 2 of the Medical Device Regulation 2017/74 (MDR) in the EU and in Section 201(h) of the Federal Food Drug & Cosmetic (FD&C) Act.

IBT Resin has been evaluated in accordance with ISO 10993-1, Biological evaluation of medical devices - Part 1: Evaluation and testing within a risk management process, and ISO 7405, Dentistry - Evaluation of biocompatibility of medical devices used in dentistry, and passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3]
EN ISO 10993-5	Not cytotoxic
EN ISO 10993-10	Not an irritant
EN ISO 10993-10	Not a sensitizer

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	Description
EN ISO 13485	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971	Medical Devices – Application of Risk Management to Medical Devices

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data were measured on post-cured samples printed on a Form 3B with 100um IBT Resin settings, washed in a Form Wash for 20 minutes in ≥99% Isopropyl Alcohol, and post-cured at 60°C for 60 minutes in a Form Cure.

[3] IBT Resin was tested at NAMSA World Headquarters, OH, USA.

formlabs | dental

Dental LT Clear V2

A durable, color-corrected material for printing hard occlusal splints

Directly print affordable, high-quality occlusal splints in-house with Dental LT Clear Resin (V2). Highly durable and resistant to fracture, this color-corrected material prints clear, polishes to high optical transparency, and resists discoloration over time for a finished appliance you'll be proud to deliver.

Occlusal guards **Splints**

V1 **FLDLCL02**

*** May not be available in all regions**

Prepared 09 . 16 . 2020
Rev. 01 09 . 16 . 2020

	METRIC [1]	METHOD
	Post-Cured [2]	
Tensile Properties		
Ultimate Tensile Strength	52 MPa	ASTM D638-10 (Type IV)
Young's Modulus	2080 MPa	ASTM D638-10 (Type IV)
Elongation	12%	ASTM D638-10 (Type IV)
Flexural Properties		
Flexural Strength	84 MPa	ASTM D790-15 (Method B)
Flexural Modulus	2300 MPa	ASTM D790-15 (Method B)
Hardness Properties		
Hardness Shore D	78D	ASTM D2240-15 (Type D)
Impact Properties		
IZOD Impact Strength	449 J/m	ASTM D4812-11 (Unnotched)
Other Properties		
Water Absorption	0.54%	ASTM D570-98 (2018)

Dental LT Clear Resin (V2) has been evaluated in accordance with ISO 10993-1:2018, Biological evaluation of medical devices - Part 1: Evaluation and testing within a risk management process, and ISO 7405:2018, Dentistry - Evaluation of biocompatibility of medical devices used in dentistry, and passed the requirements for the following biocompatibility risks:

ISO Standard	**Description [3]**
ISO 10993-5:2009	Not cytotoxic
ISO 10993-10:2010/(R)2014	Not an irritant
ISO 10993-10:2010/(R)2014	Not a sensitizer
ISO 10993-3:2014	Not mutagenic
ISO 10993-17:2002, ISO 10993-18:2005	Not toxic (subacute / subchronic)

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	**Description**
EN ISO 13485:2016	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971:2012	Medical Devices – Application of Risk Management to Medical Devices

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data were measured on post-cured samples printed on a Form 3B printer with 100 µm Dental LT Clear Resin (V2) settings, washed in a Form Wash for 20 minutes in 99% isopropyl alcohol, and post-cured at 60 °C for 60 minutes in a Form Cure.

[3] Dental LT Clear Resin (V2) was tested at NAMSA World Headquarters, OH, USA.

Custom Tray

A production-ready material that enables highly accurate definitive impressions

Use Custom Tray Resin to directly print impression trays for implants, dentures, crowns and bridges, and other comprehensive cases. Digitally manufactured impression trays provide consistent, accurate impressions for high-quality dentistry. Custom Tray Resin prints full impression trays quickly using 200 micron layer heights, reducing labor time and enabling higher throughput.

Impression Trays

V1 **FLCTBL01** * Regional availability may vary.

Prepared 10 . 07 . 2020
Rev. **02** 21 . 07 . 2020

	Post-Cured [1, 2]	Method
Ultimate Tensile Strength	> 70 MPa	ASTM D638
Young's Modulus	> 2500 MPa	ASTM D638
Elongation	> 3%	ASTM D638
Flexural Strength	≥ 100 MPa	ASTM D790
Flexural Modulus	≥ 2600 MPa	ASTM D790
Hardness Shore A	> 80 D	ASTM D2240

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

Custom Tray Resin is a Class I Medical Device as defined in Article 2 of the Medical Device Regulation 2017/74 (MDR) in the EU and in Section 201(h) of the Federal Food Drug & Cosmetic (FD&C) Act.

Custom Tray Resin has been evaluated in accordance with ISO 10993-1, Biological evaluation of medical devices - Part 1: Evaluation and testing within a risk management process, and ISO 7405, Dentistry - Evaluation of biocompatibility of medical devices used in dentistry, and passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3]
EN ISO 10993-5	Not cytotoxic
EN ISO 10993-10	Not an irritant
EN ISO 10993-10	Not a sensitizer

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	Description
EN ISO 13485	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971	Medical Devices – Application of Risk Management to Medical Devices

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data for post-cured samples were measured on Type IV tensile bars printed on a Form 2 printer with 200 µm Custom Tray Resin settings, washed in a Form Wash for 10 minutes in ≥99% Isopropyl Alcohol, and post-cured at 60°C for 30 minutes in a Form Cure.

[3] Custom Tray Resin was tested at NAMSA World Headquarters, OH, USA.

formlabs | dental

Temporary CB

A validated material for comfortable, aesthetic temporary restorations

Temporary CB Resin is a Class IIa material designed to 3D print biocompatible dental prosthetics with the Form 3B and Form 2 printers. This tooth-colored resin can print at 50 micron layer line resolutions to produce precisely fitting temporaries with a smooth surface finish, high resolution, and dimensional stability. Restorations made from Temporary CB Resin may remain in the mouth for up to 12 months.

Temporary CB Resin is only validated for use with the Stainless Steel Build Platform.

Temporary Restorations:

Bridges (up to 7 units)

Crowns

Veneers

Onlays

Inlays

V1

FLTCA201
FLTCA301

FLTCB101
FLTCC201

FLTCBL01

*** May not be available in all regions**

Prepared 06 . 09 . 2020
Rev. 02 25 . 01 . 2022

MATERIAL PROPERTIES DATA

Temporary CB Resin

VITA[1] CLASSICAL SHADES: A2, A3, B1, C2, BL

	MEASURED VALUES	METHOD
Mechanical Properties		
Density	1.4 - 1.5 g/cm^3	BEGO Standard
Viscosity	2500 - 6000 MPa*s	BEGO Standard
Flexural Strength (post cured) [2, 3, 4]	≥ 100 MPa	EN ISO 10477, EN ISO 4049

Temporary CB Resin is a Medical Device as defined in the Medical Device Directive (93/42/EEC) in the EU and in Section 201(h) of the Federal Food Drug & Cosmetic (FD&C) Act.

Restorations printed with Temporary CB Resin have been evaluated in accordance with ISO 10993-1:2018, Biological evaluation of medical devices - Part 1: Evaluation and testing within a risk management process, and ISO 7405:2009/(R)2015, Dentistry - Evaluation of biocompatibility of medical devices used in dentistry, and passed the requirements for the following biocompatibility risks:

ISO Standard	Description [5]
EN ISO 10993-5:2009	Not cytotoxic
ISO 10993-10:2010/(R)2014	Not an irritant
ISO 10993-10:2010/(R)2014	Not a sensitizer
ISO 10993-3:2014	Not genotoxic
ISO 10993-1:2009	Non toxic

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	Description
EN ISO 13485:2016	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971:2019	Medical Devices – Application of Risk Management to Medical Devices

[1] VITA is a registered trademark of a company which is not affiliated with Formlabs Inc.

[2] Material properties may vary based on part geometry, print orientation, print settings, and environmental conditions.

