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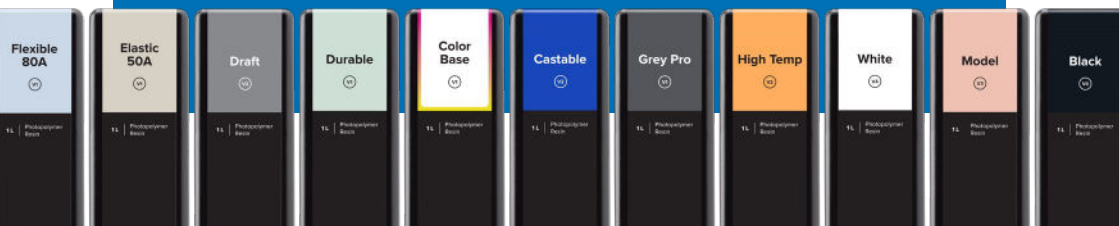
Materials Library

Functional Materials That Look the Part



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Materials Library

Functional Materials that look the part

ver D.2023

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

SLA RESIN MATERIAL LIST

General Purpose p. 9

RESIN	MICRON LAYER HEIGHT				
Clear High translucency and transparency	100 µm	50 µm	25 µm		p. 9
White Fine detail, matte white finish	100 µm	50 µm			p. 9
Grey Fine detail, matte grey finish	160 µm	100 µm	50 µm	25 µm	p. 9
Black Fine detail, matte black finish	100 µm	50 µm	25 µm		p. 9
Color Kit Full range of custom colors	100 µm	50 µm	25 µm		p. 9
Draft Print up to 4 times faster	200 µm	100 µm			p. 11
Grey Pro Versatile prototyping material	100 µm	50 µm			p. 13

Rigid p. 16

RESIN	MICRON LAYER HEIGHT		
Rigid 10K Rigid, strong, industrial-grade parts	100 µm	50 µm	p. 17
Rigid 4000 Stiff, strong, engineering-grade parts	100 µm	50 µm	p. 21

Tough and Durable p. 24

RESIN	MICRON LAYER HEIGHT		
Tough 2000 Stiff, sturdy, rugged prototyping	100 µm	50 µm	p. 25
Tough 1500 Stiff, pliable, resilient prototyping	100 µm	50 µm	p. 27
Durable Soft, pliable prototyping material	100 µm	50 µm	p. 29

SLA RESIN MATERIAL LIST

Flexible and Elastic p. 32

RESIN	MICRON LAYER HEIGHT			
Flexible 80A Hard flexible parts with slow return	100 µm	50 µm		p. 33
Elastic 50A Soft flexible parts that spring back	100 µm			p. 35

Silicone p. 38

RESIN	MICRON LAYER HEIGHT			
Silicone 40A 100% silicone material for soft, pliable, and durable parts	100 µm	50 µm		p. 39

Polyurethane p. 44

RESIN	MICRON LAYER HEIGHT			
PU Rigid 1000 Stiff, sturdy, and unyielding polyurethane parts	100 µm	50 µm		p. 45
PU Rigid 650 Impact resistant and pliable polyurethane parts	100 µm	50 µm		p. 49

Specialty p. 54

RESIN	MICRON LAYER HEIGHT			
High Temp High thermal stability	100 µm	50 µm	25 µm	p. 55
Flame Retardant UL 94 V-0 certified 3D printed parts with excellent quality and heat resistance	100 µm	50 µm		p. 57
ESD Rugged ESD-safe material for electronics manufacturing	100 µm	50 µm		p. 63
Alumina 4N Technical ceramic with extreme performance	50 µm			p. 65

Dental p. 68

RESIN	MICRON LAYER HEIGHT			
Model Model making and aligner production	100 µm	50 µm	25 µm	p. 69
Draft Print up to 4 times faster	200 µm	100 µm		p. 71

SLA RESIN MATERIAL LIST

Dental p. 68

RESIN	MICRON LAYER HEIGHT		
Castable Wax Reliable casting with clean burnout	50 µm	25 µm	p. 73
Surgical Guide Premium-quality implant guides	100 µm	50 µm	p. 75
IBT Biocompatible photopolymer resin for indirect bonding trays	100 µm	50 µm	p. 77
IBT Flex Flexible, and tear-resistant material for printing trays and guides	100 µm	50 µm	p. 79
Dental LT Clear Long-term splints and occlusal guards	100 µm		p. 81
Dental LT Comfort Comfortable long-term splints, night guards, and bleaching trays	100 µm		p. 83
Custom Tray Fast printing custom impression trays	200 µm		p. 85
Temporary CB Strong, precise temporary restorations	50 µm		p. 87
Permanent Crown Strong, precise permanent restorations	50 µm		p. 89
Denture Base + Teeth Direct printed dental prosthetics	50 µm		p. 91
Soft Tissue (Dental Pack) Flexible 80A + Color Pigments kit	100 µm	50 µm	p. 93

Medical p. 96

RESIN	MICRON LAYER HEIGHT		
BioMed Clear For long-term bodily contact	100 µm	50 µm	p. 97
BioMed Durable For strong and impact resistant medical devices and instruments	100 µm		p. 99
BioMed Flex 80A For flexible, biocompatible, transparent medical devices and models	100 µm		p. 103

SLA RESIN MATERIAL LIST

Medical

p. 96

RESIN	MICRON LAYER HEIGHT		
BioMed Elastic 50A For soft, biocompatible, transparent medical devices and models	100 µm		p. 107
BioMed White For white, rigid, biocompatible parts	100 µm	50 µm	p. 111
BioMed Black For matte black, rigid, biocompatible parts	100 µm	50 µm	p. 115
BioMed Amber For short-term bodily contact	100 µm	50 µm	p. 119

Jewelry

p. 122

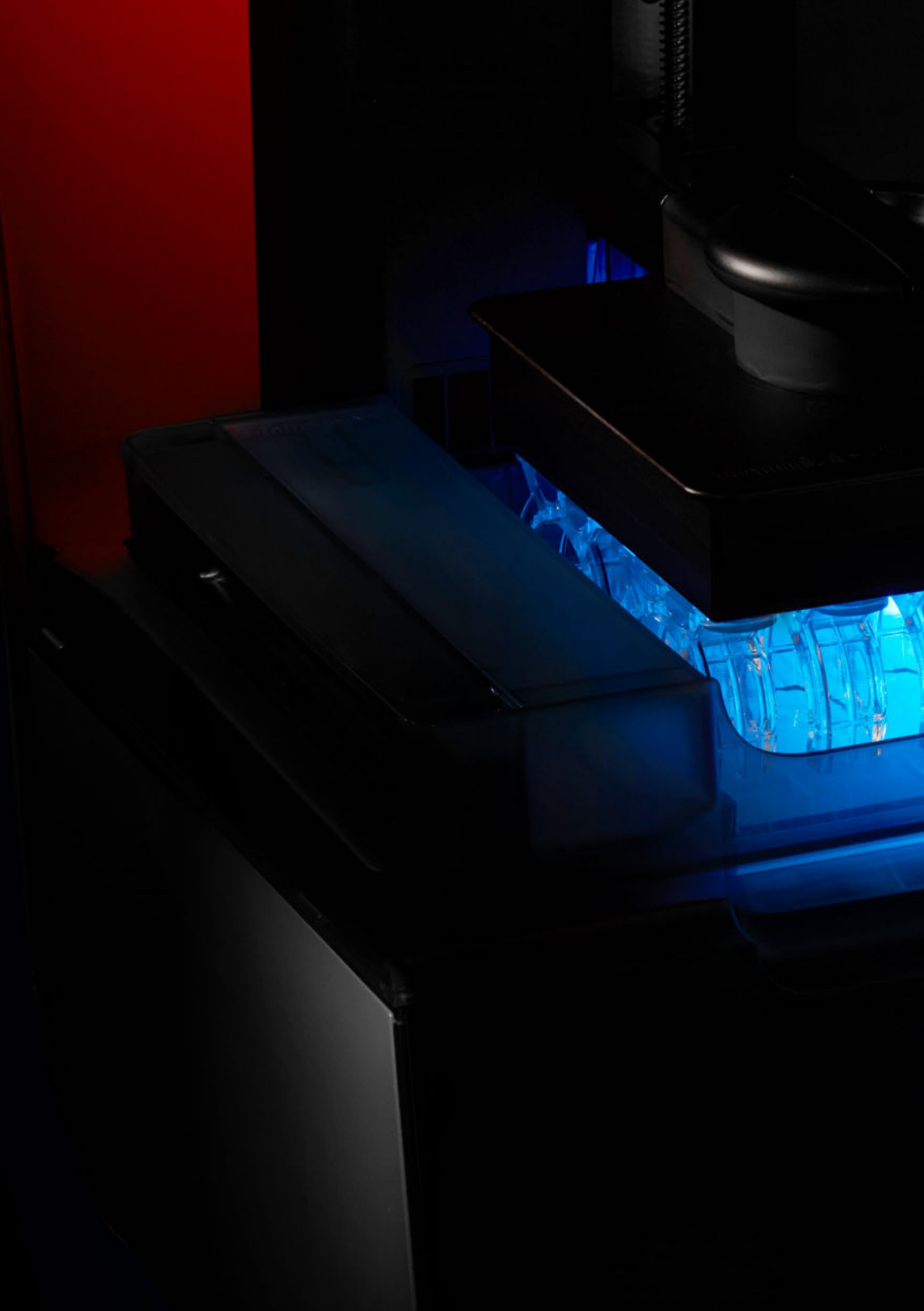
RESIN	MICRON LAYER HEIGHT		
Castable Wax 40 For casting challenging, highly detailed designs	50 µm	25 µm	p. 123
Castable Wax For casting thin, filigree patterns	50 µm	25 µm	p. 125

