

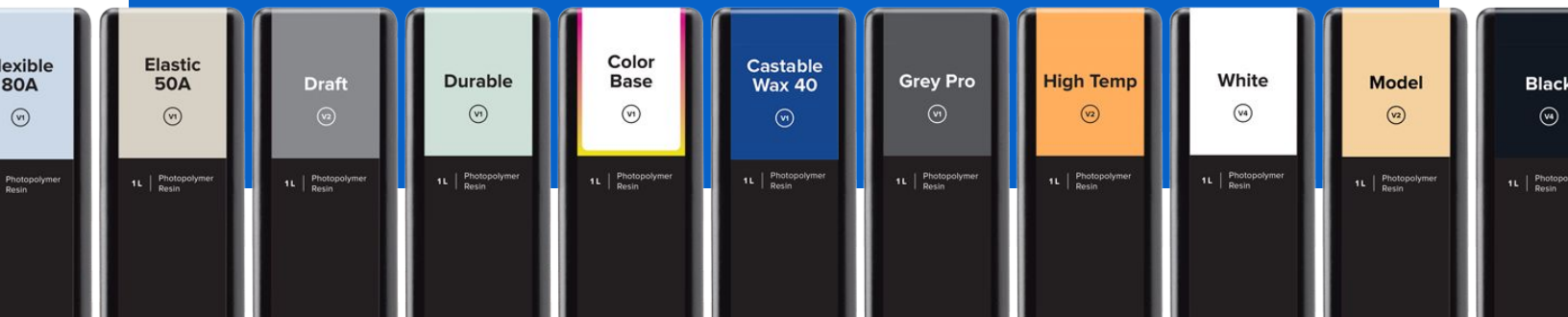


# Materials Library

Functional materials that look the part

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Prepared Q1 . 2021



# SLA Resin Material List

RESIN	MICRON LAYER HEIGHT			FEATURES
<b>STANDARD</b>				
Clear	100 µm	50 µm	25 µm	· High translucency and transparency
White	100 µm	50 µm		· Fine detail, matte white finish
Grey	160 µm	100 µm	50 µm 25 µm	· Fine detail, matte grey finish
Black	100 µm	50 µm	25 µm	· Fine detail, matte black finish
Color Kit	100 µm	50 µm	25 µm	· Full range of custom colors
Draft	200 µm	100 µm		· Print up to 4 times faster
<b>ENGINEERING</b>				
Rigid 10K	100 µm	50 µm		· Rigid, strong, industrial-grade parts
Rigid 4000	100 µm	50 µm		· Stiff, strong, engineering-grade parts
Grey Pro	100 µm	50 µm		· Versatile prototyping material
Tough 2000	100 µm	50 µm		· Stiff, sturdy, rugged prototyping
Tough 1500	100 µm	50 µm		· Stiff, pliable, resilient prototyping
Durable	100 µm	50 µm		· Soft, pliable prototyping material
Flexible 80A	100 µm	50 µm		· Hard flexible parts with slow return
Elastic 50A	100 µm			· Soft flexible parts that spring back
<b>SPECIALITY</b>				
High Temp	100 µm	50 µm	25 µm	· High thermal stability
Ceramic	100 µm	50 µm		· Experimental ceramic material
Rebound	200 µm			· Highly resilient end-use TPU material
<b>MEDICAL</b>				
BioMed Clear	100 µm			· For long-term bodily contact
BioMed Amber	100 µm	50 µm		· For short-term bodily contact

## SLA Resin Material List

RESIN	MICRON LAYER HEIGHT				FEATURES
<b>DENTAL</b>					
<b>Model</b>	140 µm (Form 2)	100 µm	50 µm	25 µm	· Model making and aligner production
<b>Draft</b>	200 µm	100 µm			· Print up to 4 times faster
<b>Castable Wax</b>	50 µm	25 µm			· Reliable casting with clean burnout
<b>Surgical Guide</b>	100 µm	50 µm			· Premium-quality implant guides
<b>IBT</b>	100 µm				· Biocompatible Photopolymer Resin for Indirect Bonding Trays
<b>Dental LT Clear v2</b>	100 µm				· Long-term splints and occlusal guards
<b>Dental LT Clear v1</b>	100 µm				· Long-term splints and occlusal guards
<b>Custom Tray</b>	200 µm				· Fast printing custom impression trays
<b>Temporary CB</b>	50 µm				· Strong, precise temporary restorations
<b>Permanent Crown</b>	50 µm				· Strong, precise permanent restorations
<b>Denture Base + Teeth</b>	50 µm				· Direct printed dental prosthetics
<b>Soft Tissue (Dental Pack)</b>	100 µm	50 µm			· Flexible 80A + Color Pigments kit
<b>JEWELRY</b>					
<b>Castable Wax 40</b>	50 µm	25 µm			· Crisp settings, sharp prongs, smooth shanks, fine surface detail
<b>Castable Wax</b>	50 µm	25 µm			· Reliable casting with clean burnout

## SLS Material List

POWDER	MICRON LAYER HEIGHT	FEATURES & APPLICATIONS
<b>STANDARD</b>		
<b>Nylon 12</b>	110 µm	· Strong, durable, production-ready parts

PRINT TECHNOLOGY

# SLA Stereolithography



PRINTING

PUMP HOUSING

4 h 28 min  
◆ Layer 459 / 682

A control panel interface for a 3D printer. It features a large circular progress indicator with a blue arc and a white pause button in the center. To the left of the progress indicator are several small icons: a home icon, a list icon, a square icon, and a wrench icon. The text 'PRINTING' is displayed at the top right, and 'PUMP HOUSING' is displayed above the progress indicator. Below the progress indicator, the text '4 h 28 min' and '◆ Layer 459 / 682' is shown, indicating the current print time and layer progress.

# Standard Resins

## Materials for High-Resolution 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 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.

\* May not be available in all regions



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V4 CLEAR  
FLGPCL04

V4 WHITE  
FLGPWH04

V4 GREY  
FLGPGR04

V4 BLACK  
FLGPBL04

V4 COLOR  
FLGPCB01

Prepared 04 . 09 . 2016  
Rev 04 . 18 . 2017

To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# Standard Resins

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

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green <sup>2</sup>	Post-Cured <sup>3</sup>	Green <sup>2</sup>	Post-Cured <sup>3</sup>	
<b>Tensile Properties</b>					
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
<b>Flexural Properties</b>					
Flexural Modulus	1.3 GPa	2.2 GPa	181 psi	320 psi	ASTM D 790-15
<b>Impact Properties</b>					
Notched IZOD	16 J/m	25 J/m	0.3 ft-lbf/in	0.46 ft-lbf/in	ASTM D256-10
<b>Temperature Properties</b>					
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

<sup>1</sup> Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup> Data was obtained from green parts, printed using Form 2, 100 µm, Clear settings, without additional treatments.

<sup>3</sup> Data was obtained from parts printed using Form 2, 100 µm, Clear settings and post-cured with 1.25 mW/cm<sup>2</sup> 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%	< 1.0	Mineral oil (Heavy)	< 1.0
Acetone	Sample cracked	Mineral oil (light)	< 1.0
Bleach ~5% NaOCl	< 1.0	Salt Water (3.5% NaCl)	< 1.0
Butyl Acetate	< 1.0	Skydrol 5	1
Diesel Fuel	< 1.0	Sodium Hydroxide solution (0.025% PH 10)	< 1.0
Diethyl glycol Monomethyl Ether	1.7	Strong Acid (HCl conc)	Distorted
Hydraulic Oil	< 1.0	Water	< 1.0
Hydrogen peroxide (3%)	< 1.0	Xylene	< 1.0
Isooctane (aka gasoline)	< 1.0		
Isopropyl Alcohol	< 1.0		

## 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 our rapid prototyping and product development.

## SMOOTH SURFACE FINISH

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



### CLEAR

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

### WHITE

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

### GREY

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

### BLACK

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

Live 3D printing demos

Rapid design iterations

High throughput applications



V2

FLDRGR02

\* May not be available in all regions

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# MATERIAL PROPERTIES DATA

# Draft V2 Resin

	METRIC <sup>1</sup>			IMPERIAL <sup>1</sup>			METHOD
	Green <sup>2</sup>	Post-Cured at Room Temperature <sup>3</sup>	Post-Cured at 60 °C <sup>4</sup>	Green <sup>2</sup>	Post-Cured at Room Temperature <sup>3</sup>	Post-Cured at 60 °C <sup>4</sup>	
<b>Tensile Properties</b>							
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
<b>Flexural Properties</b>							
Flexural Modulus	0.6 GPa	1.8 GPa	2.3 GPa	87 ksi	261 ksi	334 ksi	ASTM D790-17
<b>Impact Properties</b>							
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
<b>Temperature Properties</b>							
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

<sup>1</sup>Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup>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.

