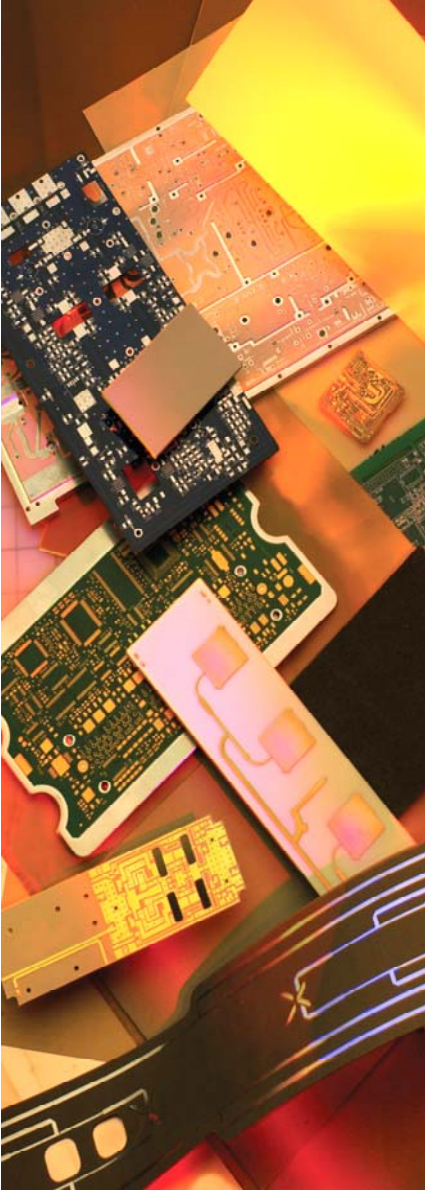


# 45NK

## WOVEN KEVLAR REINFORCED LAMINATE AND PREPREG



45NK is a woven Kevlar® aramid fiber reinforced multifunctional epoxy laminate and prepreg system engineered to provide in-plane CTE values as low as 6 ppm/°C for compatibility with leadless alumina ceramic chip carriers (LCCC's) and other low expansion SMT devices where control of laminate expansion is critical for solder joint reliability. 45NK exceeds the requirements of IPC 4101/50 (Type AFG).

### Features:

- High Tg (170°C) for improved reliability through process and in-use
- Low Dielectric Constant 3.9
- High modulus (19 x 10<sup>6</sup> psi) p-aramid woven fiber reinforcement with CTE of -4 ppm/°C provides superior X-Y CTE of 5-7 ppm/°C
- Process compatible with conventional high Tg multifunctional epoxy systems
- 100% Organic resin/reinforcement system is suitable for laser drilling
- RoHS/WEEE compliant
- UL-94 V0 exceeds IPC 4101 /50 requirements

### Typical Applications:

- SMT Board Designs using LCCC's or other low expansion chip carriers (See Figure 1)
- SMT Designs requiring both low in-plane CTE and laser drilling

# Typical Properties:

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Property	Units	Value	Test Method
<b>1. Electrical Properties</b>			
Dielectric Constant <i>(may vary with Resin %)</i>			
@ 1 MHz	-	3.9	IPC TM-650 2.5.5.3
@ 1 GHz	-		IPC TM-650 2.5.5.9
Dissipation Factor			
@ 1 MHz	-	0.016	IPC TM-650 2.5.5.3
@ 1 GHz	-		IPC TM-650 2.5.5.9
Volume Resistivity			
C96/35/90	MΩ-cm	1.3 x 10 <sup>7</sup>	IPC TM-650 2.5.17.1
E24/125	MΩ-cm		IPC TM-650 2.5.17.1
Surface Resistivity			
C96/35/90	MΩ	3.2 x 10 <sup>7</sup>	IPC TM-650 2.5.17.1
E24/125	MΩ		IPC TM-650 2.5.17.1
Electrical Strength (typical)	Volts/mil	750 min	IPC TM-650 2.5.6.2
Dielectric Breakdown	kV		IPC TM-650 2.5.6
Arc Resistance	sec		IPC TM-650 2.5.1
<b>2. Thermal Properties</b>			
Glass Transition Temperature (Tg)			
TMA	°C		IPC TM-650 2.4.24
DSC	°C	170	IPC TM-650 2.4.25
Decomposition Temperature (Td)			
Initial	°C		IPC TM-650 2.3.41
5%	°C		IPC TM-650 2.3.41
T260	min		IPC TM-650 2.4.24.1
T288	min		IPC TM-650 2.4.24.1
T300	min		IPC TM-650 2.4.24.1
CTE (x,y)	ppm/°C	5-7 ppm/ °C	IPC TM-650 2.4.41
CTE (z)			
< Tg	ppm/°C	75	IPC TM-650 2.4.24
> Tg	ppm/°C	225	IPC TM-650 2.4.24
z-axis Expansion (50-260°C)	%	2.8	IPC TM-650 2.4.24
<b>3. Mechanical Properties</b>			
Peel Strength to Copper (1 oz/35 micron)			
After Thermal Stress	lb/in (N/mm)	6	IPC TM-650 2.4.8
At Elevated Temperatures	lb/in (N/mm)	6	IPC TM-650 2.4.8.2
After Process Solutions	lb/in (N/mm)	6	IPC TM-650 2.4.8
Young's Modulus	Mpsi (GPa)	22.2	IPC TM-650 2.4.18.3
Flexural Strength	kpsi (MPa)		IPC TM-650 2.4.4
Tensile Strength	kpsi (MPa)		IPC TM-650 2.4.18.3
Compressive Modulus	kpsi (MPa)		ASTM D-695
Poisson's Ratio (x, y)	-	0.2	ASTM D-3039
<b>4. Physical Properties</b>			
Water Absorption	%	0.8%	IPC TM-650 2.6.2.1
Specific Gravity	g/cm <sup>3</sup>	1.5	ASTM D792 Method A
Thermal Conductivity	W/mK	0.22	ASTM E1461
Flammability	Class	V0	UL-94