SLS POWDER MATERIAL LIST

Standard

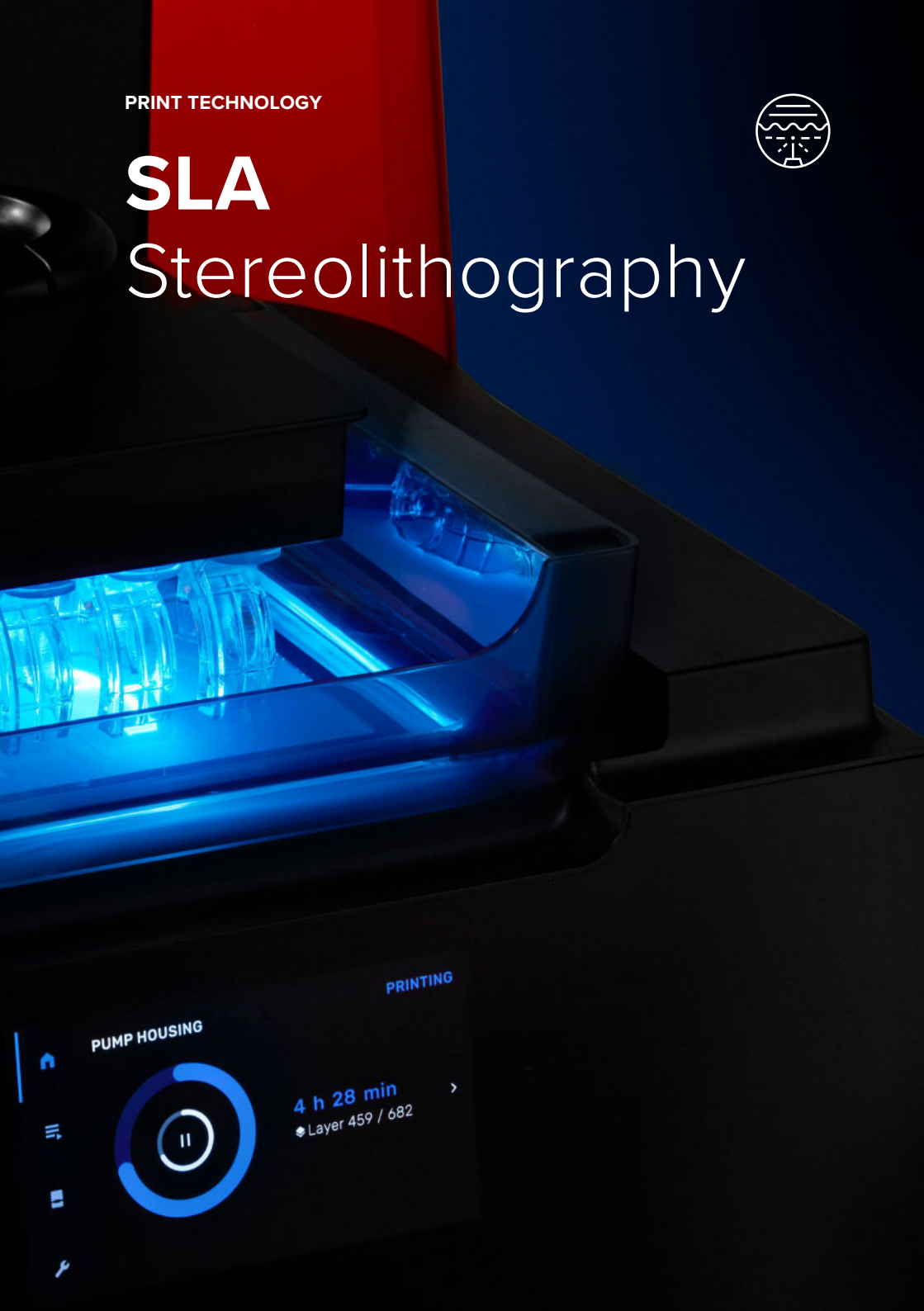
p. 128

POWDER	MICRON LAYER HEIGHT	
Nylon 12 Strong, durable, production-ready parts	110 µm	p. 129
Nylon 12 GF Stiff, thermally stable, production-ready parts	110 µm	p. 131
Nylon 11 Strong, durable, production-ready parts	110 µm	p. 133
Nylon 11 CF Carbon fiber reinforced, for strong and lightweight parts	110 µm	p. 135
TPU 90A A tough SLS elastomer for resilient, skin-safe products	110 µm	p. 137



PRINT TECHNOLOGY

SLA
Stereolithography



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General Purpose Resins

Materials for High Resolution Models and Rapid Prototyping

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

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

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

V4 Clear FLGPCL04	V4 Grey FLGPGR04	V2 Draft FLDRGR02	V1 Grey Pro FLPRGR01
V4 White LGPWH04	V4 Black FLGPBL04	V4 Color FLGPCB01	* May not be available in all regions

Prepared 04 . 09 . 2016

Rev. 02 14 . 08 . 2023

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 [1]		IMPERIAL [1]		METHOD
	Green [2]	**Post-Cured [3]**	**Green [2]**	**Post-Cured [3]**	
Tensile Properties					
Ultimate Tensile Strength	38 MPa	65 MPa	5510 psi	9380 psi	ASTM D638-14
Tensile Modulus	1.6 GPa	2.8 GPa	234 ksi	402 ksi	ASTM D638-14
Elongation at Break	12%	6%	12%	6%	ASTM D638-14
Flexural Properties					
Flexural Modulus	1.3 GPa	2.2 GPa	181 psi	320 psi	ASTM D 790-15
Impact Properties					
Notched Izod	16 J/m	25 J/m	0.3 ft-lbf/in	0.46 ft-lbf/in	ASTM D256-10
Thermal Properties					
Heat Deflection Temp. @ 1.8 MPa	43 °C	58 °C	109 °F	137 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	50 °C	73 °C	121 °F	163 °F	ASTM D 648-16

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

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

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

SOLVENT COMPATIBILITY

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

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

GENERAL PURPOSE RESIN

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Draft

Draft Resin for Truly Rapid Prototyping

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

Initial prototypes

Live 3D printing demos

Rapid design iterations

High throughput applications

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

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

Draft Resin

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

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

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

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

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

SOLVENT COMPATIBILITY

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

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

formlabs

Grey Pro

Resin for Versatile Prototyping

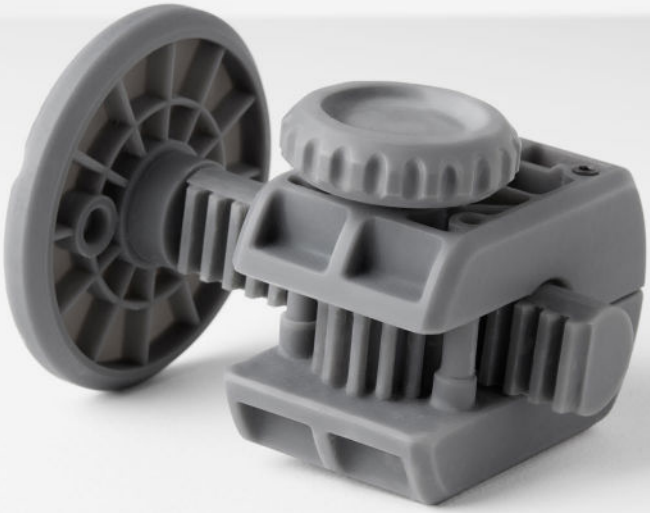
Grey Pro Resin offers high precision, moderate elongation, and low creep. This material is great for concept modeling and functional prototyping, especially for parts that will be handled repeatedly.

Form and fit testing

High quality product prototypes

Mold masters for plastics and silicones

Jigs and fixtures for manufacturing



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

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

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

Grey Pro Resin

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

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

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

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

SOLVENT COMPATIBILITY

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

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

formlabs

Rigid

Materials for Engineering, Manufacturing, and Product Design

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

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

Rigid 10K

Rigid, strong, industrial-grade parts

Rigid 4000

Stiff, strong, engineering-grade parts

formlabs

Rigid 10K

Resin for Rigid, Strong, Industrial-Grade Prototypes

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

Short-run injection molds and inserts

Heat resistant and fluid exposed components, jigs, and fixtures

Simulates stiffness of glass and fiber-filled thermoplastics

Aerodynamic test models

V1 **FLRG1001**

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

Prepared 10 . 07 . 2020
Rev. 04 12 . 12 . 2022

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

Rigid 10K Resin

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

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

Toxic Gas Generation

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

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

Flammability

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

SOLVENT COMPATIBILITY

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

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

All testing specimens were printed using Form 3.

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

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

RIGID RESIN

formlabs

Rigid 4000

Resin for Stiff, Strong, Engineering-Grade Prototypes

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

Mounts and brackets

Jigs and fixtures

Thin-walled parts

Simulates stiffness of PEEK

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

Prepared 10 . 07 . 2020

Rev. 01 10 . 07 . 2020

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MATERIAL PROPERTIES DATA

Rigid 4000 Resin

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

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

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

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

SOLVENT COMPATIBILITY

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

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

formlabs

Tough & Durable

Materials for Engineering, Manufacturing, and Product Design

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

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

Tough 2000
Stiff, sturdy, rugged prototyping

Tough 1500
Stiff, pliable, resilient prototyping

Durable
Soft, pliable prototyping material

formlabs

Tough 2000

Resin for Rugged Prototyping

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

Strong and stiff prototypes

Sturdy jigs and fixtures

ABS-like strength and stiffness

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

Prepared 10 . 07 . 2020

Rev. 01 10 . 07 . 2020

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MATERIAL PROPERTIES DATA

Tough 2000 Resin

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

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

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

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

SOLVENT COMPATIBILITY

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

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

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Tough 1500

Resin for Resilient Prototyping

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

Springy prototypes and assemblies

Snap fit and press fit connectors

Polypropylene-like strength and stiffness

Certified biocompatible for extended skin-contact

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

Prepared 10 . 07 . 2020

Rev. 02 05 . 04 . 2021

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

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

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

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

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

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

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

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

SOLVENT COMPATIBILITY

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

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

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Durable

Resin for Pliable Prototyping

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

Squeezable prototypes

Low friction and non-degrading surfaces

Impact resistant jigs

Polyethylene-like strength and stiffness

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

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

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MATERIAL PROPERTIES DATA

Durable Resin

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

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

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

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

SOLVENT COMPATIBILITY

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

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

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Flexible & Elastic

Materials for Engineering, Manufacturing, and Product Design

Replace outsourcing and molding of silicone, urethane, and rubber parts. With Formlabs 3D printers, it's possible to produce flexible parts in-house in a matter of hours using our family of Flexible and Elastic Resins.

