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Composites of Nomex²

Nomex paper or mat can be combined with nearly any other flexible insulating material to form a composite. Those which possess the most obvious advantages and are of the greatest current interest are:

Nomex/Polyester Film

The combination of Nomex paper or mat with polyester film represents an improvement in cut-through resistance and superior thermal aging characteristics. Combinations of this type can be made with any number of plies, the most common composites being of two and three plies. In selecting the type of construction to be used, it is well to consider the function of the polyester film. If the film is simply a reinforcing material, and is not required as a long term dielectric, then two ply composites are the most economical. They are also higher in tear resistance than three ply composites of the same thickness. This is especially so in applications where the composites can be inserted in such a manner that the film ply must withstand the greater elongation. For example, in motor slot applications, higher tear resistance is usually obtained when the film is next to the steel laminations.

When the film is to be used as a dielectric throughout the life of the unit, three ply combinations are recommended. This allows the film to be protected on both sides, and as tests and field experience have indicated, this greatly extends its useful life at elevated temperatures.

Nomex 416 is the standard paper used in Nomex/Polyester film composites. Nomex 416 is recognized by UL as a 200°C material.

Nomex/Kapton³

In order to utilize the full thermal stability of Nomex 410 (UL recognizes Nomex 410 paper as a 200°C material). It is desirable to form composites with films of like thermal stability. One such suitable material is duPont's Kapton polyimide film. At room temperature the properties of Kapton are similar to those of polyester films; however, both the electrical and mechanical characteristics are maintained over a much broader

temperature range. Tests indicate that Kapton is suitable for continuous operation at 230°C. In addition, it does not melt and is infusible. Thus Nomex-Kapton composites offer many of the familiar advantages of polyester mat/polyester film combinations plus thermal stability adequate for Class H applications, provided they are bonded with a suitable adhesive.

Nomex Type 416/Polyester Film/Nomex Type 416

Product	Composite Thickness ASTM D374 (inches)	Yield		Dielectric Strength ASTM D149 (2 in. Dia. Electrodes) (volts)	Volume Resistivity ¹ ASTM D257 (ohm/cm)	Surface Resistivity ¹ ASTM D257 (ohms)	Tensile Strength ASTM D828 Lbs./In. Width		Tear Strength Graves (Lbs.)	
		Sq. Yds./Lb.	Lbs./Sq. Yd.				MD	CMD	MD	CMD
3-3-3	0.010	2.01	0.50	11,600	10 ¹⁴	10 ¹³	142	116	11	10
3-5-3	0.012	1.54	0.65	12,600	10 ¹⁴	10 ¹³	175	150	14	12
3-7 1/2 - 3	0.016	---	0.77	16,000	10 ¹⁴	10 ¹³	285	200	16	22
5-3-5	0.0135	1.38	0.72	15,000	10 ¹⁴	10 ¹³	235	165	16	13
5-5-5	0.0145	---	0.78	17,000	10 ¹⁴	10 ¹³	220	200	16	22

1 - Values obtained were greater than values shown.

Nomex Type 410/Kapton/Nomex Type 410

Product	Composite Thickness ASTM D374 (inches)	Yield		Dielectric Strength ASTM D149 (2 in. Dia. Electrodes) (volts)	Volume Resistivity ¹ ASTM D257 (ohm/cm)	Surface Resistivity ¹ ASTM D257 (ohms)	Tensile Strength ASTM D828 Lbs./In. Width		Tear Strength Graves (Lbs.)	
		Sq. Yds./Lb.	Lbs./Sq. Yd.				MD	CMD	MD	CMD
3-1	0.005	4.55	0.22	5,300	10 ¹⁴	10 ¹³	60	40	4	5
3-2	0.005	3.82	0.26	6,000	10 ¹⁴	10 ¹³	70	55	6	5
5-2	0.007	2.77	0.36	9,500	10 ¹⁴	10 ¹³	115	90	10	10
2-2-2	0.006	2.77	0.36	7,300	10 ¹⁴	10 ¹³	67	57	---	---
3-1-3	0.008	2.55	0.39	6,600	10 ¹⁴	10 ¹³	104	76	8	6
3-2-3	0.009	2.22	0.45	8,900	10 ¹⁴	10 ¹³	112	81	10	6
3-3-3	0.0010	1.92	0.52	16,000	10 ¹⁴	10 ¹³	150	105	11	9

1 - Values obtained were greater than values shown.

Nomex Mat/Kapton

Product	Composite Thickness ASTM D374 (inches)	Yield Sq. Yds./Lb.	Lbs./Sq. Yd.	Dielectric Strength ASTM D149 (2 in. Dia. Electrodes) (volts)	Tensile Strength ASTM D828 Lbs./In. Width		Tear Strength MIL-I-22834 (Ships) (Lbs.)	
					MD	CMD	MD	CMD
2-1-2	0.0056	3.69	0.27	6,000	60	40	10	10
2-2-2	0.0066	3.06	0.33	12,000	84	77	16	15



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Composites of Nomex²

Pyromid[®] 180

A flexible insulation, high temperature combination material, that looks, feels and handles like DMD, but operates up to 180C. The fact that it is a mat rather than a hard paper product, enables it to absorb varnish and enhance the bonding of the wire and steel to the insulation, thus making a more homogeneous structure.

Miscellaneous Nomex Composites
 Nomex may also be combined with any number of fibrous materials, cloths or films where certain specific properties are desired; for example:

Product	Composite Thickness ASTM D374 (inches)	Yield		Dielectric Strength MIL-I-22834 2"Electrodes (Volts) as received	Aged 96 hrs. at 180°C	Tensile Strength MIL-I-22834 (Lbs./In. of Width)		Tear Resistance Finch (Lbs./In. of Width)
		Sq. Yds./ Lb.	Lbs./ Sq. Yd.			MD	CMD	
3-3-3	0.009	2.17	0.46	10,000	10,000	120	75	190
3-5-3	0.011	1.69	0.59	14,000	14,000	150	100	260
3-7 ½ -3	0.0135	1.35	0.74	18,000	18,000	190	200	350
5-5-5	0.015	1.27	0.79	14,000	14,000	130	200	320
5-7 ½ -5	0.0175	---	---	16,500	16,500	195	225	---
5-10-5	0.020	0.89	1.12	17,500	17,500	220	270	400+

Nomex-Glass where unidirectional or woven glass can be oriented to provide increased mechanical strength in one or more specific directions. Such a material would also have good thermal stability and flame resistance.

Nomex-Varnished Glass for higher electric strength and excellent physical properties over a wide temperature range.

2 – duPont registered TM for its aramid paper.
 3 – duPont registered TM for its polyimide film.

Bedford Materials has no control over the final application of the product by others, therefore, the information contained herein is intended as a general guide to product use and should not be construed as a warranty.