



Recommended Processing/Handling Procedures  
for  
**NorCLAD™** Copper Clad Laminates

The handling procedures that follow have been developed in practice and are recommended for NorCLAD (Polyphenylene Oxide). Although each user may vary these techniques somewhat, depending on the handling facilities or needs, you should be guided by the recommended procedures in order to achieve optimum results.

Polyflon Company, manufacturer of NorCLAD, will be pleased to answer specific inquiries relating to processing and handling procedures.

## **HANDLING**

### 1. Storage

- a) NorCLAD should be stored at or near room temperature (72-75°F). The material should always lie flat. Individual sheets of material should not be rested on edge for lengthy periods, particularly when the temperature of the material differs from room temperature. Failure to observe these simple rules can result in curling of the laminate. In most cases, material flatness can be restored by laying the sheet on a flat surface for a period of time or by simply bending it into shape.

## **PHOTO-PROCESSING PROCEDURES**

### 1. Photoresist coating

#### Cleaning

Pre-cleaning should be accomplished using standard chemical soak baths. All baths should be used at a temperature of less than 110°F to reduce curling.

Mechanical scrubbers can be used with care. Maintain minimum brush pressure and only use bristle brushes.

#### Photoresist coating

The use of a dry film photoresist, such as DuPont 4600 series or Dynachem Type GA, is recommended. Other manufactures and other types have been used successfully.

Laminating should be accomplished using the minimum temperature and roller presser and maximum thru put speed which will provide good adhesion of the photoresist being used. A suggested starting point, when using DuPont Riston Type 4615 and a DuPont HR24, is 105°C. roller temperature, 10 to 15 psi

pressure on the rollers and 7 to 8 feet per minute speed.

### Exposing

During the exposing procedure there is always a tendency for the vacuum frame glass to heat. Excessive heating of the glass will cause curling of the laminate. NORCLAD should not be exposed when the vacuum frame glass becomes warm to the touch (100°F) as occurs in multiple exposures. If excessive heating of the glass occurs, the use of a fan to cool the glass is recommended.

Today's high intensity exposure units are very satisfactory for processing NORCLAD and standard exposure times can be used.

### Developing

Dry film photoresist is normally developed in a 3% solution of Sodium Carbonate at 90°F. This is not detrimental to NORCLAD laminate. If other developer solutions are to be used, it is suggested that the user make test runs and do not allow the solution temperature to exceed 110°F.

## ETCHING PROCEDURES

### 1. Pre-Etching

Standard pre-etching procedures can be used with NORCLAD. However, if the final circuit has unequal copper on the front vs. back, or if the back of the board is full ground plane, then a pre-etching process is not recommended.

### Etching

The copper-cladding on NORCLAD is attacked by most commercial etching agents. The substrate is very resistant to acids and alkalis. The substrate is also resistant to most organic solvents at room temperature and particularly resistant to high temperature swelling in trichloroethylene and similar solvents used in cleaning circuit boards.

Processing may be accomplished with any of the following etching systems:

Spray Etching including both horizontal and vertical work positions, single and double side etching.

Splash Etching by paddle wheel or air driven splash

Deep tank or immersion etching

The etching bath should be maintained at a temperature of less than 110°F. A temperature of 70-80°F is highly recommended. Avoid subjecting the circuit board to temperatures above 110°F. A thermostatically controlled etching bath is the ideal choice.

For best performance use a commercial grade ferric chloride, 1.39 to 1.41 specific gravity at 68°F. as the etching agent. Check the copper content of the etching bath by calorimetric techniques (or one of similar simplicity) to an amount not exceeding 2 ounces of copper per gallon.

Other etching solutions, such as ammonium chloride-ammonium hydroxide can be used. The operating temperature should be maintained at 110°F. or less.

DO NOT use a "high speed" etchant as the operating temperature is too high

for processing NORCLAD.

Cupric chloride may be used, however, the operating temperature should be maintained at 110°F. or less.

Deep Tank or Immersion techniques require excessive processing times for large quantity production and therefore is not recommended.