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

Flexible 80A

Hard flexible parts with slow return

Elastic 50A

Soft flexible parts that spring back

FLEXIBLE & ELASTIC RESIN

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Flexible 80A

Resin for Hard Flexible Prototypes

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

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

Cartilage and ligament anatomy

Seals, gaskets, masks

Handles, grips, overmolds

V1 **FLFL8001**

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

Prepared 10 . 07 . 2020

Rev. 01 10 . 07 . 2020

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MATERIAL PROPERTIES DATA

Flexible 80A Resin

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

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

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

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

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

SOLVENT COMPATIBILITY

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

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

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Elastic 50A

Resin for Soft Flexible Parts

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

Compliant features for robotics

Wearables and consumer goods prototyping

Medical models and devices

Special effects props and models

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

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

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MATERIAL PROPERTIES DATA

Elastic 50A Resin

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

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

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

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

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

SOLVENT COMPATIBILITY

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

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

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Silicone

Materials for Engineering, Manufacturing, and Product Design

Cost and time-effective solutions for fabricating functional prototypes, validation units, tooling, and small batches of silicone parts.

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

Silicone 40A

100% silicone material for soft, pliable, and durable parts

SILICONE RESIN

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Silicone 40A

100% Silicone Material for Soft, Pliable, and Durable Parts

Enabled by Formlabs' Pure Silicone Technology™, Silicone 40A Resin produces 100% silicone parts with excellent elasticity, chemical resistance, and thermal stability.

Seals, gaskets, and connectors for industrial and automotive applications requiring high thermal and chemical resistance

Wearables, grippers, and consumer goods prototypes requiring excellent tear strength and rebound resilience

Medical device components, patient-matched prothesis, and audiology applications

Soft and Flexible fixtures and casting molds for repeated use

V1 **FLSI4001**

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

Prepared 018 . 08 . 2023

Rev. 01 018 . 08 . 2023

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.

	METRIC	IMPERIAL	METHOD
	Post-Cured [1, 2, 3]	Post-Cured [1, 2, 3]	
Mechanical Properties			
Ultimate Tensile Strength	5 MPa	725 psi	ASTM D 412-06 Type C, 500 mm/min
Elongation at Break	230%	230%	ASTM D 412-06 Type C, 500 mm/min
Tear Strength	12 kN/m	68 lbf/in	ASTM D 624-00, Type C
Stress at 50% elongation	0.4 MPa	58 psi	ASTM D 412-06 Type C, 500 mm/min
Stress at 100% elongation	1 MPa	145 psi	ASTM D 412-06 Type C, 500 mm/min
Stress at 150% elongation	2.1 MPa	305 psi	ASTM D 412-06 Type C, 500 mm/min
Compression Set 23 °C for 22 hours	20%	20%	ASTM D 395-03 (B)
Bayshore Resilience	34%	34%	ASTM D2632
Ross Flexing Fatigue at 23 °C	> 500,000 cycles		ASTM D1052, (notched), 60° bending, 100 cycles/minute
Ross Flexing Fatigue at -10 °C	> 500,000 cycles		ASTM D1052, (notched), 60° bending, 100 cycles/minute
General Properties			
Shore Hardness	40A		ASTM 2240
Color	Dark grey		
Viscosity (@ 35 °C)	7800 cP		
Thermal Properties			
Glass Transition Temperature	-107 °C	-161 °F	ASTM D4065

Biocompatability

Silicone 40A Resin is being evaluated as a skin contacting device in accordance with ISO 10993-1 for the following biocompatibility endpoints:

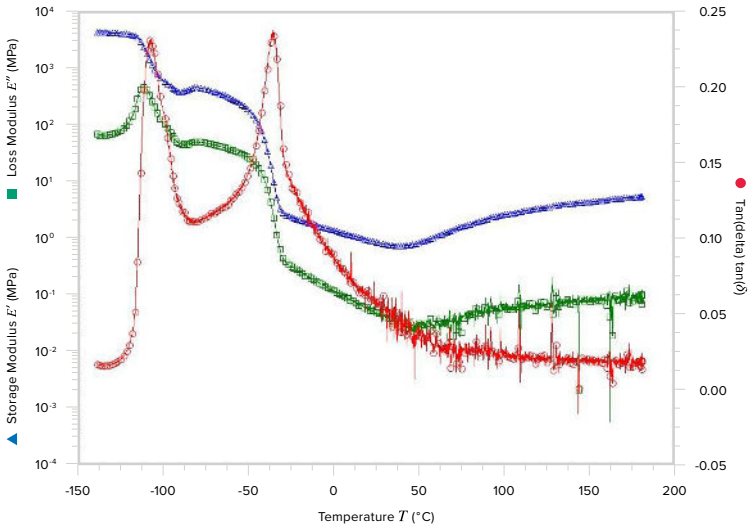
ISO Standard	Description
ISO 10993-5:2009	Pending test data
ISO 10993-23:2021	Pending test data
ISO 10993-10:2021	Pending test data

[1] The measured properties have been determined through internal testing and will be updated with results from an external lab.

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

[3] Data for post-cured samples were measured on Type C tensile bars printed on a Form 3 printer with 100 µm Silicone 40A Resin settings, washed in a Form Wash for 20 minutes in 80% Isopropyl Alcohol / 20% Butyl Acetate, and post-cured at 60 °C for 30 minutes submerged in water in a Form Cure.

Silicone 40A Resin Dynamic Mechanical Analysis (DMA)



A DMA curve from -150 deg C to 180 °C at 3 °C/min is shown. A glass transition is observed at -107 °C, and a crystalline melting transition is observed at -37 °C followed by a rubbery plateau to the conclusion of the test at 180 °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:

Cleaning Chemicals	**24 hr weight gain, %**	**Industrial Fluids**	**24 hr weight gain, %**
Acetone	11.5	Gasoline (ISO 1817, liquid C)	69.8
Bleach ~5% NaOCl	< 0.1	Diesel (Chevron #2)	32.9
Distilled Water	< 0.1	Skydrol 5	23.2
Strong Acid/Base/Alcohol	**24 hr weight gain, %**	Hydraulic Oil	10
Acetic Acid (5%)	< 0.1	Diethyl glycol monomethyl ether	2.5
Hydrochloric Acid (10%)	0.4	Mineral oil (Heavy)	1.6
Sodium hydroxide solution (0.025% pH = 10)	< 0.1	Mineral oil (Light)	2
Salt Water (3.5% NaCl)	< 0.1		
Isopropyl Alcohol	5.9		
Hydrogen peroxide (3%)	< 0.1		
Butyl Acetate	92.3		

If there's any other data that you want us to consider for future versions of the material's technical data sheet please fill out this survey form. For specific questions about how to evaluate the fit of the current material for your application, please reach out to the sales and support teams at Formlabs.

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Polyurethane

Materials for Engineering, Manufacturing, and Product Design

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

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PU Rigid 1000

Stiff, sturdy, and unyielding polyurethane parts

PU Rigid 650

Impact resistant and pliable polyurethane parts

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PU Rigid 1000

For Stiff, Sturdy, and Unyielding Polyurethane Parts

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

Protective casings, housings, and enclosures

Static jigs and fixtures undergoing high-stress

Sturdy consumer products

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

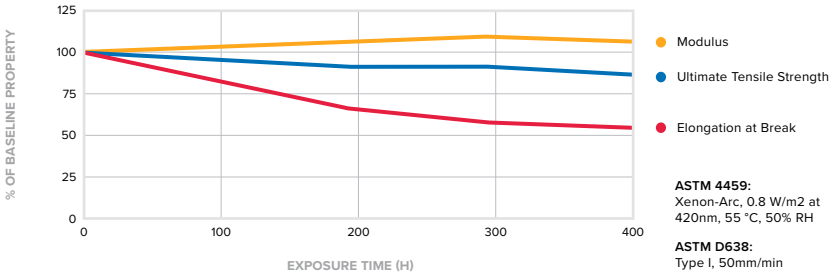
Prepared 04 . 28 . 2022
Rev. 01 04 . 28 . 2022

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.

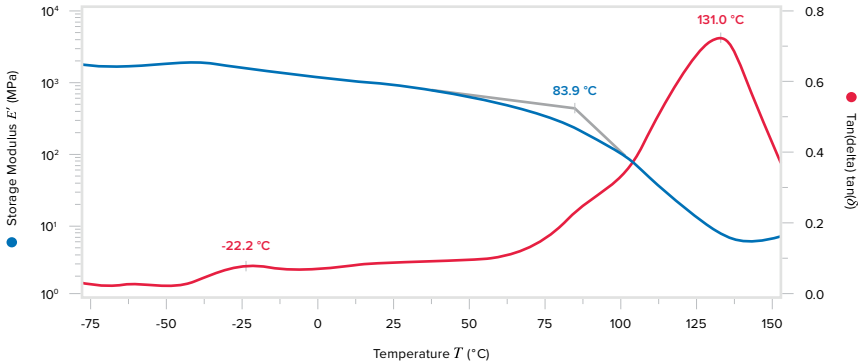
MATERIAL PROPERTIES DATA **PU Rigid 1000 Resin**

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

Accelerated Aging



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



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

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

SOLVENT COMPATIBILITY

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

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

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

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

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

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

formlabs

PU Rigid 650

For Impact Resistant and Semi-Stiff Polyurethane Parts

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

Impact-resistant components

Pliable mechanical connectors

Shock-absorbing bumpers and dampeners

Noise-dampening components

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

Prepared 05 . 03 . 2022

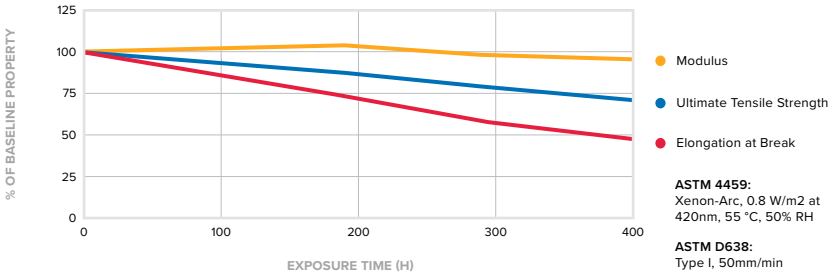
Rev. 01 05 . 03 . 2022

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.