[3] Test samples were printed with a Stainless Steel Build Platform on a Form 2 and Form 3B printer with 50 µm Temporary CB Resin settings. The printed samples were post-processed as recommended in the Instructions for Use.

[4] Data for post-cured samples were measured on 3 point bending test specimens according to EN ISO 10477 and EN ISO 4049 standards.
Screen reader support enabled.

[5] Temporary CB Resin was tested at Eurofins BioPharma Product Testing, Munich GmbH.

Permanent Crown

A validated material for comfortable, aesthetic permanent restorations

Permanent Crown Resin is a tooth-colored, ceramic-filled resin for 3D printing of permanent single crowns, inlays, onlays, and veneers. Permanent Crown Resin produces high strength, long term restorations with accurate and precise fitment. Low water absorption and a smooth finish ensure restorations have a low tendency to age, discolor, or accumulate plaque.

Permanent Crown Resin is only validated for use with the Stainless Steel Build Platform.

Permanent Restorations:

Inlays

Crowns

Veneers

Onlays

V1

FLPCA201 **FLPCB101**
FLPCA301 **FLPCC201**

*** May not be available in all regions**

Prepared 10 . 21 . 2020
Rev. 01 10 . 21 . 2020

MATERIAL PROPERTIES DATA

Permanent Crown Resin

VITA[1] CLASSICAL SHADES: A2, A3, B1, C2

	MEASURED VALUES	METHOD
Mechanical Properties		
Density	1.4 - 1.5 g/cm^3	BEGO Standard
Viscosity	2500 - 6000 MPa*s	BEGO Standard
Flexural Strength (post cured) [2, 3, 4]	116 MPa	EN ISO 10477, EN ISO 4049
Flexural Modulus (post cured)	4090 MPa	EN ISO 10477, EN ISO 4049
Water Solubility	0.23 µg/mm^3	EN ISO 4049
Water Sorption	3.6 µg/mm^3	EN ISO 10477

Permanent Crown Resin is a Medical Device as defined in the Medical Device Directive (93/42/EEC) in the EU and in Section 201(h) of the Federal Food Drug & Cosmetic (FD&C) Act.

Restorations printed with Permanent Crown Resin have been evaluated in accordance with ISO 10993-1:2018, Biological evaluation of medical devices - Part 1: Evaluation and testing within a risk management process, and ISO 7405:2009/(R)2015, Dentistry - Evaluation of biocompatibility of medical devices used in dentistry, and passed the requirements for the following biocompatibility risks:

ISO Standard	Description [5]
EN ISO 10993-5:2009	Not cytotoxic
ISO 10993-10:2010/(R)2014	Not an irritant
ISO 10993-10:2010/(R)2014	Not a sensitizer
ISO 10993-3:2014	Not genotoxic
ISO 10993-1:2009	Non toxic

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	Description
EN ISO 13485:2016	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971:2019	Medical Devices – Application of Risk Management to Medical Devices

[1] VITA is a registered trademark of a company which is not affiliated with Formlabs Inc.

[2] Material properties may vary based on part geometry, print orientation, print settings, and environmental conditions.

[3] Test samples were printed with a Stainless Steel Build Platform on a Form 3B printer with 50 µm Permanent Crown Resin settings. The printed samples were post-processed as recommended in the Instructions for Use. Screen reader support enabled.

[4] Data for post-cured samples were measured on 3 point bending test specimens according to EN ISO 10477 and EN ISO 4049 standards. Screen reader support enabled.

[5] Permanent Crown Resin was tested at Eurofins BioPharma Product Testing, Munich GmbH.

Denture Base and Teeth

Long-lasting materials for truly lifelike permanent prosthetics

Formlabs is expanding access to digital dentures with an efficient, cost-effective manufacturing solution. Class II long-term biocompatible Digital Denture Resins enable dental professionals to produce 3D printed full dentures accurately and reliably.

Dentures **Try-ins**

V1

FLDTA101 **FLDTA201** **FLDTA301** **FLDTAS01** **FLDTB101** **FLDTB201**

*** May not be available in all regions**

Prepared 09 . 16 . 2020

Rev. 01 09 . 16 . 2020

Denture Base	METRIC [1]	METHOD
	Post-Cured [2]	
Mechanical Properties		
Flexural Strength	> 50 MPa	ISO 10477
Density	1.15 g/cm^3 < X <1.25 g/cm^3	ASTM D792-00

Denture Teeth	METRIC [1]	METHOD
	Post-Cured [2]	
Mechanical Properties		
Flexural Strength	> 65 MPa	ISO 20795-1
Density	1.15 g/cm^3 < X <1.25 g/cm^3	ASTM D792-00

Denture Base and Teeth resins were tested for biological evaluation of medical devices at WuXi Apptec, 2540 Executive Drive, St. Paul, MN, and is certified biocompatible per EN-ISO 10993-1:2009/ AC:2010:

ISO Standard	**Description**
EN-ISO 10993-3:2014	Not mutagenic
EN-ISO 10993-5:2009	Not cytotoxic
EN-ISO 10993-10:2010	Not an irritant
EN-ISO 10993-10:2010	Not a sensitizer
EN-ISO 10993-11:2006	Non toxic

The product was developed and is in compliance with the following ISO Standards:

Denture Base ISO Standards	**Description**
EN-ISO 22112:2017	Dentistry - Artificial teeth for dental prostheses
EN-ISO 10477	Dentistry - Polymer-based crown and veneering materials (Type 2 and Class 2)

Denture Theeth ISO Standards	**Description**
EN-ISO 20795-1:2013	Dentistry - Base Polymers - Part 1: Denture Base Polymers

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data refers to post-cured properties obtained after exposing green parts to 108 watts each of Blue UV-A (315 – 400 nm), in a heated environment at 80 °C (140 °F) and 1hr, with six (6) 18W/78 lamps (Dulux blue UV-A)

Soft Tissue Starter Pack

A color-customizable soft model material for working digital prosthetic cases

Create flexible gingiva masks for use in combination with rigid dental models. Confidently check implant prosthetics by adding removable soft tissue components to your model production. Use the Soft Tissue Starter Pack to create your own Soft Tissue Resin in customizable dark, medium, and light pink shades.

The Soft Tissue Starter Pack uses Flexible 80A Resin as a flexible base material.

Please note: Adding Color Pigments to Flexible 80A Resin to create Soft Tissue Resin will alter some of its mechanical properties.

Soft tissue for implant models

Gingiva masks

*** May not be available in all regions**

Prepared 11 . 18 . 2020

Rev. 01 11 . 18 . 2020

MATERIAL PROPERTIES DATA **Soft TissueStarter Pack (Flexible 80A Resin)**

	METRIC [1]		IMPERIAL [1]		METHOD
	Green	Post-Cured [2]	Green	Post-Cured [2]	
Tensile Properties					
Ultimate Tensile Strength [3]	3.7 MPa	8.9 MPa	539 psi	1290 psi	ASTM D 412-06 (A)
Stress at 50% Elongation	1.5 MPa	3.1 MPa	218 psi	433 psi	ASTM D 412-06 (A)
Stress at 100% Elongation	3.5 MPa	6.3 MPa	510 psi	909 psi	ASTM D 412-06 (A)
Elongation at Break	100%	120%	100%	120%	ASTM D 412-06 (A)
Tear Strength [4]	11 kN/m	24 kN/m	61 lbf/in	137 lbf/in	ASTM D 624-00
Shore Hardness	70A	80A	80A	80A	ASTM 2240
Compression Set (23 °C for 22 hours)	Not Tested	3%	Not Tested	3%	ASTM D 395-03 (B)
Compression Set (70 °C for 22 hours)	Not Tested	5%	Not Tested	5%	ASTM D 395-03 (B)
Ross Flex Fatigue at 23 °C	Not Tested	>200,000 cycles	Not Tested	>200,000 cycles	ASTM D1052, (notched), 60° bending, 100 cycles/minute
Ross Flex Fatigue at -10 °C	Not Tested	>50,000 cycles	Not Tested	>50,000 cycles	ASTM D1052, (notched), 60° bending, 100 cycles/minute
Bayshore Resilience	Not Tested	28%	Not Tested	28%	ASTM D2632
Thermal Properties					
Glass transition temperature (Tg)	Not Tested	27 °C	Not Tested	27 °C	DMA

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from parts printed using Form 3, 100 µm, Flexible 80A settings, washed in Form Wash for 10 minutes and post-cured with Form Cure at 60 °C for 10 minutes.

