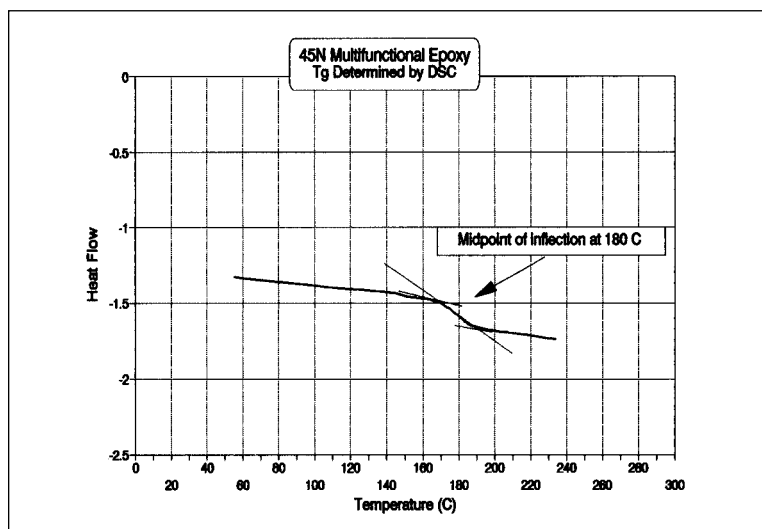


### 45N Multifunctional Epoxy

- Tg of 180° C at Press Cure
- Improved Process Yields
- PTH Reliability
- Reduced Measling
- Conventional Lamination Process



# 45N Multifunctional Epoxy

Arlon Materials for Electronics' 45N is a tough, high Tg (180°C by DSC) multifunctional epoxy laminate and prepreg system developed for use in higher layer count boards. Process yields in complex multilayers are impacted both by high cumulative Z-direction expansion and by the tendency to measle as a result of thermal shock. Lower Tg difunctional and tetrafunctional-modified epoxy products frequently cannot withstand these thermal excursions.

45N Multifunctional Epoxy offers:

- Engineered Rheology to provide control of lamination processing
- UL-94 V0 Recognized FR-4
- Qualified as Type GFG (or GFN) (IPC-4101/\_)
- Available in all standard Glass styles
- Available with HTE Copper at  $\geq 5\%$  elongation
- Available with CIC Cladding for CTE applications
- Fluorescence Compatible with AOI Equipment

Multifunctional epoxy product benefits are derived chiefly from its high Tg and the associated decreased Z-direction expansion and include:

- Reduced Pad Lifting
- Reduced Copper Barrel Cracking
- Reduced Innerlayer Foil Cracking
- Minimized Epoxy Smear
- Resistance to Measling and Solder-shock Damage
- Improved Resistance to Chemical Attack
- Superior Reworkability

Applications for 45N include:

- High layer count multilayer boards which suffer from pad lifting or PTH failures due to high Z-direction expansion
- Military MLB's with strict standards for measling and other damage caused by thermal stress
- Direct substitution for FR-4 in any board which requires an improvement in resistance to thermal cycling, such as for SMT applications
- An alternative to difficult to process BT when it has been specified for its Tg

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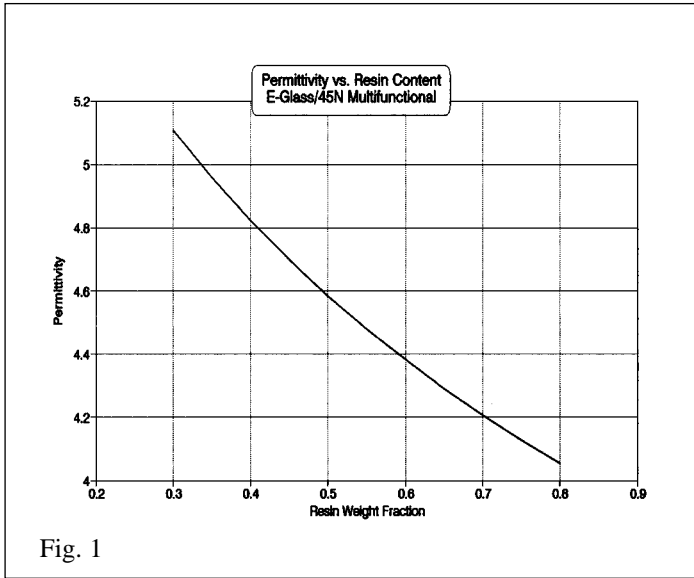