<sup>3</sup>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.

<sup>4</sup>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)	< 0.1
Acetone	4.2	Mineral oil (Heavy)	< 0.1
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	< 0.1
Isooctane (aka gasoline)	< 0.1	Xylene	< 0.1
Isopropyl Alcohol	< 0.1		

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.

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



Rigid 10K  
Rigid 4000  
Grey Pro  
Tough 2000  
Tough 1500

Durable  
Flexible 80A  
Elastic 50A

formlabs 

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 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**

**Aerodynamic test models**

**Simulates stiffness of glass and fiber-filled thermoplastics**



V1

**FLRG1001**

\* May not be available in all regions

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# MATERIAL PROPERTIES DATA

# Rigid 10K Resin

	METRIC			IMPERIAL			METHOD
	Green	UV Post-cured <sup>1</sup>	UV + Thermal <sup>2</sup>	Green	UV Post-cured <sup>1</sup>	UV + Thermal <sup>2</sup>	
<b>Tensile Properties</b>							
Ultimate Tensile Strength	55 MPa	65 MPa	53 MPa	7980 psi	9460 psi	7710 psi	ASTM D638-14
Tensile Modulus	7.5 GPa	10 GPa	10 GPa	1090 ksi	1480 ksi	1460 ksi	ASTM D638-14
Elongation at Break	2%	1%	1%	2%	1%	1%	ASTM D638-14
Flexural Strength	84 MPa	126 MPa	103 MPa	12200	18200	15000	ASTM D 790-15
<b>Flexural Properties</b>							
Flexural Modulus	6 GPa	9 GPa	10 GPa	905	1360	1500	ASTM D 790-15
<b>Impact Properties</b>							
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
<b>Temperature Properties</b>							
Heat Deflection Temp. @ 1.8 MPa	56 °C	82 °C	110 °C	133 °F	180 °F	230 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	65 °C	163 °C	218 °C	149 °F	325 °F	424 °F	ASTM D 648-16
Thermal Expansion, 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

Material properties can vary with part geometry, print orientation, print settings, and temperature. All testing was done on Form 3.

<sup>1</sup>Data was obtained from parts printed using Form 3, 100 µm and post-cured with a Formcure for 60 minutes at 70 °C.

<sup>2</sup>Data was obtained from parts printed using Form 3, 100 µm and post-cured with a Formcure for 60 minutes at 60 °C and an additional thermal cure at 90 °C for 125 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	Mineral oil (Light)	0.2
Acetone	< 0.1	Mineral oil (Heavy)	< 0.1
Bleach ~5% NaOCl	0.1	Salt Water (3.5% NaCl)	0.1
Butyl Acetate	0.1	Skydrol 5	0.6
Diesel Fuel	0.1	Sodium Hydroxide solution (0.025% PH 10)	0.1
Diethyl glycol Monomethyl Ether	0.4	Strong Acid (HCl conc)	0.2
Hydraulic Oil	0.2	Tripropylene glycol monomethyl ether	0.4
Hydrogen peroxide (3%)	< 0.1	Water	< 0.1
Isooctane (aka gasoline)	0.0	Xylene	< 0.1
Isopropyl Alcohol	< 0.1		

## 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**



**FLRGWH01**

\* May not be available in all regions

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# MATERIAL PROPERTIES DATA

# Rigid 4000 Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green <sup>2</sup>	Post-Cured <sup>3</sup>	Green <sup>2</sup>	Post-Cured <sup>3</sup>	
<b>Tensile Properties</b>					
Ultimate Tensile Strength	33 MPa	69 MPa	4786 psi	10007 psi	ASTM D638-14
Tensile Modulus	2.1 GPa	4.1 GPa	234 ksi	402 ksi	ASTM D638-14
Elongation at Break	23%	5.3%	23%	5.3%	ASTM D638-14
Flexural Stress at 5% Strain	43 MPa	105 MPa	6236 psi	15229 psi	ASTM D 790-15
<b>Flexural Properties</b>					
Flexural Modulus	1.4 GPa	3.4 GPa	203 ksi	493 ksi	ASTM D 790-15
<b>Impact Properties</b>					
Notched IZOD	16 J/m	23 J/m	0.3 ft-lbf/in	0.43 ft-lbf/in	ASTM D256-10
<b>Temperature Properties</b>					
Heat Deflection Temp. @ 1.8 MPa	41 °C	60 °C	105 °F	140 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	50 °C	73 °C	121 °F	134 °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

<sup>1</sup>Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup>Data was obtained from green parts, printed using Form 3, 100 µm, Rigid settings, without additional treatments.

<sup>3</sup>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	Mineral oil (Light)	0.2
Acetone	3.3	Mineral oil (Heavy)	0.2
Bleach ~5% NaOCl	0.7	Salt Water (3.5% NaCl)	0.7
Butyl Acetate	0.1	Skydrol 5	1.1
Diesel Fuel	< 0.1	Sodium Hydroxide solution (0.025% PH 10)	0.7
Diethyl glycol Monomethyl Ether	1.4	Strong Acid (HCl conc)	5.3
Hydraulic Oil	0.2	Tripropylene glycol monomethyl ether	0.9
Hydrogen peroxide (3%)	0.9	Water	0.7
Isooctane (aka gasoline)	< 0.1	Xylene	0.1
Isopropyl Alcohol	0.4		

ENGINEERING RESIN

# Grey Pro

## Grey Pro Resin for Versatile Prototyping

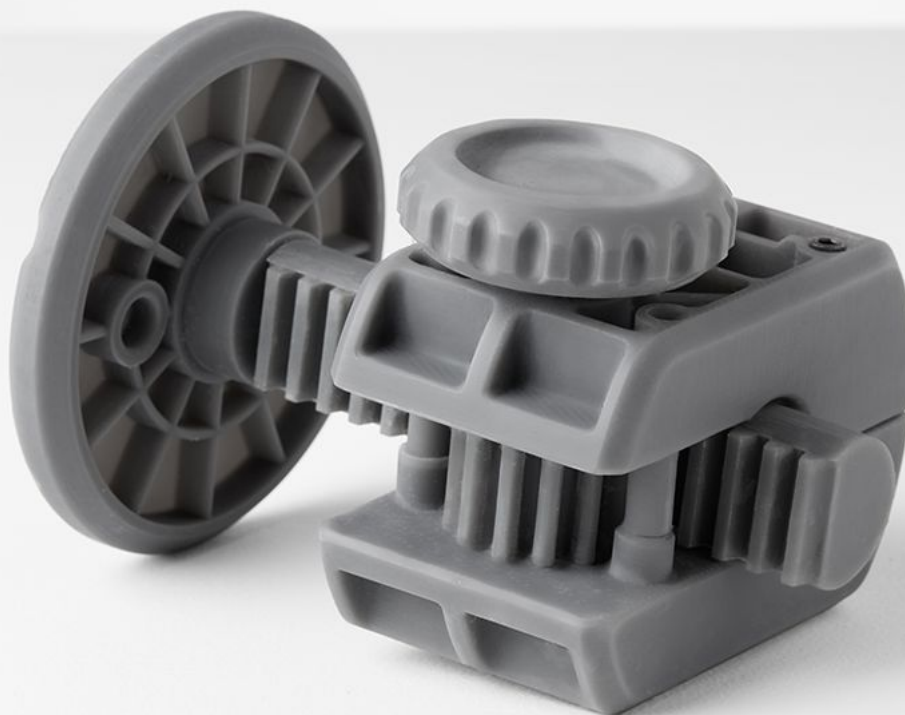
Grey Pro Resin offers high precision, moderate elongation, and low creep. This material is great for concept modeling and functional prototyping, especially for parts that will be handled repeatedly.

