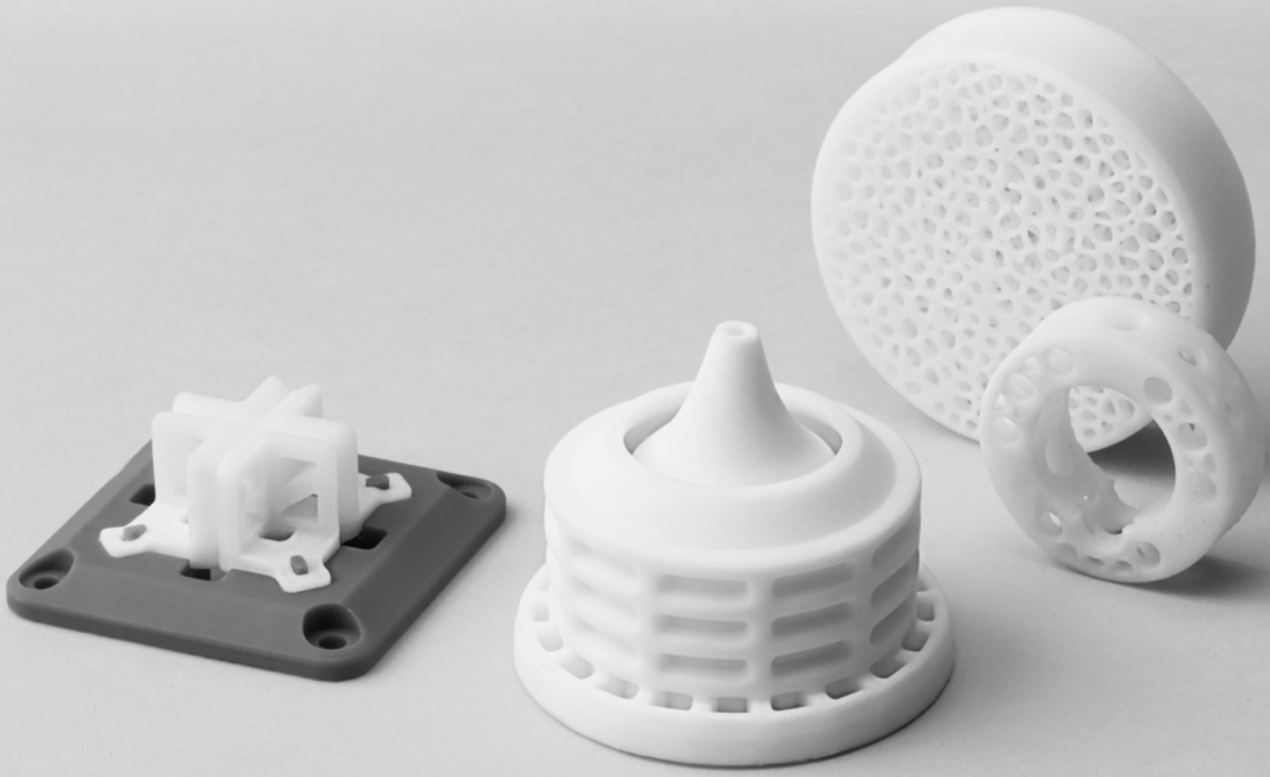
MATERIAL DATA SHEET

Ceramic

Ceramic Resin for Experimentation and Prototyping $149 / L

Parts 3D printed in silica-filled Ceramic Resin can be fired to create a fully ceramic piece. This experimental Form X material requires more trial and error than other Formlabs products. Please read the usage guide prior to printing. Supports print resolutions: 100 and 50 microns**. This resin is not compatible with Resin Tank LT.**

Technical Experimentation	Fine Art & Sculpture
Research and Development	Jewelry



FLCEWH01

formlabs

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

Material Properties Data

GREEN[1]	METRIC[2]	IMPERIAL[2]	METHOD
Tensile Properties			
Ultimate Tensile Strength	5.1 MPa	740 psi	ASTM D638-14
Tensile Modulus	1.03 GPa	149 ksi	ASTM D638-14
Elongation	1.4 %	1.4 %	ASTM D638-14
Flexural Properties			
Flexural Stress at Break	10.27 MPa	1489 psi	ASTM D790-15e2
Flexural Modulus	994.6 MPa	144 ksi	ASTM D790-15e2
Impact Properties			
Notched IZOD	18.42 J/m	0.35 ft-lb/in	ASTM D256-10e1
Thermal Properties			
Heat Deflection Temp. @ 164 psi	74.7 °C	155.5 °F	ASTM D648-16, Method B
Heat Deflection Temp. @ 66 psi	> 290 °C	> 554 °F	ASTM D648-16, Method B

FIRED[3]	METRIC[2]	IMPERIAL[2]	METHOD
Tensile Properties			
Tensile Modulus	50.0 GPa	7252 ksi	ASTM E494
Flexural Properties			
Flexural Stress at Break	33.5 MPa	4895 psi	ASTM C1161
Other Properties			
Cold Crushing Strength	72.2 MPa	10.4 ksi	ASTM C733
Shear Modulus	21.9 GPa	3176 ksi	ASTM E494
Poisson's Ration	0.140	0.140	ASTM E494
Density	1.9 g/cm^3	119 lb/ft^3	ASTM E494

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

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

[3] Data was obtained from fired parts, printed using Form 2, 100 µm, Ceramic settings, which were washed and dried without additional post-cure. Parts had been printed with a pre-applied scale factor and fired using an 30 hr schedule to a maximum firing temperature of 1275 °C as laid out in the Formlabs usage guide.