Fig. 1

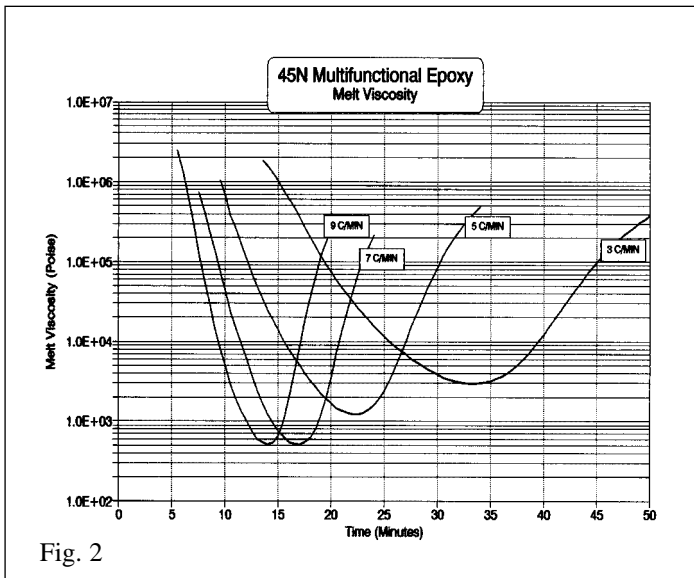


Fig. 2

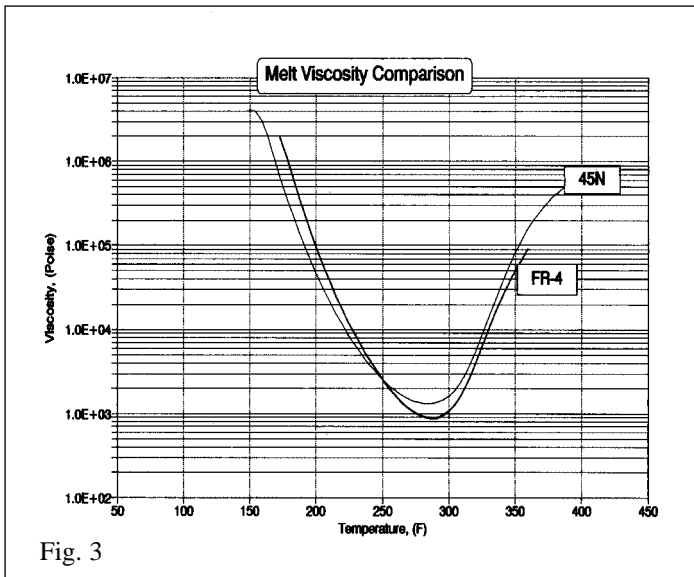


Fig. 3

## Technical Data

### Dielectric Constant

As with other epoxy systems, dielectric constant (permittivity) of 45N is dependent on the resin content. A typical 5 or 6 mil laminate with a resin content of 60% by weight would have a dielectric constant of 4.3 to 4.5. Dissipation factor of 0.025 is typical at 1 Mhz. Control of dielectric constant is dependent on the volume ratio of resin to glass. Maintaining a consistent dielectric constant in impedance sensitive layers of a MLB depends on both laminate and prepreg having approximately the same resin to glass ratio. Arlon technical service engineers can work with you to determine dielectric constant and impedance values for your designs. (Figure #1)

### Rheological Properties

The rheology of 45N is engineered to be moderately sensitive to heatup rate so that processes developed and controlled for specific designs can be adjusted readily to deal with normal design variables such as weight of copper to be filled. The Melt Viscosity Comparison on this page shows the similarity between the melt rheology of 45N and FR-4. (Figure #2)

The seemingly low gel value of 45N — in the range of 70 seconds — is due to the inherent reactivity of multifunctional components compared to conventional epoxy. As can be seen in the 45N Melt Viscosity graph of time vs. viscosity at various heating rates, actual available open time can be controlled over a wide band. We recommend a range of 4.5-7°C/min.(8-12°F/min.) as a starting point for developing a cycle. (Figure #3)

## Process Data

### Lamination Cycle

As indicated, 45N utilizes a basic epoxy-type press cycle. Based on extensive cure studies, a 90 minute cure at 360°F should achieve a Tg (by DSC) of 180°C. 45N does not require a postbake to achieve complete Tg development. Overcuring could actually result in a depression of the Tg. (Figure #4)