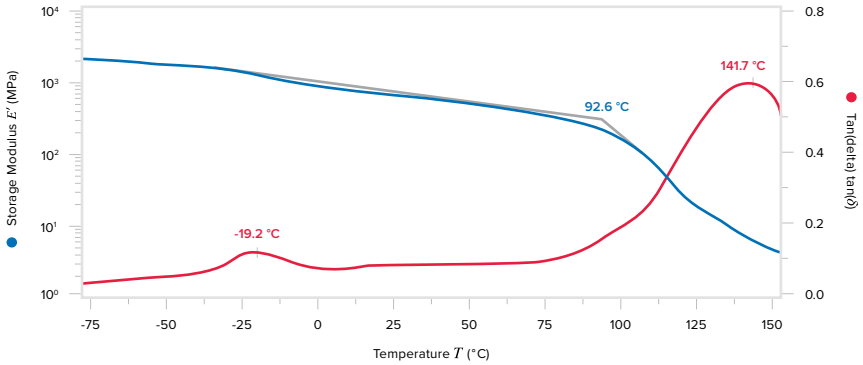
MATERIAL PROPERTIES DATA **PU Rigid 650 Resin**

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

Accelerated Aging



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



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

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

SOLVENT COMPATIBILITY

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

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

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

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

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

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

formlabs

Specialty

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

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

High Temp

High thermal stability

Flame Retardant

UL 94 V-0 certified 3D printed parts with excellent quality and heat resistance

ESD

Rugged ESD-safe material for electronics manufacturing

Alumina 4N

Technical ceramic with extreme performance

SPECIALTY RESIN

formlabs

High Temp

Resin for Heat Resistance

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

Hot air, gas, and fluid flow

Heat resistant mounts, housings, and fixtures

Molds and inserts

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

Prepared 10 . 07 . 2020

Rev. 01 10 . 07 . 2020

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

High Temp Resin

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

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

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

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

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

SOLVENT COMPATIBILITY

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

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

SPECIALTY RESIN

formlabs

Flame Retardant

For UL 94 V-0 Certified Parts With Excellent Part Quality and Heat Resistance

Easily and quickly create stiff, creep-resistant, and functional plastic parts that perform well long-term in indoor and industrial environments. FR Resin is self-extinguishing and halogen-free with favorable flame, smoke, and toxicity (FST) ratings.

Custom jigs, fixtures, and replacement parts for industrial environments with high temperatures or ignition sources

Interior parts in airplanes, automobiles, and railways with excellent surface finish

Protective and internal consumer or medical electronics components

V1 **FLFRGR01** *** May not be available in all regions**

Prepared 13 . 04 . 2023
Rev. 02 26 . 07 . 2023

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.

Flammability [1, 2]	Result			Method
UL 94	V-0 (3mm)	V-1 (2.5mm)	HB (1.5mm)	Scan to view Blue Card
FAR 25.853 Appendix F, Part I (a) (1) (ii)12 seconds Vertical Burn	Pass (2.5mm)			

Smoke Toxicity [3, 4]	Result		Method
	Ds @ 1.5 min	Ds @ 4 min	
Smoke Generation: Flaming at 3mm thickness	19.5	285	ASTM E662
Smoke Generation: Flaming at 5mm thickness	5	114	ASTM E662

Gas Toxicity [3, 4]	Result				Method
Gas Toxicity at 3mm thickness	Pass	CO: 56 PPM HCl: <1 PPM	HCN: 7 PPM HF: <1 PPM	SO2: <1 PPM (NO + NO2) NOx: <1 PPM	BSS 7239

	METRIC [3, 5]			IMPERIAL [3, 5]			METHOD
	Green	Post-Cured 70 °C 60m	Post-Cured 80 °C 120m	Green	Post-Cured 70 °C 60m	Post-Cured 80 °C 120m	
Mechanical Properties [5, 6]							
Ultimate Tensile Strength	24 MPa	38 MPa	41 MPa	3560 psi	5590 psi	5990 psi	ASTM D638-14
Tensile Modulus	1.8 GPa	2.9 GPa	3.1 GPa	263 ksi	430 ksi	446 ksi	ASTM D638-14
Elongation at Break	20%	9.4%	7.1%	20%	9.40%	7.10%	ASTM D638-14
Flexural Properties							
Flexural Strength	36 MPa	72 MPa	75 MPa	5280 psi	10500 psi	10900 psi	ASTM D790-15
Flexural Modulus	1.3 GPa	2.7 GPa	2.7 GPa	188 ksi	392 ksi	401 ksi	ASTM D790-15
Impact Properties							
Notched Izod	19 J/m	22 J/m	22 J/m	0.36 ft-lbs/in	0.41 ft-lbs/in	0.42 ft-lbs/in	ASTM D256-10
Unnotched Izod	227 J/m	241 J/m	257 J/m	4.26 ft-lbs/in	4.51 ft-lbs/in	4.82 ft-lbs/in	ASTM D4812-11
Fracture Properties							
Maximum Stress Intensity Factor (Kmax)		1.05 $MPa \cdot m^{1/2}$	1.11 $MPa \cdot m^{1/2}$		956 $psi \cdot in^{0.5}$	1009 $psi \cdot in^{0.5}$	ISO 20795-1:2013(E), Section 8.6
Work of Fracture (Wf)		311 J/m^2	277 J/m^2		21 $ft\text{-}lbs/ft^2$	19 $ft\text{-}lbs/ft^2$	ISO 20795-1:2013(E), Section 8.6
Thermal Properties							
Heat Deflection Temp. @ 1.8 MPa	45 °C	71 °C	83 °C	113 °F	160 °F	181 °F	ASTM D648-16
Heat Deflection Temp. @ 0.45 MPa	55 °C	94 °C	111 °C	131 °F	201 °F	232 °F	ASTM D648-16
Coefficient of Thermal Expansion, 20°- 80°C		98.6 µm/m/°C	68.1 µm/m/°C		54.8 µin/in/°F	37.8 µin/in/°F	ASTM E813-13
Glass Transition Temperature (Tg)	101 °C	130 °C	144 °C	214 °F	266 °F	291 °F	Peak of tan delta, Heating Rate: 3°Cpm

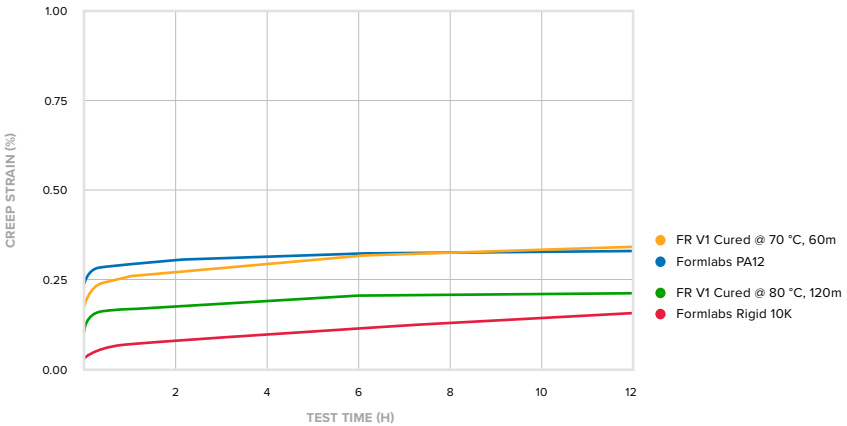
General Properties	Result		Method
Hardness	Green: 74D	Post Cured: 80D	ASTM D2240
Bulk Density	1.25 g/cm^3		ASTM D792-20
Viscosity (25 °C)	4500 - 5000 cP		
Color	Light grey		

Electrical Properties [3, 5]	Result	Method
Dielectric Strength	15.1 kV/mm	ASTM D149
Dielectric Constant	3.83	ASTM D150, 0.5 MHz
Dielectric Constant	3.82	ASTM D150, 1.0 MHz
Dissipation Factor	0.024	ASTM D150, 0.5 MHz
Dissipation Factor	0.025	ASTM D150, 1 MHz
Volume Resistivity	2.1 x 10^{15} ohm-cm	ASTM D257

Outgassing [3, 5]	Result	Method
Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment	Pass Total Mass Loss (TML): 0.87% Collected Volatile Condensable Material (CVCM): <0.01% Water Vapor Recovered (WVR): 0.2%	ASTM E595

Tensile Creep Resistance (ASTM D2990-17)

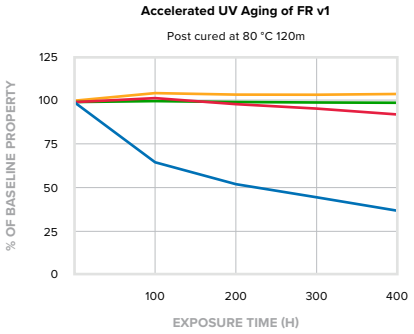
Creep resistance measurements of Formlabs materials tested at 65 °C and a 1.8 MPa load.

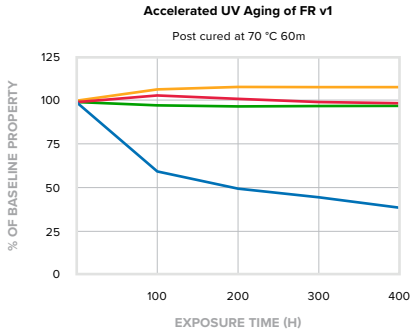


Formlabs Flame Retardant Resin parts have high creep resistance. Post-curing Flame Retardant Resin samples at 80 °C for 120 minutes shows improved creep resistance compared to post-curing at 70 °C for 60 minutes. Flame Retardant Resin samples post-cured at 80 °C and 120 minutes is slightly lower in creep resistance than Rigid 10K Resin samples. Flame Retardant Resin samples post-cured at 70 °C and 60 minutes showed similar creep behavior as Formlabs Nylon 12 SLS Powder.

