formlabs

Materials Library

Functional materials that look the part

Prepared 07 . 04 . 2020

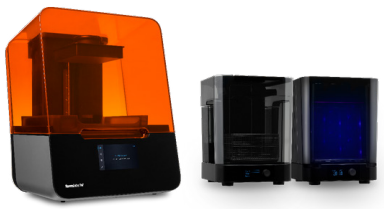
Everything You Need to Start Printing

FORM 3 BASIC PACKAGE

All of the essentials to set up a 3D printing workflow with the Form 3.

Includes

- 1 Form 3 3D Printer
- 1 Build Platform
- PreForm Software
- 1 Resin Tank
- 1 Finish Kit
- 1 Year Warranty

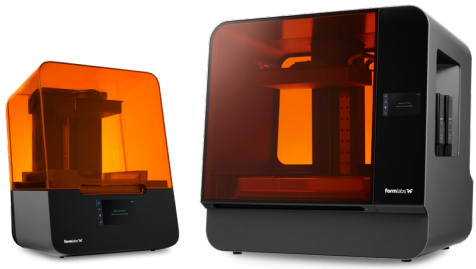


FORM 3 COMPLETE PACKAGE

An end-to-end printing and post-processing package with the support you need to print successfully.

Includes

- 1 Form 3 3D Printer
- 1 Build Platform
- PreForm Software
- 1 Form Wash
- 1 L Standard Resin
- 1 Resin Tank
- 1 Finish Kit
- 1 Year Warranty
- 1 Form Cure
- 1 Year Pro Service Plan



COMPANY SOLUTIONS

A team of Formlabs experts will help you discover and implement new ways to work better with 3D printing.

The Formlabs consulting team has unmatched expertise in solving technical and business challenges with stereolithography (SLA) 3D printers.

Exceptional Print Quality

Formlabs 3D printers deliver professional-quality printed parts at a fraction of the price.

HOBBYIST FDM [1]

Part Cost $0.41

Machine Cost $2,500

DESKTOP SLA (FORM 2) [1,2]

Part Cost $1.67

Machine Cost $3,499

INDUSTRIAL SLA [1]

Part Cost $6.00

Machine Cost $300,000

[1] All parts printed at 100 micron layer height. [2] Printed in Formlabs Grey Resin – one of our Standard prototyping resins.

Resin Material List

RESIN	MICRON LAYER HEIGHT	FEATURES & APPLICATIONS	
STANDARD			
Clear	100 µm, 50 µm, 25 µm	• Polishes to transparency • Internal channels	• Working with light • Semi-gloss surface
White	100 µm, 50 µm	• Opaque • Matte surface	• Great for large, smooth surfaces
Grey	160 µm, 100 µm, 50 µm, 25 µm	• Opaque • Matte surface	• Show details well without primer
Black	100 µm, 50 µm, 25 µm	• Opaque • Matte surface	• Show details well without primer
Color Kit	100 µm, 50 µm, 25 µm	• Opaque • Matte surface	• Colorful parts without requiring painting
Draft	300 µm	• Rapid prototyping • Speeds up design iterations	• Suitable for printing large parts quickly
ENGINEERING			* May not be available in all regions
Rigid	100 µm, 50 µm	• Thin wall parts • Jigs, fixtures, and tooling	• Electrical casings and automotive housings • Turbines and fan blades
Grey Pro	100 µm, 50 µm	• Form and fit testing • Mold masters for plastics and silicones	• Snap fits • Jigs and fixtures for manufacturing
Tough 2000	100 µm, 50 µm	• Strong and stiff prototypes	• Sturdy jigs and fixtures • ABS-like strength and stiffness
Tough 1500	100 µm, 50 µm	• Springy prototypes and assemblies • Snap fit and press fit connectors	• Polypropylene-like strength and stiffness
Durable	100 µm, 50 µm	• Squeezable prototypes • Impact resistant jigs	• Low friction and non-degrading surfaces • Polyethylene-like strength and stiffness
Flexible 80A	100 µm, 50 µm	• Wearables prototyping • Stretchable enclosures	• Soft tissue anatomy
Elastic 50A	100 µm	• Handles, grips, and overmolds • Seals, gaskets, and masks	• Cushioning and damping • Soft tissue anatomy • silicone-like flexibility
High Temp	100 µm, 50 µm, 25 µm	• Mold prototyping • Heat-resistant fixtures	• Low pressure fluidics • Environmental testing
MEDICAL			
BioMed Clear	100 µm	• Biocompatible - Long term use • USP Class VI certified	• Rigid, clear prints for end use medical, pharmaceutical, and industrial devices • Compatible with common disinfection and sterilization methods
BioMed Amber	100 µm, 50 µm	• Biocompatible - Short term use	• Rigid, translucent prints for medical or industrial uses • Compatible with common disinfection and sterilization methods

RESIN	MICRON LAYER HEIGHT	FEATURES & APPLICATIONS	
DENTISTRY			* May not be available in all regions
Custom Tray	200 µm	• Biocompatible - Temporary use	• Prints impression trays
Temporary CB	50 µm	• Biocompatible - Permanent use (up to 1 year in the mouth) • Compatible with temporary cements	• Prints temporary crowns, bridges, inlays, onlays, and veneers • Polishes to a high gloss finish with conventional dental composite polishers
Surgical Guide	50 µm	• Biocompatible - Temporary use	• Prints surgical and pilot drill guides
Dental LT Clear V2	100 µm	• Biocompatible - Permanent use	• Color corrected to remove yellowness and polishes to high optical transparency • Prints splints, retainers, and other orthodontic devices
Dental LT Clear V1	100 µm	• Biocompatible - Permanent use	• Polishes to high optical transparency • Prints splints, and other orthodontic devices
Denture Base + Teeth	50 µm	• Biocompatible - Permanent use • 3D print final dentures and try-ins orthodontic devices	• The first truly accessible direct printed dental prosthetic
Model	140 µm (Form 2), 100 µm, 50 µm, 25 µm	• Matte surface • Prints crown and bridge models with removable dies	• Contacts within ± 35 µm • Crisp margins
JEWELRY			
Castable Wax	50 µm, 25 µm	• Crisp settings, sharp prongs, smooth shanks, fine surface detail	• 20% wax-filled photopolymer • No post-curing required
Castable	100 µm, 50 µm, 25 µm	• This pure polymer requires an alternate burnout from a typical wax schedule.	• Designed for investment casting
FORM X + PARTNERSHIP			* May not be available in all regions
Ceramic	50 µm, 25 µm	• Technical experimentation	• Research and development
Rebound	200 µm	• End-use production • Gaskets, seals, and grommets • Compliant robotics	• Custom cases • Handles, grips, and overmolds • Complex geometries

MATERIAL DATA SHEET

Standard

Materials for High-Resolution Rapid Prototyping

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

Strength and Precision. Our resins create accurate and robust parts, ideal for rapid prototyping and product development.

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 WHITE FLGPWH04 | V4 GREY FLGPGR04 | V4 BLACK FLGPBL04 | V4 COLOR FLGPCB01

Prepared 04 . 19 . 2016
Rev 01 04 . 18 . 2017

Material Properties Data

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 D 638-10
Tensile Modulus	1.6 GPa	2.8 GPa	234 ksi	402 ksi	ASTM D 638-10
Elongation at Failure	12 %	6 %	12 %	6 %	ASTM D 638-10
Flexural Properties					
Flexural Modulus	1.3 GPa	2.2 GPa	181 ksi	0.5 ksi	ASTM D 790-10
Impact Properties					
Notched IZOD	16 J/m	25 J/m	0.3 ft-lbf/in	0.46 ft-lbf/in	ASTM D 256-10
Temperature Properties					
Heat Deflection Temp. @ 264 psi	42.7 °C	58.4 °C	108.9 °F	137.1 °F	ASTM D 648-07
Heat Deflection Temp. @ 66 psi	49.7 °C	73.1 °C	121.5 °F	163.6 °F	ASTM D 648-07

[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, washed and air dried without post cure.