MATERIAL DATA SHEET

Standard

Materials for High-Resolution Rapid Prototyping

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

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

Surface Finish. Perfectly smooth right out of the printer, parts printed on the Form 2 printer have the polish and finish of a final product.

CLEAR
FLGPCL04

WHITE
FLGPWH04

GREY
FLGPGR04

BLACK
FLGPBL04

COLOR
FLGPCB01

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

Material Properties Data

The following material properties are comparable for all Formlabs Standard Resins.

	METRIC[1]		IMPERIAL[1]		METHOD
	Green[2]	Post-Cured[3]	Green[2]	Post-Cured[3]	
Tensile Properties					
Ultimate Tensile Strength	38 MPa	65 MPa	5510 psi	9380 psi	ASTM D 638-10
Tensile Modulus	1.6 GPa	2.8 GPa	234 ksi	402 ksi	ASTM D 638-10
Elongation at Failure	12 %	6.2 %	12 %	6.2 %	ASTM D 638-10
Flexural Properties					
Flexural Modulus	1.25 GPa	2.2 GPa	181 ksi	320 ksi	ASTM C 790-10
Impact Properties					
Notched IZOD	16 J/m	25 J/m	0.3 ft-lbf/in	0.46 ft-lbf/in	ASTM D 256-10
Temperature Properties					
Heat Deflection Temp. @ 264 psi	42.7 °C	58.4 °C	108.9 °F	137.1 °F	ASTM D 648-07
Heat Deflection Temp. @ 66 psi	49.7 °C	73.1 °C	121.5 °F	163.6 °F	ASTM D 648-07

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

[2] Data was obtained from green parts, printed using Form 2, 100 µm, Clear settings, washed and air dried without post cure.

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

Solvent Compatibility

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

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

HIGH RESOLUTION

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

STRENGTH AND PRECISION

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

SURFACE FINISH

Perfectly smooth right out of the printer, parts printed on the Form 2 printer have the polish and finish of a final product.

CLEAR

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

WHITE

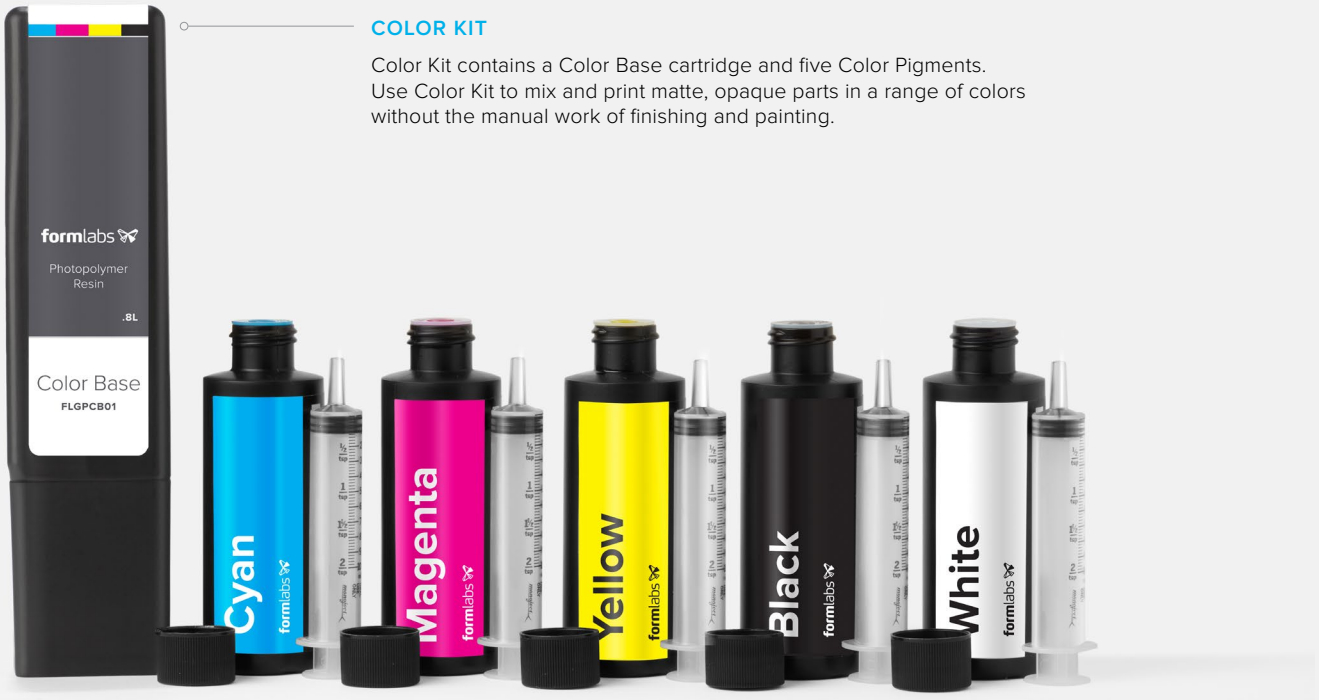
Our White Resin emphasizes fine details and has a matte finish with a warm, slightly ivory color.