**Form and fit testing**

**High quality product prototypes**

**Mold masters for plastics and silicones**

**Jigs and fixtures for manufacturing**



**FLPRGR01**

\* May not be available in all regions

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# MATERIAL PROPERTIES DATA

# Grey Pro Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green <sup>2</sup>	Post-Cured <sup>3</sup>	Green <sup>2</sup>	Post-Cured <sup>3</sup>	
<b>Tensile Properties</b>					
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 Stress at 5% Strain	39 MPa	86 MPa	5598 psi	12400 psi	ASTM D 790-15
<b>Flexural Properties</b>					
Flexural Modulus	0.94 GPa	2.2 GPa	136 ksi	319 ksi	ASTM D 790-15
<b>Impact Properties</b>					
Notched IZOD	not tested	19 J/m	not tested	0.35 ft-lbf/in	ASTM D256-10
<b>Temperature Properties</b>					
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

<sup>1</sup>Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup>Data was obtained from green parts, printed using Form 2, 100 µm, Grey Pro settings, without additional treatments.

<sup>3</sup>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	Mineral oil (Light)	0.4
Acetone	10.8	Mineral oil (Heavy)	0.3
Bleach ~5% NaOCl	0.7	Salt Water (3.5% NaCl)	0.6
Butyl Acetate	0.8	Skydrol 5	0.5
Diesel Fuel	< 0.1	Sodium Hydroxide solution (0.025% PH 10)	0.7
Diethyl glycol Monomethyl Ether	2.4	Strong Acid (HCl conc)	8.2
Hydraulic Oil	0.2	Tripropylene glycol monomethyl ether	1.5
Hydrogen peroxide (3%)	0.8	Water	0.8
Isooctane (aka gasoline)	< 0.1	Xylene	0.4
Isopropyl Alcohol	1.6		



ENGINEERING RESIN

# 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**



**FLTO2001**

\* May not be available in all regions

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# MATERIAL PROPERTIES DATA

# Tough 2000 Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green <sup>2</sup>	Post-Cured <sup>3</sup>	Green <sup>2</sup>	Post-Cured <sup>3</sup>	
<b>Tensile Properties</b>					
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 Strength	17 MPa	65 MPa	2465 psi	9427 psi	ASTM D 790-15
<b>Flexural Properties</b>					
Flexural Modulus	0.45 GPa	1.9 GPa	65 ksi	275 ksi	ASTM D 790-15
<b>Impact Properties</b>					
Notched IZOD	79 J/m	40 J/m	1.5 ft-lbf/in	0.75 ft-lbf/in	ASTM D256-10
<b>Temperature Properties</b>					
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

<sup>1</sup> Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup> Data was obtained from green parts, printed using Form 2, 100 µm, Tough 2000 settings, without additional treatments.

<sup>3</sup> 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	Mineral oil (Light)	0.2
Acetone	18.8	Mineral oil (Heavy)	0.1
Bleach ~5% NaOCl	0.6	Salt Water (3.5% NaCl)	0.6
Butyl Acetate	6.2	Skydrol 5	0.9
Diesel Fuel	< 0.1	Sodium Hydroxide solution (0.025% PH 10)	0.6
Diethyl glycol Monomethyl Ether	5.3	Strong Acid (HCl conc)	3.0
Hydraulic Oil	< 0.1	Tripropylene glycol monomethyl ether	1.0
Hydrogen peroxide (3%)	0.6	Water	0.6
Isooctane (aka gasoline)	< 0.1	Xylene	4.1
Isopropyl Alcohol	3.7		

ENGINEERING RESIN

# 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**



**FLTO1501**

\* May not be available in all regions

**formlabs** 

**Prepared** 10 . 07 . 2020  
**Rev** 01 - 10 . 07 . 2020

To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# Tough 1500 Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green <sup>2</sup>	Post-Cured <sup>3</sup>	Green <sup>2</sup>	Post-Cured <sup>3</sup>	
<b>Tensile Properties</b>					
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 Strength	15 MPa	39 MPa	2175 psi	5656 psi	ASTM D 790-15
<b>Flexural Properties</b>					
Flexural Modulus	0.44 GPa	1.4 GPa	58 ksi	203 ksi	ASTM D 790-15
<b>Impact Properties</b>					
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
<b>Temperature Properties</b>					
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

<sup>1</sup> Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup> Data was obtained from green parts, printed using Form 2, 100 µm, Tough 1500 settings, without additional treatments.

<sup>3</sup> 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.

## 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 (Light)	< 0.1
Acetone	19.1	Mineral oil (Heavy)	0.1
Bleach ~5% NaOCl	0.6	Salt Water (3.5% NaCl)	0.7
Butyl Acetate	5.1	Skydrol 5	0.5
Diesel Fuel	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		

# 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**



**FLDUCL02**

\* May not be available in all regions



**Prepared** 10 . 07 . 2020  
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# MATERIAL PROPERTIES DATA

# Durable Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green <sup>2</sup>	Post-Cured <sup>3</sup>	Green <sup>2</sup>	Post-Cured <sup>3</sup>	
<b>Tensile Properties</b>					
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 Strength	1.0 MPa	24 MPa	149 psi	3420 psi	ASTM D 790-15
<b>Flexural Properties</b>					
Flexural Modulus	0.04 GPa	0.66 GPa	5.58 ksi	94.1 ksi	ASTM D 790-15
<b>Impact Properties</b>					
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
<b>Temperature Properties</b>					
Heat Deflection Temp. @ 1.8 MPa	-	-	-	-	ASTM D 648-16
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

<sup>1</sup> Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup> Data was obtained from green parts, printed using Form 2, 100 µm, Durable settings, without additional treatments.

<sup>3</sup> 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	Mineral oil (Light)	< 1.0
Acetone	Sample cracked	Mineral oil (Heavy)	< 1.0
Bleach ~5% NaOCl	< 1.0	Salt Water (3.5% NaCl)	< 1.0
Butyl Acetate	7.9	Skydrol 5	1.3
Diesel Fuel	< 1.0	Sodium Hydroxide solution (0.025% PH 10)	< 1.0
Diethyl glycol Monomethyl Ether	7.8	Strong Acid (HCl conc)	Distorted
Hydraulic Oil	< 1.0	Tripropylene glycol monomethyl ether	1.2
Hydrogen peroxide (3%)	1.0	Water	< 1.0
Isooctane (aka gasoline)	< 1.0	Xylene	6.5
Isopropyl Alcohol	5.1		

ENGINEERING RESIN

# 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

Seals, gaskets, masks

Cartilage and ligament anatomy



V1

FLFL8001

\* May not be available in all regions

formlabs 

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# MATERIAL PROPERTIES DATA

# Flexible 80A Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green	Post-Cured <sup>2</sup>	Green	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>					
Ultimate Tensile Strength <sup>3</sup>	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	70 A	80 A	80 A	80 A	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 <sup>4</sup>	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
<b>Thermal Properties</b>					
Glass transition temperature (Tg)	Not Tested	27°C	Not Tested	27°C	DMA

<sup>1</sup> Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup> 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° for 10 minutes.

<sup>3</sup> Tensile testing was performed after 3+ hours at 23 °C, using a Die C specimen cut from sheets.

<sup>4</sup> 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		



# 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**



**FLELCL01**

\* May not be available in all regions

**formlabs** 

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To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# Elastic 50A Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green	Post-Cured <sup>2</sup>	Green	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>					
Ultimate Tensile Strength <sup>3</sup>	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 <sup>4</sup>	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)

<sup>1</sup> Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup> 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.