[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 Hour Weight Gain (%)	Solvent	24 Hour Weight Gain (%)
Acetic Acid, 5 %	< 1	Hydrogen Peroxide (3 %)	< 1
Acetone	sample cracked	Isooctane	< 1
Isopropyl Alcohol	< 1	Mineral Oil, light	< 1
Bleach, ~5 % NaOCl	< 1	Mineral Oil, heavy	< 1
Butyl Acetate	< 1	Salt Water (3.5 % NaCl)	< 1
Diesel	< 1	Sodium hydroxide (0.025 %, pH = 10)	< 1
Diethyl glycol monomethyl ether	1.7	Water	< 1
Hydrolic Oil	< 1	Xylene	< 1
Skydrol 5	1	Strong Acid (HCl Conc)	distorted

HIGH RESOLUTION

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

STRENGTH AND PRECISION

Our resins create accurate and robust parts, ideal for our rapid prototyping and product development.

SURFACE FINISH

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

CLEAR

Our Clear Resin polishes to near optical transparency, making it ideal for showcasing internal features.

WHITE

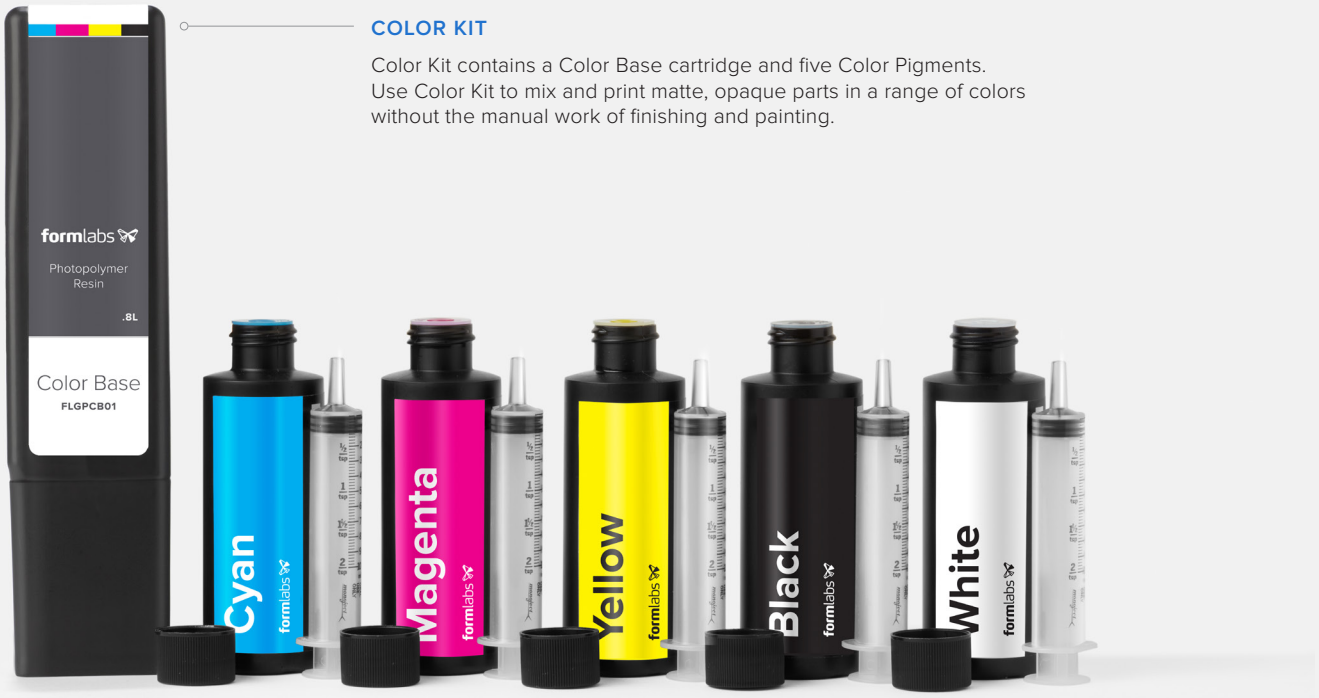
Our White Resin emphasizes fine details and has a matte finish with a warm, slightly ivory color.

GREY

Our Grey Resin has a smooth, matte finish and shows details beautifully without primer.

BLACK

Our Black Resin's opaque matte finish rivals the look of injection-molded plastics, capable of producing incredible looks-like prototypes.



COLOR KIT

Color Kit contains a Color Base cartridge and five Color Pigments. Use Color Kit to mix and print matte, opaque parts in a range of colors without the manual work of finishing and painting.

STANDARD RESIN

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**

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

DRAFT MATERIAL PROPERTIES DATA

	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 60 °C[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 D790-17
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
Temperature Properties							
Heat Deflection Temp. @ 1.8 MPa	37 °C	44 °C	57 °C	99 °F	111 °F	135 °F	ASTM D648-18
Heat Deflection Temp. @ 0.45 MPa	43 °C	53 °C	74 °C	109 °F	127 °F	165 °F	ASTM D648-18

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

[2] Data was obtained from green parts, printed using a Form 3, 200 micron, Draft v2 Resin settings, washed in Form Wash and air dried without post cure.

[3] Data was obtained from parts printed using a Form 3, 200 micron, Draft v2 Resin settings and post-cured with a Form Cure at Room Temperature for 5 minutes.

[4] Data was obtained from parts printed using a Form 3, 200 micron, Draft v2 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%	0.18	Mineral oil (Heavy)	< 0.10
Acetone	4.24	Mineral oil (light)	< 0.10
Bleach ~5% NaOCl	0.14	Salt Water (3.5% NaCl)	0.34
Butyl Acetate	0.11	Skydrol 5	0.31
Diesel Fuel	0.10	Sodium Hydroxide solution (0.025% PH 10)	0.28
Diethyl glycol Monomethyl Ether	0.77	Strong Acid (HCl conc)	< 0.10
Hydraulic Oil	< 0.10	TPM	0.29
Hydrogen peroxide (3%)	0.23	Water	< 0.10
Isooctane (aka gasoline)	< 0.10	Xylene	< 0.10
Isopropyl Alcohol	< 0.10		

