STEREOLITHOGRAPHY

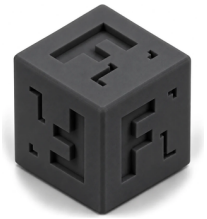
Tough 1500 Resin

Polypropylene-Like SLA Resin for Parts That Flex and Spring Back

Tough 1500 Resin is the polypropylene-like Formlabs resin: close to polypropylene in stiffness, with 155% elongation at break, so parts bend and recover instead of cracking. Snap fits, clips, latches, hinges, rugged enclosures and drop-tolerant jigs take repeated flexing and impacts, with the smooth, detailed surface of SLA in a flat dark grey.

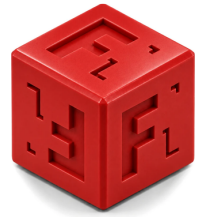


SURFACE FINISHES



Standard Finish Natural

Parts are washed, post-cured and have their supports removed, leaving the smooth, finely detailed surface SLA is known for. Sharp edges, small text and fine features hold their shape, and the surface is ready for fit checks, assembly, presentation or paint.



Performance Paint Premium Finish

A highly durable, automotive-grade coating, hand-finished for smooth surfaces and applied with professional-grade equipment for exceptional adhesion. It comes in matte to semi-gloss, with custom colour matching for parts that need specific branding or visual impact.

BUILD VOLUME	LEAD TIME	LAYER HEIGHT	TOLERANCE
353 × 196 × 350 mm	2-4 business days	0.05-0.1 mm	±0.25% (min ±0.25 mm)

MECHANICAL PROPERTIES

Read this group as a balance of stiffness and stretch. Tensile and flexural modulus show how firmly a part resists bending, and elongation at break shows how far it stretches before it fails. Tough 1500 pairs a modulus close to polypropylene with very high elongation, and its tensile curve yields and then keeps stretching, so an overloaded part bends instead of snapping.

The toughness rows describe how it handles impact and cracks. Gardner impact drops a weight on a thin plate, work of fracture measures the energy needed to drive a crack through the part, and Ross flex fatigue counts bending cycles to failure. Together they explain why thin walls, clips and latches survive drops, tapping and repeated flexing. Flexural creep shows how much a part deforms under a constant load over two weeks. It matches polypropylene, but Tough 2000 moves less than half as much, so fixtures that stay clamped or carry constant load belong in Tough 2000.

PROPERTY	VALUE	TEST STANDARD
Ultimate Tensile Strength	**34 MPa**	ASTM D638-14
Tensile Modulus	**1460 MPa**	ASTM D638-14
Tensile Strength at Yield	**34 MPa**	ASTM D638-14
Elongation at Yield	**6.1 %**	ASTM D638-14
Elongation at Break	**155 %**	ASTM D638-14
Flexural Strength	**41 MPa**	ASTM D790-17
Flexural Modulus	**1370 MPa**	ASTM D790-17
Izod Impact, Notched	**42 J/m**	ASTM D256-10
Izod Impact, Unnotched	**910 J/m**	ASTM D4812-11
Charpy Impact, Notched	**7.5 kJ/m²**	ISO 179-1
Charpy Impact, Unnotched	**57 kJ/m²**	ISO 179-1
Gardner Impact (0.79 mm)	**5.9 J**	ASTM D5420-21
Gardner Impact (1.6 mm)	**11.1 J**	ASTM D5420-21
Maximum Stress Intensity Factor (Kmax)	**1.7 MPa·m½**	ASTM D5045-14
Work of Fracture	**1011 J/m²**	ASTM D5045-14
Ross Flex Fatigue (23 °C, 30° at 1 Hz)	**8000 cycles**	Formlabs internal method
Flexural Creep Strain (4 MPa, 22 °C, 14 days)	**< 3 %**	ISO 6602

THERMAL PROPERTIES

Heat deflection is listed at two loads, and the DMA values show where stiffness starts to fall away and where the glass transition sits. Formlabs rates Tough 1500 the most heat- and UV-resistant of its high-compliance resins (those above 100% elongation), and it keeps much of its ductility after accelerated indoor ageing, which suits vehicle interiors, enclosures, consumer products and factory environments. Parts that sit near motors, lamps or hot fluids call for High Temperature Resin.

Thermal expansion is typical of a ductile photopolymer. Allow for it where a part mates with metal across a wide temperature swing.

PROPERTY	VALUE	TEST STANDARD
HDT @ 0.45 MPa	**66 °C**	ASTM D648-16
HDT @ 1.8 MPa	**53 °C**	ASTM D648-16
Storage Modulus Inflection (DMA)	**60.8 °C**	DMA, 3 °C/min
Glass Transition (DMA, tan δ peak)	**109.6 °C**	DMA, 3 °C/min
Thermal Expansion (0–150 °C)	**99 ×10^{-6}/K**	ASTM E831-19

PHYSICAL PROPERTIES

Hardness describes the cured surface, a firm Shore D. Density is Formlabs' published bulk density; parts are somewhat heavier than moulded polypropylene, which matters when a prototype is judged by weight and feel. Viscosity describes the liquid resin in the vat and guides handling and print setup.