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

<sup>4</sup> 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 weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	2.8	Mineral oil (Light)	< 1.0
Acetone	37	Mineral oil (Heavy)	< 1.0
Bleach ~5% NaOCl	2.0	Salt Water (3.5% NaCl)	< 1.0
Butyl Acetate	40	Skydrol 5	1.1
Diesel Fuel	4.2	Sodium Hydroxide solution (0.025% PH 10)	< 1.0
Diethyl glycol Monomethyl Ether	29	Strong Acid (HCl conc)	< 1.0
Hydraulic Oil	2.1	Tripropylene glycol monomethyl ether	23
Hydrogen peroxide (3%)	2.2	Water	< 1.0
Isooctane (aka gasoline)	3.5	Xylene	< 1.0
Isopropyl Alcohol	26		

# Specialty

Our family of Specialty Resins features advanced materials with unique mechanical 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  
Ceramic  
Rebound

SPECIALTY RESIN

# 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

FLFLGR02

\* May not be available in all regions

formlabs 

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# MATERIAL PROPERTIES DATA

# High Temp Resin

	METRIC <sup>1</sup>			IMPERIAL <sup>1</sup>			METHOD
	Green <sup>2</sup>	Post-Cured <sup>3</sup>	Post-Cured + additional Thermal Cure <sup>4</sup>	Green <sup>2</sup>	Post-Cured <sup>3</sup>	Post-Cured + additional Thermal Cure <sup>4</sup>	
<b>Tensile Properties</b>							
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
<b>Flexural Properties</b>							
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
<b>Impact Properties</b>							
Notched IZOD	33 J/m	18 J/m	17 J/m	061 ft-lbf/in	0.34 ft-lbf/in	0.32 ft-lbf/in	ASTM D256-10
<b>Temperature Properties</b>							
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

<sup>1</sup>Material properties may vary with part geometry, print orientation and temperature.

<sup>2</sup>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.

<sup>3</sup>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.

<sup>4</sup>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	<1.0	Mineral oil (Light)	<1	<1.0
Acetone	<1	<1.0	Mineral oil (Heavy)	<1	<1.0
Bleach ~5% NaOCl	<1	<1.0	Salt Water (3.5% NaCl)	<1	<1.0
Butyl Acetate	<1	<1.0	Skydrol 5	<1	<1.0
Diesel Fuel	<1	<1.0	Sodium Hydroxide solution (0.025% PH 10)	<1	<1.0
Diethyl glycol Monomethyl Ether	<1	<1.0	Strong Acid (HCl conc)	1.2	1.2
Hydraulic Oil	<1	<1.0	Tripropylene glycol monomethyl ether	<1	<1.0
Hydrogen peroxide (3%)	<1	<1.0	Water	<1	<1.0
Isooctane (aka gasoline)	<1	<1.0	Xylene	<1	<1.0
Isopropyl Alcohol	<1	<1.0			

SPECIALTY RESIN

# 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**

**Fine art and sculpture**

**Research and development**

**Jewelry**



**FLCEWH01**

\* May not be available in all regions.

**formlabs** 

**Prepared** 05 . 03 . 2018  
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To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# Ceramic Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green <sup>2</sup>	Fired <sup>3</sup>	Green <sup>2</sup>	Fired <sup>3</sup>	
<b>Tensile Properties</b>					
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
<b>Flexural Properties</b>					
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
<b>Impact Properties</b>					
Notched Izod	18.4 J/m	N/A	0.35 ft-lb/in	N/A	ASTM D256-10e1
<b>Impact Properties</b>					
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

<sup>1</sup>Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup>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.

<sup>3</sup>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](#).

# 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**

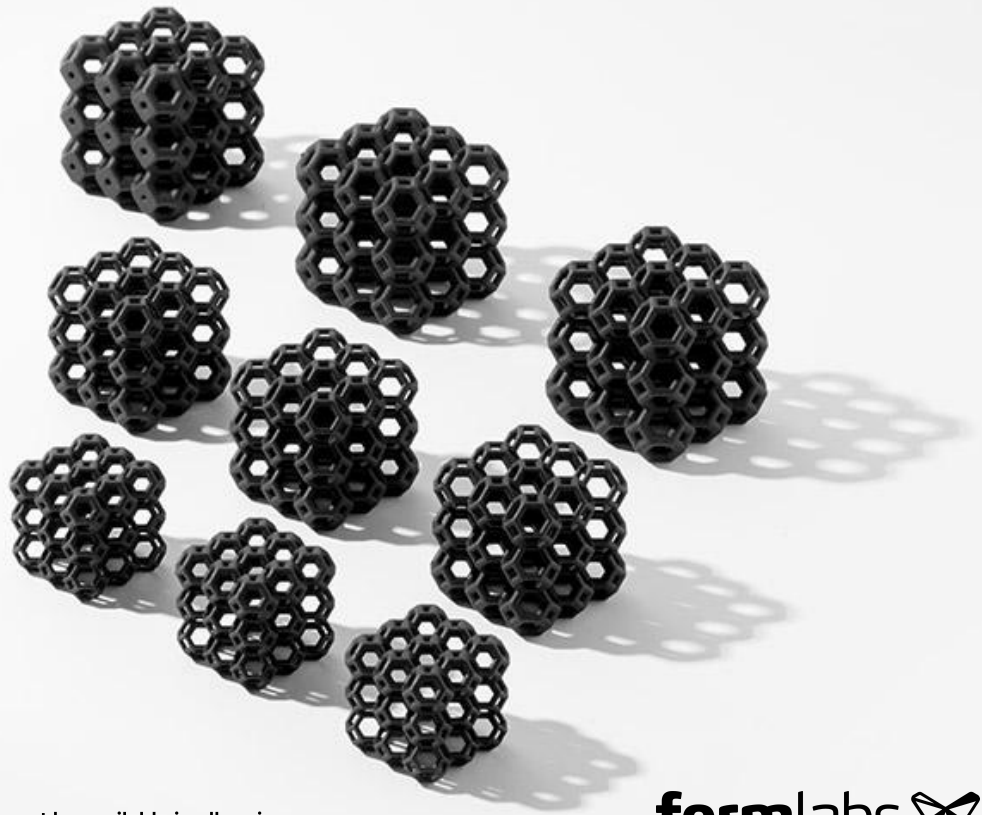
**Compliant robotics**

**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. [consulting@formlabs.com](mailto:consulting@formlabs.com)



**FLRBBL01**

\* May not be available in all regions.



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To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.



# MATERIAL PROPERTIES DATA

# Rebound Resin

	METRIC <sup>1</sup>	IMPERIAL <sup>1</sup>	METHOD
	Post-Cured	Post-Cured	
<b>Mechanical Properties</b>			
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	0.628 lbf/in	ASTM D 624-00
Hardness, Shore A	86 A	86 A	ASTM D 2633
Bayshore Rebound Resilience	57 %	57 %	ASTM D 2633
Abrasion	101 mm <sup>3</sup>	101 mm <sup>3</sup>	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
<b>Dielectric Properties</b>			
Dielectric Constant	7.7	7.7	ASTM D150, 1MHz
Dissipation Factor	0.069	0.069	ASTM D150, 1MHz
<b>Temperature Properties</b>			
Glass Transition Temperate	-50 °C	-58 °F	DSC

<sup>1</sup>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

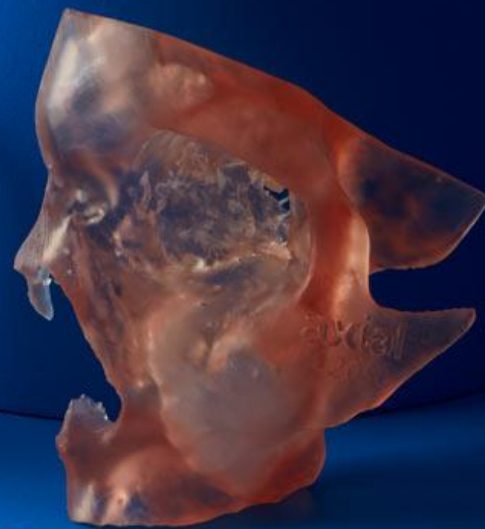
MATERIALS LIBRARY

# 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.

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



BioMed Clear  
BioMed Amber

formlabs 

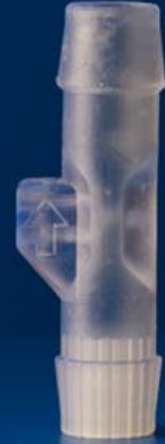
MEDICAL RESIN

# 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.



Medical devices and device components

Ventilator and PPE components

Bioprocessing equipment

Drug delivery devices

Research and Development



**FLBMCL01**

\* May not be available in all regions

**formlabs**  | **medical**

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

To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# BioMed Clear Resin

	METRIC <sup>1</sup>	IMPERIAL <sup>1</sup>	METHOD
	Post-Cured <sup>2</sup>	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>			
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)
<b>Flexural Properties</b>			
Flexural Strength	84 MPa	12.2 ksi	ASTM D790-15 (Method B)
Flexural Modulus	2300 MPa	332 ksi	ASTM D790-15 (Method B)
<b>Hardness Properties</b>			
Hardness Shore D	78 D	78 D	ASTM D2240-15 (Type D)
<b>Impact Properties</b>			
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
<b>Thermal Properties</b>			
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
<b>Other Properties</b>			
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
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For more details on sterilization compatibilities, visit [formlabs.com/medical](http://formlabs.com/medical)

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 <sup>3</sup>	ISO Standard	Description <sup>3</sup>
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

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

<sup>1</sup> Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

<sup>2</sup> 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.