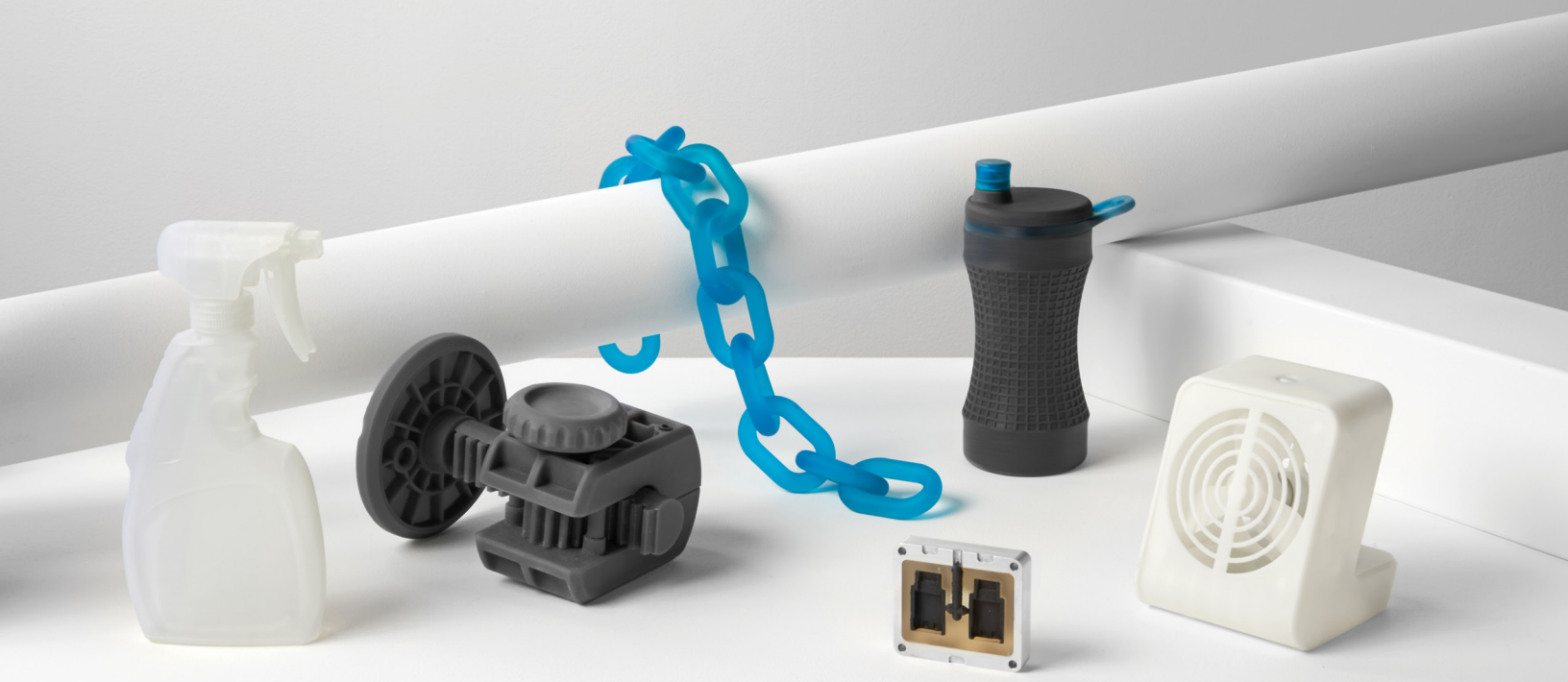
MATERIALS LIBRARY

Engineering

Materials for Engineering, Manufacturing, and Product Design

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

* May not be available in all regions



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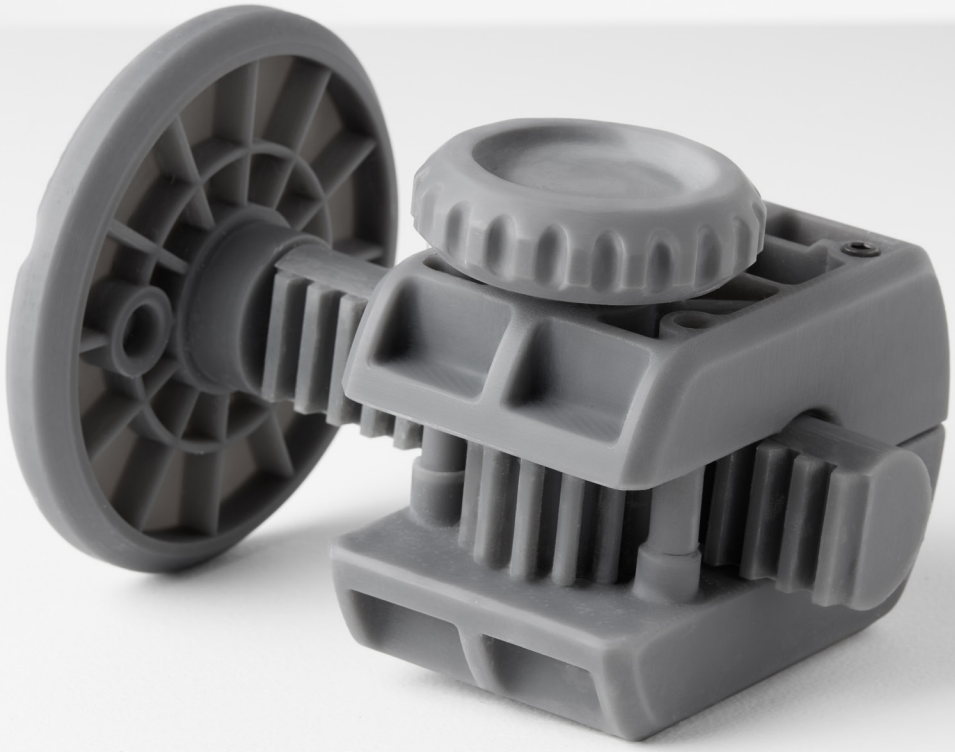
ENGINEERING RESIN

Grey Pro

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
- Mold masters for plastics, and silicones
- Injection molded product prototypes
- Jigs and fixtures for manufacturing



V1 **FLPRGR01**

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Prepared 01 . 22 . 2018
Rev 01 01 . 22 . 2018

Material Properties Data

	METRIC[1]		IMPERIAL[1]		METHOD
	Green[2]	Post-Cured[3]	Green[2]	Post-Cured[3]	
Tensile Properties					
Ultimate Tensile Strength	33 MPa	61 MPa	5076 psi	8876 psi	ASTM D 638-14
Tensile Modulus	1.4 GPa	2.6 GPa	203 ksi	377 ksi	ASTM D 638-14
Elongation	33 %	13 %	33 %	13 %	ASTM D 638-14
Flexural Properties					
Flexural Stress at 5% Strain	39 MPa	86 MPa	5598 psi	12400 psi	ASTM D 790-15
Flexural Modulus	0.9 GPa	2.2 GPa	136 ksi	319 ksi	ASTM D 790-15
Impact Properties					
Notched IZOD	not tested	18.7 J/m	not tested	0.351 ft-lbf/in	ASTM D256-10
Temperature Properties					
Heat Deflection Temp. @ 1.8 MPa	not tested	62.4 C	not tested	144.3 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	not tested	77.5 C	not tested	171.5 °F	ASTM D 648-16
Thermal Expansion (-30 to 30° C)	not tested	78.5 um/m/C	not tested	43.4 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, washed and air dried without post cure.

[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 Hour Weight Gain (%)	Solvent	24 Hour Weight Gain (%)
Acetic Acid, 5 %	<1	Hydrogen Peroxide (3 %)	<1
Acetone	10.8	Isooctane	<1
Isopropyl Alcohol	1.6	Mineral Oil, light	<1
Bleach, ~5 % NaOCl	<1	Mineral Oil, heavy	<1
Butyl Acetate	<1	Salt Water (3.5 % NaCl)	<1
Diesel	<1	Sodium hydroxide (0.025 %, pH = 10)	<1
Diethyl glycol monomethyl ether	2.4	Water	<1
Hydrolic Oil	<1	Xylene	<1
Skydrol 5	<1	Strong Acid (HCl Conc)	8.2

ENGINEERING RESIN

Rigid 4000

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**

formlabs

Prepared 10 . 20 . 2020
Rev 02 10 . 20 . 2020

RIGID 4000 MATERIAL PROPERTIES DATA

	METRIC[1]		IMPERIAL[1]		METHOD
Mechanical Properties	**Green[2]**	**UV[3]**	**Green[2]**	**UV[3]**	**Testing Standard**
Ultimate Tensile Strength	33 MPa	69 MPa	4786 psi	10007 psi	ASTM D 638-14
Tensile Modulus	2.1 GPa	4.1 GPa	305 ksi	595 ksi	ASTM D 638-14
Elongation at Break	23%	5.3%	23%	5.3%	ASTM D 638-14
Flexural Strength	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
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 4000 (formerly Rigid v1) settings, without additional treatments.

