Nelco Products Pte Ltd
4 Gul Crescent, Singapore (629520)
Tel : 6861-7117, Fax : 68617114

N4000-13
N4000-13 SI
Best Practices

This document is further elaborate on the best practise of N4000-13.

July, 2004

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1) Prepreg Storage

i) Store Prepreg in a temperature and humidity controlled environment (<21CºF and <50% RH)
ii) Keep prepreg in bags until needed
iii) Tape shut any opened bags

Reason:

- Reduce the chances of moisture trapped in the prepreg.

Effect:

i) Prevent a lower Tg at finished board.
ii) Prevent de-lamination during thermal shock.

2) Bake inner layer prior to lamination

i) Bake signal layers at 110°C for 30 minutes
ii) Bake power/ground layers at 110°C for 60 minutes

Reason:

- Ensure the laminate is fully dry and prevent moisture trapped in the laminate.

Effect:

i) Prevent a lower Tg at finished board.
ii) Prevent de-lamination during thermal shock.

3) Lamination

i) Heat rise measure from 82°C to 139°C
   - Ideal heat rise is 2.3°C to 3.4°C
   - A heat rise of 2.3°C to 4.4°C is acceptable
ii) Pressure: KISS pressure cycle (optional)

- Initial pressure of 50 psi (3.5 bar). Ramp to full pressure when product is between 90°C and 100°C at the rate of 72 psi/min (5 bar/min)
- Full pressure of 275 to 350 psi (19 to 24 bar)

iii) Cure cycle

- 90 minutes at 194°C (380°F)
- Do not allow product temperature to exceed 201°C (395°F)
- Cool to < 135°C (275°F) at a rate < 4.5°C/min (8°F/min)

It is always encourage putting in the thermal couple to check material's temperature to ensure that it is not under cured.

Reason:

i) Ensure the laminate is fully cured during the lamination cycle.

ii) Tg results is *only one of the dimensions* to check if the material is cured, the BEST way is to have the thermal couple profiling material temperature, this is the ONLY way to ensure the board is 100% fully cured

Effect:

i) Prevent a lower Tg at finished board.

ii) Prevent de-lamination during thermal shock.

iii)Have a good encapsulation to the circuitry, good wetting to the prepreg and a good resin flow.

Other inputs:

The following is one of the successful cycle in the field, it is just served as a benchmark as no one lamination cycle will be the same, as the machine, thermal lagging material, steel plates, and stack up are different from one shop to another. In short, the heat transfer package is different.

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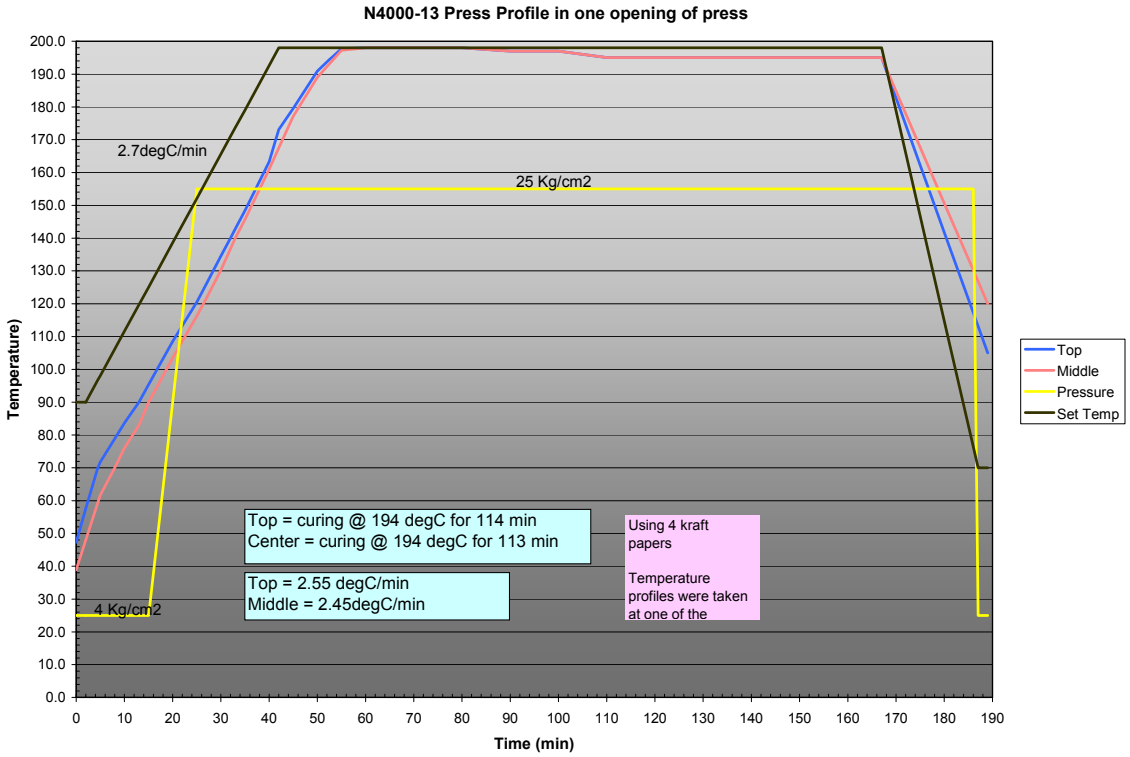