Accelerated UV Aging [3, 5]

	Method
Indoor UV Stability Formlabs evaluated the UV aging performance of FR v1 using ASTM D4459, a test standard for xenon-arc exposure of plastics for indoor applications. This test simulates polymer aging due to solar radiation exposure through glass.	ASTM D4459 Standard practice for Xenon-Arc exposure of plastics intended for indoor applications





Accelerated UV Aging

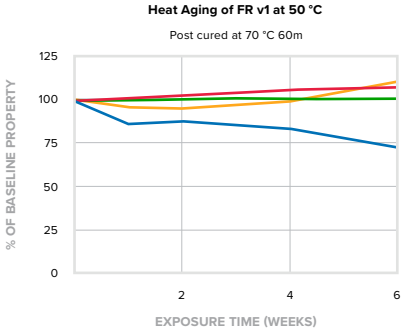
ASTM 4459: Xenon-Arc, 0.8 W/m² at 420nm, 55 C, 50% RH

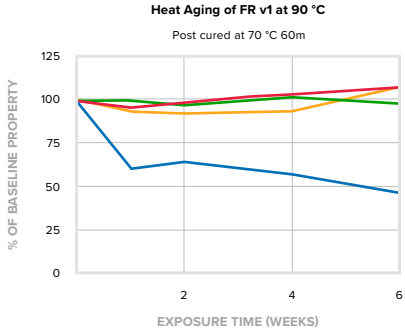
ASTM D638: Type 4, 5mm/min

- EAB (%)
- Modulus (%)
- UTS (%)
- Impact (%)

Long Term Aging [3, 5]

	Method
Heat Aging Formlabs evaluated the heat aging performance of FR v1 using ASTM D3045, a test method for evaluating heat aging of plastics without load. In this test, mechanical properties of samples placed at 50 °C or 90 °C environments are measured at different durations of time for up to 6 weeks.	ASTM D3045 A test time of 6 weeks at 50 or 90 °C





Accelerated Heat Aging

ASTM D3045: 50C and 90C for 1, 2, 4 and 6 weeks each

ASTM D638: Type 4, 5mm/min

- EAB (%)
- Modulus (%)
- UTS (%)
- Impact (%)

SOLVENT COMPATIBILITY [3]

Flame Retardant Resin

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

Cleaning Chemicals	**24 hr weight gain, %**
Acetone	2.1
Bleach ~5% NaOCl	0.3
Windex Powerized Formula	0.3
Hydrogen Peroxide (30%)	1
Soapy water	0.2
TPM	0.1
Distilled Water	0.2

Strong Acid/Base/Alcohol	
Hydrochloric Acid (10%)	< 0.1
Sodium Hypochlorite Solution	< 0.1
Sodium hydroxide solution (0.025% pH = 10)	0.3
Salt Water (3.5% NaCl)	0.2
Isopropyl Alcohol	0.2
Hydrogen peroxide (3%)	0.2
Butyl Acetate	0.4
Sulfuric Acid (30%)	Disintegrated

Industrial Fluids	
Gasoline ISO 1817, liquid C	< 0.1
Transmission Fluid (Havoline Synthetic ATF)	< 0.1
Engine Oil (Havoline SAE 5W-30	< 0.1
Brake Fluid (Castrol DOT-4)	< 0.1
Diesel (Chevron #2)	< 0.1
Power Steering Fluid	< 0.1
Skydrol 5	< 0.1
Hydraulic Oil	< 0.1
Diethyl glycol monomethyl ether	0.3
Mineral oil, heavy	< 0.1
Mineral oil, light	< 0.1

[1] UL flammability rating bars were printed on Form 3+/Form 3 printers with 50µm Flame Retardant Resin settings, washed in a Form Wash for (a) 10 minutes in ≥99% Isopropyl Alcohol or (b) 15 minutes in ≥99% Tripropylene glycol monomethyl ether, with a quick water rinse, and then post-cured at 70°C for 60 minutes in a Form Cure. This rating can be achieved printing in any orientation and any available layer height on a Form 3, Form 3+, Form 3B, Form 3B+, Form 3L or Form 3BL

[2] FAR 25.853 Appendix F Part I (a) bars were printed on a Form 3L printer with 100µm Flame Retardant Resin settings, washed in a Form Wash L for 10 min in ≥99% Isopropyl Alcohol, and then post-cured at 70°C for 60 min in a Form Cure L.

[3] Data for post-cured samples were printed on a Form3+ printer with 100 µm Flame Retardant Resin settings, washed in a Form Wash for 10 minutes in ≥99% Isopropyl Alcohol, and post-cured at 70°C for 60 minutes in a Form Cure unless specified otherwise.

[4] 5mm thickness samples pass Smoke Tests based on a passing criteria of <200 for Ds @ 4 min in flaming mode for ASTM E 662. Users can additionally test samples for thicknesses between 3mm-5mm based on their design constraints. Samples pass Gas Toxicity at 3mm thickness.

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

[6] Data for tensile samples were measured on Type I tensile bars printed on a Form 3+ printer with 100 µm Flame Retardant Resin settings, washed in a Form Wash for 10 minutes in ≥99% Isopropyl Alcohol, and post-cured at 70°C for 60 minutes or 80°C for 120 minutes in a Form Cure.

SPECIALTY RESIN

formlabs

ESD

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

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

Anti-static prototypes and end-use parts

Housings for sensitive electronics

Tooling, jigs, and fixtures for electronics manufacturing

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

Prepared 12 . 01 . 2021

Rev. 01 12 . 01 . 2021

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

ESD Resin

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

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

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

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

SOLVENT COMPATIBILITY

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

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

formlabs

Alumina 4N

Technical Ceramic with Extreme Performance

A 99.99% purity technical ceramic with exceptional performance in extreme environments: thermally resistant, hard, abrasion resistant, mechanically strong, and chemically inert.

High voltage components

Insulating housings or tubes

Mixing blades and pipes

Foundry tools for metal casting

V1 **FLAL4N01** * May not be available in all regions

Prepared 31 . 09 . 2023
Rev. 01 31 . 09 . 2023

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

Alumina 4N Resin

	METRIC	IMPERIAL	METHOD
Resin Properties			
Purity (%)	99.99%		-
Particle Size	d90 < 1 micron		-
Green State Properties			
Flexural Strength [3]	3.6 MPa	520 psi	ASTM D 790
Flexural Modulus [3]	24.5 MPa	3.5 ksi	ASTM D 790
Shore D Hardness [3]	70D		ASTM D 2240
Color	Off-White		
Sintered State Properties			
Physical and Mechanical Properties			
4 Point Flex Strength (XY) [3, 5]	400 MPa	58 ksi	ASTM C-1259
4 Point Flex Strength (Z) [3, 5]	320 MPa	46 ksi	ASTM C-1259
Weibull Modulus (XY) [3, 5]	9	-	ASTM C-1259
Theoretical Density [4, 5]	3.987 g/cm^3	0.144 lbs/in3	-
Relative Density [3, 5]	98.60%	-	ASTM C-373
Compressive Strength [4, 5]	2200 MPa	330 ksi	ASTM C-773
Color	White		-
Vickers Hardness [4, 5]	1500	-	-
Young's Modulus [4, 5]	390 GPa	58,000 ksi	ASTM C-1259
Fracture Toughness [4, 5]	3-5 MPa ·√m	-	ASTM C-1421
Surface Roughness [3, 5]	0.5-3 microns Ra	20-120 microinches Ra	
Electrical Properties			
Electrical Resistivity [4, 5]	> 1x10^{14} ohm metre (Ω·m)	-	ASTM D-257
Dielectric Loss tan delta (tan δ), 1 MHz [4, 5]	9x10^{-5}	-	-
Permittivity [4, 5]	9.8	-	-
Thermal properties			
Coefficient of Thermal Expansion [4, 5]	5 ppm/K	2.78 ppm / °F	ASTM E-228
Maximum Working Temperature [3, 5]	1500 °C	2750 °F	-
Thermal Conductivity [4, 5]	32 W/m·K	-	-

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

[2] All sintered parts were fired using a 2 oven conservative firing schedule (schedule #1)

[3] Internally measured data

[4] Literature value

[5] Currently testing at an independent testing lab

If there's any other data that you want us to consider for future versions of the material's technical data sheet please fill out this survey form. For specific questions about how to evaluate the fit of the current material for your application, please reach out to the sales and support teams at Formlabs.

To learn more about how to use Alumina 4N Resin, visit our support site.

Dental

High-Accuracy Materials for Dental Labs and Practices

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

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

Model
Stone-colored models

Draft
Fast-printing models

Castable Wax
Castable and pressable restorations

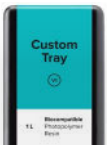
Surgical Guide
Implant guides

IBT
Indirect bonding trays

IBT Flex
Flexible, and tear-resistant material for printing trays and guides

Dental LT Clear
Occlusal splints

Dental LT Comfort
Comfortable long-term splints, night guards, and bleaching trays



Custom Tray
Custom impression trays

Temporary CB
Temporary crowns, bridges, inlays, onlays, and veneers

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

Permanent Crown
Permanent crowns, inlays, onlays, and veneers

VITA CLASSICAL SHADES:
A2, A3, B1, C2

Denture Base & Teeth
Long term, temporary, and try-in dentures

Soft Tissue (Starter Pack)
Gingiva masks

DENTAL RESIN

formlabs | dental

Model

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

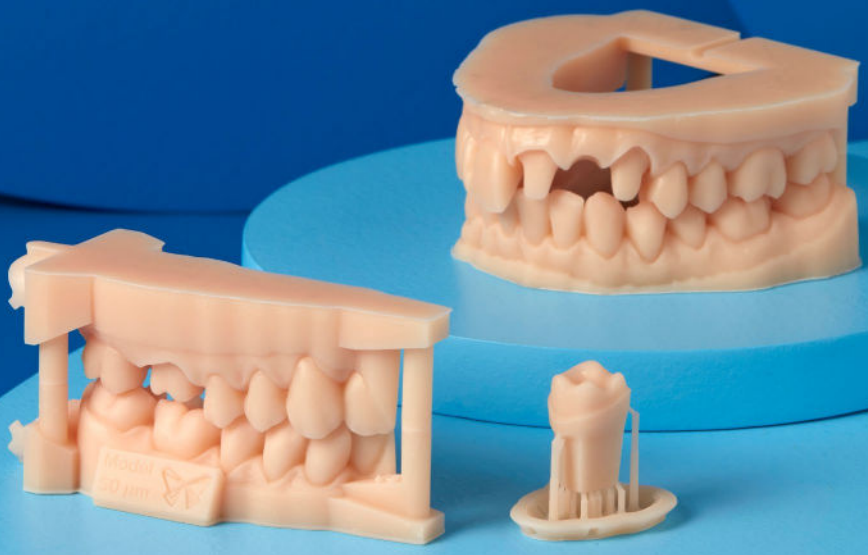
Model Resin was developed to meet the precision, reliability, and throughput requirements of restorative dentistry. Print accurate models and dies with crisp margins and contacts, delivering high-quality results on fast-paced timelines.