[3] Tensile testing was performed after 3+ hours at 23 °C, using a Die C specimen cut from sheets.

[4] Tear testing was performed after 3+ hours at 23 °C, using a Die C tear specimen directly printed.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.9	Mineral oil (Light)	0.1
Acetone	37.4	Mineral oil (Heavy)	< 0.1
Bleach ~5% NaOCl	0.6	Salt Water (3.5% NaCl)	0.5
Butyl Acetate	51.4	Skydrol 5	10.7
Diesel Fuel	2.3	Sodium Hydroxide solution (0.025% PH 10)	0.6
Diethyl glycol Monomethyl Ether	19.3	Strong Acid (HCl conc)	28.6
Hydraulic Oil	1.0	Tripropylene glycol monomethyl ether	13.6
Hydrogen peroxide (3%)	0.7	Water	0.7
Isooctane (aka gasoline)	1.6	Xylene	64.1
Isopropyl Alcohol	11.7		

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Medical

High-Performance Materials for Biocompatible Applications

Our library of biocompatible, sterilizable, BioMed Resins are manufactured in an ISO 13485 certified facility to help medical device and point-of-care manufacturers reduce costs, iterate quickly, and print a wide range of end-use tools, instruments, and devices that support the practice of medicine.

*** Please note that resins may not be available in all regions.**

BioMed White

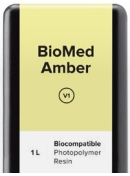
For white, rigid, bio-compatible parts

BioMed Black

For matte black, rigid, biocompatible parts

BioMed Clear

For long-term bodily contact



BioMed Amber

For short-term bodily contact

formlabs | medical

BioMed White

Medical-grade white material for 3D printing rigid, biocompatible parts

BioMed White Resin is an opaque white material for biocompatible applications requiring long-term skin contact or short-term mucosal contact. Unique in our portfolio, this medical-grade material is also USP <151> Pyrogen and Acute Systemic Toxicity tested and can be used in applications with short-term tissue, bone, dentin contact.

Parts printed with BioMed White Resin are compatible with common solvent disinfection and sterilization methods. BioMed White Resin is manufactured in our ISO 13485 facility and is also USP Class VI certified which makes it suitable for pharmaceutical and drug delivery applications.

End-use medical devices and device components

Cutting and drilling guides

Surgical guides and templates

Anatomical models that can be used in the OR

Patient-specific implant sizing models and molds

Biocompatible molds, jigs, and fixtures

V1 **FLBMWH01** *** May not be available in all regions**

Prepared 03 . 30 . 2022

Rev. 01 03 . 30 . 2022

MATERIAL PROPERTIES DATA

BioMed White Resin

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured [2]	Post-Cured [2]	
Tensile Properties			
Ultimate Tensile Strength	45.78 MPa	6640 psi	ASTM D 638-14 (Type IV)
Young's Modulus	2020.16 MPa	293 ksi	ASTM D 638-14 (Type IV)
Elongation	10%	10%	ASTM D 638-14 (Type IV)
Flexural Properties			
Flexural Stress at 5% Strain	74.46 MPa	10800 psi	ASTM D 790-15 (Procedure B)
Flexural Modulus	2020.16 MPa	293 ksi	ASTM D 790-15 (Procedure B)
Hardness Properties			
Hardness Shore D	80 D	-	ASTM D2240-15 (Type D)
Impact Properties			
Notched Izod	15.11 J/m	0.283 ft-lbf/in	ASTM D 256-10 (Method A)
Unnotched Izod	269.03 J/m	5.04 ft-lbf/in	ASTM D 4812-11
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	52.4 °C	-	ASTM D 648-18 (Method B)
Heat Deflection Temp. @ 0.45 MPa	67.0 °C	-	ASTM D 648-18 (Method B)
Coefficient of Thermal Expansion	90.1 µm/m/°C	-	ASTM E 831-13
Other Properties			
Water Absorption	0.40 wt%	-	ASTM D570-98

Sterilization Compatibility	
E-beam	35 kGy E-beam radiation
Ethylene Oxide	100% Ethylene oxide at 55 °C for 180 minutes
Gamma	29.4 - 31.2 kGy gamma radiation
Steam Sterilization	Autoclave at 134°C for 20 minutes Autoclave at 121°C for 30 minutes

For more details on sterilization compatibilities, visit formlabs.com/medical

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

Samples printed with BioMed White Resin have been evaluated in accordance with the following biocompatibility endpoints:

ISO Standard	Description [3]
ISO 10993-5:2009	Not cytotoxic
ISO 10993-10:2010/(R)2014	Not an irritant
ISO 10993-10:2010/(R)2014	Not a sensitizer
ISO 10993-11: 2017	No evidence of acute systemic toxicity
ISO 10993-11: 2017/ USP, General Chapter <151>, Pyrogen Test	Non-pyrogenic

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	Description
EN ISO 13485:2016	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971:2012	Medical Devices – Application of Risk Management to Medical Devices

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data were measured on post-cured samples printed on a Form3B with 100um BioMed White Resin settings, washed in a Form Wash for 5 minutes in 99% Isopropyl Alcohol, and post-cured at 60°C, 60 minutes in a Form Cure.

[3] BioMed White Resin was tested at NAMSA World Headquarters, OH, USA.

SOLVENT COMPATIBILITY

BioMed White Resin

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.4	Mineral oil, heavy	< 0.1
Acetone	2.9	Mineral oil, light	< 0.1
Bleach ~5% NaOCl	0.3	Salt Water (3.5% NaCl)	0.4
Butyl Acetate	0.4	Skydrol 5	0.5
Diesel Fuel	< 0.1	Sodium hydroxide solution (0.025% pH = 10)	0.3
Diethyl glycol monomethyl ether	1.0	Strong Acid (HCl Conc)	0.2
Hydraulic Oil	< 0.1	TPM	0.6
Hydrogen peroxide (3%)	0.3	Water	0.3
Isooctane	< 0.1	Xylene	0.3
Isopropyl Alcohol	0.2		

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BioMed Black

Medical-grade matte black material for 3D printing rigid, biocompatible parts

BioMed Black Resin is a matte, opaque material for biocompatible applications requiring long-term skin contact or short-term mucosal membrane contact. This medical-grade material is suitable for applications that require high contrast for visualization, excellent definition and smooth surface quality.

Parts printed with BioMed Black Resin are compatible with common solvent disinfection and sterilization methods. BioMed Black Resin is manufactured in our ISO 13485 facility and is also USP Class VI certified which makes it suitable for pharmaceutical and drug delivery applications.