GREY

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

BLACK

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



COLOR KIT

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

formlabs

Durable

Photopolymer Resin for Form 2

FLDUCL01 MATERIAL PROPERTIES

Prepared: 01/27/2017

Rev 01 04.18.17

Durable was designed to simulate polypropylene (PP) plastic, with comparable low modulus and high-impact strength. Use this wear-resistant, ductile material when parts require deformation and a smooth, glossy finish. For best mechanical properties, we recommend post-curing prints.

	METRIC[1]		IMPERIAL[1]		METHOD
	Green[2]	**Post-Cured[3]**	**Green[2]**	**Post-Cured[3]**	
Tensile Properties					
Ultimate Tensile Strength	18.6 MPa	31.8 MPa	2.7 ksi	4.61 ksi	ASTM D 638-10
Tensile Modulus	0.45 GPa	1.26 GPa	65.7 ksi	183 ksi	ASTM D 638-10
Elongation	67 %	49 %	67 %	49 %	ASTM D 638-10
Flexural Properties					
Flexural Stress at 5% Strain	4.06 MPa	27.2 MPa	0.59 ksi	3.95 ksi	ASTM D 790-10, Procedure A
Flexural Modulus	0.16 GPa	0.82 GPa	23.4 ksi	119 ksi	ASTM D 790-10, Procedure A
Impact Properties					
IZOD Impact Strength	130.8 J/m	109 J/m	2.46 ft-lbf/in	2.05 ft-lbf/in	ASTM D 256-10, Test Method A
Temperature Properties					
Heat Deflection Temp. @ 0.45 MPa	< 30 °C	43.3 °C	< 86 °F	110 °F	ASTM D 648-07, Method B
Thermal Expansion from 23 to 50°C	117.0 µm/m/°C	145.1 µm/m/°C	65.0 µin/in/°F	80.6 µin/in/°F	ASTM E831-14

NOTES:

[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 2.5 mW/cm^2 of 405 nm LED light for 120 minutes at 60°C.

SOLVENT COMPATIBILITY

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

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

MATERIAL DATA SHEET

Elastic

Elastic Resin for Soft Flexible Parts

$199 / L

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

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

FLELCL01

formlabs

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

Material Properties Data

	METRIC[1]		IMPERIAL[1]		METHOD
	Green	Post-Cured[2]	Green	Post-Cured[2]	
Ultimate tensile strength [3]	1.61 MPa	3.23 MPa	234 psi	468 psi	ASTM D 412-06 (A)
Stress at 50% elongation	.92 MPa	.94 MPa	133 psi	136 psi	ASTM D 412-06 (A)
Stress at 100% elongation	1.54 MPa	1.59 MPa	223 psi	231 psi	ASTM D 412-06 (A)
Elongation at Failure [3]	100%	160%	100%	160%	ASTM D 412-06 (A)
Compression set at 23C for 22 hrs	2%	2%	2%	2%	ASTM D 395-03 (B)
Compression set at 70C for 22 hrs	3%	9%	3%	9%	ASTM D 395-03 (B)
Tear strength [4]	8.9 kN/m	19.1 kN/m	51 lbf/in	109 lbf/in	ASTM D 624-00
Shore hardness	40A	50A	40A	50A	ASTM 2240

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

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

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

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

Solvent Compatibility

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

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

RÉSINE SPÉCIALE

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ESD Resin

Un matériau robuste et antistatique pour améliorer vos flux de production électronique.

Réduisez les risques, augmentez votre rendement et protégez vos composants électroniques des décharges statiques en imprimant en 3D des outils, des gabarits et des fixations personnalisés avec ESD Resin. ESD Resin est une solution rentable pour produire des pièces antistatiques conçues pour résister à l'utilisation en usine.