[2] Data was obtained from parts printed using Form 3, 100 µm, Rigid 4000 (formerly Rigid v1) 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	Hydrogen peroxide (3%)	0.87
Acetone	3.3	Isooctane (aka gasoline)	<0.1
Isopropyl Alcohol	0.38	Mineral oil (light)	0.22
Bleach ~5% NaOCl	0.69	Mineral oil (Heavy)	0.15
Butyl Acetate	<0.1	Salt Water (3.5% NaCl)	0.71
Diesel Fuel	<0.1	Sodium Hydroxide solution (0.025% PH 10)	0.68
Diethyl glycol Monomethyl Ether	1.4	Water	0.70
Hydraulic Oil	0.17	Xylene	<0.1
Skydrol 5	1.1	Strong Acid (HCl conc)	5.3

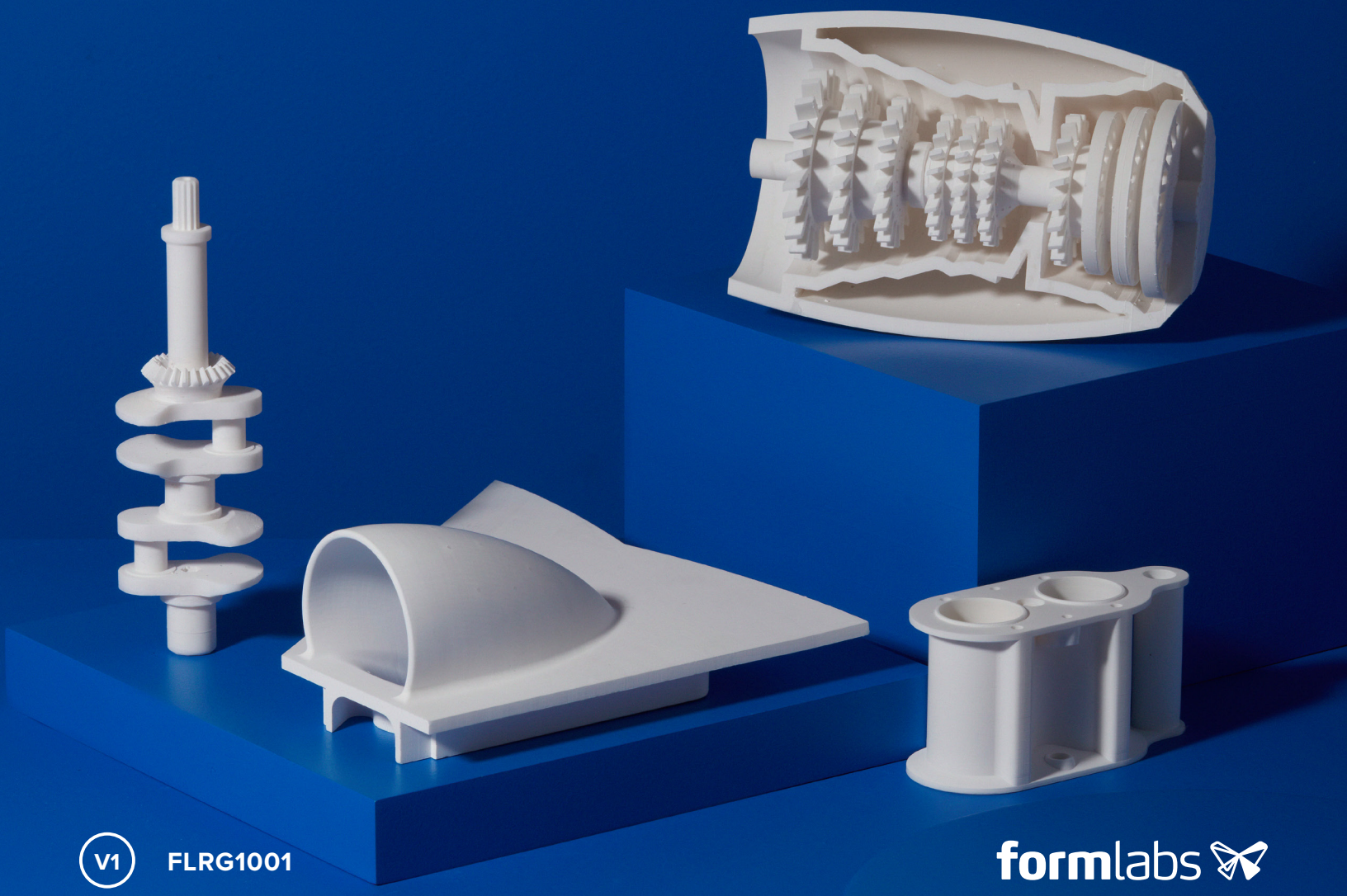
ENGINEERING RESIN

Rigid 10K

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 exhibits a smooth matte finish and is highly resistant to heat and chemicals.

- Short-run injection mold masters and inserts
- Aerodynamic test models
- Heat resistant and fluid exposed components, jigs, and fixtures
- Simulates stiffness of glass and fiber-filled thermoplastics



V1 **FLRG1001**

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Prepared		06 . 09 . 2020
Rev	01	06 . 09 . 2020

RIGID 10K MATERIAL PROPERTIES DATA

	METRIC			IMPERIAL			METHOD
Mechanical Properties	**Green**	**UV[1]**	**UV+Thermal[2]**	**Green**	**UV[1]**	**UV+Thermal[2]**	**Testing Standard**
Ultimate Tensile Strength	55 MPa	65 MPa	53 MPa	7980 psi	9460 psi	7710 psi	ASTM D 638-14
Tensile Modulus	7.5 GPa	10 GPa	10 GPa	1090 ksi	1480 ksi	1460 ksi	ASTM D 638-14
Elongation at Break	2%	1%	1%	2%	1%	1%	ASTM D 638-14
Flexural Strength	84 MPa	126 MPa	103 MPa	12200 psi	18200 psi	15000 psi	ASTM D 790-15
Flexural Modulus	6 GPa	9 GPa	10 GPa	905 ksi	1360 ksi	1500 ksi	ASTM D 790-15
Notched IZOD	16 J/m	16 J/m	18 J/m	0.3 ft-lbf/in	0.3 ft-lbf/in	0.3 ft-lbf/in	ASTM D256-10
Unnotched IZOD	41 J/m	41 J/m	41 J/m	0.8 ft-lbf/in	0.9 ft-lbf/in	0.7 ft-lbf/in	ASTM D4812-11
Thermal Properties							
HDT @ 0.45 MPa	65 °C	163 °C	218 °C	149 °F	325 °F	424 °F	ASTM D 648-16
HDT @ 1.8 MPa	56 °C	82 °C	110 °C	133 °F	180 °F	230 °F	ASTM D 648-16
CTE, 0-150 °C	48 µm/m/°C	47 µm/m/°C	46 µm/m/°C	27 µin/in/°F	26 µin/in/°F	26 µin/in/°F	ASTM E 831-13

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 60°C and an additional thermal cure at 125°C for 90 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%	<0.1	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		

ENGINEERING RESIN

Tough 2000

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**

formlabs

Prepared 03 . 02 . 2020
Rev 01 03 . 02 . 2020

Tough 2000 Resin Material Properties Data

	METRIC[1]		IMPERIAL[1]		METHOD
	Green[2]	Post-Cured[3]	Green[2]	Post-Cured[3]	
Mechanical Properties					
Ultimate Tensile Strength	29 MPa	46 MPa	4206 psi	6671 psi	ASTM D 638-14
Tensile Modulus	1.2 GPa	2.2 GPa	174 ksi	329 ksi	ASTM D 638-14
Elongation at Break	74 %	48 %	74 %	48 %	ASTM D 638-14
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
Thermal 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
Coefficient of Thermal Expansion	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, washed and air dried without post cure.

[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 Hour Weight Gain (%)	Solvent	24 Hour Weight Gain (%)
Acetic Acid, 5 %	0.71	Hydrogen Peroxide (3 %)	0.63
Acetone	18.82	Isooctane	0.03
Isopropyl Alcohol	3.7	Mineral Oil, light	0.13
Bleach, ~5 % NaOCl	0.56	Mineral Oil, heavy	0.17
Butyl Acetate	6.19	Salt Water (3.5 % NaCl)	0.56
Diesel	0.06	Sodium hydroxide (0.025 %, pH = 10)	0.61
Diethyl glycol monomethyl ether	5.32	Water	0.61
Hydrolic Oil	0.08	Xylene	4.1
Skydrol 5	0.87	Strong Acid (HCl Conc)	3.01

ENGINEERING RESIN

Tough 1500

Tough 1500 Resin for Resilient Prototyping

Tough 1500 Resin is the most resilient material in our functional family of Tough and Durable Resins. It 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

V1 **FLTO1501**

formlabs

Prepared		01 . 27 . 2020
Rev	01	01 . 27 . 2020

Tough 1500 Resin Material Properties Data

	METRIC[1]		IMPERIAL[1]		METHOD
	Green[2]	Post-Cured[3]	Green[2]	Post-Cured[3]	
Mechanical Properties					
Ultimate Tensile Strength	26 MPa	33 MPa	3771 psi	4786 psi	ASTM D 638-14
Tensile Modulus	0.94 GPa	1.5 GPa	136 ksi	218 ksi	ASTM D 638-14
Elongation at Break	69 %	51 %	69 %	51 %	ASTM D 638-14
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	114 µm/m/°C	97 µm/m/°C	63 µin/in/°F	54 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 without additional treatments.