Medical devices and device components

Biocompatible molds, jigs, and fixtures

End-use parts requiring patient contact

Consumer goods

V1 **FLBMBL01** * May not be available in all regions

Prepared 03 . 30 . 2022
Rev. 01 03 . 30 . 2022

MATERIAL PROPERTIES DATA

BioMed Black Resin

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured [2]	Post-Cured [2]	
Tensile Properties			
Ultimate Tensile Strength	35.71 MPa	5180 psi	ASTM D 638-14 (Type IV)
Young's Modulus	1523.74 MPa	221 ksi	ASTM D 638-14 (Type IV)
Elongation	14%	14%	ASTM D 638-14 (Type IV)
Flexural Properties			
Flexural Stress at 5% Strain	57.16 MPa	8290 psi	ASTM D 790-15 (Procedure B)
Flexural Modulus	1668.53 MPa	242 ksi	ASTM D 790-15 (Procedure B)
Hardness Properties			
Hardness Shore D	77 D	-	ASTM D2240-15 (Type D)
Impact Properties			
Notched Izod	24.77 J/m	0.464 ft-lbf/in	ASTM D 256-10 (Method A)
Unnotched Izod	348.03 J/m	6.52 ft-lbf/in	ASTM D 4812-11
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	49.4 °C	-	ASTM D 648-18 (Method B)
Heat Deflection Temp. @ 0.45 MPa	67.9 °C	-	ASTM D 648-18 (Method B)
Coefficient of Thermal Expansion	106.9 µm/m/°C	-	ASTM E 831-13
Other Properties			
Water Absorption	0.44 wt%	-	ASTM D570-98

Sterilization Compatibility	
E-beam	35 kGy E-beam radiation
Ethylene Oxide	100% Ethylene oxide at 55 °C for 180 minutes
Gamma	29.4 - 31.2 kGy gamma radiation
Steam Sterilization	Autoclave at 134°C for 20 minutes Autoclave at 121°C for 30 minutes

For more details on sterilization compatibilities, visit formlabs.com/medical

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

Samples printed with BioMed Black Resin have been evaluated in accordance with the following biocompatibility endpoints:

ISO Standard	Description [3]
ISO 10993-5:2009	Not cytotoxic
ISO 10993-10:2010/(R)2014	Not an irritant
ISO 10993-10:2010/(R)2014	Not a sensitizer

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	Description
EN ISO 13485:2016	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971:2012	Medical Devices – Application of Risk Management to Medical Devices

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data were measured on post-cured samples printed on a Form3B with 100um BioMed Black Resin settings, washed in a Form Wash for 5 minutes in 99% Isopropyl Alcohol, and post-cured at 70°C, 60 minutes in a Form Cure.

[3] BioMed Black Resin was tested at NAMSA World Headquarters, OH, USA.

SOLVENT COMPATIBILITY

BioMed Black Resin

Percent weight gain over 24 hours for a printed and post-cured 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.3	Mineral oil, heavy	0.2
Acetone	3.1	Mineral oil, light	0.2
Bleach ~5% NaOCl	0.2	Salt Water (3.5% NaCl)	0.3
Butyl Acetate	0.4	Skydrol 5	0.6
Diesel Fuel	0.1	Sodium hydroxide solution (0.025% pH = 10)	0.3
Diethyl glycol monomethyl ether	1.0	Strong Acid (HCl Conc)	0.2
Hydraulic Oil	0.2	TPM	0.6
Hydrogen peroxide (3%)	0.3	Water	0.3
Isooctane	< 0.1	Xylene	0.3
Isopropyl Alcohol	0.2		

formlabs | medical

BioMed Clear

Biocompatible Photopolymer Resin for Formlabs SLA Printers

BioMed Clear Resin is a rigid material for biocompatible applications requiring long-term skin or mucosal membrane contact. This USP Class VI certified material is suitable for applications that require wear resistance and low water absorption over time.

Parts printed with BioMed Clear Resin are compatible with common sterilization methods. BioMed Clear Resin is manufactured in our ISO 13485 facility and is supported with an FDA Device Master File.

Medical devices and device components

Ventilator and PPE components

Bioprocessing equipment

Drug delivery devices

Research and Development

V1 **FLBMCL01** *** Regional availability may vary.**

Prepared 06 . 12 . 2020
Rev. 03 31 . 01 . 2023

MATERIAL PROPERTIES DATA

BioMed Clear Resin

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured [2]	Post-Cured [2]	
Tensile Properties			
Ultimate Tensile Strength	52 MPa	7.5 ksi	ASTM D638-10 (Type IV)
Young's Modulus	2080 MPa	302 ksi	ASTM D638-10 (Type IV)
Elongation	12%	12%	ASTM D638-10 (Type IV)
Flexural Properties			
Flexural Strength	84 MPa	12.2 ksi	ASTM D790-15 (Method B)
Flexural Modulus	2300 MPa	332 ksi	ASTM D790-15 (Method B)
Hardness Properties			
Hardness Shore D	78D	78D	ASTM D2240-15 (Type D)
Impact Properties			
Notched Izod	35 J/m	0.658 ft-lbf/in	ASTM D256-10 (Method A)
Unnotched Izod	449 J/m	8.41 ft-lbf/in	ASTM D4812-11
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	54 °C	129 °F	ASTM D648-18 (Method B)
Heat Deflection Temp. @ 0.45 MPa	67 °C	152 °F	ASTM D648-18 (Method B)
Coefficient of Thermal Expansion	82 µm/m/°C	45 µin/in/°F	ASTM E831-14
Other Properties			
Water Absorption	0.54%	0.54%	ASTM D570-98 (2018)

Sterilization Compatibility	
E-beam	35 kGy E-beam radiation
Ethylene Oxide	100% Ethylene oxide at 55 °C for 180 minutes
Gamma	29.4 - 31.2 kGy gamma radiation
Steam Sterilization	Autoclave at 134°C for 20 minutes Autoclave at 121°C for 30 minutes

For more details on staerilization compatibilities, visit formlabs.com/medical

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

Samples printed with BioMed Clear Resin have been evaluated in accordance with ISO 10993-1:2018, ISO 7405:2018, ISO 18562-1:2017 and have passed the requirements associated with the following biocompatibility endpoints:

ISO Standard	Description [3]	ISO Standard	Description [3]
ISO 10993-5:2009	Not cytotoxic	ISO 10993-3:2014	Not mutagenic
ISO 10993-10:2010/(R)2014	Not an irritant	ISO 18562-2:2017	Does not emit particulates
ISO 10993-10:2010/(R)2014	Not a sensitizer	ISO 18562-3:2017	Does not emit VOCs
ISO 10993-17:2002, ISO 10993-18:2005	Not toxic (subacute / subchronic)	ISO 18562-4:2017	Does not emit hazardous water-soluble substances
ISO 10993-11: 2017	No evidence of acute systemic toxicity	ISO 10993-11: 2017/USP, General Chapter <151>, Pyrogen Test	Non-pyrogenic

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	Description
EN ISO 13485:2016	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971:2012	Medical Devices – Application of Risk Management to Medical Devices

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data were measured on post-cured samples printed on a Form 3B printer with 100 µm BioMed Clear Resin settings, washed in a Form Wash for 20 minutes in 99% isopropyl alcohol, and post-cured at 60 °C for 60 minutes in a Form Cure.

[3] BioMed Clear Resin was tested at NAMSA World Headquarters, OH, USA.

