Nelco Laser Drillable 1080 Evaluation Report

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1) Title:

Nelco Laser Drillable 1080 evaluation

2) Description :

RCC is the most commonly used material in HDI Build-up application. RCC is popular due to the fact that it is light weight, Laser compatible and low Dk value, but the pure resin substrate is mechanically weak. RCC is also limited in thickness availability.

Laser Drillable Glass cloth is developed to address the weaknesses in RCC and conventional woven reinforced material. The following are some the benefits of using Laser Drillable 1080 material:

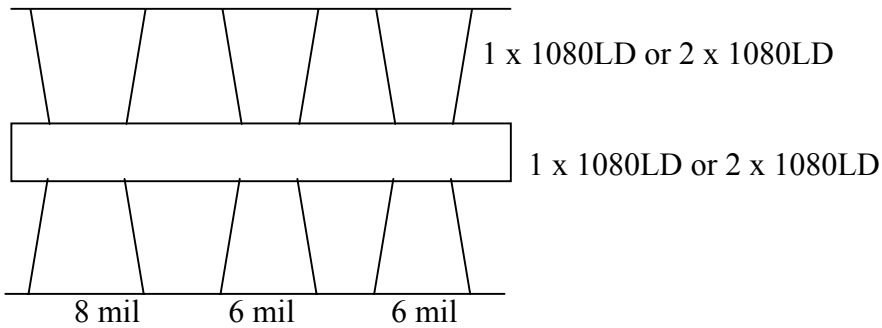
a) Better mechanical properties than RCC
b) More compatible to Laser than conventional woven reinforced material
c) More flexibility in term of thickness design than RCC
d) Buried Via Hole filling capability is much better than RCC --- better cost effectiveness than RCC as it eliminates Hole Plugging process

This evaluation is designed to study and characterize the ability of Laser Drillable 1080 material in

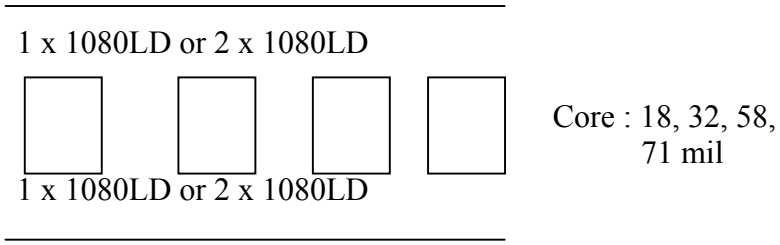
a) buried via hole filling
b) the formation of laser drilling hole

3) Test vehicle:

i) Laser via hole sizes: 6 mil, 8 mil
ii) Build-up dielectric thickness: 1 x 1080LD, 2 x 1080LD

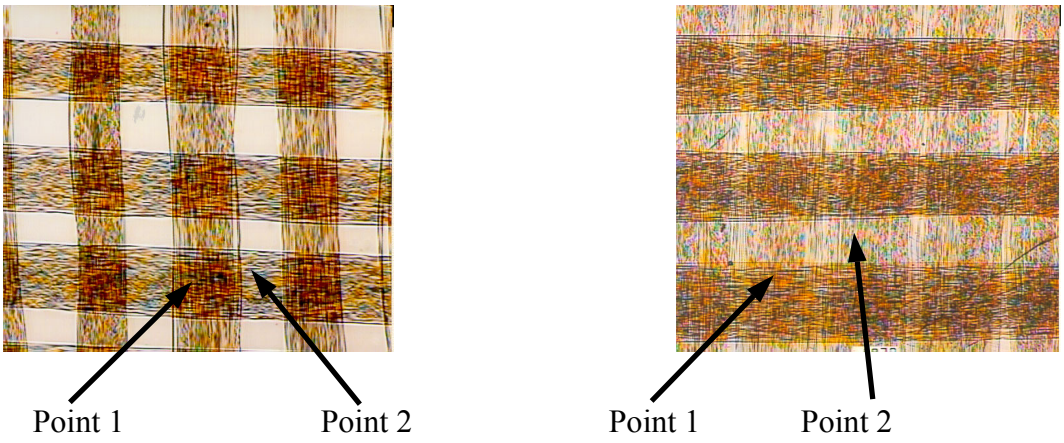


iii) Buried via hole sizes: 0.25 mm, 0.30 mm, 0.60 mm
iv) Buried via hole thickness: 18 mil, 32 mil, 58 mil, 71 mil