[3] Data was obtained from parts printed using Form 2, 100 µm and post-cured with a Form Cure for 60 minutes at 70 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 Hour Weight Gain (%)	Solvent	24 Hour Weight Gain (%)
Acetic Acid, 5 %	0.75	Hydrogen Peroxide (3 %)	0.71
Acetone	19.07	Isooctane	0.02
Isopropyl Alcohol	3.15	Mineral Oil, light	0.05
Bleach, ~5 % NaOCl	0.62	Mineral Oil, heavy	0.09
Butyl Acetate	5.05	Salt Water (3.5 % NaCl)	0.66
Diesel	0.11	Sodium hydroxide (0.025 %, pH = 10)	0.7
Diethyl glycol monomethyl ether	5.25	Water	0.69
Hydrolic Oil	0.17	Xylene	3.22
Skydrol 5	0.46	Strong Acid (HCl Conc)	4.39

MATERIAL DATA SHEET

Durable

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
- Impact resistant jigs
- Low friction and non-degrading surfaces
- Polyethylene-like strength and stiffness

V2 **FLDUCL02**

formlabs

Prepared 01 . 26 . 2018
Rev 02 03 . 16 . 2020

Durable Material Properties Data

	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 D 638-14
Tensile Modulus	0.24 GPa	1.0 GPa	34 ksi	149 ksi	ASTM D 638-14
Elongation at Break	75 %	55 %	75 %	55 %	ASTM D 638-14
Flexural Properties					
Flexural Stress at 5% Strain	1.0 MPa	24 MPa	149 psi	3420 psi	ASTM D 790-17, Procedure A
Flexural Modulus	0.04 GPa	0.66 GPa	5.58 ksi	94.1 ksi	ASTM D 790-17, Procedure A
Impact Properties					
Notched IZOD	127 J/m	114 J/m	2.37 ft-lbf/in	2.13 ft-lbf/in	ASTM D 256-10 (2018), Test Method A
Unnotched IZOD	972 J/m	710 J/m	18.2 ft-lbf/in	13.3 ft-lbf/in	ASTM D4812-11
Temperature Properties					
Heat Deflection Temp. @ 0.45 MPa	< 30 °C	41 °C	< 86 °F	105 °F	ASTM D 648-18, Method B
Thermal Expansion	124 µm/m/°C	106 µm/m/°C	69.1 µin/in/°F	59 µin/in/°F	ASTM E831-14

[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 without additional treatments.

[3] Data was obtained from parts printed using Form 2, 100 µm and post-cured with a Formcure 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:

Mechanical Properties	24 Hour Weight Gain (%)	Mechanical Properties	24 Hour Weight Gain (%)
Acetic Acid, 5 %	1.3	Hydrogen Peroxide (3 %)	1
Acetone	sample cracked	Isooctane	< 1
Isopropyl Alcohol	5.1	Mineral Oil, light	< 1
Bleach, ~5 % NaOCl	< 1	Mineral Oil, heavy	< 1
Butyl Acetate	7.9	Salt Water (3.5 % NaCl)	< 1
Diesel	< 1	Sodium hydroxide (0.025 %, pH = 10)	< 1
Diethyl glycol monomethyl ether	7.8	Water	< 1
Hydrolic Oil	< 1	Xylene	6.5
Skydrol 5	1.3	Strong Acid (HCl Conc)	distorted

ENGINEERING RESIN

Flexible 80A

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.

Handles, grips, overmolds

Cartilage and ligament anatomy

Seals, gaskets, masks

V1 **FLFL8001**

* May not be available in all regions

formlabs

Prepared 05 . 29 . 2020
Rev 01 05 . 29 . 2020

Flexible 80A Resin Material Properties Data

	METRIC[1]		IMPERIAL[1]		METHOD
	Green	Post-Cured[2]	Green	Post-Cured[2]	
Mechanical 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	80 A	70A	80 A	ASTM 2240
Compression Set (23 °C for 22 hours)	Not Tested	3%	Not Tested	3%	ASTM D 624-00
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 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 postcured 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 Hour Weight Gain (%)	Solvent	24 Hour Weight Gain (%)
Acetic Acid, 5 %	0.9	Hydrogen Peroxide (3 %)	0.7
Acetone	37.4	Isooctane (aka gasoline)	1.6
Isopropyl Alcohol	11.7	Mineral Oil, light	0.1
Bleach, ~5 % NaOCl	0.6	Mineral Oil, heavy	<0.1
Butyl Acetate	51.4	Salt Water (3.5 % NaCl)	0.5
Diesel	2.3	Sodium hydroxide (0.025 %, pH = 10)	0.6
Diethyl glycol monomethyl ether	19.3	Water	0.7
Hydrolic Oil	1.0	Xylene	64.1
Skydrol 5	10.7	Strong Acid (HCl Conc)	28.6
Tripropylene Glycol Methyl Ether	13.6		

MATERIAL DATA SHEET

High Temp

High Temp 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

Molds and insterts

Heat resistant mounts, housings, and fixtures

V2 **FLFLGR02**

formlabs

Prepared 04 . 19 . 2016
Rev 01 04 . 18 . 2017

Material Properties Data Metric

	METRIC[1]			IMPERIAL[1]			METHOD
	Green[2]	Post-Cured[2]	Post-Cured + additional thermal cure [4]	Green[2]	Post-Cured[3]	Post-Cured + additional thermal cure [4]	
Tensile Properties							
Ultimate Tensile Strength	20.9 MPa	58.3 MPa	48.7 MPa	3031 psi	8456 psi	7063 psi	ASTM D 638-14
Elongation at Break	14 %	3.3 %	2.3 %	14 %	3.3 %	2.3 %	ASTM D 638-14
Tensile Modulus	0.75 GPa	2.8 GPa	2.8 GPa	109 ksi	399 ksi	406 ksi	ASTM D 638-14
Flexural Properties							
Flexural Strength at Break	24.1 MPa	94.5 MPa	2.8 MPa	3495 psi	13706 psi	14097 ksi	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	32.8 J/m	18.2 J/m	16.9 J/m	0.61 ft-lbf/in	0.34 ft-lbf/in	0.32 ft-lbf/in	ASTM D256-10
Temperature Properties							
Coefficient of Thermal Expansion (0-150 °C)	118.1 µm/m/°C	79.6 µm/m/°C	74.5 µm/m/°C	41.4 µin/in/°F	44.2 µin/in/°F	41.4 µin/in/°F	ASTM E 831-13
Heat Deflection Temp. @ 0.45 MPa	49 °C	120 °C	238 °C	120 °F	248 °F	460 °F	ASTM D 648-16
Heat Deflection Temp. @ 1.8 MPa	44 °C	78 °C	101 °C	111 °F	172 °F	214 °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, High Temp settings, washed and air dried without post cure.

[3] Data was obtained from parts printed using a Form 2, 100 µm, 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 weight gain (%)	24 hr size gain (%)	Solvent	24 hr weight gain (%)	24 hr size gain (%)
Acetic Acid, 5 %	< 1	< 1	Hydrogen peroxide (3%)	< 1	< 1
Acetone	< 1	< 1	Isooctane (aka gasoline)	< 1	< 1
Isopropyl Alcohol	< 1	< 1	Mineral oil (light)	< 1	< 1
Bleach ~5% NaOCl	< 1	< 1	Mineral oil (Heavy)	< 1	< 1
Butyl Acetate	< 1	< 1	Salt Water (3.5% NaCl)	< 1	< 1
Diesel Fuel	< 1	< 1	Sodium Hydroxide solution (0.025% PH 10)	< 1	< 1
Diethyl glycol Monomethyl Ether	< 1	< 1	Water	< 1	< 1
Hydraulic Oil	< 1	< 1	Xylene	< 1	< 1
Skydrol 5	< 1	< 1	Strong Acid (HCl conc)	1.2	< 1

MATERIAL DATA SHEET

Elastic 50A

Elastic 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.