BioMed Amber

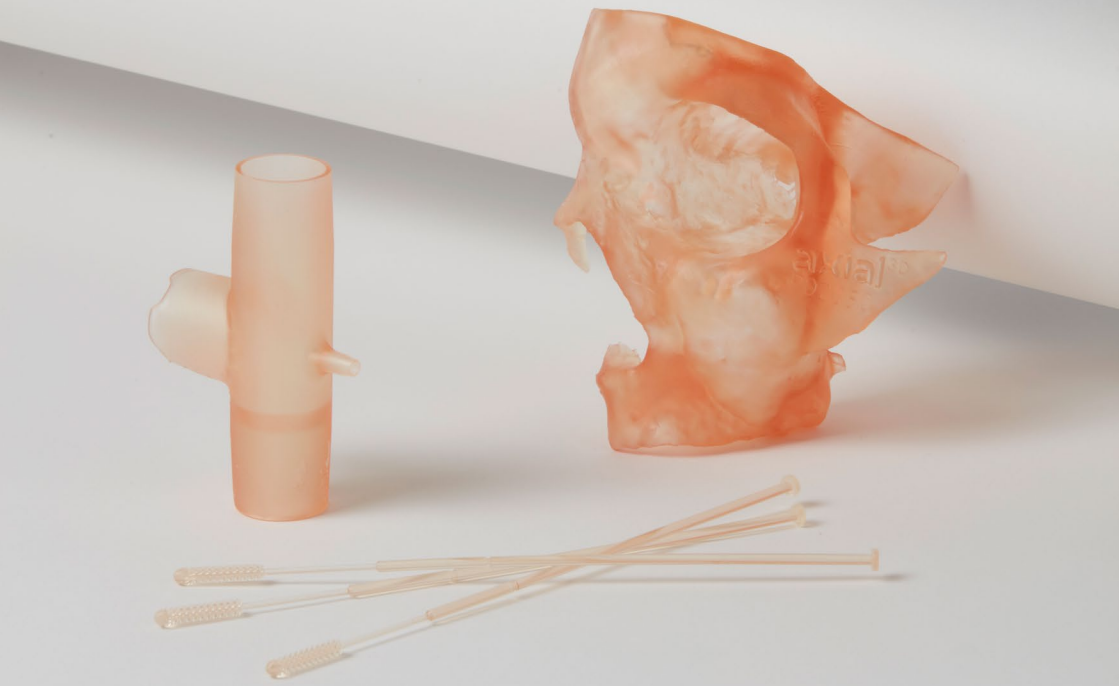
Biocompatible Photopolymer Resin for Formlabs SLA Printers

BioMed Amber Resin is a rigid material for biocompatible applications requiring short-term contact. Parts printed with BioMed Amber Resin are compatible with common solvent disinfection and sterilization methods. BioMed Amber Resin is manufactured in our ISO 13485 facility.

Medical devices and device components

Research and development

Surgical planning and implant sizing tools



V1 **FLBMAM01** *** May not be available in all regions**

Prepared 11 . 04 . 2019

Rev. 02 31 . 01 . 2023

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured [2]	Post-Cured [2]	
Tensile Properties			
Ultimate Tensile Strength	73 MPa	11 ksi	ASTM D638-10 (Type IV)
Young's Modulus	2900 MPa	420 ksi	ASTM D638-10 (Type IV)
Elongation	12%	12%	ASTM D638-10 (Type IV)
Flexural Properties			
Flexural Strength	103 MPa	15 ksi	ASTM D790-15 (Method B)
Flexural Modulus	2500 MPa	363 ksi	ASTM D790-15 (Method B)
Hardness Properties			
Hardness Shore D	67 D	67 D	ASTM D2240-15 (Type D)
Impact Properties			
Notched Izod	28 J/m	0.53 ft-lbf/in	ASTM D256-10 (Method A)
Unnotched Izod	142 J/m	2.6 ft-lbf/in	ASTM D4812-11
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	65 °C	149 °F	ASTM D648-18 (Method B)
Heat Deflection Temp. @ 0.45 MPa	78 °C	172 °F	ASTM D648-18 (Method B)
Coefficient of Thermal Expansion	66 µm/m/°C	37 µin/in/°F	ASTM E831-14

Sterilization Compatibility	
E-beam	35 kGy E-beam radiation
Ethylene Oxide	100% Ethylene oxide at 55 °C for 180 minutes
Gamma	29.4 - 31.2 kGy gamma radiation
Steam Sterilization	Autoclave at 134°C for 20 minutes Autoclave at 121°C for 30 minutes

For more details on sterilization compatibilities, visit formlabs.com/medical

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

BioMed Amber Resin has been evaluated in accordance with ISO 10993-1:2018, Biological evaluation of medical devices - Part 1: Evaluation and testing within a risk management process, and ISO 7405:2009/(R)2015, Dentistry - Evaluation of biocompatibility of medical devices used in dentistry, and passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3]	ISO Standard	Description [3]
ISO 10993-5:2009	Not cytotoxic	ISO 10993-11: 2017	No evidence of acute systemic toxicity
ISO 10993-10:2010/(R)2014	Not an irritant	ISO 10993-11: 2017/USP, General Chapter <151>, Pyrogen Test	Non-pyrogenic
ISO 10993-10:2010/(R)2014	Not a sensitizer		

The product was developed and is in compliance with the following ISO Standards:

ISO Standard	Description
EN ISO 13485:2016	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
EN ISO 14971:2012	Medical Devices – Application of Risk Management to Medical Devices

[1] Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

[2] Data for post-cured samples were measured on Type IV tensile bars printed on a Form 2 and Form 3B (impact and thermal measurements) printers with 100 µm BioMed Amber Resin settings, washed in a Form Wash for 20 minutes in 99% Isopropyl Alcohol, and post-cured at 60 °C for 30 minutes in a Form Cure.

[3] BioMed Amber Resin was tested at NAMSA World Headquarters, OH, USA.

Jewelry

High-Accuracy Materials for Dental Labs and Practices

Reliably reproduce crisp settings, sharp prongs, smooth shanks, and fine surface detail with Formlabs Jewelry Resins and the world's best-selling desktop stereolithography 3D printers. Whether you are 3D printing try on pieces for customers, ready to cast custom jewelry, or masters for reusable jewelry molds, Formlabs offers a material up to the task.

*** Please note that resins may not be available in all regions.**

Castable Wax 40

For casting challenging, highly detailed designs

Castable Wax

For casting thin, filigree patterns

formlabs

Castable Wax 40

From intricate bridal jewelry to large demanding pieces, Castable Wax 40 Resin offers the easiest workflow on the market for 3D printing and casting challenging, highly detailed designs.

Castable Wax 40 resin offers high detail and surface smoothness, with handling characteristics similar to blue carving wax. With a 40% wax fill and low expansion, Castable Wax 40 Resin supports a wide range of lost wax casting conditions and is compatible with leading gypsum investments.

V1 **FLCW4001** * May not be available in all regions

Prepared 12 . 10 . 2020
Rev. 01 12 . 10 . 2020

MATERIAL PROPERTIES DATA

Castable Wax 40 Resin

	METRIC [1]	IMPERIAL [1]	METHOD
	Green [2]	Green [2]	
Burnout Properties			
Temperature @ 5% Mass Loss	249 °C	480 °C	ASTM E 1131
Ash content (TGA)	0.0 - 0.1%	0.0 - 0.1%	ASTM E 1131

[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

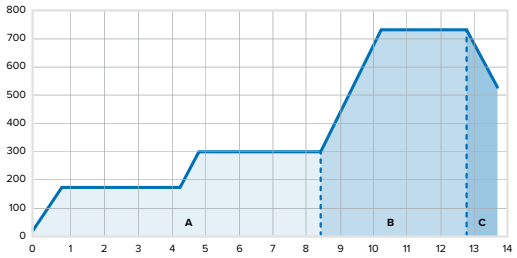
[2] Data was obtained from green parts, printed using Form 3, 50 µm, Castable Wax 40 Resin settings, without post-cure.

STANDARD BURNOUT SCHEDULE

The following burnout schedule is designed to help reduce thermal expansion of resin in the mold, while ensuring a complete burnout for thick jewelry parts. Formlabs recommends Certus Prestige Optima™ investment powder.

Use this schedule as a starting point and make adjustments as needed.
Learn how to fine tune burnout and investment preparation for best performance on the support page.

		PHASE	TIME	SCHEDULE °C	SCHEDULE °F
	Heated Bench Rest Place flasks into oven for heated drying after investment set period (30-60 min). Elevated temperature melts solid wax in resin to reduce expansion.	Hold	180 minutes	55 °C	131 °F
A	**Thermal Transition** Wax sprue melts out, increasing airflow to the resin pattern. Wax in resin diffuses out into investment. Burnout begins gently, breaking down pattern without forceful expansion.	Ramp	48 minutes	2 °C / min	3.6 °F / min
		Hold	180 minutes	150 °C	302 °F
		Ramp	75 minutes	2.0 °C / min	3.6 °F / min
		Hold	180 minutes	300 °C	572 °F
B	**Burnout** Eliminates the remaining resin and ash in the investment.	Ramp	108 minutes	4.0 °C / min	7.2 °F / min
		Hold	180 min	732 °C	1350 °F
C	**Casting Temperature** Cool the flask to casting temperature of the selected metal.	Ramp	44 minutes	- 5 °C / min	- 9 °F / min
		Casting Window	Up to 2 hours	Desired casting temp	Desired casting temp



Washing Info:

Wash Castable Wax 40 prints in isopropyl alcohol (IPA) for 5 minutes. Rinse for 5 minutes in a second, cleaner IPA bath to eliminate any remaining uncured material. Fully dry parts with compressed air. Do not use TPM to wash.