Composants antistatiques pour prototypes et pièces finales

Boîtiers pour composants électroniques sensibles

Outillage, gabarits et fixations pour la fabrication de composants électroniques

V1 **FLESDS01** * **Peut ne pas être disponible partout**

Préparé le : 12 . 01 . 2021
Rev. 01 12 . 01 . 2021

DONNÉES DES PROPRIÉTÉS DU MATÉRIAU

ESD Resin

	MÉTRIQUE [1, 2]	IMPÉRIAL [1,2]	MÉTHODE
	Pièce post-polymérisée	**Pièce post-polymérisée**	
Propriétés mécaniques			
Résistance à la rupture par traction	44,2 MPa	6410 psi	ASTM D 638-14
Module de traction	1,937 GPa	280,9 ksi	ASTM D 638-14
Allongement à la rupture	12 %	12 %	ASTM D 638-14
Propriétés en flexion			
Résistance à la flexion	61 MPa	8860 psi	ASTM D 790-17
Module de flexion	1,841 GPa	267 ksi	ASTM D 790-17
Propriétés de résistance aux chocs			
Résistance au choc Izod	26 J/m	0,489 ft-lbs/in	ASTM D 256-10
Résistance au choc Izod	277 J/m	5,19 ft-lbs/in	ASTM D 4812-11
Propriétés thermiques			
Température de fléchissement sous charge à 1,8 MPa	62,2 °C	143,9 °F	ASTM D 648-18
Température de fléchissement sous charge à 0,45 MPa	54,2 °C	129,6 °F	ASTM D 648-18
Dilatation thermique	123,7 µm/m/°C	68,7 µin/in/°F	ASTM E 813-13
Propriétés électriques			
Résistivité superficielle	10^5 - 10^8	10^5 - 10^8	ANSI/ESD 11.11 [3]
Résistivité volumique	10^5 - 10^7	10^5 - 10^7	ANSI/ESD 11.11 [3]
Propriétés physiques			
Densité		1,016	ASTM D792
Rigidité		90 Shore D	ASTM D2240

[1] Les propriétés de la résine peuvent varier en fonction de la géométrie de la pièce, de son orientation pendant l'impression, des paramètres d'impression, de la température et des méthodes de désinfection ou de stérilisation utilisées.

[2] Les données pour les échantillons post-polymérisés ont été mesurées sur des barres de traction de type IV, imprimées sur une imprimante Form 3 avec les paramètres ESD Resin à 100 µm, puis lavées dans une Form Wash pendant 20 minutes dans de l'alcool isopropylique ≥ 99 %, et post-polymérisées à 70 °C pendant 60 minutes dans la Form Cure.

[3] ESD Resin a été testée au siège mondial de NAMSA, Ohio, aux États-Unis.

COMPATIBILITÉ AVEC LES SOLVANTS

Gain de poids pour un cube de 1 cm d'arête, après impression et post-polymérisation, lorsqu'il est plongé dans l'un des solvants suivants pendant 24 heures :

Solvant	**Gain de poids après 24 heures, %**	**Solvant**	**Gain de poids après 24 heures, %**
Acide acétique à 5 %	0,5	Huile minérale, lourde	0,1
Acétone	13,1	Huile minérale, légère	0,1
Eau de Javel (NaOCl ~5 %)	0,5	Eau salée (3,5 % NaCl)	0,6
Acétate de butyle	3,8	Skydrol 5	0,5
Carburant diesel	0,2	Solution d'hydroxyde de sodium (0,025 % pH 10)	0,7
Éther monométhylique de diéthylène-glycol	3,6	Acide fort (HCl concentré)	1,4
Huile hydraulique	0,2	Éther monométhylique de tripropylène-glycol (TPM)	0,6
Peroxyde d'hydrogène (à 3 %)	0,6	Eau	0,7
Isooctane	< 0,1	Xylène	1,60
Alcool isopropylique	2,6		

RÉSINE TECHNIQUE

Flexible 80A Resin

Flexible 80A Resin pour la fabrication de prototypes flexibles rigides

Flexible 80A Resin est le matériau à surface douce au toucher le plus rigide de notre famille de résines Flexible et Elastic. Sa dureté Shore de 80A reproduit la flexibilité du caoutchouc ou du TPU.

Associant souplesse et résistance, Flexible 80A Resin peut supporter des contraintes cycliques de pliage, de flexion et de compression. Ce matériau convient au matelassage et aux dispositifs d'amortissement.

Poignées, manches et surmoulages

Modèles anatomiques de cartilages, tendons et ligaments

Sceaux, joints et masques

V1 **FLFL8001**

formlabs

Préparé le 29 . 05 . 2020
Révision 01 le 29 . 05 . 2020

Propriétés du matériau Flexible 80A Resin

	MÉTRIQUE[1]		IMPÉRIAL[1]		MÉTHODE
	Pièce brute	Pièce post-polymérisée[2]	Pièce brute	Pièce post-polymérisée[2]	
Propriétés mécaniques					
Résistance à la rupture par traction[3]	3,7 MPa	8,9 MPa	539 psi	1290 psi	ASTM D 412-06 (A)
Contrainte à 50 % d'allongement	1,5 MPa	3,1 MPa	218 psi	433 psi	ASTM D 412-06 (A)
Contrainte à 100 % d'allongement	3,5 MPa	6,3 MPa	510 psi	909 psi	ASTM D 412-06 (A)
Allongement à la rupture	100 %	120 %	100 %	120 %	ASTM D 412-06 (A)
Dureté Shore	70A	80A	70A	80A	ASTM 2240
Déformation permanente par compression à 23 °C pendant 22 heures	Non testé	3 %	Non testé	3 %	ASTM D 624-00
Déformation permanente par compression à 70 °C pendant 22 heures	Non testé	5 %	Non testé	5 %	ASTM D 395-03 (B)
Résistance au déchirement[4]	11 kN/m	24 kN/m	61 lbf/in	137 lbf/in	ASTM D 395-03 (B)
Résistance à la fatigue par flexion Ross à 23 °C	Non testé	> 200 000 cycles	Non testé	> 200 000 cycles	ASTM D1052, (entaillée), courbure de 60 °, 100 cycles/minute
Résistance à la fatigue par flexion Ross à -10 °C	Non testé	> 50 000 cycles	Non testé	> 50 000 cycles	ASTM D1052, (entaillée), courbure de 60 °, 100 cycles/minute
Résilience Bayshore	Non testé	28 %	Non testé	28 %	ASTM D2632
Propriétés thermiques					
Température de transition vitreuse (Tv)	Non testé	27 °C	Non testé	27 °C	AMD