<sup>3</sup> BioMed Clear Resin was tested at NAMS World Headquarters, OH, USA.

MEDICAL RESIN

# 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

formlabs  | medical

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# MATERIAL PROPERTIES DATA

# BioMed Amber Resin

	METRIC <sup>1</sup>	IMPERIAL <sup>1</sup>	METHOD
	Post-Cured <sup>2</sup>	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>			
Ultimate Tensile Strength	73 MPa	11 ksi	ASTM D638-10 (Type IV)
Young's Modulus	2080 MPa	420 ksi	ASTM D638-10 (Type IV)
Elongation	12%	12%	ASTM D638-10 (Type IV)
<b>Flexural Properties</b>			
Flexural Strength	103 MPa	15 ksi	ASTM D790-15 (Method B)
Flexural Modulus	2500 MPa	363 ksi	ASTM D790-15 (Method B)
<b>Hardness Properties</b>			
Hardness Shore D	67 D	67 D	ASTM D2240-15 (Type D)
<b>Impact Properties</b>			
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
<b>Thermal Properties</b>			
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

## Disinfection Compatibility

Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes
-----------------------	-------------------------------------

For more details on sterilization compatibilities, visit [formlabs.com](http://formlabs.com)

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 <sup>3</sup>
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

<sup>1</sup>Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

<sup>2</sup>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.

<sup>3</sup>BioMed Amber Resin was tested at NAMSA World Headquarters, OH, USA.

# 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

Draft

Castable Wax

Surgical Guide

Dental LT Clear V2

Dental LT Clear V1

Custom Tray

Temporary CB

Permanent Crown

Denture Base & Teeth

Soft Tissue

# Model

## Photopolymer Resin for Formlabs SLA Printers

Designed for crown and bridge models with removable dies, Model Resin is a high-precision, high-accuracy resin. Print crisp margins and contacts within  $\pm 35$  microns, and removable dies with consistently tight fit. A smooth, matte surface finish and color similar to gypsum make it easy to switch from analog to digital model production.

**Highly accurate models**

**Removable die models**

**Restorative work**

**Stone color models**



**FLDMBE02**

\* May not be available in all regions

**formlabs**  | dental

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# MATERIAL PROPERTIES DATA

# Model Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green <sup>2</sup>	Post-Cured <sup>3</sup>	Green <sup>2</sup>	Post-Cured <sup>3</sup>	
<b>Mechanical Properties</b>					
Ultimate Tensile Strength	33 MPa	61 MPa	4800 psi	8820 psi	ASTM D 638-14
Tensile Modulus	1.6 GPa	2.7 GPa	230 ksi	397 ksi	ASTM D 638-14
Elongation at Break	25%	5%	25%	5%	ASTM D 638-14
<b>Flexural Properties</b>					
Flexural Modulus	0.95 GPa	2.5 GPa	138 psi	365 psi	ASTM D 790-15
<b>Impact Properties</b>					
Notched Izod	27 J/m	33 J/m	0.5 ft-lbf/in	0.6 ft-lbf/in	ASTM D256-10
<b>Impact Properties</b>					
Heat Deflection Temp. @ 1.8 MPa	33 °C	46 °C	91 °F	115 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	40 °C	49 °C	105 °F	119 °F	ASTM D 648-16

<sup>1</sup>Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup>Data was obtained from green parts, printed using Form 2, 100 µm, Dental Model settings, without additional treatments.

<sup>3</sup>Data was obtained from parts printed using Form 2, 100 µm, Dental Model settings and post-cured with 1.25 mW/cm<sup>2</sup> of 405 nm LED light for 60 minutes.

## SOLVENT COMPATIBILITY

### G = Good resistance

Parts exposed to this solvent should not experience a decrease in mechanical properties.

(> 2% weight gain, > 2% width increase over 24 hours for a 1 x 1 x 1 cm cube)

### X = Unacceptable resistance

Parts exposed to this solvent will experience a significant decrease in mechanical properties as well as visible degradation.

(> 2% weight gain, > 2% width increase over 24 hours for a 1 x 1 x 1 cm cube)

Solvent	Green	Post-Cured	Solvent	Green	Post-Cured
Acetic Acid 5%	G	G	Hydrogen peroxide (3%)	G	G
Acetone	X	X	Isooctane (aka gasoline)	G	G
Bleach ~5% NaOCl	G	G	Isopropyl Alcohol	X	G
Butyl Acetate	X	G	Sodium Hydroxide solution (0.025% PH 10)	G	G
Diethyl glycol Monomethyl Ether	X	G	Water	G	G
Salt Water (3.5% NaCl)	G	G	Xylene	X	G

DENTAL RESIN

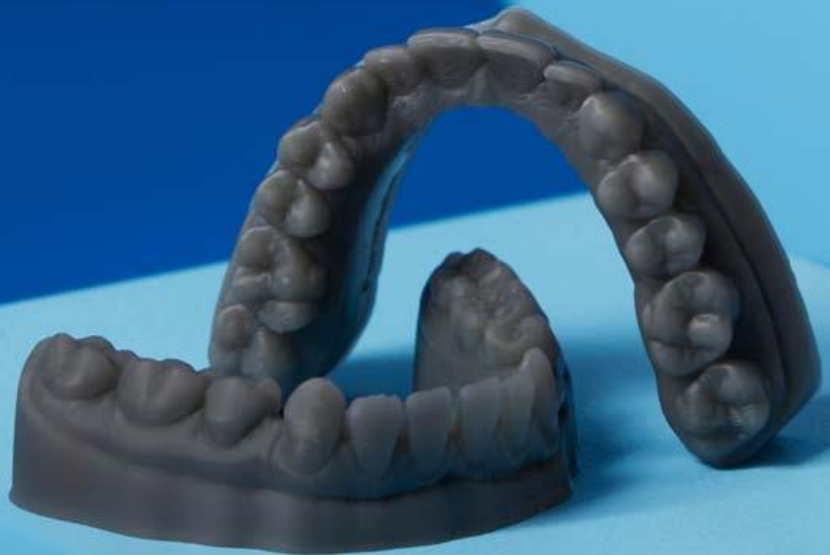
# Draft

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

**formlabs**  | dental

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# MATERIAL PROPERTIES DATA

# Draft V2 Resin

	METRIC <sup>1</sup>			IMPERIAL <sup>1</sup>			METHOD
	Green <sup>2</sup>	Post-Cured at Room Temperature <sup>3</sup>	Post-Cured at 60 °C <sup>4</sup>	Green <sup>2</sup>	Post-Cured at Room Temperature <sup>3</sup>	Post-Cured at 60 °C <sup>4</sup>	
<b>Tensile Properties</b>							
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
<b>Flexural Properties</b>							
Flexural Modulus	0.6 GPa	1.8 GPa	2.3 GPa	87 ksi	261 ksi	334 ksi	ASTM D790-17
<b>Impact Properties</b>							
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
<b>Temperature Properties</b>							
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

<sup>1</sup>Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup>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.

<sup>3</sup>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.

