ROGERS CORPORATION

Fabrication Notes

RO4730G3™ Antenna Grade Laminates Fabrication Guidelines

DRILLING CONDITIONS:

Surface speeds greater than 500 SFM and chip loads less than 0.002" (0.05mm) should be avoided whenever possible. When using small diameter drills (<0.0135") use below a 0.002" chip load to avoid random breakage of drill bits.

Recommended Ranges:

Surface Speed:	300-500 SFM (90 to 150m/min)
Chip Load:	0.002"-0.004"/rev. (0.05-0.10 mm)
Retract Rate:	500-1000 IPM 500 IPM (12.7 m/min) for tools less than 0.0135" (0.343mm), 1000 IPM (25.4 m/min) for all others.
Tool Type:	Standard carbide
Tool Life:	2000-3000 hits

Hole quality should be used to determine the effective tool life rather than tool wear. These materials will yield good hole quality when drilled with bits which are considered worn by epoxy/glass standards. Unlike epoxy/glass, RO4730G3™ material hole roughness does not increase significantly with tool wear. Typical values range from 8-25mm regardless of hit count (evaluated up to 8000 hits). The roughness is directly related to the ceramic filler size and provides topography that is beneficial for hole-wall adhesion. Drilling conditions used for epoxy/glass boards have been found to yield good hole quality with hit counts in excess of 2000.

A minimum PTH spacing of 12 mil wall to wall for electrically isolated vias and 6-8 mils for thermal and shielding vias that redundantly connect copper layers (to prevent sphere edge to edge drilling and chemical ingress) and a hole wall roughness min spec of 2 mils.

CALCULATING SPINDLE SPEED AND INFEED:

$$\text{Spindle Speed (RPM)} = \frac{12 \times [\text{Surface Speed (SFM)}]}{p \times [\text{Tool Diam. (in.)}]}$$

Feed Rate (IPM) = [Spindle Speed (RPM)] x [Chip Load (in/rev.)]

Example:

Desired Surface Speed: 400 SFM

Desired Chip Load: 0.003"(0.08 mm)/rev.

Tool Diameter: 0.0295"(0.75 mm)

$$\text{Spindle Speed} = \frac{12 \times [400]}{3.14 \times [0.0295]} = 51{,}800 \text{ RPM}$$

Infeed Rate = [51,800] x [0.003] = 155 IPM

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QUICK REFERENCE TABLE:

Tool Diameter	Spindle Speed (kRPM)	Infeed Rate (IPM)
0.0100" (0.254mm)	95.5	190
0.0135" (0.343mm)	70.7	141
0.0160" (0.406mm)	95.5	190
0.0197" (0.500mm)	77.6	190
0.0256" (0.650mm)	60.0	180
0.0258" (0.655mm)	60.0	180
0.0295" (0.749mm)	51.8	155
0.0354" (0.899mm)	43.2	130
0.0394" (1.001mm)	38.8	116
0.0453" (1.151mm)	33.7	101
0.0492"(1.257mm)	31.1	93
0.0531" (1.349mm)	28.8	86
0.0625" (1.588mm)	24.5	74
0.0925" (2.350mm)`	16.5	50
0.1250" (3.175mm)	15.0	45

** Conditions stated are tapered from 200SFM and 0.002" chip load up to 400 SFM and 0.003"chip load.*

DEBURRING:
RO4730G3 materials can be deburred using conventional nylon brush scrubbers.

DESMEAR:
RO4730G3 materials may be desmeared using traditional chemical or plasma processes. Recommended plasma conditions are provided below:

Plasma Desmear Cycle:

Frequency:	40 KHz
Voltage:	500-600V
Power:	4000-5000 Watts
Pre-Heat to 60°C using:	
Gases:	90% O2, 10% N2
Pressure:	250 mTORR
Desmear using:	
Gases:	75% O2, 15% CF4, 10% N2
Pressure:	250 mTORR
Time:	10-30 minutes

COPPER PLATING:
No special treatments are required prior to electroless copper plating. Board should be processed using conventional epoxy/glass procedures. Desmear of drilled holes is not typically required, as the high Tg (280°C [536°F]) resin system is not prone to smearing during drill. Resin can be removed using a standard CF4/O2 plasma cycle or a double pass through an alkaline permanganate process should smear results from aggressive drilling practices.

