

## Somos<sup>®</sup> NanoTool<sup>™</sup>

### Third Generation ProtoComposite<sup>™</sup> Material for High Strength, High Temperature Applications



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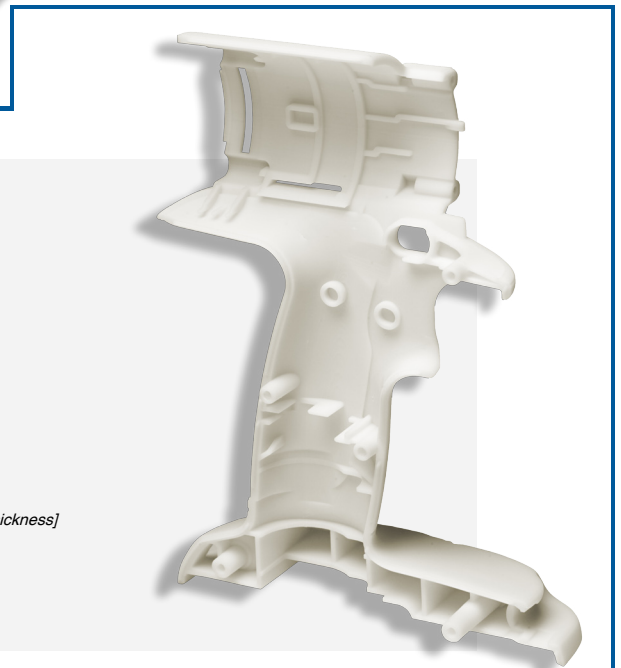
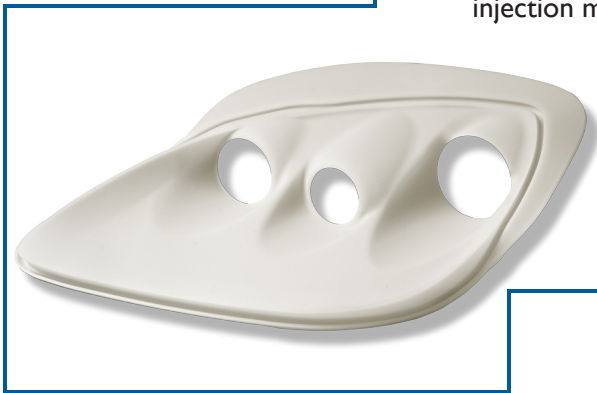
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#### Description

NanoTool produces strong, stiff, high temperature resistant composite parts on conventional stereolithography machines. This third generation of Somos<sup>®</sup> ProtoComposite materials is heavily filled with non-crystalline nanoparticles allowing for faster processing. It exhibits superior sidewall quality, along with excellent detail resolution as compared to other composite stereolithography materials.

#### Application

NanoTool's smooth surface quality and high initial modulus make it an excellent resin for metal plating, a growing application which saves time and money as an alternative to fully metal prototypes. It's also ideal for creating strong, stiff parts that need to resist high temperatures, including wind tunnel models for aerospace and automotive applications. A third major application area is rapid tooling for injection molding.



#### Physical Properties – Liquid

Appearance	Off White
Viscosity	~2,500 cps at 30°C
Density	~1.65 g/cm <sup>3</sup> at 25°C

#### Optical Properties at 355 nm

$E_c$	8.3 mJ/cm <sup>2</sup> <i>[critical exposure]</i>
$D_p$	0.11 mm (0.0043 inches) <i>[slope of cure-depth vs. ln(E) curve]</i>
$E_{10}$	84 mJ/cm <sup>2</sup> <i>[exposure that gives 0.254 mm (0.010 inch) thickness]</i>

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# Mechanical Properties (Metric)

ASTM Method	Description	Somos® NanoTool UV Postcure	Somos® NanoTool UV & Thermal Postcure
D638M	Tensile Strength	61.7 - 78.0 MPa	66.3 - 80.3 MPa
	Tensile Modulus	11,000 - 11,400 MPA	10,400 - 11,200 MPA
	Elongation at Break	0.7 - 1.0 %	0.7 - 1.0 %
	Poisson's Ratio	0.34 - 0.38	0.29 - 0.36
D790M	Flexural Strength	79 - 121 MPa	103 - 149 MPa
	Flexural Modulus	10,200 - 10,800 MPa	9,960 MPa - 10,200 MPa
D256A	Izod Impact-Notched	0.12 - 0.15 J/m	0.14 - 0.16 J/m
D2240	Hardness (Shore D)	94	94
D570-98	Water Absorption	0.23 %	0.15 - 0.16 %