- Wearables and consumer goods prototyping
- Medical models and devices
- Compliant features for robotics
- Special effects props and models

V1 **FLELCL01**

formlabs

Prepared 01 . 07 . 2019
Rev 01 01 . 07 . 2019

Material Properties Data

	METRIC[1]		IMPERIAL[1]		METHOD
	Green	Post-Cured[2]	Green	Post-Cured[2]	
Ultimate tensile strength [3]	1.61 MPa	3.23 MPa	234 psi	468 psi	ASTM D 412-06 (A)
Stress at 50% elongation	.92 MPa	.94 MPa	133 psi	136 psi	ASTM D 412-06 (A)
Stress at 100% elongation	1.54 MPa	1.59 MPa	223 psi	231 psi	ASTM D 412-06 (A)
Elongation at Failure [3]	100%	160%	100%	160%	ASTM D 412-06 (A)
Compression set at 23C for 22 hrs	2%	2%	2%	2%	ASTM D 395-03 (B)
Compression set at 70C for 22 hrs	3%	9%	3%	9%	ASTM D 395-03 (B)
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

[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 postcured with Form Cure at 60C 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:

Mechanical Properties	24 hr size gain (%)	24 hr weight gain (%)	Mechanical Properties	24 hr size gain (%)	24 hr weight gain (%)
Acetic Acid, 5 %	<1	2.8	Hydrogen Peroxide (3 %)	<1	2.2
Acetone	19.3	37.3	Isooctane	<1	3.5
Isopropyl Alcohol	13.3	25.6	Mineral Oil, light	<1	<1
Bleach, ~5 % NaOCl	<1	2	Mineral Oil, heavy	<1	<1
Butyl Acetate	18.2	39.6	Salt Water (3.5 % NaCl)	<1	1.7
Diesel	1.2	4.2	Sodium hydroxide (0.025 %, pH = 10)	<1	2
Diethyl glycol monomethyl ether	12	28.6	Water	<1	2.3
Hydrolic Oil	<1	2.1	Xylene	20.4	46.6
Skydrol 5	9.9	21.7	Strong Acid (HCl Conc)	14.2	39.4

MATERIALS LIBRARY

Medical

High-Performance Materials for Biocompatible Applications

Our new 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.

formlabs | medical

MEDICAL RESIN

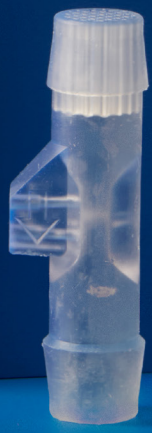
BioMed Clear

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.

Consider BioMed Clear Resin for:

- Medical devices and device components
- Parts containing breathing gas pathways
- Respirator and ventilator components
- Drug delivery devices
- Surgical planning and implant sizing tools
- Bioprocessing equipment
- Research and development
- Jigs and fixtures
- Masks



V1 **FLBMCL01**

formlabs | medical

Prepared 06 . 12 . 2020
Rev 02 09 . 16 . 2020

BIOMED CLEAR MATERIAL PROPERTIES DATA

	METRIC	IMPERIAL	METHOD
	Post-Cured[1,2]	Post-Cured[1,2]	
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	78 D	78 D	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

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

For more details on sterilization compatibilities, visit **formlabs.com.**

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

ISO Standard	Test Description[3]
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 Standard	Test Description[3]
ISO 10993-11:2017	Not mutagenic
ISO 18562-2:2017	Does not emit particulates
ISO 18562-3:2017	Does not emit VOCs
ISO 18562-4:2017	Does not emit hazardous water-soluble substances

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.

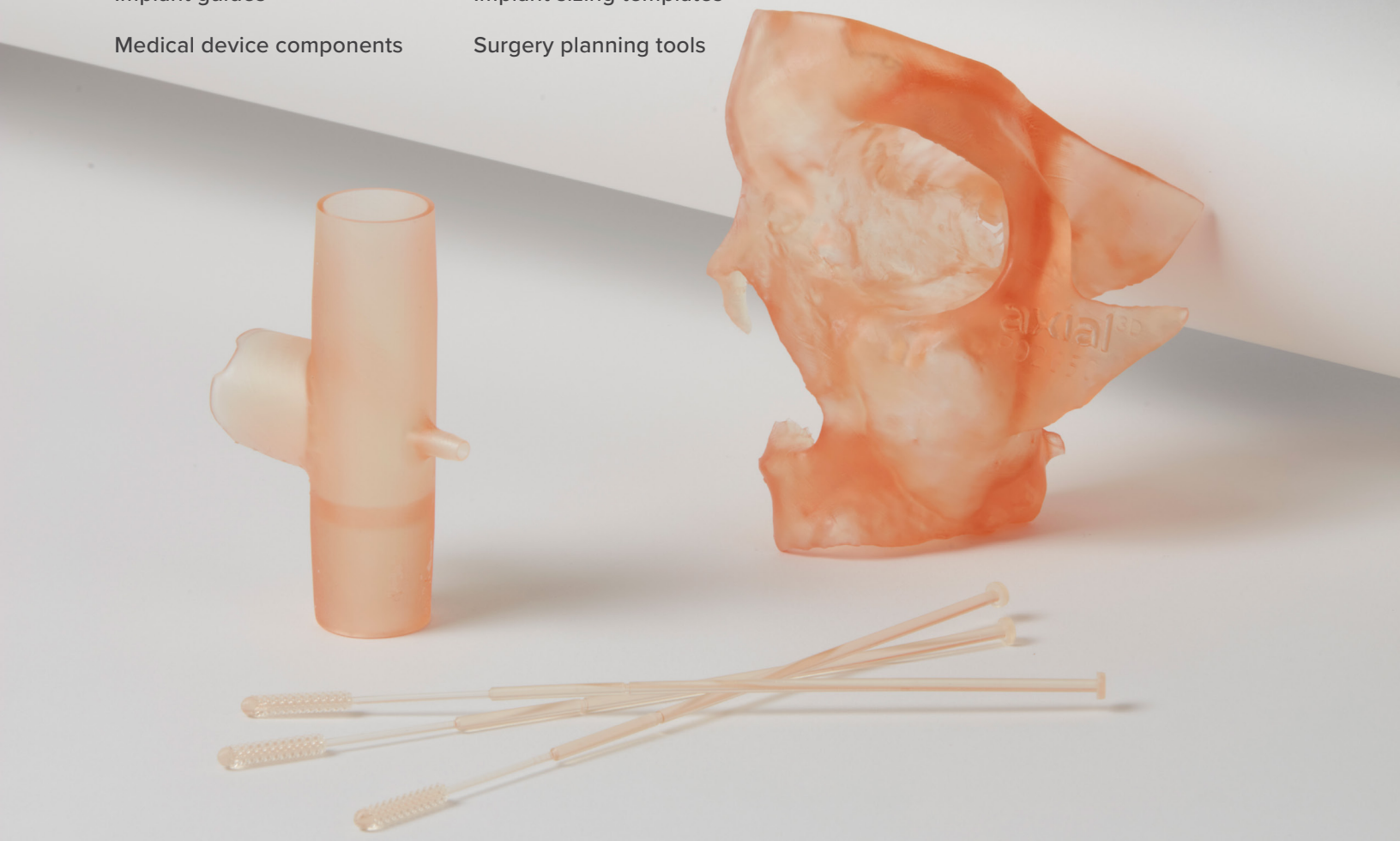
MATERIAL DATA SHEET

BioMed Amber

BioMed Amber Resin for Short-Term Bodily Contact

BioMed Amber Resin is designed for the manufacture of biocompatible 3D printed parts with high dimensional accuracy, stiffness, and strength. This material is developed specifically for Formlabs printers, rigorously tested, and manufactured in a clean room at our own ISO 13485 certified facility for consistent cross-batch quality. The parts printed with BioMed Amber Resin are compatible with common solvent disinfection and sterilization methods.