[1] Les propriétés du matériau peuvent varier en fonction de la géométrie de la pièce, de son orientation pendant l'impression, des paramètres d'impression et de la température.

[2] Les données ont été obtenues à partir de pièces imprimées sur la Form 3 avec les paramètres Flexible 80A Resin à 100 µm, et après 10 minutes de lavage dans la Form Wash, puis post-polymérisation dans la Form Cure à 60 °C pendant 10 minutes.

[3] L'essai de traction a été réalisé après plus de 3 heures à 23 °C, sur une éprouvette de type C usinée dans des feuilles.

[4] L'essai de déchirement a été réalisé après plus de 3 heures à 23 °C, sur une éprouvette de type C imprimée directement.

Compatibilité avec les solvants

Gain de poids pour un cube de 1 cm d'arête, après impression et post-polymérisation, lorsqu'il est plongé dans l'un des solvants suivants pendant 24 heures :

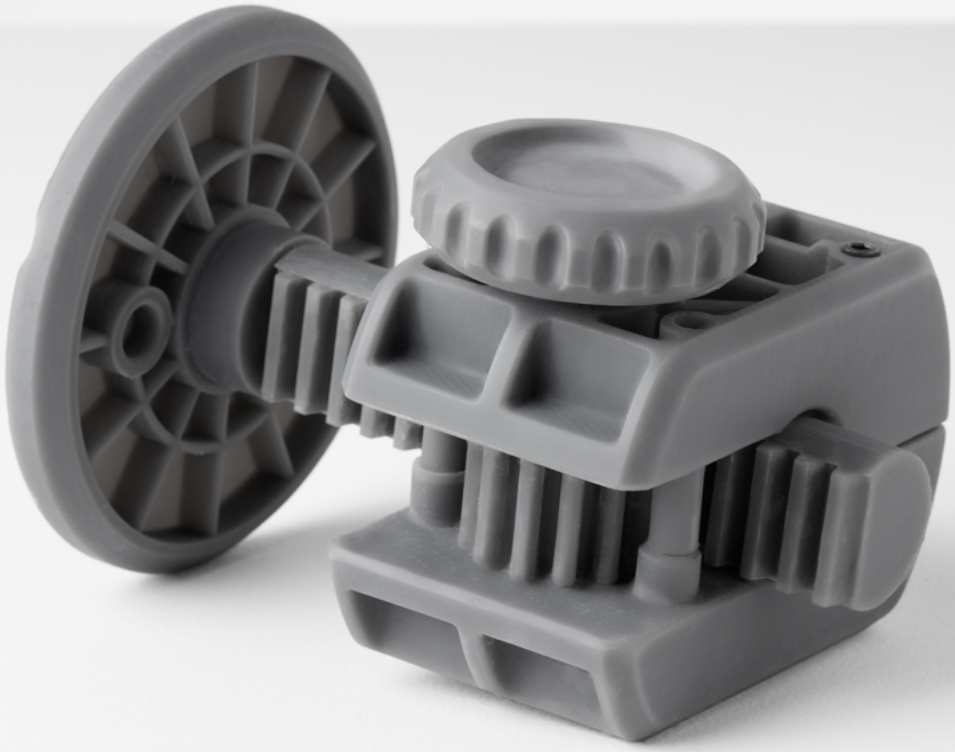
Solvant	Gain de poids après 24 heures (%)	Solvant	Gain de poids après 24 heures (%)
Acide acétique à 5 %	0,9	Peroxyde d'hydrogène (3 %)	0,7
Acétone	37,4	Isooctane (essence)	1,6
Alcool isopropylique	11,7	Huile minérale, légère	0,1
Eau de Javel, ~5 % NaOCl	0,6	Huile minérale, lourde	< 0,1
Acétate de butyle	51,4	Eau salée (à 3,5 % NaCl)	0,5
Diesel	2,3	Hydroxyde de sodium (0,025 %, pH = 10)	0,6
Éther monométhylique de diéthylène-glycol	19,3	Eau	0,7
Huile hydraulique	1,0	Xylène	64,1
Skydrol 5	10,7	Acide fort (HCl concentré)	28,6
Éther méthylique de tripropylène glycol	13,6		

MATERIAL DATA SHEET

Grey Pro

Photopolymer Resin for Form 2

Grey Pro Resin's high precision, moderate elongation, and resistance to deformation over time make it a versatile material suitable for a wide range of engineering applications. Supports print resolutions: 100 and 50 microns. **Requires Resin Tank LT.**