## Availability:

Arlon Part Number	Fabric Style	Resin Content	Volatiles	Nominal Pressed
45NK257	3500 Kevlar	57 ± 3%	0.5% max	0.004"
45NK262	3500 Kevlar	62 ± 3%	0.5% max	0.0045"

## Recommended Process Conditions:

Process inner-layers through develop, etch, and strip using standard industry practices. Use brown oxide on inner layers. Adjust dwell time in the oxide bath to ensure uniform coating.

Bake inner layers in a rack for 60 minutes at 225°F - 250°F (107°C - 121°C) immediately prior to lay-up.

Vacuum desiccate the prepreg for 8 - 12 hours prior to lamination.

Lamination Cycle (vacuum press is preferred - see notes, below):

- 1) Pre-vacuum for 30 minutes
- 2) Control the heat rise to 8°F - 12°F (4°C - 6°C) per minute between 130°F and 230°F (55°C and 110°C)

Panel Size		Pressure		Pressure (Vacuum Press)	
in	cm	psi	kg/sq cm	psi	kg/sq cm
12 x 18	40 x 46	275	19	150	10.5
16 x 18	30 x 46	350	25	170	12.3
18 x 24	46 x 61	400	28	200	14.1

- 3) Product temperature at start of cure = 360°F (180°C).
- 4) Cure time at temperature = 90 minutes
- 5) Cool down under pressure at ≤ 10°F/min (5°C/min)

## Process Notes:

Kevlar® fabric compresses and distorts under pressure, more so than E Glass, which dictates the use of lower lamination pressures. The use of an autoclave or vacuum assist lamination makes the use of lower pressure possible. Typically the pressures used under vacuum should be about 50% of those used for standard press lamination e.g. 12" x 18" (30 cm x 45 cm) panel non-vacuum 300 PSI (2 kg/cm<sup>2</sup>) versus vacuum 150 PSI (10.5 kg/cm<sup>2</sup>).

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The use of a low pressure “kiss cycle” until the resin has melted will minimize stresses on the material, and should improve registration. The resin melts at 160 °F (71 °C) and gels at 340 °F (170 °C). The transition from low pressure to high pressure should occur in the lower end of this window (165 - 175 °F/74-79 °C). A cure cycle of 360 °F (182 °C) for 90 minutes should give a Tg of 175 °C. A properly cured laminate is essential for minimizing processing problems in subsequent process operations.

**Drilling:** Drilling techniques that work well with laminates made with E Glass may produce snags and tears in Kevlar®. Basic parameters of 450 SFM (135m/min) and 1 mil (27 micron) chip load seem to work well. It is necessary to check for proper drill geometry and quality, as well as checking the hole quality at set-up before proceeding with drilling the complete panel.

**Hole Cleaning:** A vapor hone/blast with 300-350 grit Aluminum Oxide to remove debris and loose fibers is advantageous prior to plasma etch.

**Prebake Prior to Plasma Etch:** A prebake process prior to plasma etch of 250 °F (121 °C) for 90 to 120 minutes is recommended to remove any absorbed moisture.

**Plasma Etch:** A plasma etch process that has worked on epoxy Kevlar® to achieve positive etch-back is as follows:

1. Prebake at 250 °F (121 °C) for
2. Plasma treatment: 90 to 120 minutes. RF Power – 2 kw. Gas mixture - CF<sub>4</sub> (Freon™) 70% O<sub>2</sub> (Oxygen) 30%. Flow rate - 750 cc / minute each. Electrode temperature - 250 °F to 300 °F (121 - 149 °C). Duration - 20 to 30 minutes. Purge - O<sub>2</sub> 100%.

**Prebake Prior to Electroless:** A prebake process of 250 °F (121 °C) for 60 to 90 minutes prior to electroless copper process is recommended to remove absorbed moisture.

**Electroless Copper and Copper Plating:** Standard practices for electroless deposition have been used as well as a double pass to aid in the encapsulation of any protruding fibers. A heavier copper plating (possibly 2 to 2.5 mils/50 - 63 microns as opposed to 1 to 1.5 mils/25 - 38 microns) may be desirable to improve thermal management and to resist barrel cracking due to the higher Z axis expansion of laminates reinforced with Kevlar® fabric.

**Routing:** The use of sharp cutters is more important with Kevlar® fabric than with glass fabric. Feed rates may need to be reduced by 10 to 25% to minimize the incidence of frayed edges.

**Solder Reflow:** A prebake process of 250 °F (121 °C) for 90 to 120 minutes prior to any solder reflow process is recommended.

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