- Drilling templates
- Implant guides
- Medical device components
- Fixation trays
- Implant sizing templates
- Surgery planning tools



V1 **FLBMAM01**

formlabs | medical

Prepared 11 . 04 . 2019
Rev 01 11 . 04 . 2019

Material Properties Data

	METRIC	IMPERIAL	METHOD
	Post-Cured [1,2]	Post-Cured [1,2]	
Tensile Properties			
Ultimate Tensile Strength	73 MPa	11 ksi	ASTM D638-10 (Type IV)
Young's Modulus	2.9 GPa	420 ksi	ASTM D638-10 (Type IV)
Elongation	12.3%	12.3%	ASTM D638-10 (Type IV)
Flexural Properties			
Flexural Strength	103 MPa	15 ksi	ASTM D790-15 (Method B)
Flexural Modulus	2.5 GPa	363 ksi	ASTM D790-15 (Method B
Hardness Properties			
Hardness Shore D	67 D	67 D	ASTM D2240-15 (Type D)

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

Sterilization Compatibility	
Steam Sterilization	Autoclave at 134 °C for 20 minutes Autoclave at 121 °C for 30 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]
EN ISO 10993-5:2009	Not Cytotoxic
ISO 10993-10:2010/(R)2014	Non Irritation
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

NOTES:

[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 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.

MATERIALS LIBRARY

Jewelry

High-Detail Materials for Jewelry Design and Manufacturing

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. The Formlabs workflow supports jewelers from design to client try-on to casting, ideal for rapidly expanding custom services and production as your business grows.

MATERIALS LIBRARY

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**

formlabs

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

Material Properties Data for Castable Wax FLCWPU - Green[1]

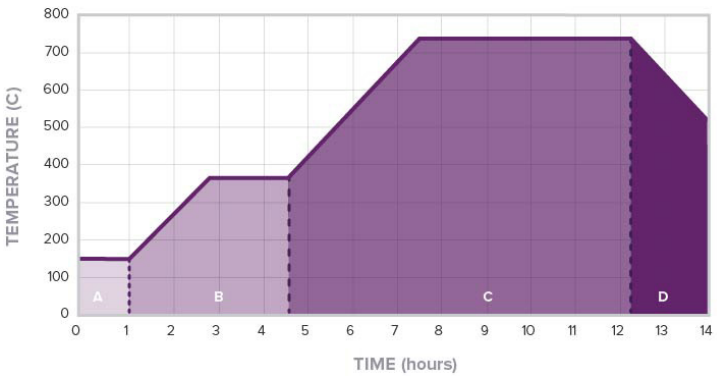
	METRIC[1]	IMPERIAL[1]	METHOD
Tensile Properties [2]			
Ultimate Tensile Strength	11.6 MPa	1680 psi	ASTM D 638-10
Tensile Modulus	220 MPa	32 ksi	ASTM D 638-10
Elongation at Break	13 %	13 %	ASTM D 638-10
Burnout Properties [2]			
Temp @ 5% Mass Loss	249 °C	480 °F	ASTM E 1131
Ash content (TGA)	0.0-0.1%	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 R&R Plasticast or similar investment materials. Use this schedule as a starting point and make adjustments as needed.



Post-Curing Info:

No post-cure required.

	PHASE	TIME	SCHEDULE °C	SCHEDULE °F
A	Insert Flasks	0 min	150 °C	302 °F
	Hold	60 min	150 °C	302 °F
B	Ramp	100 min	2.2 °C / min	4 °F / min
	Hold	120 min	371 °C	700 °F
C	Ramp	180 min	2.0 °C / min	3.6 °F / min
	Hold	280 min	732 °C	1350 °F
D	Ramp	100 min	- 2.2 °C / min	- 4 °F / min
	Hold (casting window)	Up to 2 hours	512 °C or casting temp	954 °F or casting temp

MATERIALS LIBRARY

Castable

Original Formulation for Direct Investment Casting

This pure polymer requires an alternate burnout to a typical wax schedule.
Post-curing recommended.

V2 **FLCABL02**

formlabs

Prepared 06 . 01 . 2016
Rev 01 03 . 02 . 2018

Castable Material Properties Data

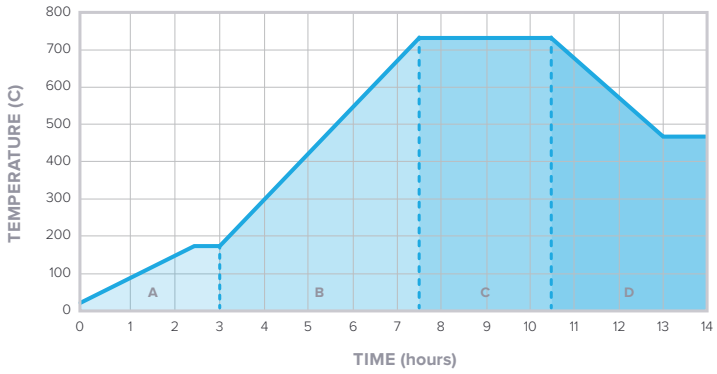
	METRIC[1]	IMPERIAL[1]	METHOD
Mechanical Properties [2]			
Tensile Strength at Break	11.6 MPa	1680 psi	ASTM D 638-10
Tensile Modulus	220 MPa	32 ksi	ASTM D 638-10
Elongation at Failure	13 %	13 %	ASTM D 638-10

[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 post-cured with 2.5 mW/cm^2 of fluorescent bulb UV light, centered at 405 mm.

Recommended Burnout Curve

We specifically recommend Plasticast with BANDUST. If seeking alternatives, look for investments advertised to work with photopolymers. Customers have reported success with Kerr SatinCast and Omega+ by Goldstar Powders. You can also experiment with bonded investments, like those typically used for dental applications. Some casting houses have also developed proprietary investments.



Post-Curing Info:

Formlabs recommends post-curing Castable Resin parts for 280 minutes at 45 °C.

	PHASE	TIME	SCHEDULE °C	SCHEDULE °F
A	Insert Flasks	0 min	Room temp	Room temp
	Ramp	150 min	1.0 °C / min	1.9 °F / min
	Hold	30 min	177 °C	350 °F
B	Ramp	270 min	2.1 °C / min	3.7 °F / min
C	Hold	180 min	732 °C	1350 °F
D	Ramp	150 min	- 1.7 °C / min	- 3.0 °F / min
	Hold (casting window)	Up to 2 hours	482 °C or desired casting temp	900 °F or desired casting temp

