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Fabrication Guidelines

RO3730™ Antenna Grade Laminates Fabrication Guidelines

RO3730™ series high frequency material is a ceramic filled polytetrafluoroethylene (PTFE) composite which provides the electrical and mechanical properties essential to meet the specific demands of the antenna market for reliable antenna board constructions.

These guidelines were developed to provide fabricators with basic information on processing antenna assemblies. For more specific information regarding your applications, please contact your Rogers' representative.

DRILLING CONDITIONS:

RO3730 dielectric antenna boards can be stacked for drilling. The total thickness of the stack plus entry and exit material penetration should never exceed 75% of the flute length. For most applications, the maximum stack height should be less than 0.240 inch (6.1mm). Drill bits should be inspected prior to drilling.

Recommended Ranges:

Entry: Phenolic Composite	0.010"-0.030" (0.25-0.76 mm)	
Exit: Phenolic Composite	>0.060" (1.5mm)	
Chip Load:	0.002"-0.004" (050-100mm) per revolution	
Surface Speed:	300-600 ft/min (90-180m/min)	
Retract Rate:	500-600 inch/min (13-15 m/min	
Tool Type:	Carbide	
Tool Life:	**Stack Height**	**Maximum Hit Count**
	0.060" (1.5mm) 0.120" (3.0mm) 0.180" (4.5mm)	300 250 100

CALCULATING SPINDLE SPEED AND INFEED:

Spindle Speed (RPM) = Tool Size (in) Tool size (mm)

Infeed Rate (IPM) = 0.003 x Spindle Speed (RPM) (using 3 mil chip)
or
Infeed (m/min) = 76 X 10_{-6} x Spindle Speed (RPM) (using 300 sfm)

QUICK REFERENCE TABLE:

Tool Diameter	(RPM)	Infeed Rate (IPM)	Spindle Speed (kRPM)
0.0197" (0.50mm)	58200	175	4.4
0.0256" (0.65mm)	44800	134	3.4
0.0295" (0.75mm)	38800	117	3.0
0.0354" (0.90mm)	32400	97	2.5
0.0394" (1.00mm)	29100	87	2.2
0.0453" (1.15mm)	25300	76	1.9
0.0492 (1.25mm)	23300	70	1.8
0.0531 (1.35mm)	21600	65	1.6
0.0625" (1.59mm)	20000	60	1.5
0.0925" (2.35mm)	20000	60	1.5
0.1250 (3.18mm)	20000	60	1.5

DEBURRING:

Flat, rigid entry and exit materials are necessary to properly constrain panels near the hole and minimize copper burring. If mechanical scrubbing or hand scrubbing processes are used to deburr boards, the force applied must be minimized to prevent dimensional change

Hole Cleaning:

Loose debris in the hole can be removed by using a pressure wash or hydrohone process.

Through-Hole Treatment (Surface Activation)

Drilled holes in filled PTFE composites must be treated prior to metalization to ensure good coverage. This is usually accomplished by sodium etching or plasma processes.

Sodium Etching:

Commercial sodium etchants consist of highly reactive sodium naphthalene complex in glycol ether solution. They are very effective at making PTFE surfaces wettable prior to electroless copper plating. The surface energy of PTFE can be increased from about 20 dyne/cm to 60 - 70 dyne/cm. This allows electroless copper bath solutions to wet through-hole surfaces and readily displace gasses in the holes. This is essential for void free plating. Sodium etchant chemistry is available from:

FluoroEtch®
Acton Associates
100 Thompson St.
Pittston, PA 18640
Tel: 570-654-0612
Fax: 570-654-2810

Specific recommendations regarding sodium etching processes are available from sodium etchant suppliers. Processes typically consist of a 15 - 30 second dip in etchant chemistry followed by hot water >80°C (>170°F) and solvent rinses. Rinse solutions must be kept clean. Prior to electroless copper, panels should be baked for at least 2 hours at 150°C (302°F).

Plasma:

Plasma processes typically used to desmear epoxy based boards, (O_2/CF_4 or O_2/NF_3) have not been found to be very effective for treating PTFE surfaces. However, blends of hydrogen and nitrogen, pure nitrogen, and pure helium have been found to yield good results. The process conditions outlined below have been found to increase surface energies to the same levels (>60 dyne/cm) as those obtained by sodium etching. Holes were pressure washed to remove loose debris prior to treatment.

Plasma Conditions:

A recommended plasma treatment prior to direct metallization would use a 70/30 H_2/N_2 blend, NH_3, or N_2, and HE gases.

