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SCHEDA TECNICA DEI MATERIALI **FORMLABS**





Materials Data Sheet

Photopolymer Resin for Form 1+ and Form 2

FORMLABS MATERIAL PROPERTIES

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P.I./C.F. IT07751450961 – Reg. imprese MI – 1979501

CLEAR FLGPCL03¹

	METRIC ²		IMPERIAL ³		METHOD
	Green ⁴	Postcured ⁴	Green ⁴	Postcured ⁴	
Mechanical Properties					
Ultimate Tensile Strength	38 MPa	65 MPa	5510 psi	9380 psi	ASTM D 638-10
Young's Modulus	16 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 Modulus	1.25 GPa	2.2 GPa	181 ksi	320 ksi	ASTM C 790-10
Notched IZOD	16 J/m	25 J/m	0.3 ft-lbf/in	0.46 ft-lbf/in	ASTM D 256-10
Thermal Properties					
Heat deflection temp. @ 264 psi	42.7 °C	58.4 °C	108.9 °F	1371 °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

NOTES:

¹Clear material properties are representative of all Standard Resins: Clear, White, Black and Grey.

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

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

⁴Data was obtained from parts printed using Form 2, 100 µm, Clear settings and post-cured with 1.25 mW/cm² of 405 nm LED light at 60 °C for 60 minutes.

HIGH TEMP FLHTAM01

	METRIC ¹		IMPERIAL ¹		METHOD
	Green ²	Post-Cured ²	Green ²	Post-Cured ²	
Mechanical Properties					
Ultimate Tensile Strength	33 MPa	511 MPa	4790 psi	7410 psi	ASTM D 638-14
Young's Modulus	1.5 GPa	3.6 GPa	222 ksi	525 ksi	ASTM D 638-14
Elongation at Break	9 %	2 %	9 %	2 %	ASTM D 638-14
Flexural Strength at Break	41.2 MPa	106.9 MPa	5980 psi	15500 psi	ASTM D 790-15
Flexural Modulus	11 GPa	3.3 GPa	158 ksi	478 ksi	ASTM D 790-15
Notched IZOD	12.3 J/m	14 J/m	0.23 ft-lbf/in	0.26 ft-lbf/in	ASTM D 256-10
Water Absorption	N/A	0.21 %	N/A	0.21 %	ASTM D 570-98
Thermal Properties					
Heat Deflection Temp. @ 18 MPa	42.3 °C	130 °C	108.1 °F	266 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	55.9 °C	289 °C	132.6 °F	552.2 °F	ASTM D 648-16
Thermal Expansion (0 – 150 °C)	120.9 µm/m/°C	87.5 µm/m/°C	67.2 µin/in/°F	48.6 µin/in/°F	ASTM E 831-13

NOTES:

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

²Data was obtained from green parts, printed using Form 2, 100 µm, High Temp settings, without additional treatments.

³Data was obtained from parts printed using Form 2, 100 µm, High Temp settings and post-cured with 80.5 mW/cm² of 365 nm fluorescent light for 60 minutes.

TOUGH FLTOTL03

	METRIC ¹		IMPERIAL ¹		METHOD
	Green ²	Post-Cured ²	Green ²	Post-Cured ²	
Mechanical Properties					
Ultimate Tensile Strength	34.7 MPa	55.7 MPa	5040 psi	8080 psi	ASTM D 638-14
Young's Modulus	1.7 GPa	2.7 GPa	239 ksi	387 ksi	ASTM D 638-14
Elongation at Break	42 %	24 %	42 %	24 %	ASTM D 638-14
Flexural Strength at 5% Strain	20.8 MPa	60.6 MPa	3020 psi	8790 psi	ASTM D 790-15
Flexural Modulus	0.6 GPa	1.6 GPa	90.3 ksi	241 ksi	ASTM D 790-15
Notched IZOD	32.6 J/m	38 J/m	0.61 ft-lbf/in	0.71 ft-lbf/in	ASTM D 256-10
Thermal Properties					
Heat Deflection Temp. @ 18 MPa	32.8 °C	45.9 °C	91.1 °F	114.6 °F	ASTM D 648-16
Heat Deflection Temp. @ 0.45 MPa	40.4 °C	48.5 °C	104.7 °F	119.3 °F	ASTM D 648-16
Thermal Expansion (23 – 50 °C)	159.7 µm/m/°C	119.4 µm/m/°C	88.7 µm/m/°F	66.3 µm/m/°F	ASTM E 831-13

NOTES:

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

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

³Data was obtained from parts printed using Form 2, 100 µm, Tough settings and post-cured with 2.5 mW/cm² of 405 nm LED light for 120 minutes at 60°C.

DURABLE FLDUCL01

	METRIC ¹		IMPERIAL ¹		METHOD
	Green ²	Post-Cured ²	Green ²	Post-Cured ²	
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:

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

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

³Data was obtained from parts printed using Form 2, 100 µm, Durable settings and post-cured with 2.5 mW/cm² of 405 nm LED light for 120 minutes at 60°C.