Post-Curing Info:

Post-curing is not required for bulky Castable Wax 40 prints, but can increase handling strength if desired. Cure parts for up to 30 minutes with no heat.

formlabs

Castable Wax

Sharp Detail and Clean Casting Every Time.

A 20% wax-filled photopolymer for reliable casting with zero ash content and clean burnout, Castable Wax Resin accurately captures intricate features and offers the smooth surfaces stereolithography 3D printing is known for.

V1 **FLCWPU01** *** May not be available in all regions**

Prepared 07 . 05 . 2018
Rev. 01 07 . 05 . 2018

MATERIAL PROPERTIES DATA

Castable Wax Resin

	METRIC [1]	IMPERIAL [1]	METHOD
	Green [2]	Green [2]	
Tensile Properties			
Ultimate Tensile Strength	12 MPa	1680 psi	ASTM D 638-10
Tensile Modulus	220 MPa	32 ksi	ASTM D 638-10
Elongation at Break	13%	13%	ASTM D 638-10
Burnout Properties			
Temp @ 5% Mass Loss	249 °C	480 °C	ASTM E 1131
Ash Content (TGA)	0.0 - 0.1%	0.0 - 0.1%	ASTM E 1131

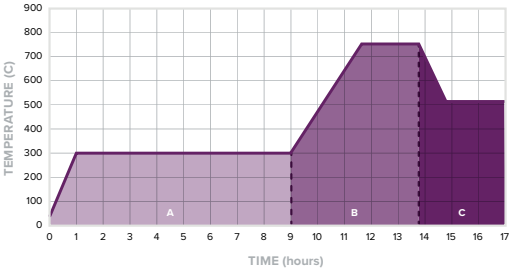
[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

[2] Data was obtained from parts printed using Form 2, Castable 50 µm Fine Detail settings and washed without post-cure.

STANDARD BURNOUT SCHEDULE

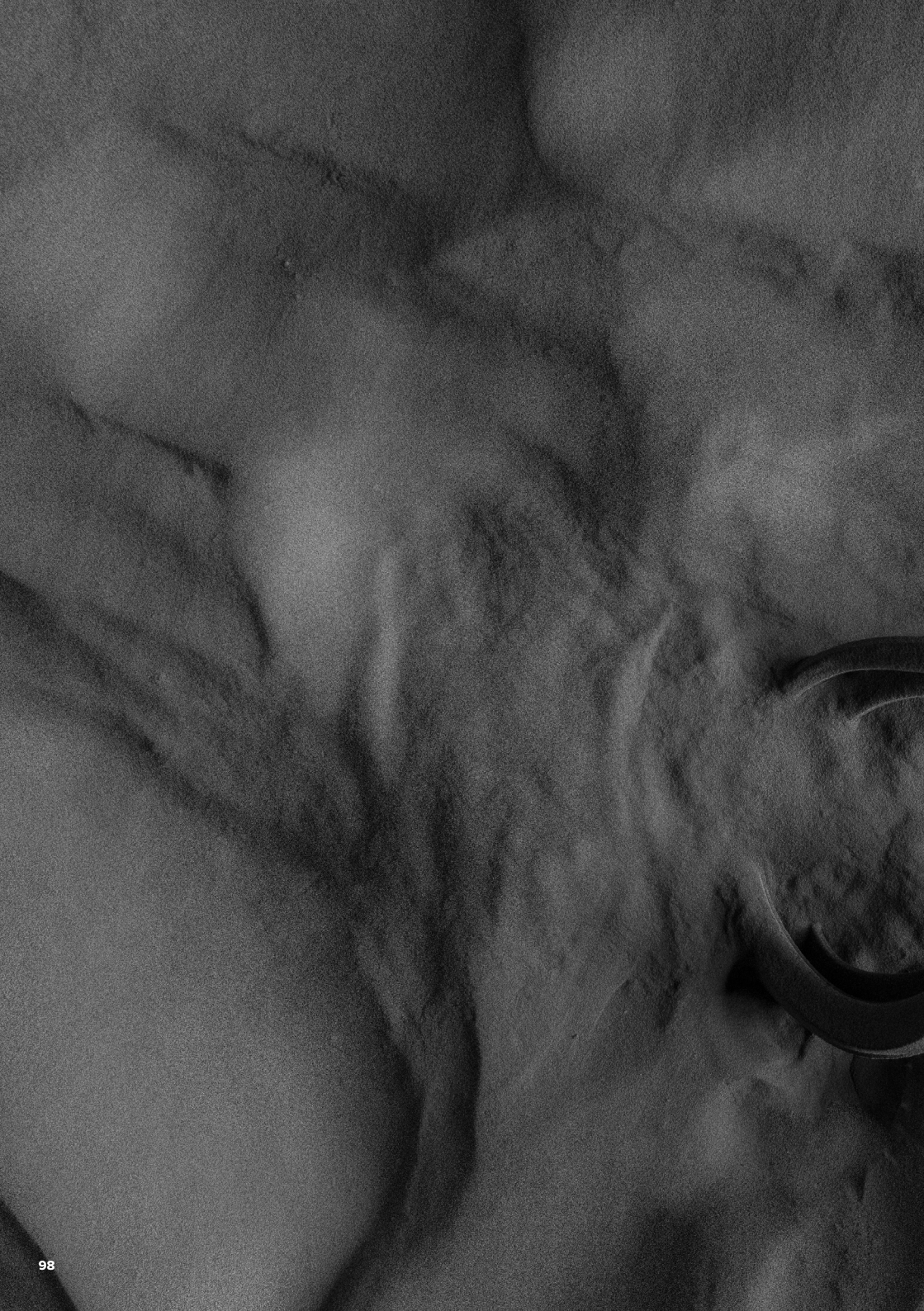
The Standard Burnout Schedule is designed to provide the maximum possible investment strength and complete burnout of the finest details using Certus Prestige Optima or similar investment materials. Use this schedule as a starting point and make adjustments as needed.

	PHASE	TIME	SCHEDULE °C	SCHEDULE °F
A	Insert Flasks	0 min	21 °C	70 °F
	Ramp	60 min	4.7 °C / min	8.4 °F / min
	Hold	480 min	300 °C	572 °F
B	Ramp	100 min	4.5 °C / min	8.1 °F / min
	Hold	180 min	750 °C	1382 °F
C	Ramp	60 min	- 4.0 °C / min	- 7.1 °F / min
	Casting Window	Up to 2 hours	512 °C (or desired casting temp)	954 °F (or desired casting temp)