N/A: Not Available

# Thermal & Electrical Properties (Metric)

ASTM Method	Description	Somos® NanoTool UV Postcure	Somos® NanoTool UV & Thermal Postcure
E831-00	C.T.E. -40°C – 0°C	25.3 - 26.0 $\mu\text{m}/\text{m}\cdot\text{°C}$	25.0 - 25.7 $\mu\text{m}/\text{m}\cdot\text{°C}$
	C.T.E. 0°C – 50°C	30.4 - 32.4 $\mu\text{m}/\text{m}\cdot\text{°C}$	25.5 - 31.3 $\mu\text{m}/\text{m}\cdot\text{°C}$
	C.T.E. 50°C – 100°C	175.9 - 87.4 $\mu\text{m}/\text{m}\cdot\text{°C}$	57.0 - 58.9 $\mu\text{m}/\text{m}\cdot\text{°C}$
	C.T.E. 100°C – 150°C	90.0 - 95.7 $\mu\text{m}/\text{m}\cdot\text{°C}$	95.2 - 99.6 $\mu\text{m}/\text{m}\cdot\text{°C}$
D150-98	Dielectric Constant 60Hz	4.0	3.9
	Dielectric Constant 1KHz	3.9	3.8
	Dielectric Constant 1MHz	3.6	3.6
DI49-97a	Dielectric Strength	15.6 - 16.8 kV/mm	16.1 - 16.9 kV/mm
E1545-00	Tg	57 - 62 °C	86 - 89 °C
D648-98c	HDT@ 0.46 MPa	225 °C	258 - 263 °C
	HDT @ 1.82 MPa	85 - 90 °C	104 °C

N/A: Not Available

# Mechanical Properties (Imperial)

ASTM Method	Description	Somos® NanoTool UV Postcure	Somos® NanoTool UV & Thermal Postcure
D638M	Tensile Strength	8.9 - 11.3 ksi	9.6 - 11.6 ksi
	Tensile Modulus	1,590 - 1,650 ksi	1,510 - 1,620 ksi
	Elongation at Break	0.7 - 1.0 %	0.7 - 1.0 %
	Poisson's Ratio	0.34 - 0.38	0.29 - 0.36
D790M	Flexural Strength	11.5 - 17.5 ksi	14.9 - 21.6 ksi
	Flexural Modulus	1,480 - 1,570 ksi	1,440 - 1,480 ksi
D256A	Izod Impact-Notched	0.23 - 0.29 ft-lb/in	0.26 - 0.31 ft-lb/in
D2240	Hardness (Shore D)	93 - 95	93 - 94
D570-98	Water Absorption	0.23 %	0.15 - 0.16 %

N/A: Not Available

# Thermal & Electrical Properties (Imperial)

ASTM Method	Description	Somos® NanoTool UV Postcure	Somos® NanoTool UV & Thermal Postcure
E831-00	C.T.E. -40°F – 32°F	14.1 - 14.4 µin/in-°F	13.9 - 14.3 µin/in-°F
	C.T.E. 32°F – 122°F	16.9 - 18.0 µin/in-°F	14.2 - 17.4 µin/in-°F
	C.T.E. 122°F – 212°F	42.2 - 48.6 µin/in-°F	31.7 - 32.7 µin/in-°F
	C.T.E. 212°F – 302°F	50.1 - 53.2 µin/in-°F	52.9 - 55.3 µin/in-°F
D150-98	Dielectric Constant 60Hz	4.0	3.9
	Dielectric Constant 1KHz	3.8 - 3.9	3.8
	Dielectric Constant 1MHz	3.6 - 3.7	3.6
D149-97a	Dielectric Strength	396 - 427 V/mil	408 - 428 V/mil
E1545-00	T <sub>g</sub> (TMA)	135 - 144 °F	187 - 192 °F
D648-98c	HDT@ 66 psi	437 °F	496 - 506 °F
	HDT @ 264 psi	185 - 193 °F	220 °F

N/A: Not Available