Crown and bridge models

Implant analog models

Orthodontic models

Diagnostic models



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

Prepared 11 . 09 . 2021

Rev. 01 11 . 09 . 2021

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

Model Resin

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

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

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

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

SOLVENT COMPATIBILITY

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

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

DENTAL RESIN

formlabs | dental

Draft

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

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

Rapid model production

Orthodontic models

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

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

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

Draft Resin

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

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

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

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

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

SOLVENT COMPATIBILITY

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

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

formlabs | dental

Castable Wax

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

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

Patterns for casting and pressing

Crowns

Removable partial denture frameworks

Bridges

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

Prepared 10 . 02 . 2017

Rev. 01 10 . 02 . 2017

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

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

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

formlabs | dental

Surgical Guide

A premium-quality material for printing surgical implant guides

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

Surgical guides

Device sizing templates

Pilot drill guides

Drilling templates

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

Prepared 11 . 04 . 2019

Rev. 02 21 . 07 . 2021

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.

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

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

For more details on sterilization compatibilities, visit formlabs.com

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

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

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

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

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

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

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

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

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

DENTAL RESIN

formlabs | dental

IBT

A flexible material that enables efficient, accurate orthodontic bracket placement

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

Indirect Bonding Trays

V1 **FLIBCL01** *** Regional availability may vary.**

Prepared 14 . 01 . 2021

Rev. 02 21 . 07 . 2021

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.

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

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

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

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

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

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

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

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

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

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

DENTAL RESIN

formlabs | dental

IBT Flex

A Flexible, and Tear-Resistant Material for Printing Highly Accurate Indirect Bonding Trays and Direct Composite Restoration Guides with Enhanced Translucency

3D print flexible and tear-resistant translucent trays and guides that save you time and deliver consistent, predictable outcomes. IBT Flex Resin is a Class I biocompatible material with enhanced flexibility, strength, translucency, and color to guarantee optimal clinical outcomes while providing a great patient experience and for seamless and precise transfer of orthodontic brackets and restorative composite materials.

Direct Composite Restoration Guides

Indirect Bonding Trays

V1 **FLIBFL01** *** Regional availability may vary.**

Prepared 14 . 09 . 2023

Rev. 01 14 . 09 . 2023

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.

	Post-Cured [1, 2]	Method
Disinfection Compatibility		
Tensile Strength	7.2 MPa	ASTM D412
Tensile Modulus	8 MPa	ASTM D412
Elongation at Break	135 %	ASTM D412
Hardness Shore A	77 - 80A	ASTM D2240
Transparency (2 mm sample)	85%	-

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

IBT Flex 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 7405:2018, Dentistry - Evaluation of biocompatibility of medical devices used in dentistry, and passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3]
ISO 10993-5:2009	Met requirements of test
ISO 10993-23:2021	Met requirements of test
ISO 10993-10:2021	Met requirements of test

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

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

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

[2] Data was obtained from parts printed using Form 3B(+), 100 µm, IBT Flex Resin settings, and using post-processing instructions listed in the IBT Flex Resin Manufacturing Guide.

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

DENTAL RESIN

formlabs | dental

Dental LT Clear

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

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

Occlusal guards **Splints**

V2 **FLDLCL02** *** May not be available in all regions**

Prepared 09 . 16 . 2020
Rev. 01 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 **Dental LT Clear V2 Resin**

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

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

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

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

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

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

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

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

DENTAL RESIN

formlabs | dental

Dental LT Comfort

A Flexible And Durable Material For Optimally Comfortable Long-Term Splints, Night Guards, and Bleaching Trays

Directly print flexible occlusal splints in-house, more easily than ever. Printed splints are easily polished to high optical transparency, and offer enhanced comfort and durability that boosts patient adoption and compliance.

Occlusal Splints

Night Guards

Bleaching Trays

V1 **FLDLCO01** *** May not be available in all regions**

Prepared 23 . 05 . 2023

Rev. 01 23 . 05 . 2023

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 Comfort Resin

	METRIC [1]	METHOD
	Post-Cured [2]	
Mechanical Properties		
Elongation	33 %	ASTM D 638-14 (Type IV)
Flexural Properties		
Flexural Strength	21 MPa	ASTM D 790-15 (Method B)
Flexural Modulus	643 MPa	ASTM D 790-15 (Method B)
Hardness Properties		
Hardness Shore D	75D	ASTM D 2240-15 (Type D)
Impact Properties		
Notched IZOD	98 J/m	ASTM D 256-10 (Method A)
Other Properties		
Water Sorption	31 ug/mm^3	ISO 20795-2
Water Solubility	4 ug/mm^3	ISO 20795-2

Dental LT Comfort 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 7405:2018, Dentistry - Evaluation of biocompatibility of medical devices used in dentistry, and passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3]
ISO 10993-5:2009	Not cytotoxic
ISO 10993-23: 2021	Not an irritant
ISO 10993-10:2021	Not a sensitizer
ISO 10993-11:2017	Not toxic
ISO 10993-3:2014	Not genotoxic

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

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

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

[2] Data were measured on post-cured samples printed on a Form 3B with 100 µm Dental LT Comfort Resin settings, washed in a Form Wash for 10 minutes in 99% Isopropyl Alcohol, and post-cured at 60 C for 20 minutes in a Form Cure.

[3] Dental LT Comfort Resin was tested at NAMSA World Headquarters, OH, USA.

DENTAL RESIN

formlabs | dental

Custom Tray

A production-ready material that enables highly accurate definitive impressions

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

Impression Trays

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

Prepared 10 . 07 . 2020

Rev. 02 21 . 07 . 2020

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.

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

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

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

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

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

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

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

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

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

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

formlabs | dental

Temporary CB

A validated material for comfortable, aesthetic temporary restorations

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

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

Temporary Restorations:

Bridges (up to 7 units)

Crowns

Veneers

Onlays

Inlays

V1

FLTCA201
FLTCA301

FLTCB101
FLTCC201

FLTCBL01

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

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

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

Temporary CB Resin

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

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

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

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

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

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

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

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

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

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

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

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

DENTAL RESIN

formlabs | dental

Permanent Crown

A validated material for comfortable, aesthetic permanent restorations

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

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

Permanent Restorations:

Inlays

Crowns

Veneers

Onlays

V1

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

formlabs | dental

Denture Base and Teeth

Long-lasting materials for truly lifelike permanent prosthetics

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

Dentures **Try-ins**

V1

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

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

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

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.

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

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

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

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

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

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

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

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

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

formlabs | dental

Soft Tissue Starter Pack

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

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

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

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

Soft tissue for implant models

Gingiva masks

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

Prepared 11 . 18 . 2020

Rev. 01 11 . 18 . 2020

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 **Soft TissueStarter Pack (Flexible 80A Resin)**

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

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

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

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

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

SOLVENT COMPATIBILITY

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

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

formlabs

Medical

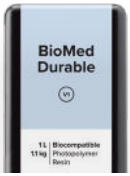
High-Performance Materials for Biocompatible Applications

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

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

BioMed Clear

For long-term bodily contact



BioMed Durable

For matte black, rigid, biocompatible parts

BioMed Flex 80A

For long-term bodily contact

BioMed Elastic 50A

For short-term bodily contact

BioMed White

For white, rigid, biocompatible parts

BioMed Black

For matte black, rigid, biocompatible parts

BioMed Amber

For short-term bodily contact

MEDICAL RESIN

formlabs | healthcare

BioMed Clear

Biocompatible Photopolymer Resin for Formlabs SLA Printers

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

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

Medical devices and device components

Ventilator and PPE components

Bioprocessing equipment

Drug delivery devices

Research and Development

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

Prepared 06 . 12 . 2020

Rev. 04 24 . 04 . 2023

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

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

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

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

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

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

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

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

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

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

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

MEDICAL RESIN

formlabs | healthcare

BioMed Durable

For Strong and Impact Resistant Medical Devices and Instruments

BioMed Durable Resin is a clear material for biocompatible applications requiring impact, shatter, and abrasion resistance. This USP Class VI material is made in an FDA-registered, ISO 13485 facility and can be used in applications for long-term skin (>30 days), and short-term tissue, bone, and dentin contact (<24hrs).

Other biocompatibility endpoints have not been evaluated and may be added over time.

End-Use Devices and Components Requiring Biocompatibility and Impact Resistance

Patient-Specific Instruments

Single-Use Instruments

V1 **FLBMDU01** *** May not be available in all regions**

Prepared 19 . 05 . 2023

Rev. 01 19 . 05 . 2023

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 Durable Resin

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured [2]	Post-Cured [2]	
Tensile Properties			
Ultimate Tensile Strength	29.1 MPa	4230 psi	ASTM D 638-14 (Type IV)
Young's Modulus	994 MPa	144 ksi	ASTM D 638-14 (Type IV)
Elongation	33%		ASTM D 638-14 (Type IV)
Flexural Properties			
Flexural Stress at 5% Strain	21 MPa	92 ksi	ASTM D 790-15 (Procedure B)
Flexural Modulus	643 MPa	3070 psi	ASTM D 790-15 (Procedure B)
Hardness Properties			
Hardness Shore D	75D		ASTM D 2240-15 (Type D)
Impact Properties			
Notched IZOD	98 J/m	1.84 ft-lbf/in	ASTM D 256-10 (Method A)
Unnotched IZOD	1340 J/m	25.1 ft-lbf/in	ASTM D 4812-11
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	40 °C	104 °F	ASTM D 648-18 (Method B)
Heat Deflection Temp. @ 0.45 MPa	46 °C	115 °F	ASTM D 648-18 (Method B)
Coefficient of Thermal Expansion	102.9 um/m/C		ASTM E 831-13

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

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

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

ISO Standard	Description [3]	ISO Standard	Description [3]
EN ISO 10993-5:2009	Not cytotoxic	ISO 10993-11: 2017	No evidence of acute systemic toxicity
ISO 10993-10:2010/(R)2014	Not an irritant	ISO 10993-11: 2017/USP, General Chapter <151>, Pyrogen Test	Non-pyrogenic
ISO 10993-10:2010/(R)2014	Not a sensitizer	USP <88> Biological Reactivity Tests, In-vivo	USP Class VI Certified

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

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

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

[2] Data were measured on post-cured samples printed on a Form 3B with 100um BioMed Durable Resin settings, washed in a Form Wash for 10 minutes in 99% Isopropyl Alcohol, and post-cured at 60°C, 20 minutes in a Form Cure.