<sup>4</sup>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)	< 0.1
Acetone	4.2	Mineral oil (Heavy)	< 0.1
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	< 0.1
Isooctane (aka gasoline)	< 0.1	Xylene	< 0.1
Isopropyl Alcohol	< 0.1		

DENTAL RESIN

# Castable Wax

A highly accurate material for casting and pressing crowns, bridges, and RPDs

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



FLCWPU01

\* May not be available in all regions

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# MATERIAL PROPERTIES DATA

# Castable Wax Resin

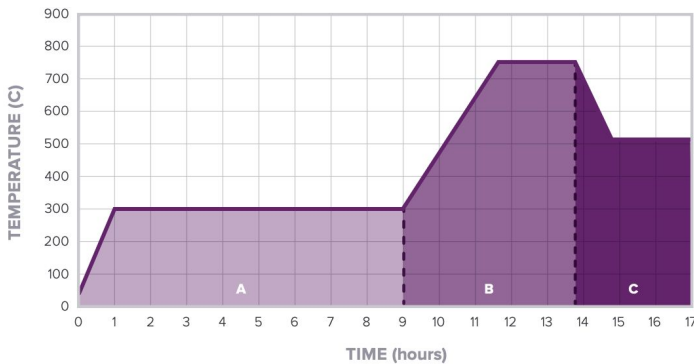
	METRIC <sup>1</sup>	IMPERIAL <sup>1</sup>	METHOD
	Green <sup>2</sup>	Green <sup>2</sup>	
<b>Tensile Properties</b>			
Ultimate Tensile Strength	12 MPa	1680 psi	ASTM D 638-10
Tensile Modulus	220 MPa	32 ksi	ASTM D 638-10
Elongation at Break	13%	13%	ASTM D 638-10
<b>Burnout Properties</b>			
Flexural Strength	249 °C	480 °C	ASTM E 1131
Flexural Modulus	0.0 - 0.1%	0.0 - 0.1%	ASTM E 1131

<sup>1</sup>Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup>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.

DENTAL RESIN

# Surgical Guide

Biocompatible Photopolymer Resin for Formlabs SLA Printers

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

Device sizing templates

Pilot drill guides


Drilling templates



V1

FLSGAM01

\* May not be available in all regions

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# MATERIAL PROPERTIES DATA

# Surgical Guide Resin

	METRIC <sup>1</sup>	METHOD
	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>		
Ultimate Tensile Strength	73 MPa	ASTM D638-10 (Type IV)
Young's Modulus	2900 MPa	ASTM D638-10 (Type IV)
Elongation	12%	ASTM D638-10 (Type IV)
<b>Flexural Properties</b>		
Flexural Strength	103 MPa	ASTM D790-15 (Method B)
Flexural Modulus	2500 MPa	ASTM D790-15 (Method B)
<b>Hardness Properties</b>		
Hardness Shore D	67 D	ASTM D2240-15 (Type D)

<b>Sterilization Compatibility</b>	
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

<b>Disinfection Compatibility</b>	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

For more details on sterilization compatibilities, visit [formlabs.com](http://formlabs.com)

Surgical Guide Resin is a Class I Medical Device as defined in Article I of the Medical Device Directive (93/42/EEC) 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 10993-1:2018, 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 <sup>3</sup>
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

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

<sup>1</sup>Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

<sup>2</sup>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.

<sup>3</sup>Surgical Guide Resin was tested at NAMSA World Headquarters, OH, USA.

DENTAL RESIN

# IBT Resin

## Biocompatible Photopolymer Resin for Indirect Bonding Trays

Use Class I compliant 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

\* May not be available in all regions

formlabs  | dental

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# MATERIAL PROPERTIES DATA

# IBT Resin

	METRIC <sup>1</sup>	IMPERIAL <sup>1</sup>	METHOD
	Post-Cured <sup>2</sup>	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>			
Ultimate Tensile Strength	5.2 MPa	754 psi	ASTM D638-14
Young's Modulus	18 MPa	2.66 ksi	ASTM D638-14
Elongation	29 %	29 %	ASTM D638-14
<b>Hardness Properties</b>			
Hardness Shore A	< 90 A	< 90 A	ASTM D2240-15
<b>Disinfection Compatibility</b>			
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes		

IBT 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 <sup>3</sup>
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

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

<sup>1</sup>Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

<sup>2</sup>Data for post-cured samples were measured on Type IV tensile bars printed on a Form 3B printer with 100 µm IBT Resin settings, washed in a Form Wash for 20 minutes in ≥ 96% Isopropyl Alcohol, and post-cured at 60 °C for 60 minutes in a Form Cure.

<sup>3</sup>IBT Resin was tested at NAMS World Headquarters, OH, USA.

DENTAL RESIN

# Dental LT Clear v2

## Biocompatible Photopolymer Resin for Formlabs SLA Printers

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

Retainers



V1

FLDLCL02

\* May not be available in all regions

formlabs  | dental

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# MATERIAL PROPERTIES DATA

# Dental LT Clear V2 Resin

	METRIC <sup>1</sup>	METHOD
	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>		
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)
<b>Flexural Properties</b>		
Flexural Strength	84 MPa	ASTM D790-15 (Method B)
Flexural Modulus	2300 MPa	ASTM D790-15 (Method B)
<b>Hardness Properties</b>		
Hardness Shore D	78 D	ASTM D2240-15 (Type D)
<b>Impact Properties</b>		
IZOD Impact Strength	449 J/m	ASTM D4812-11 (Unnotched)
<b>Other Properties</b>		
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 <sup>3</sup>
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

<sup>1</sup>Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

<sup>2</sup>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.

<sup>3</sup>Dental LT Clear Resin (V2) was tested at NAMSA World Headquarters, OH, USA.

DENTAL RESIN

# Dental LT Clear V1

Biocompatible Photopolymer Resin for Formlabs SLA Printers

Formlabs Dental LT Clear Resin (V1) is specifically designed to print with Formlabs SLA printers to produce strong, accurate, biocompatible appliances for long-term mucousal membrane contact.

Occlusal guards

Splints



FLDLCL01

\* May not be available in all regions

formlabs  | dental

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

To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# Dental LT Clear V1 Resin

	METRIC <sup>1</sup>	METHOD
	Post-Cured	
<b>Mechanical Properties</b>		
Maximum Stress Intensity Factor	$\geq 1.1 \text{ MPa}\cdot\text{m}^{1/2}$	ISO 179:2010
Total Fracture Work	$\geq 250 \text{ J/m}^2$	ISO 20795-2:2013
<b>Flexural Properties</b>		
Flexural Strength	$\geq 50 \text{ MPa}$	ISO 20795-2:2013
Flexural Modulus	$\geq 1300 \text{ MPa}$	ISO 20795-2:2013
<b>Hardness Properties</b>		
Hardness Shore D	80 - 90 D	ISO 868:2003

Dental LT Clear Resin (V1) is tested at NAMSA, Chasse sur Rhône in France, and is 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:

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

<sup>1</sup>Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

DENTAL RESIN

# Custom Tray

## Biocompatible Photopolymer Resin for Formlabs SLA Printers

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

\* May not be available in all regions

formlabs  | dental

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To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# Custom Tray Resin

	METRIC <sup>1</sup>	IMPERIAL <sup>1</sup>	METHOD
	Post-Cured <sup>2</sup>	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>			
Ultimate Tensile Strength	74 MPa	11.7 ksi	ASTM D638-10 (Type IV)
Young's Modulus	2900 MPa	435 ksi	ASTM D638-10 (Type IV)
Elongation	3.2%	3.2%	ASTM D638-10 (Type IV)
<b>Flexural Properties</b>			
Flexural Strength	110 MPa	15.9 ksi	ASTM D790-15 (Method B)
Flexural Modulus	2700 MPa	392 ksi	ASTM D790-15 (Method B)
<b>Hardness Properties</b>			
Hardness Shore D	82 D	82 D	ASTM D2240-15 (Type D)
<b>Disinfection Compatibility</b>			
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes		

Custom Tray Resin is a Class I Medical Device as defined in Article I of the Medical Device Directive (93/42/EEC) 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 10993-1:2018, 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 <sup>3</sup>
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

<sup>1</sup>Material properties may vary based on part geometry, print orientation, print settings, temperature, and disinfection or sterilization methods used.

<sup>2</sup>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

<sup>3</sup>Custom Tray Resin was tested at NAMSA World Headquarters, OH, USA.

DENTAL RESIN

# Temporary CB

Biocompatible Photopolymer Resin for Formlabs SLA Printers

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**



**FLTCA201**  
**FLTCA301**

**FLTCB101**  
**FLTCC201**

\* May not be available  
in all regions

**formlabs**  | **dental**

**Prepared** 06 . 09 . 2020  
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# MATERIAL PROPERTIES DATA

## Temporary CB Resin

VITA<sup>1</sup> Classical Shades: A2, A3, B1, C2

	MEASURED VALUES	METHOD
<b>Mechanical Properties</b>		
Density	1.4 - 1.5 g/cm <sup>3</sup>	BEGO Standard
Viscosity	2500 - 6000 MPa*s	BEGO Standard
Flexural Strength (post cured) <sup>2, 3, 4</sup>	≥ 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 <sup>5</sup>
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	Not 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 14971:2012	Medical Devices – Application of Risk Management to Medical Devices

<sup>1</sup>VITA is a registered trademark of a company which is not affiliated with Formlabs Inc.

