Experiment # 2.
12 panels are to be made for this test segment using only 1 ply of 1080 B-Stage. Micro-via size to remain constant at 125 micron.

Table 8,

Panel #	1	2	3	4	5	6	7	8	9	10	11	12
Mat & Vias	1080 Glass -125u via dia											
Plasma	1	2	3	4	5	6	no	no	no	no	no	no
Glass Etch	1	2	3	no	no	no	7	8	9	no	no	no

Variable 1, Plasma Desmear.
Panels # 1 to 6 with Plasma, P # 7 to 12 without Plasma

Variable 2, Glass Etch.
Panels # 1, 2, 3, & 4 with Glass Etch
Panels # 4, 5, 6 & 10, 11, 12 without GE.
Common Steps for all 12 panels.
Pressure wash prior electroless; permanganate de-smear; double dip electroless. Following the image process 2 cycles of RPP Plating at 11 ASF.
No copper Overhang reduction process for all Panel.

Experiment # 3.
12 Panels are to be made for this test segment using 2 plys of 106 B-Stage. Micro-via size to remain constant at 150 micron.

Panel #	1	2	3	4	5	6	7	8	9	10	11	12
Mat & via Diam.	2x106 Glass -150 via dia											
Plasma	1	2	3	4	5	6	no	no	no	no	no	no
Glass Etch	1	2	3	no	no	no	7	8	9	no	no	no

Common Steps - same as Experiment # 2
All 24 Panels of Experiment 2 and 3 where prepared as a lot.
Variable 1, with or with-out Plasma Desmear
Panels # 1 through 6 with Plasma, P # 7 to 12 without Plasma.
Variable # 2, with or without Glass Etch.
Panels # 1, 2, 3 & 7, 8, 9 with Glass Etch.
Panels # 4, 5, 6 & 10, 11, 12 without GE.

Evaluation:
After Etching of Patterns all panels to be electrically probed for Failures and recorded, location and counts. All Panels to be Probed after each Thermal Pass through the HASL Process, failures to be recorded by count and location.

RESULTS from Experiment 2 & 3.

Opens/defects for 24 Panel were ***ZERO.***
This represent a total of 24x2x 38,701 vias = ***1,857,648 micro vias.***

1) There where NO Failures detected after 7 passes through the HASL Process and it was decided to delete the 8 Pass.
2) No functional difference was recorded when plasma was employed vs. No Plasma cleaning.
3) No functional difference was recorded when Glass Etch was used vs. No Glass Etch.

Further Examination of the test subjects by micro-section evaluations indicates that the process of desmear and glass etch had no real impact on the 125 dia micro-via structures. It was noted from past evaluations that the subject processes did improve the visual aspects of the micro-via in most instances.

Figure 3 Two typical cross-sectional pictures from Experiment 2,
A) dielectric is one ply of 1080, µvia size is 0.005" µvia with plasma desmear and glass etch;

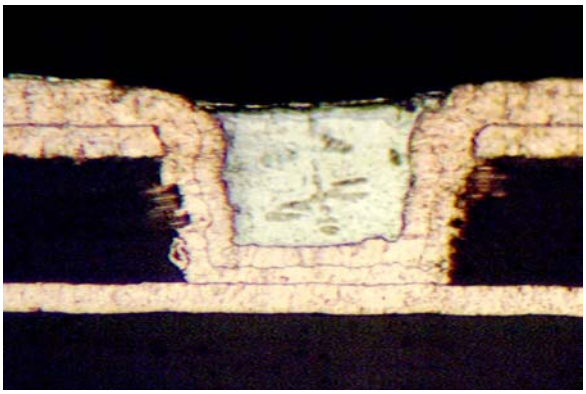


Figure 4
B) µvia without plasma desmear and glass etch.