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

SOLVENT COMPATIBILITY

BioMed Durable Resin

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

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	0.7	Mineral oil, heavy	0.1
Acetone	12.4	Mineral oil, light	0.1
Bleach ~5% NaOCl	0.5	Salt Water (3.5% NaCl)	0.5
Butyl Acetate	5.0	Skydrol 5	0.6
Diesel Fuel	0.1	Sodium hydroxide solution (0.025% pH = 10)	0.5
Diethyl glycol monomethyl ether	3.0	Strong Acid (HCl Conc)	0.7
Hydraulic Oil	0.2	TPM	1.1
Hydrogen peroxide (3%)	0.6	Water	0.5
Isooctane	0.02	Xylene	4.8
Isopropyl Alcohol	2.0		

MEDICAL RESIN

formlabs | healthcare

BioMed Flex 80A

For Flexible, Biocompatible, Transparent Medical Devices and Models

BioMed Flex 80A Resin is a firm, flexible, medical-grade material for applications requiring durability, biocompatibility, and transparency. This ISO 10993 and USP Class VI certified material is made in an FDA-registered, ISO 13485 facility and can be used in applications for long-term skin (> 30 days), and short-term mucosal membrane contact (< 24hrs).

Flexible Biocompatible Medical Devices

Firm Tissue Models to Assist in Surgeries

V1 **FLBMFL01** *** May not be available in all regions**

Prepared 20 . 09 . 2023

Rev. 01 20 . 09 . 2023

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 Flex 80A

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured [2]	Post-Cured [2]	
Mechanical Properties			
Ultimate Tensile Strength [3]	7.2 MPa	1040 psi	ASTM D 412-06 (A)
Stress at 50% Elongation	2.6 MPa	377 psi	ASTM D 412-06 (A)
Stress at 100% Elongation	4.5 MPa	653 psi	ASTM D 412-06 (A)
Elongation at Break	135 %	135 %	ASTM D 412-06 (A)
Tear Strength [4]	22 kN/m	125 lbf/in	ASTM D 624-00
Shore Hardness	77 - 80A	77 - 80A	ASTM 2240
Compression Set 23 °C for 22 hours	24.7 %	24.7 %	ASTM D 395-03 (B)
Compression Set 70 °C for 22 hours	5.3 %	5.3 %	ASTM D 395-03 (B)
Bayshore Resilience	29 %	29 %	ASTM D2632
Thermal Properties			
Glass transition temperature (Tg)	37 °C	99 °F	DMA

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

Samples printed with BioMed Flex 80A Resin have been evaluated in accordance with the following biocompatibility endpoints:

ISO Standard	Description [3]
ISO 10993-5:2009	Met requirements of test
ISO 10993-23:2021	Met requirements of test
ISO 10993-10:2021	Met requirements of test
USP <88> Biological Reactivity Tests, In-vivo	USP Class VI Certified

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

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

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

[2] Data was obtained from parts printed using Form 3B, 100 µm, BioMed Flex 80A Resin settings, and using the BioMed Flex 80A MFG guide.

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

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

SOLVENT COMPATIBILITY

BioMed Flex 80A

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%	1.42	Isooctane (aka gasoline)	9
Acetone	65.3	Mineral oil (light)	0.4
Isopropyl Alcohol	25.9	Mineral oil (Heavy)	0.2
Bleach ~5% NaOCl	0.5	Salt Water (3.5% NaCl)	0.5
Butyl Acetate	97.5	Sodium Hydroxide solution (0.025% PH 10)	0.6
Diesel Fuel	5.1	Water	0.6
Diethyl Glycol Monomethyl Ether	30.9	Xylene	112.5
Hydraulic Oil	2.5	Strong Acid (HCl conc)	37.3
Skydrol 5	28.1	Tripropylene Glycol Methyl Ether (TPM)	31.2
Hydrogen peroxide (3%)	0.7		

MEDICAL RESIN

formlabs | healthcare

BioMed Elastic 50A

For Soft, Biocompatible, Transparent Medical Devices and Models

BioMed Elastic 50A Resin is a soft, elastic, medical grade material for applications requiring comfort, biocompatibility, and transparency. This ISO 10993 and USP Class VI certified material is made in an FDA-registered, ISO 13485 facility and can be used in applications for long-term skin contact (> 30 days), and short-term mucosal membrane contact (< 24hrs).

Elastic Biocompatible Medical Devices

Soft Tissue Models to Assist in Surgeries

V1 **FLBMEL01** * May not be available in all regions

Prepared 20 . 09 . 2023
Rev. 01 20 . 09 . 2023

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 Elastic 50A

	METRIC [1]	IMPERIAL [1]	METHOD
	Post-Cured [2]	Post-Cured [2]	
Mechanical Properties			
Ultimate Tensile Strength [3]	2.3	339	ASTM D 412-06 (A)
Stress at 50% Elongation	1	145	ASTM D 412-06 (A)
Stress at 100% Elongation	1.3	189	ASTM D 412-06 (A)
Elongation at Break	150%	150%	ASTM D 412-06 (A)
Tear Strength [4]	11	60.8	ASTM D 624-00
Shore Hardness	50A	50A	ASTM 2240
Compression Set 23 °C for 22 hours	8%	8%	ASTM D 395-03 (B)
Compression Set 70 °C for 22 hours	11%	11%	ASTM D 395-03 (B)
Bayshore Resilience	15%	15%	ASTM D2632
Thermal Properties			
Glass transition temperature (Tg)	-36 °C	-32.8 °F	DMA

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

Samples printed with BioMed Elastic 50A Resin have been evaluated in accordance with the following biocompatibility endpoints:

ISO Standard	Description [3]
ISO 10993-5:2009	Met requirements of test
ISO 10993-23:2021	Met requirements of test
ISO 10993-10:2021	Met requirements of test
USP <88> Biological Reactivity Tests, In-vivo	USP Class VI Certified

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

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

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

[2] Data was obtained from parts printed using Form 3B, 100 µm, BioMed Elastic 50A settings, and using the BioMed Elastic 50A MFG guide.

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

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

SOLVENT COMPATIBILITY

BioMed Elastic 50A

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%	1.5	Isooctane (aka gasoline)	15.6
Acetone	43.4	Mineral oil (light)	0.7
Isopropyl Alcohol	39.2	Mineral oil (Heavy)	0.4
Bleach ~5% NaOCl	0.6	Salt Water (3.5% NaCl)	0.6
Butyl Acetate	133.1	Sodium Hydroxide solution (0.025% PH 10)	0.7
Diesel Fuel	7.9	Water	0.7
Diethyl Glycol Monomethyl Ether	31.4	Xylene	163.9
Hydraulic Oil	3.9	Strong Acid (HCl conc)	45.6
Skydrol 5	41.2	Tripropylene Glycol Methyl Ether (TPM)	43.6
Hydrogen peroxide (3%)	0.9		

MEDICAL RESIN

formlabs | healthcare

BioMed White

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

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

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

End-use medical devices and device components

Cutting and drilling guides

Surgical guides and templates

Anatomical models that can be used in the OR

Patient-specific implant sizing models and molds

Biocompatible molds, jigs, and fixtures

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

Prepared 03 . 30 . 2022

Rev. 01 03 . 30 . 2022

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 White Resin

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

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

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

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

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

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

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

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

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

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

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

SOLVENT COMPATIBILITY

BioMed White Resin

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

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

MEDICAL RESIN

formlabs | healthcare

BioMed Black

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

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

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

Medical devices and device components

Biocompatible molds, jigs, and fixtures

End-use parts requiring patient contact

Consumer goods

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

Prepared 03 . 30 . 2022

Rev. 01 03 . 30 . 2022

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 Black Resin

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

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

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

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

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

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

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

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

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

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

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

SOLVENT COMPATIBILITY

BioMed Black Resin

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

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

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BioMed Amber

Biocompatible Photopolymer Resin for Formlabs SLA Printers

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

Medical devices and device components

Research and development

Surgical planning and implant sizing tools

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

Prepared 11 . 04 . 2019

Rev. 02 31 . 01 . 2023

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 Amber Resin

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

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

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

Disinfection Compatibility	
Chemical Disinfection	70% Isopropyl Alcohol for 5 minutes

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

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

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

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

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

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

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

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Jewelry

High-Accuracy Materials for Dental Labs and Practices

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

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

Castable Wax 40

For casting challenging, highly detailed designs

Castable Wax

For casting thin, filigree patterns

formlabs

Castable Wax 40

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

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

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

Prepared 12 . 10 . 2020

Rev. 01 12 . 10 . 2020

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.

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

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

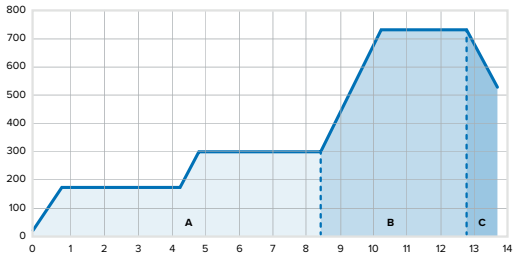
[2] Data was obtained from green parts, printed using Form 3, 50 µm, Castable Wax 40 Resin settings, without post-cure.

STANDARD BURNOUT SCHEDULE

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

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

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



Washing Info:

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

Post-Curing Info:

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

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Castable Wax

Sharp Detail and Clean Casting Every Time.

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

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

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

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

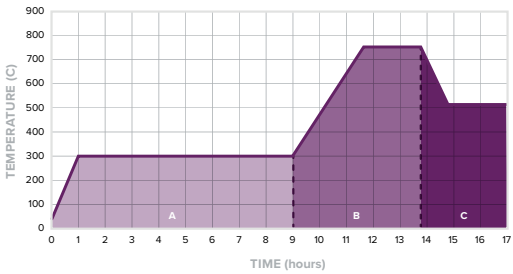
[1] Material properties can vary with part geometry, print orientation, print settings, and temperature.