MATERIAL DATA SHEET

Ceramic

An Experimental Material for Engineering, Art, and Design

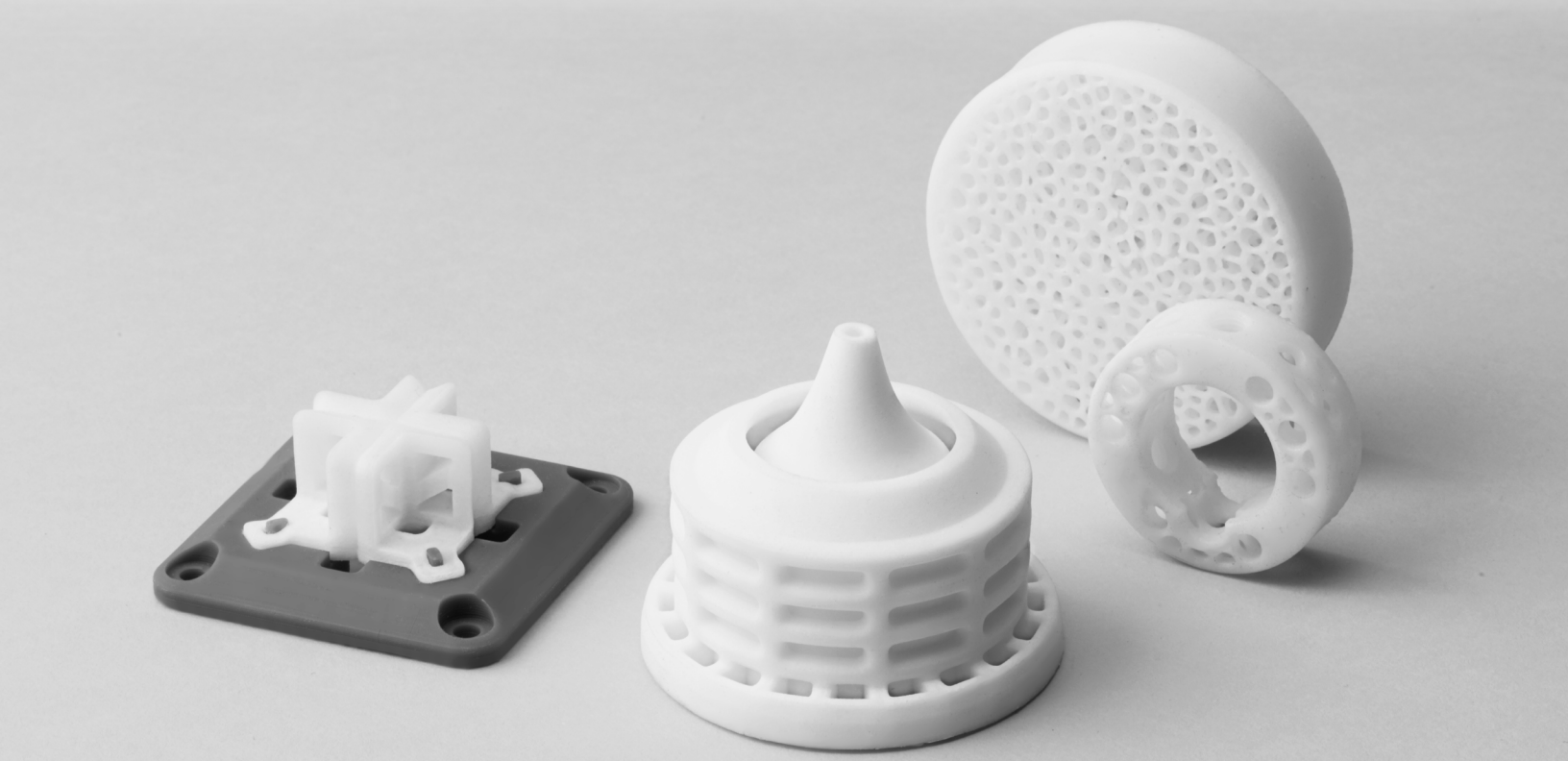
Parts 3D printed in silica-filled Ceramic Resin can be fired to create a fully ceramic piece. This experimental Form X material requires more trial and error than other Formlabs products. Please read the usage guide prior to printing.

Technical experimentation

Research and development

Fine art and sculpture

Jewelry



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

formlabs

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

Material Properties Data

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

FIRED[3]	METRIC[2]	IMPERIAL[2]	METHOD
Tensile Properties			
Tensile Modulus	5.1 GPa	740 ksi	ASTM D638-14
Flexural Properties			
Flexural Stress at Break	10.3 MPa	1489 psi	ASTM D790-15e2
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	75 °C	155 °F	ASTM D648-16, Method B
Heat Deflection Temp. @ 0.45 MPa	> 290 °C	> 554 °F	ASTM D648-16, Method B

[1] 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.

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

[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.

MATERIAL DATA SHEET

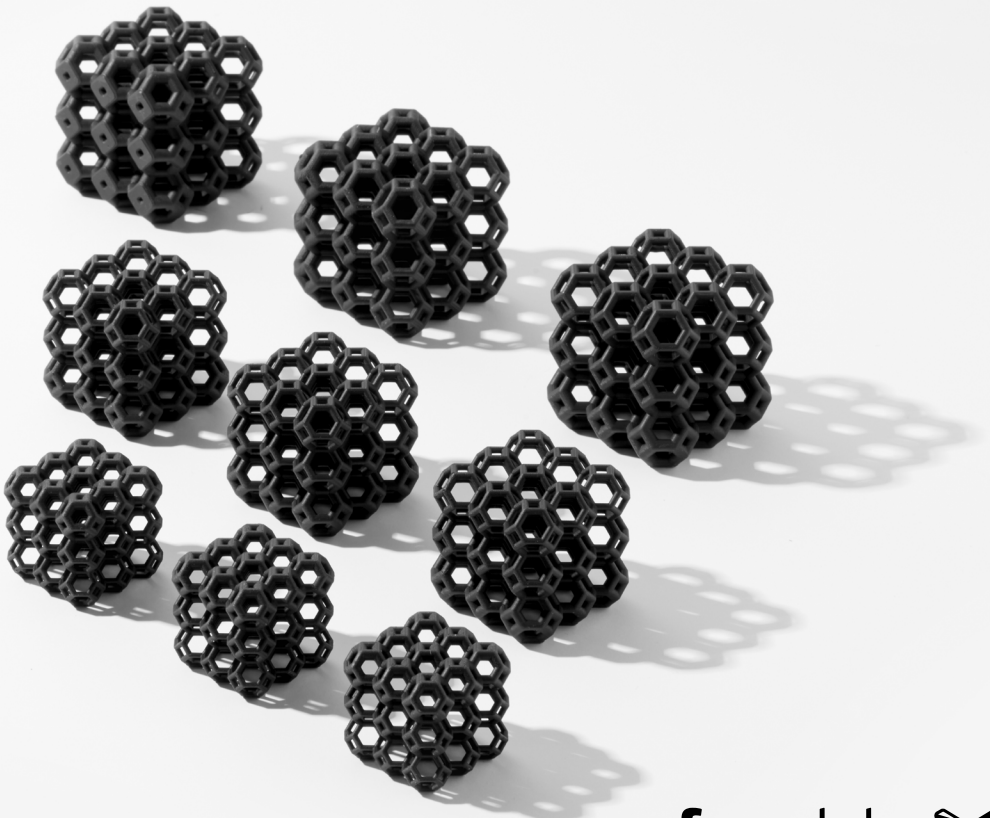
Rebound

Rebound Resin: Production-Ready Elastic 3D Printing Material

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
- Compliant robotics
- Handles, grips, and overmolds
- Gaskets, seals, and grommets
- Custom cases
- 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. **consulting@formlabs.com**



V1 **FLRBBL01**

formlabs

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

Material Properties Data Metric

	METRIC[1]	IMPERIAL[1]	METHOD
	Post-Cured	Post-Cured	
Mechanical 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 %		ASTM D 412-06 (A)
Compression set at 25 °C for 22 hrs	16 %		ASTM D 395-03 (B)
Compression set at 70 °C for 22 hrs	40 %		ASTM D 395-03 (B)
Tear Strength	110 kN/m	0.628 lbf/in	ASTM D 624-00
Hardness, Shore A	86 A		ASTM D 2633
Bayshore Rebound Resilience	57 %		ASTM D 2633
Abrasion	101 mm^3		ISO 4649, 40 rpm, 10 N load
Ross Flexing Fatigue	> 50,000 cycles (no crack propagation)		ASTM D1052, (notched), 23 °C, 60 degree bending, 100 cycles/minute
Ross Flexing Fatigue	> 50,000 cycles (no crack propagation)		ASTM D1052, (notched) -10 °C, 60 degree bending, 100 cycles/minute
Dielectric Properties			
Dielectric Constant	7.7		ASTM D150, 1MHz
Dissipation Factor	0.069		ASTM D150, 1MHz
Temperature 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
Hexane	1	Castor Oil	< 1
Butyl Acetate	26	Hydraulic Oil	< 1

Form Wash + Form Cure

Stronger Parts, Less Effort

AUTOMATE CLEANING WITH FORM WASH

Form Wash automatically cleans uncured liquid resin from 3D printed parts' surfaces, getting every nook and cranny perfectly clean.

POST-CURING SIMPLIFIED WITH FORM CURE

Form Cure precisely controls temperature and light to bring parts to their maximum mechanical properties.