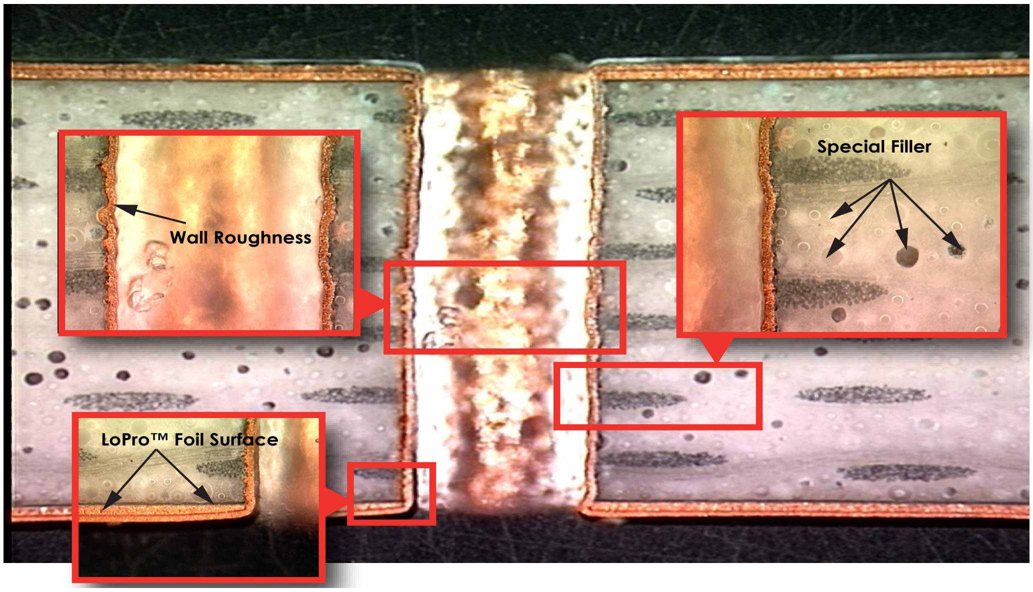

Figure 1: Cross-section of a typical RO4730G3 laminate plated through-hole. Note that the appearances of the special filler and slightly increased hole-wall roughness are normal for this product. Additionally, the LoPro foil surface contains a thin coating of modifed base resin, which appears colorless. We suggest discussing hole quality/appearance with a Rogers' Technical Service Engineer prior to processing RO4730G3 laminates for the first time.

IMAGING/ETCHING:
Panel surfaces may be mechanically and/or chemically prepared for photoresist. Standard aqueous or semiaqueous photoresists are recommended. Any of the commercially available copper etchants can be used.

SOLDERMASK:
Any screenable or photoimageable solder masks typically used on epoxy/glass laminates bond very well to the surface of RO4730G3 material. Mechanical scrubbing of the exposed dielectric surface prior to solder mask application should be avoided as an "as etched" surface provides for optimum bonding.

HASL and REFLOW:
RO4730G3 material baking requirements are comparable to epoxy/glass. In general, facilities which do not bake epoxy/glass boards will not need to bake RO4730G3 boards. For facilities that do bake epoxy/glass as part of their normal process, we recommend a 1-2 hour bake at 250°F-300°F (121°C-149°C).

Prolonged exposure in an oxidative environment may cause changes to the dielectric properties of hydrocarbon based materials. The rate of change increases at higher temperatures and is highly dependent on the circuit design. Although Rogers' high frequency materials have been used successfully in innumerable applications and reports of oxidation resulting in performance problems are extremely rare, Rogers recommends that the customer evaluate each material and design combination to determine fitness for use over the entire life of the end product.

SHELF LIFE:
Rogers' high frequency copper clad laminates, not etched material, can be stored indefinitely under ambient room temperatures (55-85°F, 13-30°C) and humidity levels. At room temperature, the dielectric materials are inert to high humidity. However, metal claddings such as copper can be oxidized during exposure to high humidity. Standard PWB pre-exposure cleaning procedures can readily remove traces of corrosion from properly stored materials.

ROUTING:
RO4730G3 material can be machined using carbide tools and conditions typically used for epoxy/glass. Copper foil should be etched away from the routing channels to prevent burring.

MAXIMUM STACK HEIGHT:

The maximum stack height should be based on 70% of the actual flute length to allow for debris removal.

Example:

Flute Length:	0.300" x 0.70	=	0.210"(5.33 mm)
Backer Penetration:			– 0.030"(0.762mm)
Max. Stack Height:			0.180"(4.572mm)

TOOL TYPE:

Carbide multifluted spiral chip breakers or diamond cut router bits.

ROUTING CONDITIONS:

Surface speeds below 500 SFM should be used whenever possible to maximize tool life. Tool life is generally greater than 50 linear feet when routing the maximum allowable stack height.

Chip Load: 0.0010-0.0015"(0.0254-0.0381mm)/rev

Surface Speed: 300 – SFM

QUICK REFERENCE TABLE:

Tool Diameter	Spindle Speed	Lateral Feed Rate
1/32	40k RPM	50 IPM
1/16	25k RPM	31 IPM
3/32	20k RPM	25 IPM
1/8	15k RPM	19 IPM

MULTILAYER BOARD PROCESSING: Please refer to the fabrication guidelines for RO4003C(TM)/RO4350B(TM)/RO4835(TM) Materials titled "RO4003C/RO4350B/RO4835 Laminate Circuit Processing Guidelines" PUB #92-433.

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