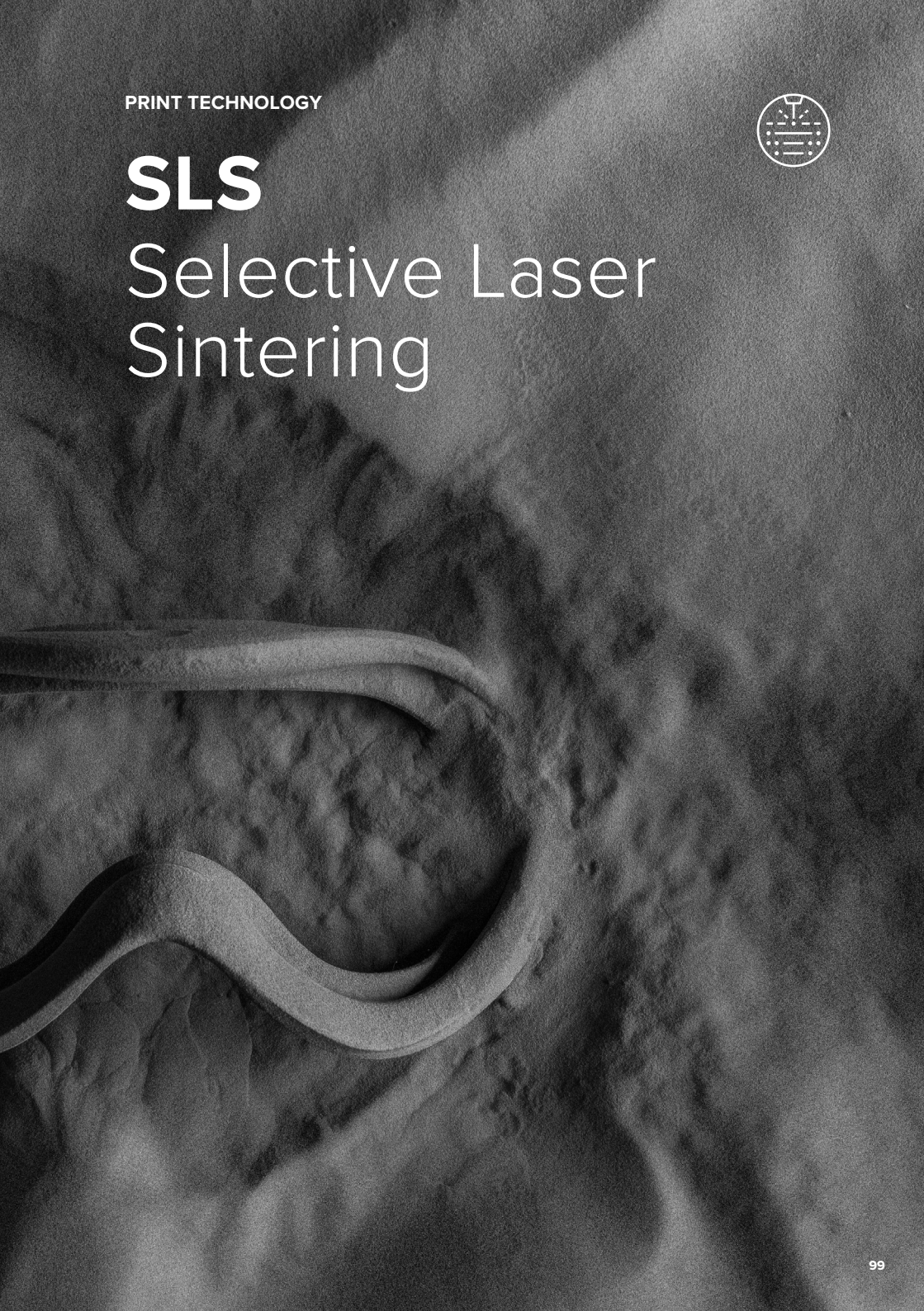


Post-Curing Info:

No post-cure required.



SLS
Selective Laser Sintering



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Nylon 12 Powder

SLS Powder For Strong, Functional Prototypes and End-Use Parts

With high tensile strength, ductility, and environmental stability, Nylon 12 Powder is suitable for creating complex assemblies and durable parts with minimal water absorption.

Nylon 12 Powder is specifically developed for use on the Fuse Series printers.

V1 **FLP12G01** * May not be available in all regions

Prepared 08 . 19. 2020
Rev. 01 08 . 19. 2020

MATERIAL PROPERTIES DATA

Nylon 12 Powder

	METRIC [1]	IMPERIAL [1]	METHOD
Mechanical Properties			
Ultimate Tensile Strength	50 MPa	7252 psi	ASTM D638 Type 1
Tensile Modulus	1850 MPa	268 ksi	ASTM D638 Type 1
Elongation at Break (X/Y)	11%	11%	ASTM D638 Type 1
Elongation at Break (Z)	6%	6%	ASTM D638 Type 1
Flexural Properties			
Flexural Strength	66 MPa	9572 psi	ASTM D 790-15
Flexural Modulus	1600 MPa	232 ksi	ASTM D 790-15
Impact Properties			
Notched Izod	32 J/m	0.60 ft-lb/in	ASTM D256-10
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	87 °C	189 °F	ASTM D648
Heat Deflection Temp. @ 0.45 MPa	171 °C	340 °F	ASTM D648
Vicat Softening Temperature	175 °C	347 °F	ASTM D1525
Other Properties			
Moisture Content (powder)	0.25%	0.25%	ISO 15512 Method D
Water Absorption (printed part)	0.66%	0.66%	ASTM D570

Samples printed with Nylon 12 Powder have been evaluated in accordance with ISO 10993-1:2018, and has passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3,4]
ISO 10993-5:2009	Not cytotoxic
ISO 10993-10:2010/(R)2014	Not an irritant
ISO 10993-10:2010/(R)2014	Not a sensitizer

Flammability Properties

Testing Standard	Rating
UL 94 Section 7	HB *

* Thickness of the sample tested = 3.00mm

[1] Material properties may vary with part geometry, print orientation and temperature.

[2] Parts were printed using Fuse 1 with Nylon 12 Powder. Parts were conditioned at 50% relative humidity and 23 °C for 7 days before testing.

[3] Material properties may vary based on part design and manufacturing practices. It is the manufacturer's responsibility to validate the suitability of the printed parts for the intended use.

[4] Nylon 12 was tested at NAMSA World Headquarters, OH, USA.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.1	Mineral oil (Heavy)	0.7
Acetone	0.1	Mineral oil (Light)	0.5
Bleach ~5% NaOCl	0.2	Salt Water (3.5% NaCl)	0.2
Butyl Acetate	0.2	Skydrol 5	0.6
Diesel Fuel	0.4	Sodium Hydroxide solution (0.025% PH 10)	0.2
Diethyl glycol Monomethyl Ether	0.5	Strong Acid (HCl conc)	0.8
Hydraulic Oil	0.6	Tripropylene glycol monomethyl ether	0.3
Hydrogen peroxide (3%)	0.2	Water	0.1
Isooctane (aka gasoline)	<0.1	Xylene	0.1
Isopropyl Alcohol	0.2		

formlabs

Nylon 12 GF Powder

For stiff, stable, functional parts.

A high-performance SLS material for in-house production of parts that require high rigidity, dimensional accuracy, and thermal stability.

Specifically developed for use on the Fuse Series Printers.

Fixtures Undergoing Long-Term Sustained Loading

Functional Prototypes for composite products

Stiff Structural Components

Thermally Stressed Housings

End-Use Industrial Parts

V1 **FLP12B01** *** May not be available in all regions**

Prepared 02 . 01. 2022
Rev. 01 02 . 01. 2022

MATERIAL PROPERTIES DATA

Nylon 12 GF Powder

	METRIC [1, 2]	IMPERIAL [1, 2]	METHOD
Mechanical Properties			
Ultimate Tensile Strength	38 MPa	5510 psi	ASTM D 638-14 Type 1
Tensile Modulus	2800 MPa	406 ksi	ASTM D 638-14 Type 1
Elongation at Break (X/Y)	4%	4%	ASTM D 638-14 Type 1
Elongation at Break (Z)	3%	3%	ASTM D 638-14 Type 1
Flexural Properties			
Flexural Strength	56 MPa	8122 psi	ASTM D 790-15
Flexural Modulus	2400 MPa	348 ksi	ASTM D 790-15
Impact Properties			
Notched Izod	36 J/m	0.67 ft lb/in	ASTM D256-10
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	113°C	235°F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	170°C	338°F	ASTM D 648-16
Vicat Softening Temperature	175°C	347°F	ASTM D1525
Other Properties			
Moisture Content (powder)	0.23%	0.23%	ISO 15512 Method D
Water Absorption (printed part)	0.24%	0.24%	ASTM D570

Samples printed with Nylon 12 GF Powder have been evaluated in accordance with ISO 10993-1:2018, and has passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3,4]
ISO 10993-5:2009	Not cytotoxic
ISO 10993-10:2010/(R)2014	Not an irritant
ISO 10993-10:2010/(R)2014	Not a sensitizer

Flammability Properties

Testing Standard	Rating
UL 94 Section 7	HB *

* Thickness of the sample tested = 3.00mm

[1] Material properties may vary with part geometry, print orientation and temperature.

