



Transformer Spacer Stick Comparative Data Sheet

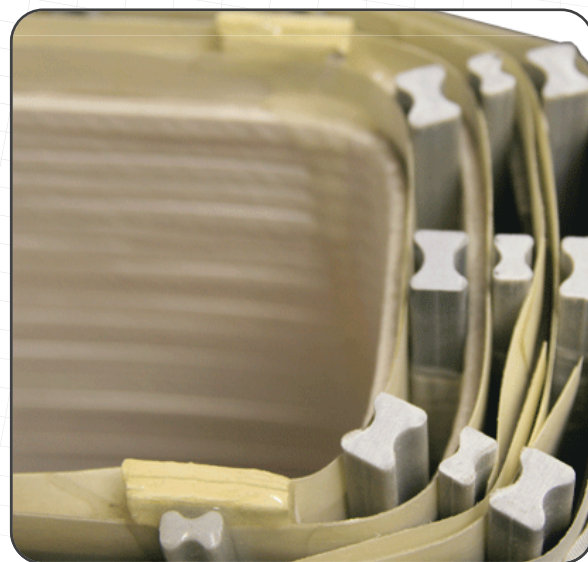
High Temperature Spacer Stick



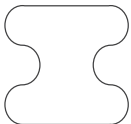
Grades N155, n180, and N220 are high temperature pultruded glass fiber reinforced thermoset resin rods that provides outstanding performance in demanding applications.

- » Excellent mechanical strength
- » Long term thermal stability
- » RoHS Compliant
- » Cost effective solution

Typical applications for Grade N155 and N220 include spacer sticks for dry type transformers as pictured to the right. These grades have been tested and listed by UL per UL 1446- Standard for Systems of Insulation Materials for compatibility with 155 °C, 180 °C, and 220 °C insulation systems. Custom sizes and shapes are available upon request.

Cut to size spacer stick may be kitted along with other fabricated parts, including, but not limited to winding bobbins, flexible N200F sheet material, Nomex® layer insulation, 3M® Layer Insulation, and insulating tapes.



Type	Availability
Rods	Dogbones, Rectangles, and Bars (upon request)
Parts	Fabricated parts, per customer drawings & specifications
Shapes	<div> Rectangles</div> <div> Squares</div> <div> Dogbones</div>



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Item:	High Temperature Spacer Sticks, Grades N155 and N220
Description:	<p>High temperature spacer sticks are commonly used in applications where mechanical strength and outstanding dielectric strength are required. N155 is available for Class F applications while N220 is available for Class H applications. High Temperature spacer sticks can handle the high temperature environments of many demanding applications.</p> <p>*Common profiles for high temperature spacer sticks can be found on the following pages.</p>

Key Characteristics		Test Method	Units - English (SI)	Typical Values N155	Typical Values N180	Typical Values N220
Standard Color		--	--	White	Light Grey	Natural/Beige
Specific Gravity		ASTM D-792	--	1.9	1.9	1.9
Water Absorption (1/8" thick)		ASTM D-570	%	0.2	0.15	0.15
Tensile Strength		ASTM D-638	psi (MPa)	60,000 (414)	80,000 (551)	80,000 (551)
Compressive Strength	Axial	ASTM D-695	psi (MPa)	45,000 (310)	60,000 (414)	60,000 (414)
	Transverse			15,000 (103)	15,000 (103)	15,000 (103)
Flexural Strength		ASTM D-790	psi (MPa)	80,000 (552)	90,000 (621)	90,000 (621)
Shear Strength (In Plane)		ASTM D-732	psi (MPa)	3,000 (21)	3,000 (21)	3,000 (21)
IZOD Impact Strength		ASTM D-256	ft-lbs/in	40	40	40
Arc Resistance		ASTM D-495	Seconds	130	180	180
Breakdown Voltage (Parallel Pin)		ASTM D-149 (Condition A - Oil)	kV	70	70	70
Relative Temperature Index		UL 746B	°C	155	180	220

All of the information, suggestions and recommendations pertaining to the properties and uses of the products herein are based upon tests and data believed to be accurate; however, the final determination regarding suitability of any material described herein for the use contemplated, the manner of such use, and whether the use infringes any patents is the sole responsibility of the user. There is no warranty, expressed or implied, including, without limitation warranty of merchantability or fitness for a particular purpose. Under no circumstances shall we be liable for incidental or consequential loss or damage.