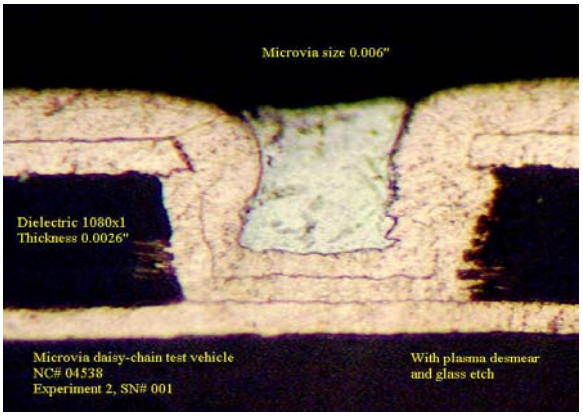


Figure 5
Two typical cross-sectional pictures
from Experiment 3, dielectric is two plies of **106,**
microvia size is 0.006".
(a) a microvia with plasma desmear and glass etch;

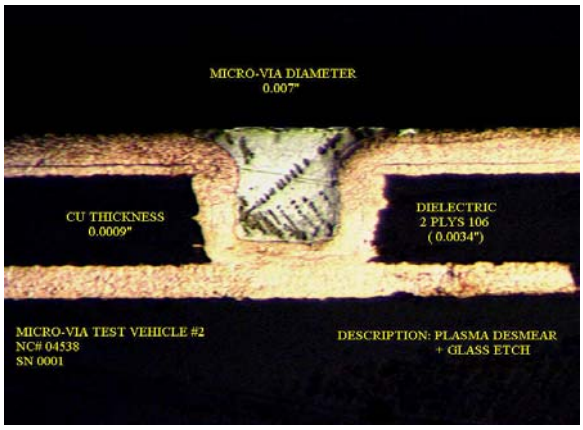
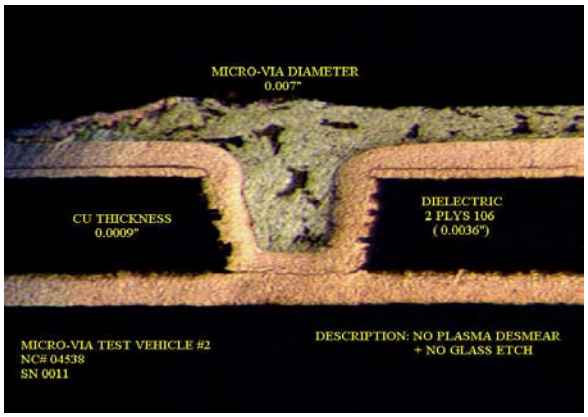


Figure 6
b) a μvia without plasma desmear and without glass etch.
The .006" μvia size was used to represent same type of aspect ratio that is encountered when real product is processed.



CONCLUSION:
Plasma desmear and Glass etch had no real impact on the micro-via performance, when 125 and 150 micron diameter is present on the design of the parts. Overhang reduction will probably be of less importance when Plasma is not performed.
The overhang created during the permanganate cycle is negligible to need compensation by removing more of the protruding copper face of the outer layer. UV lasered μ-vias exhibit less overhang at the laser stage and when cleaning processes are minimized hole wall resin attack is restricted. The Glass Etch process will only be of benefit if there is a high glass concentration in the laminated dielectric, as found when 2116 style b-stage is used, or the resin content is lowered, when substructures with buried via holes are laminated, thereby consuming additional resin volume. The electroless copper bond to the capture pads was of excellent quality and exhibited none of the analyzed failures. All the Failures of the 1st EXPERIMENT were the result of plated Voids.

Other micro-via Products
EXAMPLES: Figure 7 to 10
Pictures of Micro-vias on PWB's, 1080 Glass dielectric layer .005" Via, UV Laser generated at Coretec-inc.
The 4 Pictures are of μ-via designs using single ply. The pictures may not be at center of micro-via and therefore appear to be of high aspect plating design. Dielectric is only .0032", capture pad copper thickness is Half oz.