4) Drilling

i) Drilling parameters per chart on Park/Nelco website. Small hole drill speed based on 430 sfpm cutting speed.

ii) Use new drills

iii) Limit hit count to 1000 hits

iv) Use undercut drill for the smaller holes down to 0.25 mm (0.010")

v) Recommend using lubricated entry or backup material (Mitsubishi LE sheet or LCOA Slick Back)

vi) Bake the board for 180°C for 3 hrs (place the panels into the oven when it reach 180°C, for a period of 3 hrs) prior to chemical desmearing

Reasons:

i) Reduce heat generated along the through holes

ii) Lower the mechanical damage along the through hole, which resulted as crack along the inter face between the glass and the resin.

iii) Reduce the stress which created during the drilling operation.

iv) Reduce the hole wall roughness and reduce wicking.

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v) Reduce nail heading and smear generation.

Effect:

i) Better resin recession results

ii) Reduce crazing and wicking

iii) Prevent de-lamination at locations with high density through holes.

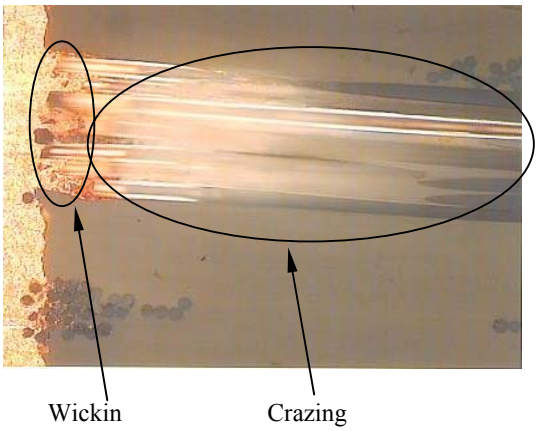
iv) Better hole wall quality

Other inputs:

The following are drilling parameters:

Drill size (mils)	Feed (IPM)	SFPM	Chip load (mils)	Hit count	Retract (IPM)
3.9	20	102	0.2	150	150
7.9	30	207	0.3	250	250
9.8	40	256	0.4	500	500
11.8	60	309	0.6	750	750
13.8	80	361	0.8	1000	1000
15.7	83	400	0.85	1000	1000
17.7	82	400	0.95	1000	1000
19.7	78	400	1.0	1000	1000
21.7	106	400	1.5	1200	1000
23.6	97	400	1.5	1200	1000
27.6	83	400	1.5	1200	1000
31.5	73	400	1.5	1500	1000

Crazing and wicking



5) Resin smear removal

i) Plasma desmar followed by a mild permanganate desmear is preferred process.

ii) Crazing can be minimized by optimizing the exposure times in each of these processes.

iii) Plasma process

- Dry boards at 110°C for 60 minutes before plasma processing
- Preheat boards to 71°C to improve the uniformity of plasma attack.
- Typical plasma desmear conditions are as follows:
  - Temperature: 80±2°C
  - Gas mixture: 10% CF_4, 80%O_2, 10%N_2
  - Power: 4000W
  - Time: 25~30 minutes

iv) Permanganate process

Minimal solvent swell and permanganate etch should be utilized per the following table:

Option	Type	Temp (°C)	Time
1	Butyl carbitol / hydroxide	70±2	4~6 min
2	NMP 50% v/v	70±2	3~5 min
Note : NMP 100% solvent is not recommended for N4000-13			
Alkaline permanganate		80±2	8~12 min

v) The best way is to start off with a low Tg FR4 conditions

Reasons:

i) Reduce chemical attacks along the through holes, which resulted as crazing

ii) Improve the resin recession results during thermal shock

iii)Reduce the hole wall roughness and reduce wicking.