[2] Parts were printed using Fuse 1, with Nylon 12 GF powder. Parts were conditioned at 50% relative humidity and 23 °C for 7 days before testing.

[3] Material properties may vary based on part design and manufacturing practices. It is the manufacturer's responsibility to validate the suitability of the printed parts for the intended use.

[4] Nylon 12 GF was tested at NAMSA World Headquarters, OH, USA.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.2	Mineral oil (Heavy)	1.0
Acetone	0.2	Mineral oil (Light)	1.3
Bleach ~5% NaOCl	0.2	Salt Water (3.5% NaCl)	0.2
Butyl Acetate	0.2	Skydrol 5	0.8
Diesel Fuel	0.6	Sodium Hydroxide solution (0.025% PH 10)	0.2
Diethyl glycol Monomethyl Ether	0.5	Strong Acid (HCl conc)	0.8
Hydraulic Oil	1.0	Tripropylene glycol monomethyl ether	0.8
Hydrogen peroxide (3%)	0.2	Water	0.1
Isooctane (aka gasoline)	0.0	Xylene	0.2
Isopropyl Alcohol	0.2		

formlabs

Nylon 11 Powder

Nylon 11 Powder for High Performance, High Impact

For ductile, robust parts, Nylon 11 Powder is a high performance, bio-based nylon material for functional prototyping and small batch production. Nylon 11 Powder is suitable for printing parts that need to bend or resist impact.

Nylon 11 Powder is specifically developed for use on the Fuse Series printers.

V1 **FLP11B01**

* **May not be available in all regions**

Prepared 06 . 05 . 2021
Rev. 01 06 . 05 . 2021

MATERIAL PROPERTIES DATA

Nylon 11 Powder

	METRIC [1,2]	IMPERIAL [1,2]	METHOD
Tensile Properties			
Ultimate Tensile Strength	49 MPa	7107 psi	ASTM D 638-14 Type 1
Tensile Modulus	1.6 GPa	232 ksi	ASTM D 638-14 Type 1
Elongation at Break (X/Y)	40%	40%	ASTM D 638-14 Type 1
Flexural Properties			
Flexural Strength	55 MPa	7977 psi	ASTM D 790-15
Flexural Modulus	1.4 GPa	203 ksi	ASTM D 790-15
Impact Properties			
Notched Izod	71 J/m	1.3 ft-lb/in	ASTM D256-10
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	46 °C	115 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	182 °C	360 °F	ASTM D 648-16
Vicat Softening Temperature	189 °C	372°F	ASTM D 1525
Other Properties			
Moisture Content (powder)	0.37%	0.37%	ISO 15512 Method D
Water Absorption (printed part)	0.07%	0.07%	ASTM D570

Samples printed with Nylon 11 Powder have been evaluated in accordance with ISO 10993-1, and has passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3,4]
ISO 10993-5:2009	Not cytotoxic
ISO 10993-10:2010/(R)2014	Not an irritant
ISO 10993-10:2010/(R)2014	Not a sensitizer

Flammability Properties

Testing Standard	Rating
UL 94 Section 7	HB *

* Thickness of the sample tested = 3.00mm

[1] Material properties may vary with part geometry, print orientation and temperature.

[2] Parts were printed using Fuse 1 with Nylon 11 Powder. Parts were conditioned at 50% relative humidity and 23 °C for 7 days before testing.

[3] Material properties may vary based on part design and manufacturing practices. It is the manufacturer's responsibility to validate the suitability of the printed parts for the intended use.

[4] Nylon 11 Powder was tested at NAMSA World Headquarters, OH, USA.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.1	Mineral oil (Light)	0.4
Acetone	0.1	Mineral oil (Heavy)	0.4
Bleach ~5% NaOCl	0.1	Salt Water (3.5% NaCl)	0.1
Butyl Acetate	0.1	Skydrol 5	0.2
Diesel Fuel	0.2	Sodium Hydroxide solution (0.025% pH 10)	0.1
Diethyl glycol Monomethyl Ether	0.4	Strong Acid (HCl conc)	1.0
Hydraulic Oil	0.5	Tripropylene glycol monomethyl ether	0.3
Hydrogen peroxide (3%)	< 0.1	Water	0.1
Isooctane (aka gasoline)	< 0.1	Xylene	0.1
Isopropyl Alcohol	0.1		

formlabs

Nylon 11 CF Powder

Carbon Fiber Reinforced, for Strong and Lightweight parts

Get the best of nylon and carbon fiber with this highly stable, high-performance material, perfect for end-use applications that require both high stiffness and superior strength and can take an impact.

Nylon 11 CF Powder is specifically developed for use on the Fuse 1+ 30W.

Functional composite prototypes

Tooling, Jigs, Fixtures

Replacement and spare alternatives to metal parts

High-impact equipment

V1 **FLP11C01**

* **May not be available in all regions**

Prepared 06 . 22 . 2022
Rev. 01 06 . 22 . 2022

MATERIAL PROPERTIES DATA

Nylon 11 CF Powder

	METRIC [1,2]			IMPERIAL [1,2]			METHOD
Tensile Properties	X	Y	Z	X	Y	Z	
Ultimate Tensile Strength	69 MPa	52 MPa	38 MPa	10 ksi	7.6 ksi	5.5 ksi	ASTM D 638-14 Type 1
Tensile Modulus	5.3 GPa	2.8 GPa	1.6 GPa	770 ksi	410 ksi	240 ksi	ASTM D 638-14 Type 1
Elongation at Break	9%	15%	5%	9%	15%	5%	ASTM D 638-14 Type 1
Mechanical Properties							
Flexural Strength	110 MPa			16 ksi			ASTM D 790-15
Flexural Modulus	4.2 GPa			610 ksi			ASTM D 790-15
Notched Izod	74 J/m			1.4 ft-lb/in			ASTM D256-10
Thermal Properties							
Heat Deflection Temp. @ 1.8 MPa	178 °C			352 °F			ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	188 °C			370 °F			ASTM D 648-16
Vicat Softening Temperature	188 °C			370 °F			ASTM D 1525

[1] Material properties may vary with part geometry, print orientation and temperature.

[2] Parts were printed using Fuse 1+ 30W, with Nylon 11 CF Powder. Parts were conditioned at 50% relative humidity and 23 °C for 7 days before testing.

SOLVENT COMPATIBILITY

Percent weight gain over 24 hours for a printed 1 x 1 x 1 cm cube immersed in respective solvent:

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.2	Mineral oil, heavy	1.0
Acetone	0.2	Mineral oil, light	1.3
Bleach ~5% NaOCl	0.2	Salt Water (3.5% NaCl)	0.2
Butyl Acetate	0.2	Skydrol 5	0.8
Diesel Fuel	0.6	Sodium hydroxide solution (0.025% pH = 10)	0.2
Diethyl glycol monomethyl ether	0.5	Strong Acid (HCl Conc)	0.8
Hydraulic Oil	1.0	TPM	0.8
Hydrogen peroxide (3%)	0.2	Water	0.1
Isooctane	0.0	Xylene	0.2
Isopropyl Alcohol	0.2		

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North America Sales Inquiries

sales@formlabs.com
617-702-8476

www.formlabs.com

Europe Sales Inquiries

eu-sales@formlabs.com
+44 330 027 0040 (UK)
+49 1573 5993322 (EU)

www.formlabs.com/eu

International Sales Inquiries

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formlabs.com/find-a-reseller