The use of Spray Etching techniques may be limited by excessive solution heating, if no provision is available for controlling the solution temperature.

When processing circuitry which requires that extremely close tolerances between adjacent lines must be held, it is generally better to use an etching bath which has been worked. A fresh bath works more actively and 'bites' harder than is desired for such close tolerance procedures. 'Etching by inspection' is recommended in this case. The operator should withdraw the board or boards approximately half way through the etching cycle for inspection. Depending on the degree of etch, the operator should then withdraw the circuit at frequent intervals, stopping the process when the desired tolerance has been achieved.

It is recommended that each time the board is removed from the bath for inspection, it is rotated 180 degrees before being re-immersed. This ensures that the critical areas are evenly and cleanly etched. For complicated circuits with several critical tolerance areas, etching by inspection should be carried out, each critical area being masked as it achieves the proper degree of etching.

It is desirable, in certain instances, to incorporate maximum ground plane area on the circuit side of the board. This technique can provide better circuit stability without heavy ground planes or secondary packaging and conserves etchant.

The degree of curling experienced in above-normal etching bath temperatures depends on the size of the etched piece, thickness of dielectric and copper, and etch area. It is obvious that a large thick board, thinly clad and lightly etched will curl less than a small thin board heavily clad and etched. The size of the etched board is the major factor in curling.

It is suggested that with uneven copper, as in circuits with full ground planes, and when using horizontal spray etchers, the circuit side of the board should be placed in the down position.

## **PHOTORESIST REMOVAL**

Dry film photoresist is normally stripped in a 3% solution of Sodium Hydroxide at 90°F. This is not detrimental to NORCLAD laminate. If other stripping solutions are to be used, it is suggested that the user make test runs and do not allow the solution temperature to exceed 100°F.

Processing may be accomplished with any of the following stripping systems:

Spray systems including both horizontal and vertical work positions, single and double side stripping.

Splash stripping by paddle wheel and air driven splash

Deep tank or immersion stripping.

The stripping bath should be maintained at a temperature less than 110°F. A temperature of 80-90°F is highly recommended. Avoid subjecting the circuit board to temperatures above 110°F. A thermostatically controlled stripping system the ideal choice.

It is suggested that with uneven copper, as in circuits with full ground planes, and when using horizontal spray strippers, the circuit side of the board should be placed in the down position.

## **PLATING**

1. Using typical thru hole processing techniques, the bond of copper to dielectric will be less than acceptable. There are modified techniques that can be used. Please contact Polyflon for details.
2. For finish plating, any room temperature plating system is satisfactory, providing the maximum substrate temperature is not exceeded. Plating processes that involve temperatures near 150°F are not recommended.

## **ASSEMBLY**

1. Whether the final circuit is to be riveted or bolted together, consideration should be given to pressure exerted on the laminate by fastening when the circuit is to function in high ambient (i.e. 160°F) temperatures. Steps should be taken to distribute fastener pressure over the widest possible area in order to prevent distortion of the circuit board at elevated temperatures. It is estimated that maximum unit pressure should not exceed 3060 psi. Practice has demonstrated that intelligent design and empirical testing of circuitry under storage and operating conditions is the best guide.

## **MACHINING**

General practice for machining NorCLAD for minimum burring dictates the following order of tool preference: 1) Straight fluted end mills; 2) Minimum spiral two lip end mills; 3) Right hand cut with left hand spiral end mills. Use minimum speed and feed to prevent overheating of the thermoplastic.

Rough Cutting: Power or foot operated shears are used to cut NORCLAD sheet in thickness' up to approximately 1/4 inch. A band or table saw is recommended for the thicker sizes and also for the smaller sizes when shears are not available.

## **IN SUMMARY**

1. The successful processing of NORCLAD and other unsupported laminates requires attention to two basic principles:  
The material should always be stored or rested on a flat surface at or near room temperature.  
The material should, if possible, be handled and processed at or near room temperature.

'Electric Packaging and Production', January 1965, pp. 12-18.

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Data subject to change without notice.

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