FLPRGR01

formlabs

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

Material Properties Data

	METRIC[1]		IMPERIAL[1]		METHOD
	Green[2]	Post-Cured[3]	Green[2]	Post-Cured[3]	
Tensile Properties					
Ultimate Tensile Strength	35 MPa	61 MPa	5076 psi	8876 psi	ASTM D 638-14
Tensile Modulus	1.4 GPa	2.6 GPa	203 ksi	377 ksi	ASTM D 638-14
Elongation	32.5 %	13 %	32.5 %	13 %	ASTM D 638-14
Flexural Properties					
Flexural Stress at 5% Strain	39 MPa	86 MPa	5598 psi	12400 psi	ASTM D 790-15
Flexural Modulus	0.94 GPa	2.2 GPa	136 ksi	319 ksi	ASTM D 790-15
Impact Properties					
Notched IZOD	not tested	18.7 J/m	not tested	0.351 ft-lbf/in	ASTM D256-10
Temperature Properties					
Head Deflection Temp. @ 1.8 MPa	not tested	62.4 C	not tested	144.3 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	not tested	77.5 C	not tested	171.5 °F	ASTM D 648-16
Thermal Expansion (-30 to 30° C)	not tested	78.5 um/m/C	not tested	43.4 µin/in/°F	ASTM E 831-13

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

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

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

Mechanical Properties	24 hr weight gain (%)	Mechanical Properties	24 hr weight gain (%)
Acetic Acid, 5 %	0.75	Hydrogen Peroxide (3 %)	0.75
Acetone	10.77	Isooctane	0.02
Isopropyl Alcohol	1.56	Mineral Oil, light	0.35
Bleach, ~5 % NaOCl	0.65	Mineral Oil, heavy	0.27
Butyl Acetate	0.84	Salt Water (3.5 % NaCl)	0.64
Diesel	0.08	Sodium hydroxide (0.025 %, pH = 10)	0.72
Diethyl glycol monomethyl ether	2.38	Water	0.83
Hydrolic Oil	0.16	Xylene	0.42
Skydrol 5	0.54	Strong Acid (HCl Conc)	8.21

MATERIAL DATA SHEET

High Temp

High Temp Resin for Heat Resistance

$199 / L

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

Hot air, gas, and fluid flow

Molds and inserts

Heat resistant mounts, housings, and fixtures

FLHTAM02

formlabs

Prepared 09 . 15 . 2016
Rev 02 12 . 05 . 2018

Material Properties Data Metric

	METRIC[1]			METHOD
	Green[2]	Post-Cured[3]	Post-Cured + Thermally Post-Cured[4]	
Thermal Properties				
Heat Deflection Temp. @ 1.8 MPa	43.6 °C	99.2 °C	101 °C	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	49.3 °C	142 °C	238 °C	ASTM D 648-16

	METRIC[1]			METHOD
	Green[2]	Post-Cured[5]	Post-Cured + Thermally Post-Cured[6]	
Mechanical Properties				
Ultimate Tensile Strength	20.9 MPa	58.3 MPa	51.1 MPa	ASTM D 638-14
Elongation at break	14 %	3.3 %	2.4 %	ASTM D 638-14
Tensile modulus	0.75 GPa	2.75 GPa	2.9 GPa	ASTM D 638-14
Flexural strength at break	24.1 MPa	94.5 MPa	93.8 MPa	ASTM D 790-15
Flexural modulus	0.69 GPa	2.62 GPa	2.62 GPa	ASTM D 790-15
Impact Properties				
Notched IZOD	32.8 J/m	18.2 J/m	24.2 J/m	ASTM D 256-10
Thermal Properties				
Thermal Expansion (0-150 °C)	118.1 (µm/m/°C)	79.6 (µm/m/°C)	74 (µm/m/°C)	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 80 °C for 120 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.

[5] 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.

[6] 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 plus an additional thermal cure in a lab oven at 160 °C for 90 minutes

Material Properties Data Imperial

	IMPERIAL[1]			METHOD
	Green[2]	Post-Cured[3]	Post-Cured + Thermally Post-Cured[4]	
Thermal Properties				
Heat Deflection Temp. @ 1.8 MPa	110.48 °F	210.56 °F	213.8 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	120.74 °F	287.6 °F	460.4 °F	ASTM D 648-16

	IMPERIAL[1]			METHOD
	Green[2]	Post-Cured[5]	Post-Cured + Thermally Post-Cured[6]	
Mechanical Properties				
Ultimate Tensile Strength	3031 psi	8456 psi	7411 psi	ASTM D 638-14
Elongation at break	14 %	3.3 %	2.4 %	ASTM D 638-14
Tensile modulus	109 ksi	399 ksi	421 ksi	ASTM D 638-14
Flexural strength at break	3495 psi	13706 psi	13605 psi	ASTM D 790-15
Flexural modulus	100 ksi	400 ksi	400 ksi	ASTM D 790-15
Impact Properties				
Notched IZOD	0.61 ft-lbf/in	0.34 ft-lbf/in	0.45 ft-lbf/in	ASTM D 256-10
Thermal Properties				
Thermal Expansion (0-150 °C)	65.6 µin/in/°F	44.2 µin/in/°F	41.1 µin/in/°F	41.1 uin/in/°F

[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 80 °C for 120 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.