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

STANDARD BURNOUT SCHEDULE

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

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

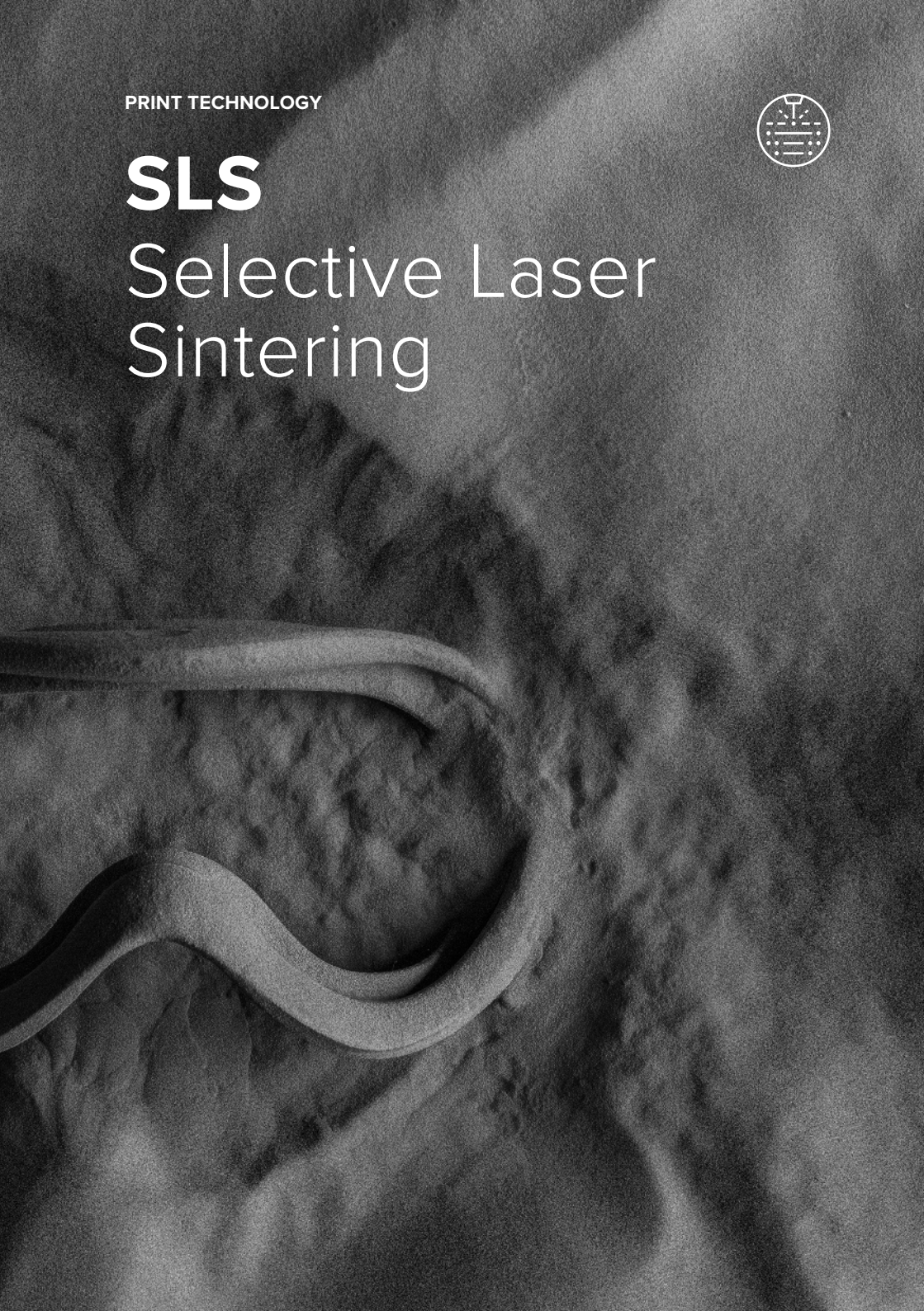


Post-Curing Info:

No post-cure required.

PRINT TECHNOLOGY

SLS
Selective Laser Sintering



formlabs

Nylon 12 Powder

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

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

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

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

Prepared 08 . 19. 2020

Rev. 01 08 . 19. 2020

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 Powder

	METRIC [1,2]	IMPERIAL [1,2]	METHOD
Mechanical Properties			
Ultimate Tensile Strength	50 MPa	7252 psi	ASTM D638 Type 1
Tensile Modulus	1850 MPa	268 ksi	ASTM D638 Type 1
Elongation at Break (X/Y)	11%	11%	ASTM D638 Type 1
Elongation at Break (Z)	6%	6%	ASTM D638 Type 1
Flexural Properties			
Flexural Strength	66 MPa	9572 psi	ASTM D 790-15
Flexural Modulus	1600 MPa	232 ksi	ASTM D 790-15
Impact Properties			
Notched Izod	32 J/m	0.60 ft-lb/in	ASTM D256-10
Thermal Properties			
Heat Deflection Temp. @ 1.8 MPa	87 °C	189 °F	ASTM D648
Heat Deflection Temp. @ 0.45 MPa	171 °C	340 °F	ASTM D648
Vicat Softening Temperature	175 °C	347 °F	ASTM D1525
Other Properties			
Moisture Content (powder)	0.25%	0.25%	ISO 15512 Method D
Water Absorption (printed part)	0.66%	0.66%	ASTM D570

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

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

Flammability Properties

Testing Standard	Rating
UL 94 Section 7	HB *

* Thickness of the sample tested = 3.00mm

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

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

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

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

SOLVENT COMPATIBILITY

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

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

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Nylon 12 GF Powder

For stiff, stable, functional parts.

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

Specifically developed for use on the Fuse Series Printers.

Fixtures Undergoing Long-Term Sustained Loading

Functional Prototypes for composite products

Stiff Structural Components

Thermally Stressed Housings

End-Use Industrial Parts

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

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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 GF Powder

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

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

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

Flammability Properties

Testing Standard	Rating
UL 94 Section 7	HB *

* Thickness of the sample tested = 3.00mm

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

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

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

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

SOLVENT COMPATIBILITY

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

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

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Nylon 11 Powder

Nylon 11 Powder for High Performance, High Impact

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

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

V1 **FLP11B01**

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

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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 11 Powder

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

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

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

Flammability Properties

Testing Standard	Rating
UL 94 Section 7	HB *

* Thickness of the sample tested = 3.00mm

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

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

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

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

SOLVENT COMPATIBILITY

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

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

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Nylon 11 CF Powder

Carbon Fiber Reinforced, for Strong and Lightweight parts

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

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

Functional composite prototypes

Tooling, Jigs, Fixtures

Replacement and spare alternatives to metal parts

High-impact equipment

V1 **FLP11C01**

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

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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 11 CF Powder

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

Samples printed with Nylon 11 CF Powder have been evaluated in accordance with ISO 10993-1:2020 and is biologically safe for long term (>30 day) surface (intact skin) contacting devices. It has passed the requirements for the following biocompatibility risks:

ISO Standard	Description [3,4]
ISO 10993-5: 2009	Not cytotoxic
ISO 10993-23:2021	Not an irritant
ISO 10993-10:2021	Not a sensitizer

SOLVENT COMPATIBILITY

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

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

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

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

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

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

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TPU 90A Powder

A Tough SLS Elastomer for Resilient, Skin-Safe Products

Create flexible TPU parts with unmatched design freedom and ease. Balancing high elongation at break and superior tear strength, TPU 90A Powder enables you to produce flexible, skin-safe prototypes and end-use parts that withstand the demands of everyday use – all at a low cost per part thanks to a 20% refresh rate.

TPU 90A Powder is specifically developed for use on Fuse Series printers.

Wearables and soft-touch elements

Gaskets, seals, masks, belts, plugs, and tubes

Padding, dampers, cushions, and grippers

Soles, splints, orthotics, and prosthetics

Protective sports equipment

V1 **FLTP9G01** * **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

TPU 90A Powder

	METRIC [1,2]	IMPERIAL [1,2]	METHOD
Mechanical Properties			
Ultimate Tensile Strength (X/Y)	8.7 MPa	1260 PSI	ASTM D412-16, Method A
Ultimate Tensile Strength (Z)	7.2MPa	1050 PSI	ASTM D412-16, Method A
Elongation at Break (X/Y)	310%		ASTM D412-16, Method A
Elongation at Break (Z)	110%		ASTM D412-16, Method A
Stress @ 50% Elongation (X/Y)	6.1 MPa	889 PSI	ASTM D412-16, Method A
Stress @ 50% Elongation (Z)	5.9 MPa	860 PSI	ASTM D412-16, Method A
Stress @ 100% Elongation (X/Y)	7.2 MPa	1050 PSI	ASTM D412-16, Method A
Stress @ 100% Elongation (Z)	7.0 MPa	1020 PSI	ASTM D412-16, Method A
Tear Resistance (X/Y)	66 kN/m	378 lbf/in	ASTM D624-00 (2020)
Tear Resisitance (Z)	39 kN/m	247 lbf/in	ASTM D624-00 (2020)
Compression Set (23°C)	20.5%		ASTM D395-18, Method B
Compression Set (70°C)	59.9%		ASTM D395-18, Method B
Shore Hardness	90A		ASTM D2240-15 (2021)
Taber Abrasion	122mm^3	7 x 10^{-3} in^3	ISO 4649 (40rpm, 10N load)
Thermal Properties			
Vicat Softening Temperature	94.3 °C	201.7 °F	ASTM D 1525
Other Properties			
Moisture Content (powder)	0.19%		ISO 15512 Method D
Water Absorption (Printed Part)	0.89%		ASTM D570
Bulk Density (Sintered)	1.14 g/cm^3	71.2 lb/ft^3	In-house method

Samples printed with TPU 90A powder have been evaluated in accordance with ISO 10993-1:2018, and has passed the requirements for the following biocompatibility risks:

ISO Standard	Result [3,4]
ISO 10993-5: 2009	Non-cytotoxic
ISO 10993-23:2021	Non-irritant
ISO 10993-10:2021	Non-sensitizer

SOLVENT COMPATIBILITY

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

Solvent	24 hr weight gain, %	Solvent	24 hr weight gain, %
Acetic Acid 5%	1.3	Isooctane (aka gasoline)	0.7
Acetone	28.6	Mineral oil (light)	2.3
Isopropyl Alcohol	4.8	Mineral oil (Heavy)	2.1
Bleach ~5% NaOCl	0.8	Salt Water (3.5% NaCl)	0.9
Butyl Acetate	16.5	Sodium Hydroxide solution (0.025% PH 10)	0.9
Diesel Fuel	2.0	Water	0.9
Diethyl glycol Monomethyl Ether	14.4	Xylene	20.8
Hydraulic Oil	2.8	Strong Acid (HCl conc)	- 5.2
Skydrol 5	6.5	TPM	9.9
Hydrogen peroxide (3%)	1.0		

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

[2] Results on Fuse 1 and Fuse 1+ 30W are equivalent within the bounds of experimental uncertainty

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

[4] TPU 90A was tested at NAMSA World Headquarters, OH, USA.

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