<sup>2</sup>Material properties may vary based on part geometry, print orientation, print settings, and environmental conditions.

<sup>3</sup>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.

<sup>4</sup>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.

<sup>5</sup>Temporary CB Resin was tested at Eurofins BioPharma Product Testing, Munich GmbH.

# Permanent Crown

Biocompatible Photopolymer Resin for Formlabs SLA Printers

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.*

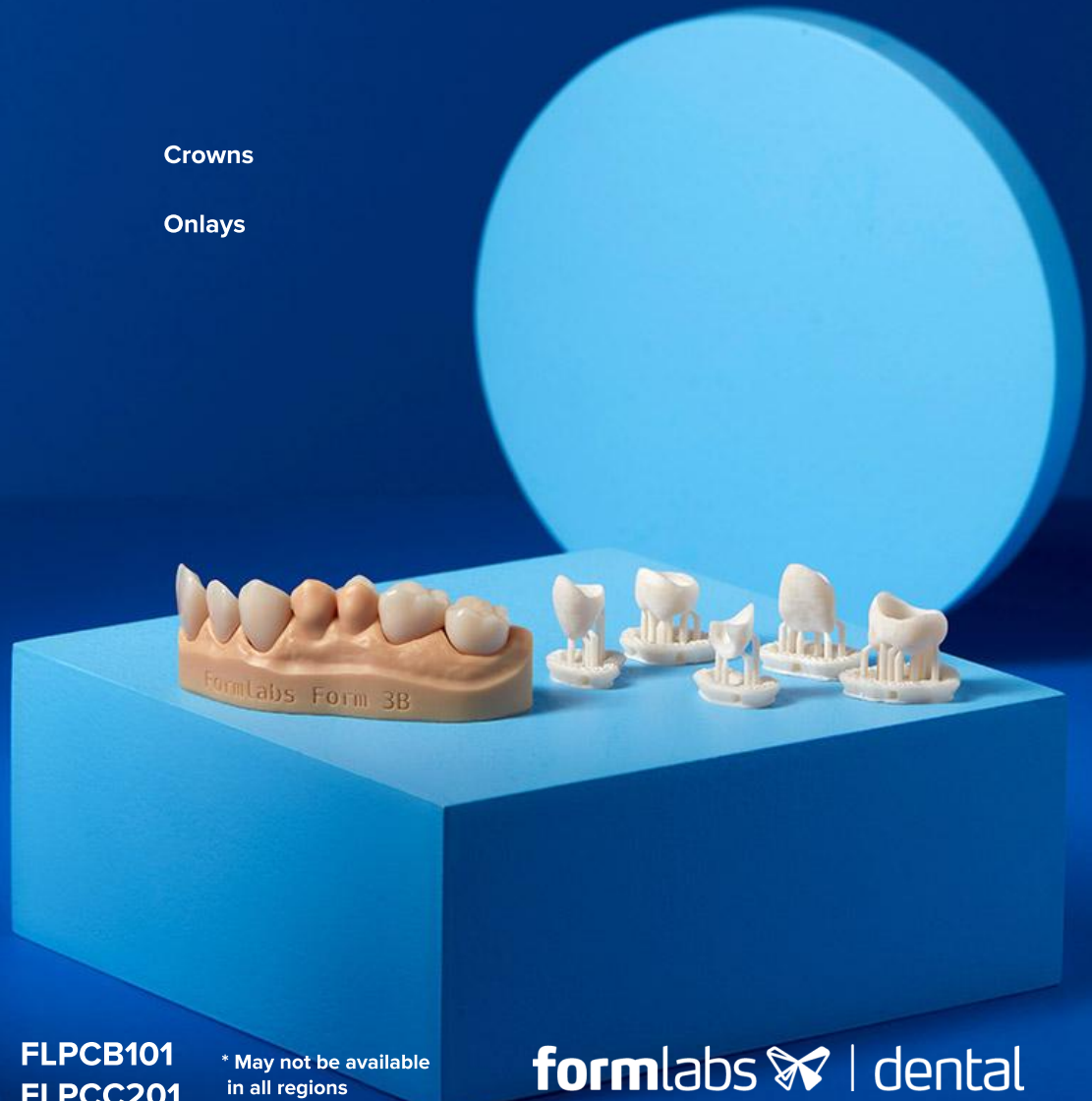
**Permanent Restorations:**

**Inlays**

**Crowns**

**Veneers**

**Onlays**



**FLPCA201**  
**FLPCA301**

**FLPCB101**  
**FLPCC201**

\* May not be available  
in all regions

**formlabs**  | **dental**

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To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

## Permanent Crown Resin

VITA<sup>1</sup> Classical Shades: A2, A3, B1, C2

	MEASURED VALUES	METHOD
<b>Mechanical Properties</b>		
Density	1.4 - 1.5 g/cm <sup>3</sup>	BEGO Standard
Viscosity	2500 - 6000 MPa*s	BEGO Standard
Flexural Strength (post cured) <sup>2, 3, 4</sup>	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 <sup>3</sup>	EN ISO 4049
Water Sorption	3.6 µg/mm <sup>3</sup>	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 <sup>5</sup>
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	Not 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 14971:2012	Medical Devices – Application of Risk Management to Medical Devices

<sup>1</sup>VITA is a registered trademark of a company which is not affiliated with Formlabs Inc.

<sup>2</sup>Material properties may vary based on part geometry, print orientation, print settings, and environmental conditions.

<sup>3</sup>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.

<sup>4</sup>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.

<sup>5</sup>Permanent Crown Resin was tested at Eurofins BioPharma Product Testing, Munich GmbH.

DENTAL RESIN

# Denture Base and Teeth

Biocompatible Photopolymer Resin for Formlabs SLA Printers

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



\* May not be available in all regions.



FLDTA101  
FLDTA201

FLDTA301  
FLDTAS01

FLDTB101  
FLDTB201

formlabs  | dental

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# MATERIAL PROPERTIES DATA

# Denture Base and Teeth Resins

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

Denture Teeth	METRIC <sup>1</sup>	METHOD
	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>		
Flexural Strength	> 65 MPa	ISO 20795-1
Density	1.15 g/cm <sup>3</sup> < X <1.25 g/cm <sup>3</sup>	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	Not 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 Teeth ISO Standards	Description
EN-ISO 20795-1:2013	Dentistry - Base Polymers - Part 1: Denture Base Polymers

<sup>1</sup>Material properties can vary with part geometry, print orientation, print settings, and temperature

<sup>2</sup>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

## Photopolymer Resin Mixing Kit for Formlabs SLA Printers

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.

**formlabs**  | dental

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# MATERIAL PROPERTIES DATA

# Flexible 80A Resin

	METRIC <sup>1</sup>		IMPERIAL <sup>1</sup>		METHOD
	Green	Post-Cured <sup>2</sup>	Green	Post-Cured <sup>2</sup>	
<b>Mechanical Properties</b>					
Ultimate Tensile Strength <sup>3</sup>	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	70 A	80 A	80 A	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 <sup>4</sup>	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
<b>Thermal Properties</b>					
Glass transition temperature (Tg)	Not Tested	27°C	Not Tested	27°C	DMA

<sup>1</sup> Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup> 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° for 10 minutes.

<sup>3</sup> Tensile testing was performed after 3+ hours at 23 °C, using a Die C specimen cut from sheets.