Figure 7

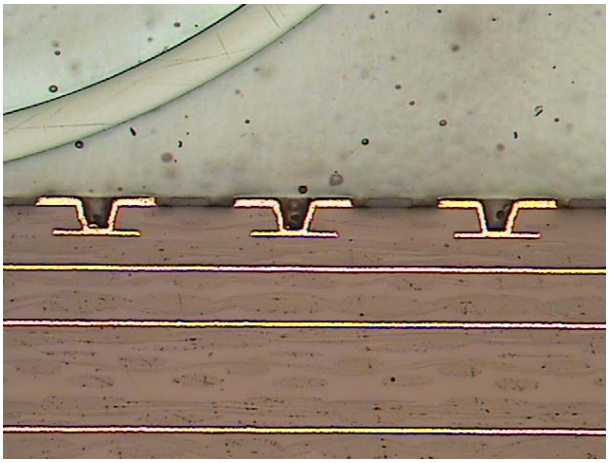


Figure 8

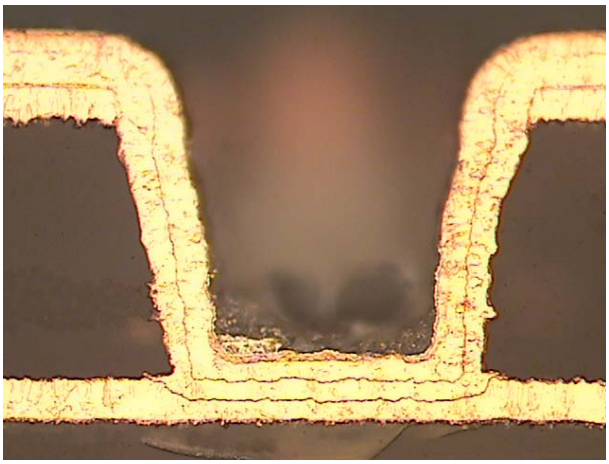


Figure 9

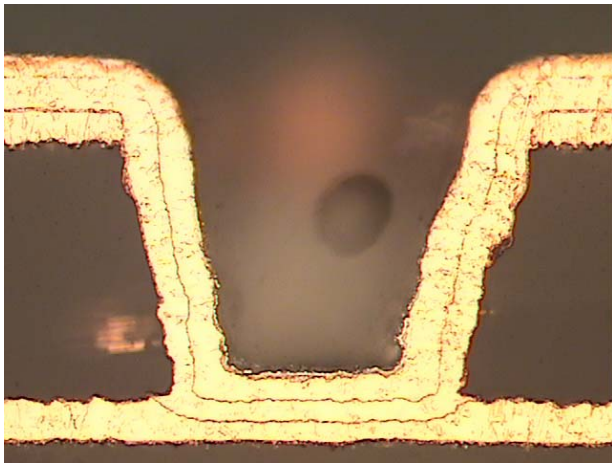
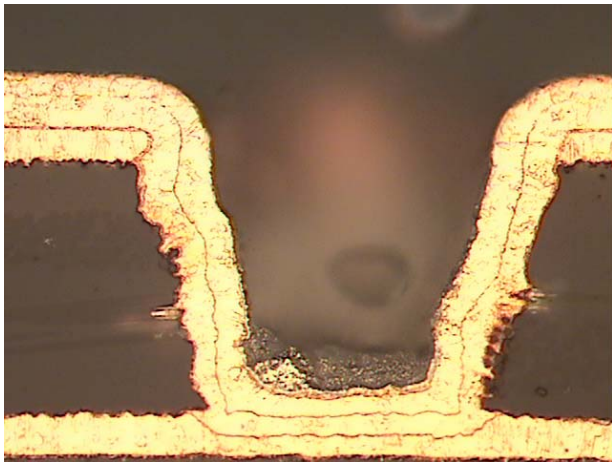
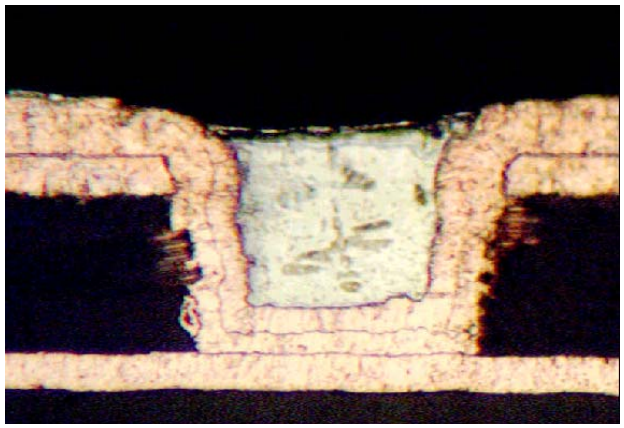