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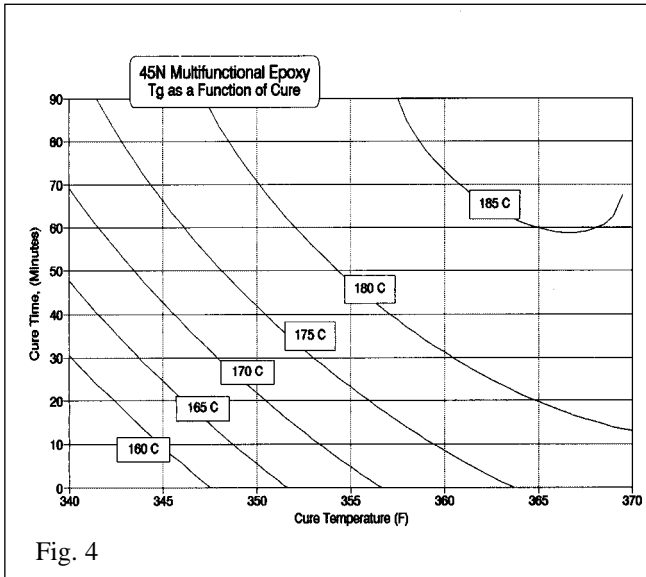


Fig. 4

Note: 45N, like some other multifunctionals, may react chemically with moisture during cure. We recommend desiccation of prepreg prior to lamination to eliminate moisture which might result in depression of the cured Tg.

Tg as determined by DSC will differ from that obtained by TMA by about 10°C. DSC, which gives the 180°C value, is typically used in measuring epoxy Tg's. TMA will give a value of about 170°C on a properly cured board. (Figure #5)

Heatup rate during lamination should be in the range of 4.5-7°C/min. (8-12°F/min.) from 150°F to 250°F (65-121°C) product temperature during which melt occurs. This will ensure that the melt viscosity is controlled and reproducible.

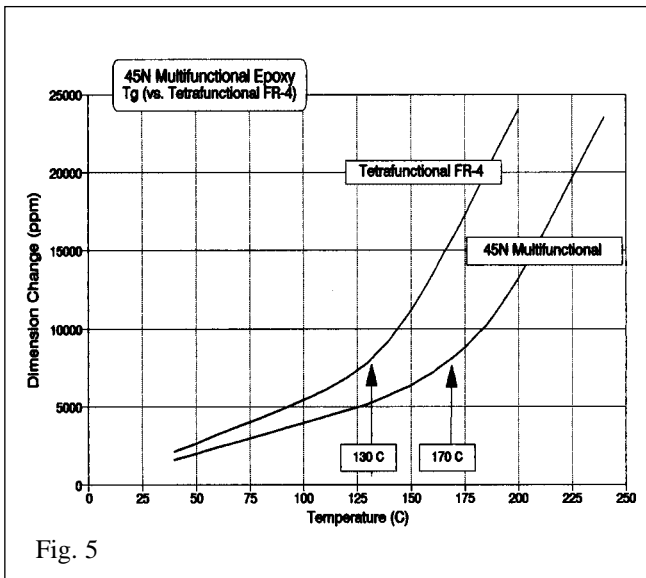


Fig. 5

We recommend the use of a kiss cycle of 50 psi (35 kg/cm<sup>2</sup>) (or whatever is appropriate for the particular equipment involved) until the multilayer temperature has reached 180°F (82°C). This allows application of full pressure just as the resin has reached its melt point.

We suggest full pressure be proportional to laminate panel size. For a typical 12 x 18 (30 x 46 cm) MLB, a pressure of 300 psi (21 Kg/cm<sup>2</sup>) should work well in a hydraulic press. In a vacuum application, we usually recommend about 60-70% of normal pressure. A starting point for vacuum lamination would be 200 psi (14 Kg/cm<sup>2</sup>). (Figure #6)

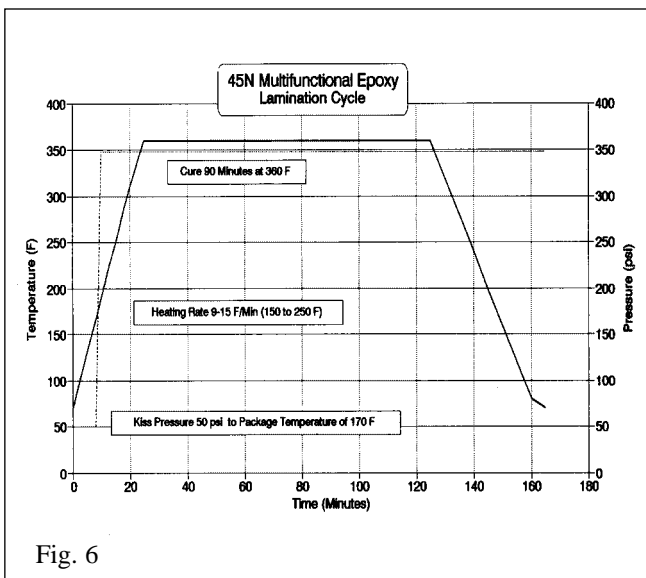


Fig. 6

### Drilling

Drilling is similar to that for FR-4, although with all laminates that are more tightly crosslinked, drill life may be reduced somewhat. A starting point recommendation of 300-450 sfm at a chipload of 1-1.5 mils should result in good hole quality.