[5] 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.

[6] 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 plus an additional thermal cure in a lab oven at 160 °C for 90 minutes

Solvent Compatibility

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

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

ENGINEERING RESIN

Rigid 10K

Rigid 10K Resin for Rigid, Strong, Industrial-Grade Prototypes

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

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

V1 **FLRG1001**

formlabs

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

RIGID 10K MATERIAL PROPERTIES DATA

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

All testing specimens were printed using Form 3

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

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

Solvent Compatibility

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

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

MATERIAL DATA SHEET

Standard

Materials for High-Resolution Rapid Prototyping

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

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

Surface Finish. Perfectly smooth right out of the printer, parts printed on the Form 2 printer have the polish and finish of a final product.

CLEAR
FLGPCL04

WHITE
FLGPWH04

GREY
FLGPGR04

BLACK
FLGPBL04

COLOR
FLGPCB01

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

Material Properties Data

The following material properties are comparable for all Formlabs Standard Resins.

	METRIC[1]		IMPERIAL[1]		METHOD
	Green[2]	Post-Cured[3]	Green[2]	Post-Cured[3]	
Tensile Properties					
Ultimate Tensile Strength	38 MPa	65 MPa	5510 psi	9380 psi	ASTM D 638-10
Tensile Modulus	1.6 GPa	2.8 GPa	234 ksi	402 ksi	ASTM D 638-10
Elongation at Failure	12 %	6.2 %	12 %	6.2 %	ASTM D 638-10
Flexural Properties					
Flexural Modulus	1.25 GPa	2.2 GPa	181 ksi	320 ksi	ASTM C 790-10
Impact Properties					
Notched IZOD	16 J/m	25 J/m	0.3 ft-lbf/in	0.46 ft-lbf/in	ASTM D 256-10
Temperature Properties					
Heat Deflection Temp. @ 264 psi	42.7 °C	58.4 °C	108.9 °F	137.1 °F	ASTM D 648-07
Heat Deflection Temp. @ 66 psi	49.7 °C	73.1 °C	121.5 °F	163.6 °F	ASTM D 648-07

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

[2] Data was obtained from green parts, printed using Form 2, 100 µm, Clear settings, washed and air dried without post cure.

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

Solvent Compatibility

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

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

HIGH RESOLUTION

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

STRENGTH AND PRECISION

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

SURFACE FINISH

Perfectly smooth right out of the printer, parts printed on the Form 2 printer have the polish and finish of a final product.

CLEAR

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

WHITE

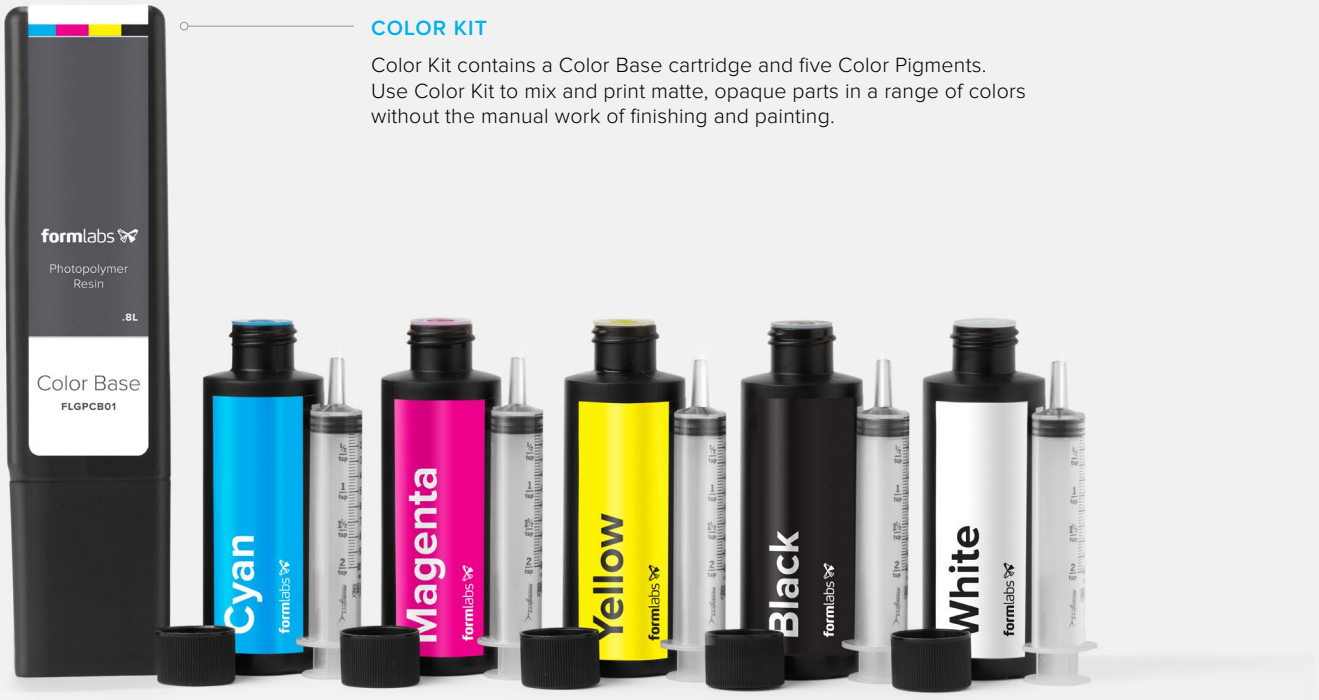
Our White Resin emphasizes fine details and has a matte finish with a warm, slightly ivory color.