Effect:

i) Better resin recession results

ii) Reduce crazing and wicking

iii)Prevent de-lamination at locations with high density through holes.

iv)Better hole wall quality

Other inputs:

The following is the picture of crazing, wicking and hole wall roughness:

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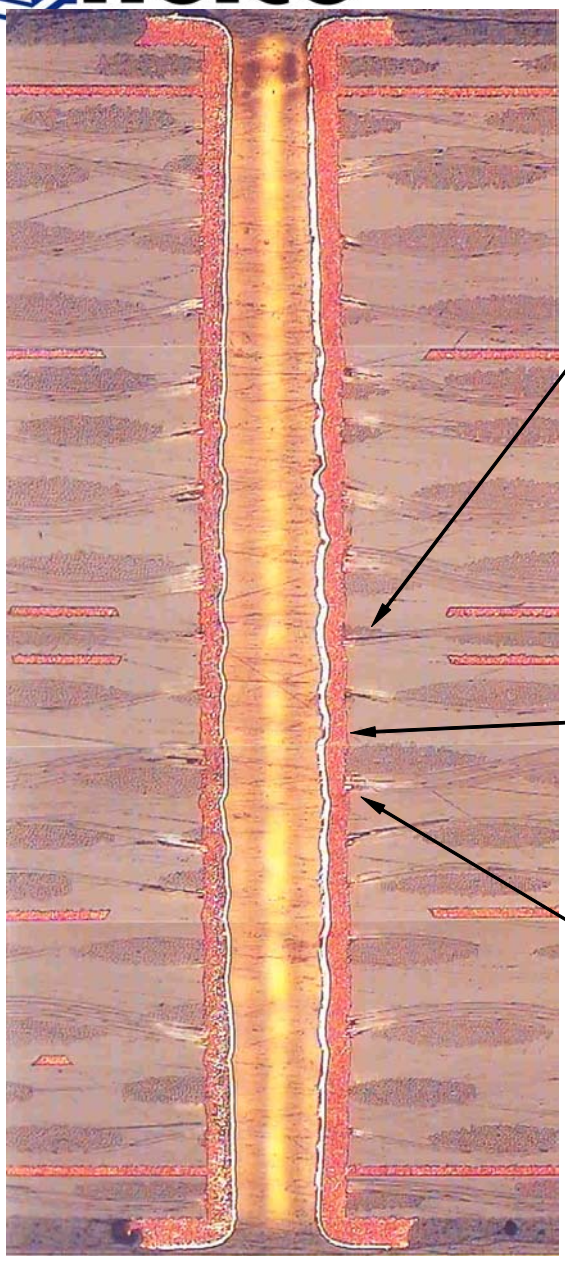
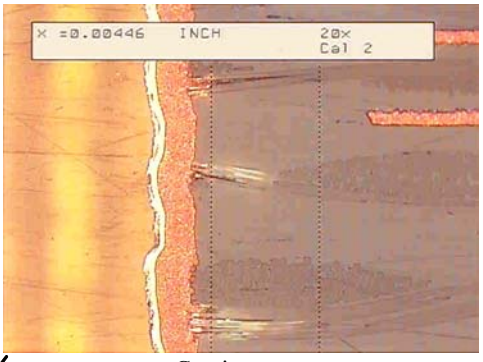
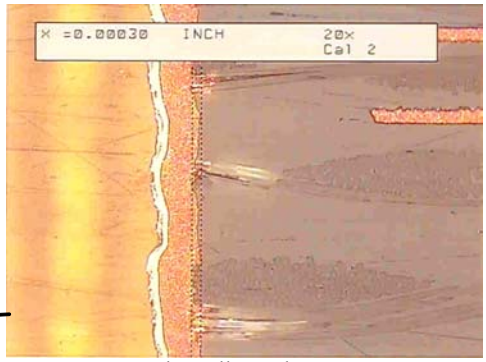
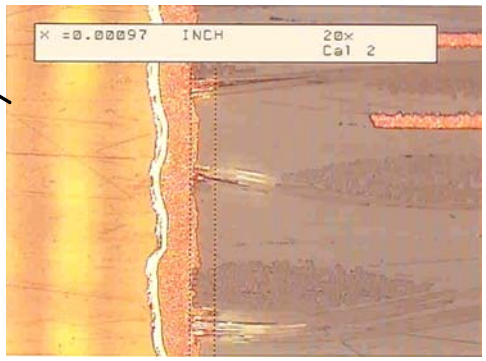




Crazing



Hole wall roughness



Wicking