Figure 10



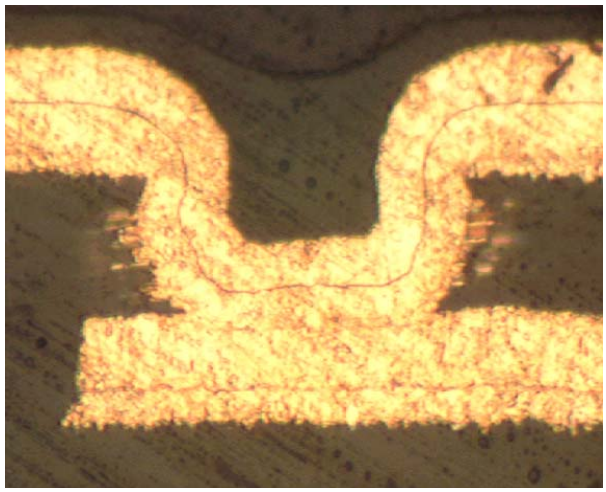
Picture 11
From Experiment # 2, single ply 1080
with Plasma process, but without Glass Etch,
after 8 times Thermal stress, μvia diameter is .005",
dielectric is .0033".



The examples show that when micro-vias are lasered with UV-Dual beam CO2 laser
Quality depends more on the lasering method than the following processing. Leaving minimum debris on capture pads and the sidewalls will reduce the necessity of extraordinary processing to compensate. However, additional cleaning and removal of obstructions has proven to be beneficial for any following plating process.
Judgement should be made to institute the appropriate method or process sequence.

Figure 12
is μ-via, single ply 1080 over plated
Buried via layer segment. Plated thickness on
Layer 2 is .0014", dielectric is .0021", μvia
Plating is .0013" at bottom, via diameter is .0038"
Specification –MIL – Spec- Product.

Figure 12



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And the plating department at the Ellesmere facility.

No DATA Chart for Experiment 2 & 3 , (No Failures to Record.)

Appendix "A"
Results Data Chart from Experiment 1

Experiment 1: Variables and Result Details: numbers on this sheet are open counts after each test.

Panel SN#	1	2	3	4	5	6	7	8	9	10	11	12
Construction	1080x1	1080x1	1080x1	1080x1	2313x1	2313x1	2313x1	2313x1	2116x1	2116x1	2116x1	2116x1
uvia size CS	0.005"	0.005"	0.005"	0.005"	0.006"	0.006"	0.006"	0.006"	0.006"	0.006"	0.006"	0.006"
uvia size SS	0.004"	0.004"	0.004"	0.004"	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"	0.005"
Plasma	yes	yes	no	no	yes	yes	no	no	yes	yes	no	no
	38,701	38,701	38,701	38,701	38,701	38,701	38,701	38,701	38,701	38,701	38,701	38,701
Glass Etch	yes	no	yes	no	yes	no	yes	no	yes	no	yes	no
after Etch (Cs)	0	0	1	0	0	1	0	0	30	2	30	1
after Etch (Ss)	12	2	1	0	12	1	3	0	30	30	30	2
1st HASL (cs)	0	0	1	0	0	1	0	0	30	2	30	1
1st HASL (ss)	12	2	1	0	12	1	3	0	30	30	30	2
2nd HASL (cs)	0	0	1	0	0	1	0	0		2		1
2nd HASL (ss)	12	2	1	0	12	1	3	0	all greater than 30 failures			2
3rd HASL (cs)	0	0	1	0	0	1	0	0		2		1
3rd HASL (ss)	12	2	1	0	12	1	3	0				2
4th HASL (cs)	0	0	1	2	0	1	0	0		2		1
4th HASL (ss)	12	2	1	0	12	1	3	0				2
5th HASL (cs)	0	0	1	2	0	1	0	0		2		1
5th HASL (ss)	12	2	1	0	12	1	3	0				2
6th HASL (cs)	0	0	1	3	0	1	0	0		2		1
6th HASL (ss)	12	2	1	0	12	1	3	0				2
7th HASL (cs)	0	0	1	4	0	1	0	0		2		1
7th HASL (ss)	12	2	1	0	12	1	3	0				2
8th HASL (cs)	0	0	1	7	0	1	0	0		2		1
8th HASL (ss)	12	2	1	0	12	1	3	0				1
CompSide	**0**	**0**	**1**	**7**	**0**	**1**	**0**	**0**	**30**	**2**	**30**	**1**
Sold Side	**12**	**2**	**1**	**0**	**12**	**1**	**3**	**0**	**30**	**30**	**30**	**2**
CompSide % Fail	0	0	0.002584	0.018087	0	0.002584	0	0	0.077517	0.005168	0.077517	0.002584
SoldSide %Fail	0.031007	0.005168	0.002584	0	0.031007	0.002584	0.007752	0	0.077517	0.077517	0.077517	0.005168