Gases:	70/30 or 80/20 H_2/N_2, NH_3, N_2 or He
Pressure:	100 mTORR pumpdown
Power:	4000 Watts
Frequency:	40 KHz
Voltage:	500-600 V
Cycle Time:	10-30 minutes

Courtesy of Nordson March Plasma

Gases	H_2/N_2	He	N_2
Power	1800W	1800W	1800w
Frequency	13.56 MHz	13.56 MHz	13.56 MHz
Pressure	150 mTor	173 mTor	181 mTor
Gas Mixture (%)	70/30	100	100
Temperature	200°F	200 °F	200°F
Time (minutes)	10 to 20	5 to 10	5 to 10

Courtesy of Plasma Etch Systems

Panels should be baked for at least 1 hour at 150°C (302°F) prior to plasma treatment. Plasma treated holes are more delicate than sodium etched holes. Panels should not be exposed to any pressure wash or scrubbing process prior to metallization.

Metallization:

Metallization of treated holes should occur within 24 hours of plasma treatment or within 48 hours of sodium treatment. Standard low or regular dep rate electroless copper and direct deposit processes can be used to metalize properly prepared hole walls. Electroless process controls may need to be more tightly controlled when plasma activation processes are used rather than sodium etching.

Panels are often flash electroplated 0.0001 - 0.0003 inch (2.5 - 7.6 mm) after electroless copper plating to reduce the risk of voiding holes while preparing surfaces for photoresist.

External Circuitization

The following guidelines are based on a conventional pattern plate process.

Photoresist Application/Imaging/Developing:

Panels should be chemically prepared for photoresist application rather than mechanically scrubbed. Once prepared, RO3730 cores are compatible with liquid and dry photoresists and their associated processes. Leader boards or frames may be required to support thin cores through conveyorized processes.

***Electroplating Cu & Sn/Pb*:**

Panels should be handled carefully during racking and unracking to prevent damage. Any conventional plating process may be used.

Resist Stripping/Etching:

Standard etchants and resist strip solutions may be used. Thorough rinsing is essential after etching. Thicker panels typically do not require leaders or frames during processing.

Sn or Pb Stripping:

If Sn or Pb stripping is required, boards must be immediately rinsed with CLEAN DI water. Heated DI water 65°C (150°F) baths are preferred.

Soldermask

***Types of Soldermask*:**

Epoxy based soldermasks such as Hysol® SR1000 or PCK Technology's PC501 typically yield good adhesion to ceramic filled fluoropolymer composites. Acrylate based soldermasks typically yield poor results. If a photoimageable soldermask is desirable, Enthone® DSR 3242 soldermask or Ciba Geigy's Probimer™ 52 have been found to yield good adhesion.

Treatment Prior to Soldermask Application:

Ceramic filled fluoropolymer surfaces typically do not require treatment prior to soldermask application. Surfaces should not be disturbed after etch since the roughness left behind by copper dendrites promotes adhesion. Also, surfaces must be clean and dry. Organic cleaners may be used along with sulfuric acid and DI water rinses to clean boards. A 1-2 hour bake at 100°-150°C (212°F-302°F) is recommended prior to soldermask application to insure that boards are dry.

Soldermask Cure:

In general, soldermask vendor recommendations should be followed when curing soldermasks. If gas bubbles form during cure, it may be necessary to complete a short pre-bake (»10 min.) at lower temperatures 80°C (»176°F) to drive off solvent prior to cure.

Reflow/HASL

Bake prior to Reflow/HASL:

Panels must be baked for at least 1 hour (2 hours preferred) at 150°C (302°F) prior to reflow or Hot Air Solder Leveling. Panels should be racked or stacked with spacers to allow air flow between boards. Panels should be baked in a vacuum or nitrogen purged oven if Sn/Pb oxidation is a concern.

Flux Applications:

Soak time in flux should be short (<30 seconds). If rework is required after reflow or HASL, boards should be rebaked.

Reflow:

Any conventional reflow process may be used (ie. hot oil, vapor phase, IR). However, reflow process temperature must be below the melt temperature of the adhesive used to bond boards. Preheat is recommended.

Hot Air Leveling:

Panels may need to be supported along the sides as well as the top when processed.

Cleaning:
Aqueous cleaning solutions are preferable. Thorough rinsing is essential to prevent contamination. Rinses must be kept clean.

Recommended Routing Conditions:

Entry: Phenolic Composite	0.025" (>0.6 mm)
Exit: Phenolic Composite	>0.060" (1.5mm)
Chip Load:	0.00100"-0.00125" (25-32mm) per revolution
Surface Speed:	300-600 ft/min (90-180m/min)
Tools:	Double Fluted Spiral Endmill (Carbide)

Quick Reference Table for Various Tool Sizes:

Tool Size Spindle Speed Lateral Feed Rate

(in)	(mm)	(RPM)	IPM	m/min
1/32"		36,000	45	1.14
	1.0	29,000	36	0.92
1/16"		18,000	23	0.57
	1.5	19,000	24	0.60
3/32"		14,000	19	0.48
	2.0	14,000	19	0.48

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Singapore:	Rogers Technologies Singapore Inc.	Tel: 65-747-3521	Fax: 65-747-7425
China:	Rogers (Shanghai)	Tel: 86-21-62175599	Fax: 86-21-62677913
China:	Rogers (Shenzhen)	Tel: 86-755-8236 6060	Fax: 86-755-8236 6123

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