GREY

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

BLACK

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



COLOR KIT

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

ENGINEERING RESIN

Tough 1500

Tough 1500 Resin for Resilient Prototyping

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

Springy prototypes and assemblies

Snap fit and press fit connectors

Polypropylene-like strength

V1 **FLTO1501**

formlabs

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

Tough 1500 Resin Material Properties Data

	METRIC[1]		IMPERIAL[1]		METHOD
	Green[2]	Post-Cured[3]	Green[2]	Post-Cured[3]	
Mechanical Properties					
Ultimate Tensile Strength	26 MPa	33 MPa	3771 psi	4786 psi	ASTM D 638-14
Tensile Modulus	0.94 GPa	1.5 GPa	136 ksi	218 ksi	ASTM D 638-14
Elongation at Break	69 %	51 %	69 %	51 %	ASTM D 638-14
Flexural Properties					
Flexural Strength	15 MPa	39 MPa	2175 psi	5656 psi	ASTM D 790-15
Flexural Modulus	0.44 GPa	1.4 GPa	58 ksi	203 ksi	ASTM D 790-15
Impact Properties					
Notched IZOD	72 J/m	67 J/m	1.3 ft-lbf/in	1.2 ft-lbf/in	ASTM D256-10
Unnotched IZOD	902 J/m	1387 J/m	17 ft-lbf/in	26 ft-lbf/in	ASTM D4812-11
Thermal Properties					
Heat Deflection Temp. @ 1.8 MPa	34 °C	45 °C	93 °F	113 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	42 °C	52 °C	108 °F	126 °F	ASTM D 648-16
Thermal Expansion	114 µm/m/°C	97 µm/m/°C	63 µin/in/°F	54 µin/in/°F	ASTM E 831-13

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

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

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

Solvent Compatibility

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

Solvent	24 Hour Weight Gain (%)	Solvent	24 Hour Weight Gain (%)
Acetic Acid, 5 %	0.75	Hydrogen Peroxide (3 %)	0.71
Acetone	19.07	Isooctane	0.02
Isopropyl Alcohol	3.15	Mineral Oil, light	0.05
Bleach, ~5 % NaOCl	0.62	Mineral Oil, heavy	0.09
Butyl Acetate	5.05	Salt Water (3.5 % NaCl)	0.66
Diesel	0.11	Sodium hydroxide (0.025 %, pH = 10)	0.7
Diethyl glycol monomethyl ether	5.25	Water	0.69
Hydrolic Oil	0.17	Xylene	3.22
Skydrol 5	0.46	Strong Acid (HCl Conc)	4.39

ENGINEERING RESIN

Tough 2000

Tough 2000 Resin for Rugged Prototyping

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

Strong and stiff prototypes

Sturdy jigs and fixtures

ABS-like strength and stiffness

V1 **FLTO2001**

formlabs

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

Tough 2000 Resin Material Properties Data

	METRIC[1]		IMPERIAL[1]		METHOD
	Green[2]	Post-Cured[3]	Green[2]	Post-Cured[3]	
Mechanical Properties					
Ultimate Tensile Strength	29 MPa	46 MPa	4206 psi	6671 psi	ASTM D 638-14
Tensile Modulus	1.2 GPa	2.2 GPa	174 ksi	329 ksi	ASTM D 638-14
Elongation at Break	74 %	48 %	74 %	48 %	ASTM D 638-14
Flexural Properties					
Flexural Strength	17 MPa	65 MPa	2465 psi	9427 psi	ASTM D 790-15
Flexural Modulus	0.45 GPa	1.9 GPa	65 ksi	275 ksi	ASTM D 790-15
Impact Properties					
Notched IZOD	79 J/m	40 J/m	1.5 ft-lbf/in	0.75 ft-lbf/in	ASTM D256-10
Unnotched IZOD	208 J/m	715 J/m	3.9 ft-lbf/in	13 ft-lbf/in	ASTM D256-10
Thermal Properties					
Heat Deflection Temp. @ 1.8 MPa	42 °C	53 °C	108 °F	127 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	48 °C	63 °C	118 °F	145 °F	ASTM D 648-16
Coefficient of Thermal Expansion	107 µm/m/°C	91 µm/m/°C	59 µin/in/°F	50 µin/in/°F	ASTM E 831-13

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

[2] Data was obtained from green parts, printed using Form 2, 100 µm, Tough settings, washed and air dried without post cure.

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

Solvent Compatibility

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

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