## Etchback

Multifunctional epoxies are harder to desmear or etchback than traditional FR-4. Good success has been achieved using permanganate solutions. An aggressive permanganate is necessary in achieving military etchback as opposed to hole cleaning or hole wall preparation after plasma etchback.

Typically:

- Hole conditioner (Full Strength), 110°F(43°C), 5 minutes, rinse 5 minutes
- Permanganate at 180°F(82°C), 15 minutes, with two 3 minute rinses
- Neutralizer as required
- Glass etch, rinse, and rinse as required
- Final water rinse before going to electroless

## 45N Typical Properties

Property (Units)	IPC-4101	45N Typical
Peel strength (1 oz./35μ) [N/mm]		
As Received	6.0 (1.05)	8.0 (1.4)
After Thermal Stress	6.0 (1.05)	8.0 (1.4)
At Elevated Temperature	5.0 (0.88)	8.0 (1.4)
After Process Chemical Exposure	5.0 (0.88)	8.0 (1.4)
CTE – X-Y Below 180°C (ppm/°C)		15
CTE – Z Below 180°C (ppm/°C)		55
Young's Modulus (X/Y psi)		4.4E5/3.7E5
Poisson's Ratios (X/Y)		0.14/0.16
Glass Transition Temperature (Tg) DSC (°C)		*180
Arc Resistance (seconds minimum)		65
Electrical Strength [V/mil (kV/mm)]	750 (29.5)	1500 (59)
Permittivity at 1 MHz	5.4 Max.	4.4 - 4.6
Loss Tangent at 1 MHz	0.035 Max.	0.025
Volume Resistivity (min) [Megohm-cm]		
At Elevated Temperature	1.0E3	2.6E-7
After Moisture Exposure	1.0E-4	3.3E-7
Surface Resistivity (min) [Megohms-cm]		
At Elevated Temperature	1.0E3	2.9E-7
After Moisture Exposure	1.0E-4	4.0E-4
Moisture Absorption (%)		0.1

\*Tg nominal on laminates. Finished MLB's value may be lower due to printed circuit processes.

*Data is believed to be accurate but values are average and not guaranteed. All sales of these products are governed by the terms and conditions under which they are sold. Determination of the suitability of any of these materials for a particular application is the sole responsibility of the user.*



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# Products Available

**Prepreg**

Arlon P/N	Glass	Resin	Scaled Flow
45N0675	106	75±5%	1.5 mil (0.038 mm) ±0.2
45N8065	1080	65±5%	2.4 mil (0.058 mm) ±0.2
45N2355	2313	55±5%	3.4 mil (0.084 mm) ±0.2
45N2650	2116	50±5%	3.9 mil (0.094 mm) ±0.2
45N2842	7628	42±3%	6.8 mil (0.160 mm) ±0.3

Note:

Styles 1080 and 108 are considered interchangeable.  
 Styles 2313 and 113 are considered interchangeable.  
 Styles 2116 and 116 are considered interchangeable.

Arlon produces a full range of laminate thicknesses. Standard thin 45N laminates for multilayers include:

**Laminates**

Thickness	Construction	Notes/Comments
0.0045"	106/1080 Construction	
0.0050"	106/2313 Construction	Best D.S.
	2-1080 Construction	Alternate
0.0060"	106/2116 Construction	Best D.S.
	2-1080 Construction	Alternate
0.0080"	2313/2116 Construction	Best D.S.
	1080/2116 Construction	Alternate
0.0120"	1080/7628/1080 Construction	

Other thicknesses and constructions are available. Please consult an Arlon customer service representative for current stock levels and pricing information.

**Cladding**

45N Multifunctional can be supplied with a variety of copper and specialty claddings: We recommend the use of HTE (Class III) copper on all laminates of ≤0.0120" thick.

Double treat copper available in standard copper weights  
 5 and 9 micron (1.8 and 1.4 oz.) foils available  
 Heavier copper foils available on special order  
 Copper-Invar-Copper, 0.006" 12.5/75/12.5, for CTE control  
 Planar resistor foil (typically 25 ohm/sq.) is also available

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