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Item:	High Temperature Spacer Sticks, Grades N155 and N220
Description:	High Temperature spacer sticks are commonly used in applications where mechanical strength and outstanding dielectric strength are required. The chart below compares several grades of High Temperature spacer sticks.

Key Characteristics		Test Method	Units English (SI)	Typical Values NTR-N220	Typical Values SG-200	Typical Values Supersil
Standard Color		--	--	Natural/Beige	Tan	Grey
Specific Gravity		ASTM D-792	--	1.9	1.85	1.95
Water Absorption (1/8" thick)		ASTM D-570	%	0.15	0.15	0.3
Tensile Strength		ASTM D-638	psi (MPa)	80,000 (551)	70,000 (485)	70,000 (485)
Compressive Strength	Axial	ASTM D-695	psi (MPa)	60,000 (414)	40,000 (275)	40,000 (275)
	Transverse			15,000 (103)	14,000 (97)	20,000 (138)
Flexural Strength		ASTM D-790	psi (MPa)	90,000 (621)	80,000 (552)	70,000 (483)
Shear Strength (In Plane)		ASTM D-732	psi (MPa)	3,000 (21)	3,000 (21)	N/A
IZOD Impact Strength		ASTM D-256	ft-lbs/in	40	40	30
Arc Resistance		ASTM D-495	Seconds	180	150	120
Breakdown Voltage (Parallel Pin)		ASTM D-149 (Condition A - Oil)	kV	70	70	50
Relative Temperature Index		UL 746E	°C	220	220	N/A

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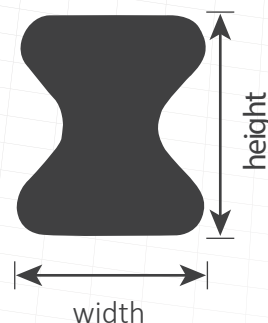
Mexico

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TECHNICAL WHITE PAPER

Size (in) width x height	Feet / Package	Length/Rod (ft)	Molded Tolerance
1/4 x 3/8	1080	9'	+0.010"
3/8 x 3/8	810	9'	+0.010"
3/8 x 1/2	576	9'	+0.010"
3/8 x 5/8	432	9'	+0.010"
3/8 x 3/4	360	9'	+0.010"
3/8 x 1	288	9'	+0.010"
1/2 x 1/2	432	9'	+0.010"
1/2 x 5/8	324	9'	+0.010"
1/2 x 3/4	270	9'	+0.015"
1/2 x 1	216	9'	+0.015"
5/8 x 3/4	225	9'	+0.015"
5/8 x 7/8	180	9'	+0.015"
3/4 x 1	144	9'	+0.015"
Size (in) width x height	Feet / Package	Length/Rod (ft)	Molded Tolerance
1/4 x 1/4	1620	9'	+ 0.010"
1/4 x 3/8	1080	9'	+ 0.010"
1/4 x 1/2	864	9'	+ 0.010"
1/4 x 5/8	648	9'	+ 0.010"
1/4 x 3/4	540	9'	+ 0.010"
1/4 x 1-3/16	324	9'	+ 0.010"
5/16 x 5/16	972	9'	+ 0.010"
5/16 x 1/2	648	9'	+ 0.010"
5/16 x 1	324	9'	+ 0.010"
3/8 x 3/8	720	9'	+ 0.010"
3/8 x 1/2	576	9'	+ 0.010"
3/8 x 5/8	432	9'	+ 0.010"
3/8 x 3/4	360	9'	+ 0.010"
7/16 x 1/2	504	9'	+ 0.010"
1/2 x 1/2	432	9'	+ 0.010"
1/2 x 5/8	324	9'	+ 0.010"
1/2 x 3/4	270	9'	+ 0.015"
1/2 x 1-3/8	162	9'	+ 0.015"
9/16 x 9/16	315	9'	+ 0.015"
9/16 x 1	180	9'	+ 0.015"
9/16 x 1-1/8	135	9'	+ 0.015"
5/8 x 3/4	225	9'	+ 0.015"
3/4 x 1	144	9'	+ 0.015"
1-1/4 x 1-1/4	54	9'	+ 0.015"

N155 or N220 Dogbones



N155 or N220 Rectangles & Squares

