Preliminary Processing Guidelines

N4000-29

Lead Free, High Tg Multifunctional Epoxy

N4000-29 provides superior performance in high-density multilayer applications while maintaining standard high-Tg FR-4 processing latitude. This product is designed for superior thermal resistance for lead free assembly applications and reduced Z-axis expansion for high layer count PWB designs.

Note: The following guidelines are provided to assist Nelco laminate and prepreg users with general recommendations for successful processing during PWB fabrication. The recommendations are for general review purposes only and process adjustments may be required to achieve optimum results in your specific manufacturing environment.

Material Handling & Storage

Store laminates flat in a dry environment
Do not bend, scratch or dent laminate.
Store prepreg flat, in a cool, dry environment at less than 68°F (21°C) and ≤50% RH.
For extended prepreg storage, reduce storage temperature to <40° F (<4°C).
Reseal opened bags of unused prepreg.

Copper & Surface Preparation

Prepare copper surface for photo resist application according to the following options:

The type of copper surface preparation employed should relate to the foil type as specified below:

- **Reverse Treat Foil (RTFoil®):** Chemical clean followed by a light tack clean.
- **Shiny Copper Foil:** Chemical and / or Mechanical clean followed by a light tack clean.
- **Double Treat Foil:** Chemical clean followed by a light tack clean.

Note: Chemical clean consists of a mild cleaner to remove soils followed by a mild acid to remove the passivation.

Bond Enhancing Treatments

One of the following options can be used successfully:

- Option 1: Brown oxide with DMAB (dimethylamino borane) reduction.
- Option 2: Brown oxide with controlled dissolution post-treatment.
- Option 3: Peroxysulfuric oxide alternative.

Note: The brown oxide deposit should be tested using a weight loss test. Thick oxide deposits tend to yield poor thermal resistance. The oxide deposit should not exceed 0.7 mg/cm^2.

Inner Layer Drying

Inner layers should be oven dried to remove absorbed moisture. Absorbed moisture in the inner layer can affect the curing properties of the prepreg.

	U.S. Recommendations	Europe / Asia Recommendations
Innerlayer Bake Cycle	225 °F in vertical racks with minimum 0.5" separation for 30 minutes	110°C in vertical racks with minimum 1.2 cm separation for 30 minutes

Note: 1) If inner layers are baked horizontally in stacks of 1 - 2 "(25-50mm) extend time to at least 90 minutes.
2) Check with oxide supplier if using DMAB oxide reducer. Excessive exposure to heat may re-oxidize the reduced treatment.
3) Drying temperatures below 100°C are not effective in removing absorbed moisture from the layer.

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Lay-up

For best results, use inner layers within 2 hours after drying. Rebake inner layers if not used within 24 hours.

Lamination

For best results, fully cure in vacuum assisted hydraulic press

	U.S. Recommendations	Europe / Asia Recommendations
Vacuum:	A minimum of 28.5” Hg for 15 minutes before applying heat & pressure	A maximum of 1 torr for 15 minutes before applying heat & pressure
Heat Up Rate:	8 – 12 °F per minute	4.4 – 7 °C per minute
Critical Range:	150 – 250 °F	70 – 130 °C
Pressure:	200 - 300 psi	15 – 20 bar
Cure Time, Temp:	75 minutes @ 365 °F	75 minutes @ 185 °C
Cool Down Rate:	7 °F per minute or less until stack reaches 260°F	4 °C per minute or less until stack reaches 126°C
Breakdown:	After panels have cooled below 130 °F	After panels have cooled below 55 °C

*Note: Heat rise is usually controlled by using an acceptable thermal lagging such as kraft paper or press pads. Alternately the heat rise can be controlled by ramping the platen temperature 5 – 10 °F (5 °C) higher than book temperature and controlling the heat up rate through the critical temperature range.
**Note: For other types of presses, check with your Nelco technical representative.

Drilling

Typical Drilling Parameters	U.S. Recommendations		Europe / Asia Recommendations	
Drill Sizes:	0.012” – 0.020	0.020” - 0.040”	0.3 – 0.5 mm	0.5 – 1.0 mm
Surface Speed:	325 – 350 SFM	350 - 375 SFM	99 – 106 m/min.	106 – 114 m/min.
Chip Load:	0.7 – 1.2 mil	1.2 – 2.6 mil	18 - 31 microns	31 - 66 microns
Maximum Hit Count:	1200	900 - 1200	1200	900 – 1200
Typical Stack Height:	< 0.180”	< 0.180”	< 4.5 mm	< 4.5 mm

Note: Drilling parameters should be adjusted depending on hole size, layer count, panel thickness, copper content and stack height. For specific feed and speed parameters, contact your drill supplier or Nelco technical representative. Detailed typical drilling parameters are available in the Resources section at www.parkelectro.com.

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Resin Smear Removal

Most commonly used desmear methods are compatible.

Chemical: Solvent swell and permanganate etch processes are preferred. Solvent conditioning options:

	Type	Temp (°F)	Temp (°C)	Time
Option 1:	Butyl / OH	173 ± 5	78 ± 2	5 - 8 min.
Option 2:	Cyclic Amine 50% v/v	170 ± 5	77± 2	3 - 5 min.
Option 3:	Cyclic Amine 100%	130 ± 5	54 ± 2	3 - 5 min.
Alkaline Permanganate oxidizer		175 ± 5	79 ± 2	10 - 15 min.

Plasma: Typical desmear conditions:

Temperature	Gas mixture	Power	Time
80± 2°C	10%CF_4 , 80% O_2, 10% N_2	4000 W	20-25 min

Note: Depending on the amount of resin removal required, a preheat cycle and an oxygen burn cycle for ash removal may be necessary. Following the plasma cycle a permanganate desmear process is desirable to provide resin texturing. See your technical representative for additional information.

Routing

Typical Drilling Parameters	U.S. Recommendations	Europe / Asia Recommendations
Stack Height:	0.250"	6.25 mm
Tool Size:	0.093"	2.4 mm
Feed Rate:	60 IPM	1.5 m/min.
Speed:	24K RPM	24K RPM

The above processing guides are recommendations only and intended for general review purposes. Process adjustments may be required to achieve optimum results in your specific manufacturing environment.

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