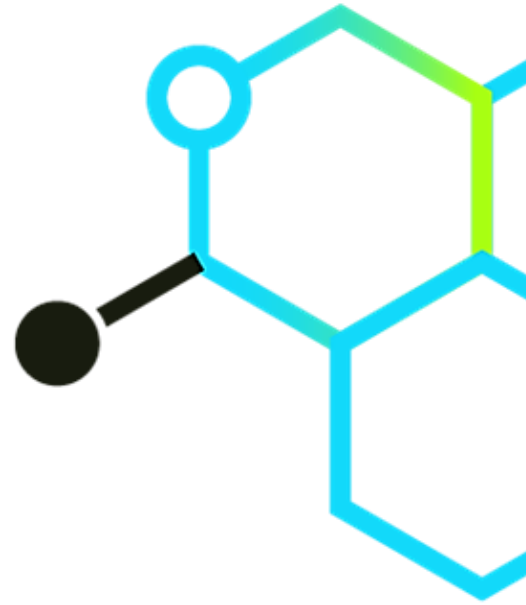


## Technical Datasheet

# TOUGH ESD

High Toughness Static Dissipative  
Photopolymer Resin

Black



## TOUGH ESD

Tough ESD is a high impact static dissipative photopolymer resin. It uses a urethane methacrylate base that includes a stable dispersion of discrete functionalized carbon nanotubes (D'Func) to achieve consistent static dissipative properties without compromising mechanical performance.



### Advantages

- Static dissipative properties
- Impact resistance 50 J/m
- Smooth surface finish & fine details



### Industries

- Electronics
- Automotive
- Aerospace & Defense



### Applications

- Routing clamps
- Clamping handles
- Nozzles
- Speaker handles

## PROPERTIES

Mechanical Properties	Green	Post-Cured	Units	Method
Ultimate Tensile Strength	19	38	MPa	ASTM D 638-14
Tensile Modulus	230	751	MPa	ASTM D 638-14
Yield Strength (Offset 0.2%)	13	27	MPa	ASTM D 638-14
Elongation at Break	68	44	%	ASTM D 638-14
Flexural Stress @5% Strain <sup>1</sup>	8	28	MPa	ASTM D 790-15
Flexural Modulus	217	910	MPa	ASTM D 790-15
IZOD Impact Strength (Notched)	65	50	J/m	ASTM D 256-10
Hardness Shore "D"	61	73		ASTM D 2240
Thermal Properties				
Heat Deflection Temperature (1.82 MPa)	65	79	°C	ASTM D 648 <sup>2</sup>
Other Properties				
Surface Resistance	10 <sup>8</sup>	10 <sup>6</sup>	Ω	ANSI ESD S11.11
Liquid Properties				
Viscosity (25°C) <sup>3</sup>	1200-1300		cps	ASTM D7867
Density	1.1 – 1.2		g/cm <sup>3</sup>	ASTM D1475

### Notes

<sup>1</sup>Specimens did not break within the 5% strain limit when tested by Procedure A and B per ASTM D790-15. Beyond 5% strain, this test is not applicable. Testing was continued until 20% strain without a break on both green and post-cured specimens.

<sup>2</sup>Measured using ElectroForce DMA in air.

<sup>3</sup>The resin is shear-thinning. The data reported at shear rate 10, [1/s] @25°C



## WORKFLOW

To achieve the properties specified in the TDS, validated workflows must be complied with. The following is an example of the verified workflow steps.

## MACHINE SETTINGS

Tough ESD is designed to fabricate parts on desktop and industrial DLP machines.

Recommended Build Parameters		Example Build Parameters (10 mW/cm <sup>2</sup> at 405 nm, 22°C):	
Temperature, [°C]	20 – 22	Layer Height, [µm]	100
Wavelength, [nm]	385, 405	Base Layer Exposure, [s]	8 – 12
Irradiance, [mW/cm <sup>2</sup> ]	3 – 10	Model Layer Exposure, [s]	6 – 8

## POST-PROCESSING

Tough ESD requires post-processing to achieve specified performance. Prior to post-curing, support structures should be removed from the fabricated component, and the part should be washed. It is recommended to use compressed air to remove residual solvent from features such as holes, pockets, slots, etc. between cleaning steps and prior to post-curing.

Step	Agent	Method	Duration	Intervals
Cleaning 1	Glycol-Ether based cleaner	Agitated Bath	2 – 5 min	1 to 2
Cleaning 2 <sup>1</sup>	IPA	Agitated Bath	2 – 3 min	1 to 2
Dry <sup>2</sup>	n/a	Compressed air	60 s	1 or 2
Wait before post-cure	n/a	Ambient	60 min	1

### Notes

<sup>1</sup>Dry before intervals

<sup>2</sup>Dark space is recommended for storage

## POST-CURE

Tough ESD requires post-curing to achieve specified properties. The following protocol and post-curing equipment has been qualified to date. Other post-curing protocols will be added later.

Curing Unit	Energy Source	Wavelength	Cure Time/side	Cure Temperature
Photocentric Cure L2	UV LED	405 nm	15 min	60°C

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