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FLEXIBLE FLFLGR02

	METRIC ¹		IMPERIAL ¹		METHOD
	Green	Postcured ²	Green	Postcured ²	
Mechanical Properties					
Ultimate Tensile Strength ³	3.3 – 3.4 MPa	77 – 8.5 MPa	483 – 494 psi	1110 – 1230 psi	ASTM D 412-06 (A)
Elongation at Failure ³	60 %	75 – 85 %	60 %	75 – 85 %	ASTM D 412-06 (A)
Compression Set ⁴	0.40 %	0.40 %	0.40 %	0.40 %	ASTM D 395-03 (B)
Tear Strength ⁵	9.5 – 9.6 kN/m	13.3 – 14.1 kN/m	54 – 55 lbf/in	76 – 80 lbf/in	ASTM D 624-00
Shore Hardness	70 – 75 A	80 – 85 A	70 – 75 A	80 – 85 A	ASTM 2240
Thermal Properties					
Vicat Softening Point ⁶	231 °C	230 °C	448 °F	446 °F	ASTM D 1525-09

NOTES:

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

²Data was obtained from parts printed using Form 2, 100 µm, Flexible settings and post-cured with 80.5 mW/cm² of 365 nm fluorescent light for 60 minutes.

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

⁴Compression testing was performed at 23 °C after aging at 23 °C for 22 hours.

⁵Tear testing was performed after 3+ hours at 23 °C, using a Die C tear specimen and a 20 in/min cross head speed.

⁶Thermal testing was performed after 40+ hours with a 10 N loading at 50 °C/hour. Cracks formed in samples during testing.

CASTABLE FLCABL02

	METRIC		IMPERIAL		METHOD
Mechanical Properties¹					
Ultimate Tensile Strength	116 MPa		1680 psi		ASTM D 638-10
Young's Modulus	220 MPa		32 ksi		ASTM D 638-10
Elongation at Failure	13 %		13 %		ASTM D 638-10

NOTES:

¹Data was obtained from parts printed using Form 2, Castable 50 µm Fine Detail settings and post-cured with 2.5 mW/cm² of fluorescent bulb UV light, centered at 405 nm

DENTAL SG FLDGOR01

	METRIC		METHOD
		Postcured	
Flexural Properties			
Flexural Strength		≥ 50 MPa	ISO 20795-1:2013
Flexural Modulus		≥ 1500 Mpa	ISO 20795-1:2013
Hardness Properties			
Hardness Shore D		≥ 80D	per ISO 868:2003
Impact Properties			
Charpy Impact Strength Unnotched		12 – 14 kg/m ²	ISO 179:2010

Dental SG is tested at NAMSA, Chasse sur Rhône in France, and is certified biocompatible per EN-ISO 10993-1:2009/AC:2010:

- Non-mutagenic.
- Non-cytotoxic.
- Not induce any erythema or edema reactions.
- Not a sensitizer.
- Not cause systemic toxicity.

The product is in compliance with ISO Standards:

- EN-ISO 20795-1:2013 (Dentistry – Base Polymers – Part 1 Denture Base Polymers)
- EN-ISO 7405:2009/A1:2013 (Dentistry – Evaluation of biocompatibility of medical devices used in dentistry)
- EN-ISO 10993-1:2009/AC:2010 (Biological evaluation of medical devices – Part 1 – Evaluation and testing)

NOTES:

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

²Data refers to post-cured properties obtained after exposing green parts to 108 watts each of Blue UV-A (315 – 400 nm) and UV-Blue (400 – 550 nm) light, in a heated environment at 60 °C (140 °F), with six (6) 18W/71 lamps (Dulux L Blue) and six (6) 18W/78 lamps (Dulux blue UV-A).

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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:

24 HR WEIGHT GAIN (%)

Mechanical Properties	CLEAR	HIGH TEMP	TOUGH	DURABLE	FLEXIBLE
Acetic Acid, 5 %	<1	<1	2.8	1.3	1.3
Acetone	sample cracked	<1	sample cracked	sample cracked	33
Isopropyl Alcohol	<1	<1	2.1	5.1	9.8
Bleach, ~5 % NaOCl	<1	<1	1.7	<1	11
Butyl Acetate	<1	<1	1.6	7.9	16
Diesel	<1	<1	<1	<1	not tested
Diethyl glycol monomethyl ether	1.7	<1	6.6	7.8	30
Hydrolic Oil	<1	<1	<1	<1	not tested
Skydrol 5	1	not tested	1.2	1.3	not tested
Hydrogen Peroxide (3 %)	<1	<1	2.1	1	1.3
Isooctane	<1	<1	<1	<1	<1
Mineral Oil, light	<1	<1	<1	<1	not tested
Mineral Oil, heavy	<1	<1	<1	<1	not tested
Salt Water (3.5 % NaCl)	<1	<1	1.5	<1	<1
Sodium hydroxide (0.025 %, pH = 10)	<1	<1	1.5	<1	1
Water	<1	not tested	1.6	<1	not tested
Xylene	<1	not tested	<1	6.5	29
Strong Acid (HCl Conc)	distorted	not tested	distorted	distorted	not tested