<sup>4</sup> 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:

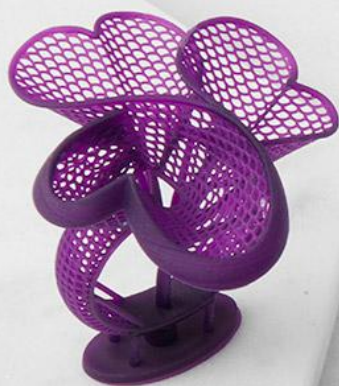
Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.9	Mineral oil (Light)	0.1
Acetone	37.4	Mineral oil (Heavy)	< 0.1
Bleach ~5% NaOCl	0.6	Salt Water (3.5% NaCl)	0.5
Butyl Acetate	51.4	Skydrol 5	10.7
Diesel Fuel	2.3	Sodium Hydroxide solution (0.025% PH 10)	0.6
Diethyl glycol Monomethyl 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		

# 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. 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  
Castable Wax



JEWELRY RESIN

# 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.



**FLCW4001**

\* May not be available in all regions

**formlabs** 

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To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# Castable Wax 40 Resin

	METRIC <sup>1</sup>	IMPERIAL <sup>1</sup>	METHOD
	Green <sup>2</sup>	Green <sup>2</sup>	
<b>Burnout Properties</b>			
Temperature @ 5% Mass Loss	249 °C	480 °F	ASTM E 1131
Ash content (TGA)	0.0 - 0.1 %	0.0 - 0.1 %	ASTM E 1131

<sup>1</sup> Material properties can vary with part geometry, print orientation, print settings, and temperature.

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

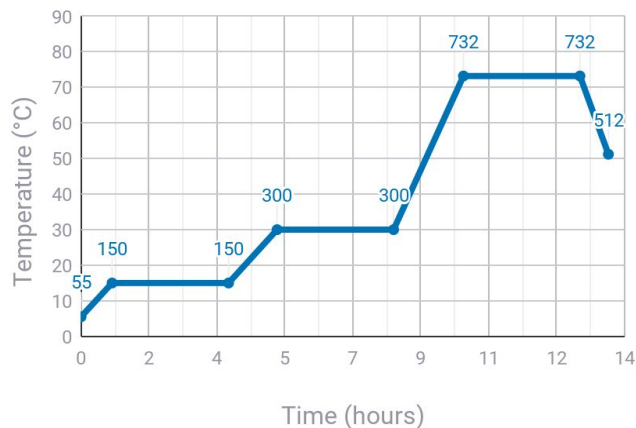
## CASTABLE WAX 40 BURNOUT SCHEDULE 2021

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
	<b>Heated Bench Rest</b> 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
<b>A</b>	<b>Thermal Transition</b> 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 / min
<b>B</b>	<b>Burnout</b> Eliminates the remaining resin and ash in the investment.	Ramp	108 minutes	4.0 °C / min	7.2 °F / min
		Hold	180 minutes	732 °C	1350 °F
<b>C</b>	<b>Casting Temperature</b> 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.

JEWELRY RESIN

# 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.



**FLCWPU01**

\* May not be available in all regions

**formlabs** 

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To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# Castable Wax Resin

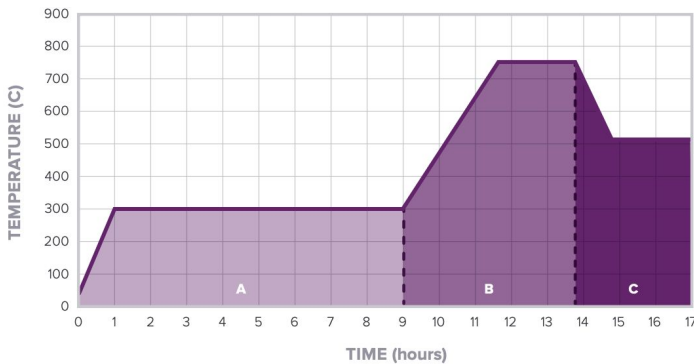
	METRIC <sup>1</sup>	IMPERIAL <sup>1</sup>	METHOD
	Green <sup>2</sup>	Green <sup>2</sup>	
<b>Tensile Properties</b>			
Ultimate Tensile Strength	12 MPa	1680 psi	ASTM D 638-10
Tensile Modulus	220 MPa	32 ksi	ASTM D 638-10
Elongation at Break	13%	13%	ASTM D 638-10
<b>Burnout Properties</b>			
Flexural Strength	249 °C	480 °C	ASTM E 1131
Flexural Modulus	0.0 - 0.1%	0.0 - 0.1%	ASTM E 1131

<sup>1</sup>Material properties can vary with part geometry, print orientation, print settings, and temperature.

<sup>2</sup>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)

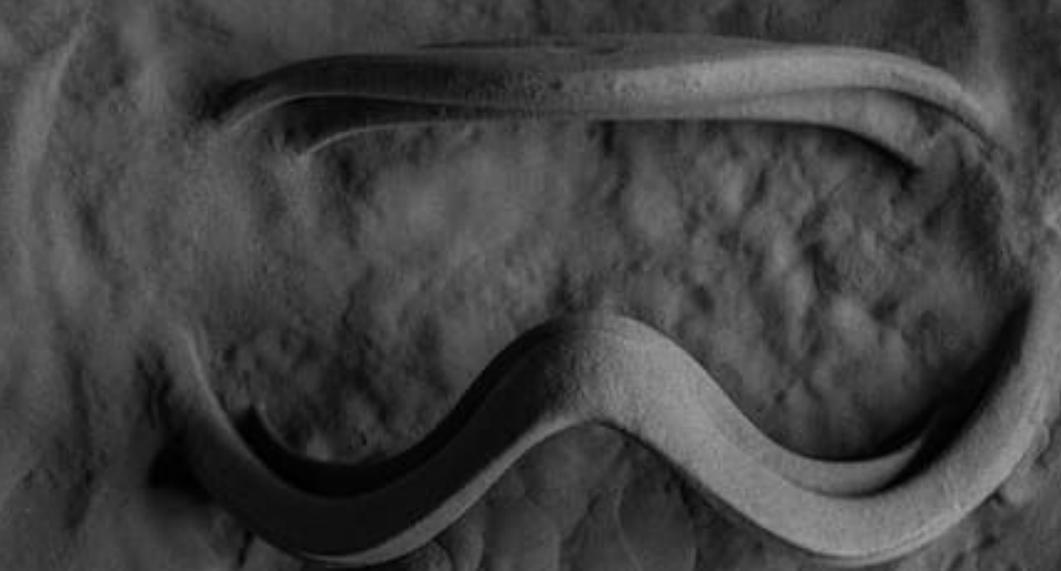
**Post-Curing Info:**  
No post-cure required.

PRINT TECHNOLOGY



# SLS

# Selective Laser Sintering



SLS MATERIALS

# Nylon 12

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 1.*



V1

FLP12G01

\* May not be available in all regions

formlabs 

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To the best of our knowledge the information contained herein is accurate. However, Formlabs, Inc. makes no warranty, expressed or implied, regarding the accuracy of these results to be obtained from the use thereof.

# MATERIAL PROPERTIES DATA

# Nylon 12

	METRIC <sup>1</sup>	IMPERIAL <sup>1</sup>	METHOD
<b>Mechanical Properties</b>			
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
<b>Flexural Properties</b>			
Flexural Strength	66 MPa	9572 psi	ASTM D790 A
Flexural Modulus	1600 MPa	232 ksi	ASTM D790 A
<b>Impact Properties</b>			
Notched IZOD	32 J/m	0.60 ft-lb/in	ASTM D256
<b>Thermal Properties</b>			
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
<b>Other Properties</b>			
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 <sup>3,4</sup>
ISO 10993-5:2009	Not cytotoxic
ISO 10993-10:2010/(R)2014	Not an irritant
ISO 10993-10:2010/(R)2014	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%	0.10	Mineral oil (Light)	0.54
Acetone	0.14	Mineral oil (Heavy)	0.66
Bleach ~5% NaOCl	0.21	Salt Water (3.5% NaCl)	0.15
Butyl Acetate	0.18	Skydrol 5	0.59
Diesel Fuel	0.43	Sodium Hydroxide solution (0.025% PH 10)	0.20
Diethyl glycol Monomethyl Ether	0.49	Strong Acid (HCl conc)	0.76
Hydraulic Oil	0.59	Tripropylene glycol monomethyl ether	0.31
Hydrogen peroxide (3%)	0.20	Water	0.05
Isooctane (aka gasoline)	0.01	Xylene	0.12
Isopropyl Alcohol	0.19		

<sup>1</sup> Material properties may vary with part geometry, print orientation and temperature.

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> Nylon 12 was tested at NAMS World Headquarters, OH, USA.

# Materials Library

Functional materials that look the part