4) Test Result:

4-1 Conventional 1080 glass Vs 1080LD glass

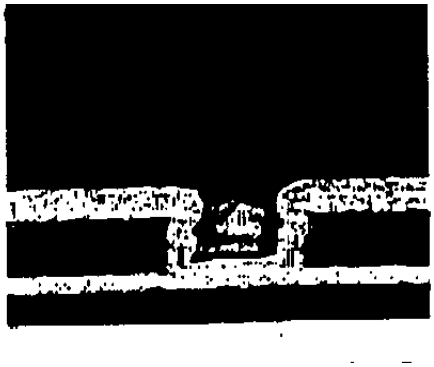


Conventional 1080 glass has a very distinctive glass/resin distribution. There are pure resin area (Point 1) and high glass content area(Knuckle or Point 2) , as illustrated as Point 1 and Point 2 in the diagram above. Such unevenness in glass fiber distribution will lead to different loading, as a result, causing difficulties in Laser energy and No. of shot setting on the laser drilling machine.

In 1080 LD glass, the glass/resin distribution is more even. The spreading of glass filament reduces the glass content at the knuckle, allowing a better, more even laser ablation process with lower laser energy and no. of shoot.

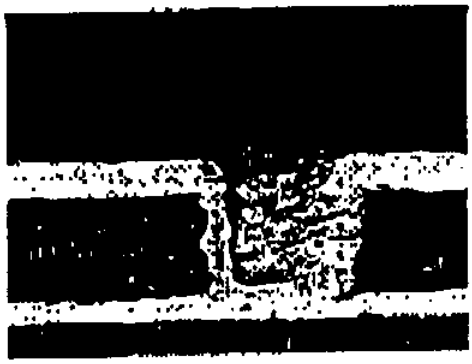
4.2 Laser via hole micro-section pictures and laser energy/ no. of shoot

i) 18 mj / 5 pulses and layer thickness 3.0 mil



1 x 1080LD 6 mil hole 1 x 1080LD 8 mil hole

ii) 18 mj / 9 pulses and layer thickness 6.0 mil



2 x 1080LD 6 mil hole 2 x 1080LD 8 mil hole

Laser energy / no. of shoot setting for various types of material

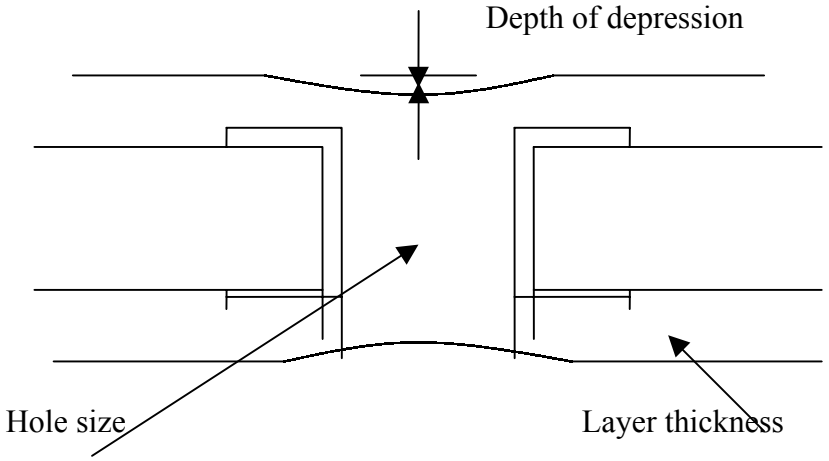
Material	Energy (mj)	Pulses
RCC	6	4
1 x 1080LD	18	5
1 x 1080	20	5
2 x 1080LD	18	9
2 x 1080	20	12

1080LD, be it 1 ply or 2, the energy /no. of shoot setting is always between RCC and conventional 1080.

