



Electrical Insulating Laminates

Our laminates offer a superior combination of electrical and mechanical properties – properties such as dielectric strength, flame resistance, arc and track resistance, high flexural and impact strength. These fiberglass-reinforced polyester thermoset sheets will not melt under heat and have excellent overall electrical properties.

Among the property advantages of these laminates are:

Electrical Insulation

Insulating laminates have inherently good dielectrics. The various grades of the laminates featured here have been engineered to maximize the specific properties required for a wide range of electrical and electronic applications.

Flame Resistance

Flame resistance meeting UL 94V-0 specifications is available in combination with a variety of properties.

Mechanical Strength

These high-impact fiberglass-reinforced polyester laminates won't shatter. Rigid laminates provide structural support as they insulate. Flexible laminates are available for applications which require a minimum bend radius of $\frac{3}{4}$ " diameter.

Custom Grades

Custom grades of laminates and colors are available. Please contact us for more information.

Grade	Part Number	Temp. Index Electrical/ Mechanical	Property Highlights
TSF	1312	130°C/130°C	NEMA GPO-1. Economical, general-purpose laminate.
T-180	1360	160°C/160°C	NEMA GPO-1. High strength, high heat resistance.
UTS	1478 141	130°C/160°C 130°C/130°C	NEMA GPO-2. Highly flame resistant. Meets UL 94V-0.
UTR	1494	130°C/160°C	NEMA GPO-3. UL-recognized. Flame resistant, arc and track resistant.
1580	1580	120°C/140°C	NEMA GPO-3. UL-recognized. Highly flame resistant. Meets UL 94V-0. Combines high arc and track resistance, in thicknesses of .025" to $\frac{3}{32}$ ".
SG-200	1906	210°C/140°C	High heat resistance. Excellent retention of physical and electrical properties at elevated temperatures.
FHT	1800	190°C/190°C ($\frac{1}{32}$ " 200°C/200°C ($\frac{1}{16}$ "	Highly flexible. Excellent dielectric strength. High heat resistance. In $\frac{1}{32}$ " and $\frac{1}{16}$ " thicknesses. For 220°C systems for dry-type transformers.



Laminates Properties – Typical Average Values*

	UNIT	ASTM/UL Number	Grade TSF	Grade UTS	Grade UTR	Grade 1580	Grade SG-200	Grade FHT	Grade T-160	
General Information										
Part Number	–	–	1312	1478	141	1494	1580	1906	1800	1360
Standard Color	–	–	Brown	Red	Red	Red	White	Natural/Tan	Natural/Cream	White
Mechanical Properties										
NEMA Grade Li 1-1989			GPO-1/GPO-1P	GPO-2/GPO-2P	GPO-2	GPO-3	GPO-3	GPO-1	–	GPO-1
Military Specification	–	–	–	L-P 509/GPO-2	–	–	–	–	–	–
Tensile Strength	Psi	D638	9,400	8,900	8,000	7,800	8,400	12,500	10,500	14,000
Flexural Strength	Psi	D790	22,300	24,600	18,000	22,100	24,600	29,000	–	29,000
Compressive Strength	Psi	D695	38,900	39,000	30,000	33,100	31,200	36,000	14,000	56,000
Shear Strength	Psi	D732	13,400	13,400	14,000	11,600	12,00	11,100	–	–
IZOD Impact Strength (notched)	ft.lb./in.	D256	8	10.7	8.0	8.9	8.9	12	10	12
Water Absorption	% by wt.	D570	0.3	0.6	0.8	0.4	0.2	0.3	1.1	0.3
Specific Gravity	–	D792	1.78	1.8	1.8	1.81	1.83	1.7	1.6	1.9
Electrical Properties										
Electrical Strength – Perpendicular S/T in air	Vpm	D149	417	433	300	450	425	500	450	270
Electrical Strength – Perpendicular S/T in oil	Vpm	D149	493	567	–	584	577	625	570	412
Arc Resistance	Sec.	D495	127	130	130	180	181	120/180**	139	140
IEC Track Resistance (CTI)	V.	UL746A	500+	500+	–	500+	500+	500+	500+	–
Dissipation Factor, 60 Hz	–	D150	0.011	0.011	0.05	0.013	0.011	0.037	0.070	–
Dissipation Factor, MHz	–	D150	0.010	0.010	–	0.010	0.010	0.13	0.033	–
Insulation Resistance	Ohm x 10 ¹²	D257	270	270	–	3.1	823	145	–	–
Flame Resistance Properties										
UL Subject 94	–	UL94	HB	VO	VO	0.94" & Thicker Less than 0.93"	VO	HB	HB	–
UL Hot Wire Ignition	Sec.	UL746A	–	300+	–	–	300+	0.028 in./35 0.058 in./39	0.028 in./49 0.058 in./102	–
UL High Amp Ignition	# Exposure	UL746A	–	200+	–	–	200+	200+	200+	–
UL Standard 723 Flame Spread	–	E84	–	–	–	–	–	–	–	–
Oxygen Index	%O ₂	D2863	21.8	36	–	35	39	21.8	21.8	–
Ignition Time	Min.	–	–	81	75	85	84	–	–	–
Burn Time	Min	–	–	48	85	49	23	–	–	–
Thermal Properties										
Coefficient of Thermal Expansion	ln/ln/°C x 10 ⁻⁵	D696	2.2	2	2	2	2	2	2	–
Thermal Conductivity	BTU/HR/Ft ² /In/°F	C177	1.8	1.8	–	1.9	1.9	1.7	1.7	–
UL Temperature Index									0.028 in./190 0.058 in./200	
– Electrical	°C	UL 746B	130	130	130	130	120	210		–
– Mechanical	°C	UL 746B	160	160	130	160	140	210	0.028 in./190 0.058 in./200	
UL Recognition File Number	–	–	E23525	E81928	E23525	E81928	E81928	E81928	E81928	–
UL Classification Number	–	–	E23525	E81928	E23525	E81928	E81928	E81928	E81928	–

* Typical average values for testing 0.063" thick material. Values will vary somewhat from thickness with a material grade.

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