PROPERTY	VALUE	TEST STANDARD
Hardness	**76 Shore D**	ASTM D2240
Bulk Density	**1.12 g/cm^3**	ASTM D792-20
Resin Viscosity (liquid, 25 °C)	**1000 cP**	Formlabs TDS

ELECTRICAL PROPERTIES

Post-cured Tough 1500 is an electrical insulator. Dielectric strength and volume resistivity suit housings, covers, connector bodies and cable clips around low-voltage electronics, and the dielectric constant and dissipation factor at 50 Hz and 1 kHz help evaluate parts near mains-frequency and signal circuits.

PROPERTY	VALUE	TEST STANDARD
Dielectric Strength	**23.4 kV/mm**	ASTM D149-20
Dielectric Constant (50 Hz)	**4.5**	ASTM D150
Dielectric Constant (1 kHz)	**3.9**	ASTM D150
Dissipation Factor (50 Hz)	**0.018**	ASTM D150
Dissipation Factor (1 kHz)	**0.013**	ASTM D150
Volume Resistivity	**2.91 × 10^{15} Ω·cm**	ASTM D257-14

CHEMICAL PROPERTIES

Formlabs publishes two solvent tests: the 24-hour weight gain of a printed cube, and an ASTM D543 test that measures how much tensile strength and stiffness remain after a week of immersion. Water, salt water, dilute acids and bases, bleach, diesel and mineral oils add almost no weight in a day, and a week in water, dilute acid, dilute alkali, hydrogen peroxide or motor oil leaves strength close to its original value. Gasoline, xylene, acetone and butyl acetate swell it heavily within a day, and a week in diesel or Skydrol cuts its strength noticeably.

Strength holds, but a week in water, dilute acids and bases or hydrogen peroxide cuts elongation at break roughly in half, and bleach cuts it further, so parts that must keep flexing after long wet exposure should be tested in the actual fluid. Unlike moulded polypropylene, Tough 1500 is not chosen for chemical resistance: keep parts away from gasoline, xylene, acetone and strong solvents, and confirm any long fluid exposure with application-specific testing before production release.

CHEMICAL	24 H WEIGHT GAIN	STRENGTH RETAINED AFTER 1 WEEK	STIFFNESS RETAINED AFTER 1 WEEK
Water	**0.21%**	**99%**	**97%**
Salt water (3.5% NaCl)	**0.24%**	**Not tested**	**Not tested**
Acetic acid 5%	**0.22%**	**Not tested**	**Not tested**
Hydrochloric acid 10%	**Not tested**	**101%**	**104%**
Strong acid (HCl, concentrated)	**2.15%**	**Not tested**	**Not tested**
Sodium hydroxide 0.025% (pH 10)	**0.17%**	**103%**	**89%**
Bleach (~5% NaOCl)	**-0.05%**	**98%**	**73%**
Hydrogen peroxide 3%	**0.31%**	**99%**	**99%**
Mineral oil (light)	**0.02%**	**Not tested**	**Not tested**
Mineral oil (heavy)	**0.04%**	**Not tested**	**Not tested**
Motor oil	**Not tested**	**102%**	**93%**
Hydraulic oil	**0.04%**	**Not tested**	**Not tested**
Diesel fuel	**0.04%**	**63%**	**60%**
Skydrol 5	**2.41%**	**44%**	**50%**
Isopropyl alcohol	**6.54%**	**29%**	**12%**
Diethylene glycol monomethyl ether	**5.71%**	**Not tested**	**Not tested**
Tripropylene glycol monomethyl ether	**5.90%**	**Not tested**	**Not tested**
Acetone	**29.64%**	**49%**	**38%**
Butyl acetate	**41.35%**	**Not tested**	**Not tested**
Isooctane (gasoline)	**42.92%**	**Not tested**	**Not tested**
Xylene	**72.57%**	**Not tested**	**Not tested**

BIOCOMPATIBILITY AND COMPLIANCE

Formlabs tested Tough 1500 Resin V2 as a skin-contacting material to ISO 10993-1: it is not cytotoxic, not an irritant and not a sensitizer when parts are washed for 20 minutes in 99% or stronger isopropyl alcohol and post-cured to the Formlabs schedule. That suits grips, handles, wearables and device housings that touch skin; specify skin contact at quote so parts are processed to that protocol.

Formlabs states that its resins are produced in accordance with the EU RoHS directive. Post-cured parts are rated UL 94 HB, so Tough 1500 is not used where a flame-retardant material is required; Flame Retardant Resin covers that need.

STANDARD	STATUS
ISO 10993-5 (Cytotoxicity) Not cytotoxic; evaluated as a skin-contacting material to ISO 10993-1 at NAMSA, when washed and post-cured to the Formlabs instructions	Formlabs tested
ISO 10993-10 (Irritation) Not an irritant; skin-contact evaluation to ISO 10993-1 at NAMSA	Formlabs tested
ISO 10993-10 (Sensitization) Not a sensitizer; skin-contact evaluation to ISO 10993-1 at NAMSA	Formlabs tested
UL 94 flammability Post-cured parts rated HB on the Formlabs datasheet; not flame retardant	HB
RoHS Directive 2011/65/EU Formlabs states that its resins are produced in accordance with the EU RoHS directive	Formlabs declaration

SUPPORTING DOCUMENTS

RoHS declaration