Bare board (or core) is used in this evaluation run. The absence of buried via hole and circuitry made the press out thickness to be higher than usual, resulted in higher than usual energy/no. of shoot setting. It is anticipated that in actual PWB fabrication, the press out thickness, energy / no. of shoot will be lower. Laser machine setting has to be adjusted to meet characteristic of every individual PWB design.

4.3 Buried via hole filling capability of 1080LD

The relationship between core thickness, hole filling and depth of depression:



Core thickness: 71 mil Prepreg : 2 x 1080LD

Drill size (mm)	0.6	0.3	0.25
Depth of depression (mil)	0.5	0.2	<0.1
Layer thickness (mil)	5.4	5.5	5.5
Resin in hole	Full	Full	Full

Core thickness: 58 mil Prepreg: 2x 1080LD

Drill size (mm)	0.6	0.3	0.25
Depth of depression (mil)	0.4	0.2	<0.1
Layer thickness (mil)	5.4	5.6	5.7
Resin in hole	Full	Full	Full

Core thickness: 32 mil Prepreg: 1 x 1080LD

Drill size (mm)	0.6	0.3	0.25
Depth of depression (mil)	0.3	0.2	<0.1
Layer thickness (mil)	2.8	2.9	3.0
Resin in hole	Full	Full	Full

Core thickness: 18 mil Prepreg: 1 x 1080LD

Drill size (mm)	0.6	0.3	0.25
Depth of depression (mil)	0.2	<0.1	<0.1
Layer thickness (mil)	2.7	2.7	2.8
Resin in hole	Full	Full	Full

Observations:

1. From the result above, it is noticed that 1080LD, be it 1 ply or 2 plies is able to go well with 0.3 mm buried via hole. As the hole size increase, so as the depth of depression.

2. Microscopic inspection suggested that the buried via holes are filled with resin ---- no micro-voids is observed. As a precaution step, Thermal shock test is performed to verify the integrity of the buried via holes.

   No delamination is found after 3 cycles at 288 C x 10 sec thermal shock test.

3. In this evaluation, this core has no circuitry hence it does not fully representative of the actual PWB manufacturing. However, it helps to set up some general Design guideline:

   i) For inner core thickness < 20 mil, Layer thickness 2~3 mil, use 1 x 1080LD.

   ii) For inner core thickness < 60 mil, Layer thickness 4~6 mil, use 2 x 1080LD.

iii) 1080LD goes well with 0.3 mm, 0.25 mm inner core buried via hole sizes. For 0.25 mm hole size, precaution is needed at plating as the expect ratio is high.

Conclusion:

1. Laser Drillable 1080LD comes in the following flexibility:

   i) come with various Tg (130 C ~ 180 C) resin systems
   ii) resin content is adjustable to meet various press out thickness
   iii) stack up the prepreg to achieve various press out thickness

   Comparatively, RCC has less flexibility in term of dielectric thickness and no flexibility in resin content. Too high the resin content will cause “Run Back” in RCC.

2. 1080LD prepreg shared the similar parameters as conventional 1080 prepreg. No change to in-coming test and specification.

3. 1080LD serves as a build-up layer as well as “buried via hole plugging ink”. This 2-in-1 feature is achieved during lamination press process. Significantly reduces the cost of PWB fabrication by eliminating Plugging Ink printing and baking processes.

4. Based on the assessment above , 1080LD is granted approval for batch test run. When use in actual part-no, a First Article Run is necessary for various process stations to familiarize and fine-tune the condition to maximize the performance.