



TEST REPORT

(Self-Tested Data)

CLIENT: IPC Validation Services
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Attention: Mr. Randy Cherry
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TEST ITEMS: Peel Strength, Volume Resistivity, Surface Resistivity, Moisture Absorption, Dielectric Breakdown, Permittivity @ 1 MHz, Loss Tangent @ 1 MHz, Flexural Strength, Arc Resistance, Thermal Stress, Electric Strength, Flammability, Glass Transition Temperature, Decomposition Temperature, CTE (TMA), Time to Delamination (T260, T288, T300), Dimensional Stability, Solderability, Metal Surfaces Cleanability, Pressure Cooker Test.

SAMPLE: Copper-Clad Laminate

TEST MATERIAL: Arlon Product 33N

SPECIFICATION: IPC-4101/40

TEST RESULTS: The specimens were tested by the indicated test methods within this report.
The actual detailed test results are enclosed.

DATE OF REPORT: 17 February 2023

SUMMARIZED TEST RESULTS:

Test Item	Thin	Thick
Peel Strength	Pass	Pass
Volume Resistivity	Pass	Pass
Surface Resistivity	Pass	Pass
Moisture Absorption	--	Pass
Dielectric Breakdown	--	Pass
Permittivity @ 1MHz	Pass	Pass
Loss Tangent @ 1MHz	Pass	Pass
Flexural Strength	--	Pass
Arc Resistance	Pass	Pass
Surface Resistivity	Pass	Pass
Thermal Stress	Pass	Pass
Electric Strength	Pass	Pass
Flammability	Pass	Pass
Glass Transition Temperature	--	Pass
Decomposition Temperature	--	<u>N/A for SS40</u>
Z-Axis CTE	--	<u>N/A for SS40</u>
Time to Delamination	--	<u>N/A for SS40</u>
Dimensional Stability	Pass	Pass
Solderability	--	Pass
Chemical Resistance	Report Only	Report Only
Metal Surface Cleanability	--	Report Only
Pressure Cooker Test	--	Report Only

Peel Strength

Reference:

IPC-TM-650 Method 2.4.8 Peel Strength of Metal Clad Laminates

IPC-TM-650 Method 3.4.8.3 Peel Strength of Metal Clad Laminates at Elevated Temperature

IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 1 Peel Strength After Thermal Stress Thin

Side A Cross-Wise and Length-Wise Average	1.2	
Side B Cross-Wise and Length-Wise Average	1.1	
Requirement	≥ 0.95	Pass

Table 2 Peel Strength After Thermal Strength Thick

Side A Cross-Wise and Length-Wise Average	1.2	
Side B Cross-Wise and Length-Wise Average	1.3	
Requirement	≥ 0.95	Pass

Table 3 Peel Strength At Elevated Temperature Thin

Side A Cross-Wise and Length-Wise Average	1.4	
Side B Cross-Wise and Length-Wise Average	1.5	
Requirement	≥ 0.60	Pass

Table 4 Peel Strength At Elevated Temperature Thick

Side A Cross-Wise and Length-Wise Average	1.1	
Side B Cross-Wise and Length-Wise Average	1.0	
Requirement	≥ 0.70	Pass

Table 5 Peel Strength After Process Solutions Thin

Side A Cross-Wise and Length-Wise Average	1.4	
Side B Cross-Wise and Length-Wise Average	1.5	
Requirement	≥ 0.60	Pass

Table 6 Peel Strength After Process Solutions Thick

Side A Cross-Wise and Length-Wise Average	1.3	
Side B Cross-Wise and Length-Wise Average	1.1	

Requirement	≥ 0.80	Pass
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Table 7 Peel Strength As Received Low Profile Copper Thin

Side A Cross-Wise and Length-Wise Average	N/A
Side B Cross-Wise and Length-Wise Average	N/A
Requirement	<u>N/A for SS40</u>

Table 8 Peel Strength As Received Low Profile Copper Thick

Side A Cross-Wise and Length-Wise Average	<u>N/A</u>
Side B Cross-Wise and Length-Wise Average	<u>N/A</u>
Requirement	<u>N/A for SS40</u>

Volume & Surface Resistivity

Reference:

IPC-TM-650 Method 2.5.17.1 Volume and Surface Resistivity of Dielectric Materials
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 9 Volume and Surface Resistivity Humidity Conditioning Thin

Volume Resistivity	Average of three specimens	1.3E+05	
Requirement after moisture		$\geq 1.00 \text{ E}+04$	Pass
Surface Resistivity	Average of three specimens	2.6E+04	
Requirement C-96/35/90		$\geq 1.00 \text{ E}+04$	Pass

Table 10 Volume and Surface Resistivity At Elevated Temperature Thin

Volume Resistivity	Average of three specimens	1.9E+08	
Requirement 125°C		$\geq 6.00 \text{ E}+04$	Pass
Surface Resistivity	Average of three specimens	1.8E+07	
Requirement 125°C		$\geq 1.00 \text{ E}+04$	Pass

Table 11 Volume and Surface Resistivity Humidity Conditioning Thick

Volume Resistivity	Average of three specimens	3.70E+07	
Requirement after moisture		$\geq 1.00 \text{ E}+06$	Pass

Surface Resistivity	Average of three specimens	1.30E+07	
Requirement after moisture		$\geq 1.00 \text{ E}+06$	Pass

Table 12 Volume and Surface Resistivity At Elevated Temperature Thick

Volume Resistivity	Average of three specimens	6.8E+06	
Requirement 125°C		$\geq 1.00 \text{ E}+06$	Pass
Surface Resistivity	Average of three specimens	2.3E+06	
Requirement 125°C		$\geq 1.00 \text{ E}+06$	Pass

Moisture Absorption

Reference:

IPC-TM-650 Method 2.6.2.1 Water Absorption of Metal Clad Plastic Laminates
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 13 Moisture Absorption Thick

Moisture Absorption	<1.55 mm Average of three specimens	0.31	
Requirement		≤ 1.0	Pass

Dielectric Breakdown

Reference:

IPC-TM-650 Method 2.5.6 Dielectric Breakdown
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 14 Dielectric Breakdown

Minimum Voltage	Average of four specimens	46	
Requirement		≥ 40	Pass

Permittivity and Loss Tangent

Reference:

IPC-TM-650 Method 2.5.5.9 Permittivity and Loss Tangent, Parallel Plate 1 MHz to 1.5 MHz
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 15 Permittivity and Loss Tangent

Permittivity @ 1 MHz Thin Requirement	Average of three specimens	4.26 ≤ 5.4	Pass
Loss Tangent @ 1 MHz Thin Requirement	Average of three specimens	0.016 ≤ 0.035	Pass
Permittivity @ 1 MHz Thick Requirement	Average of three specimens	4.87 ≤ 5.4	Pass
Loss Tangent @ 1 MHz Thick Requirement	Average of three specimens	0.007 ≤ 0.035	Pass

Flexural Strength

Reference:

IPC-TM-650 Method 2.4.4 Flexural Strength of Laminates at Ambient Temperature
IPC-TM-650 Method 2.4.4.1 Flexural Strength of Laminates at Elevated Temperature
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 16 Flexural Strength

Flexural Strength Length Direction Requirement	Average of two specimens	106,721 $\geq 60,190$	Pass
Flexural Strength Cross Direction Requirement	Average of two specimens	68,969 $\geq 47,140$	Pass

Flexural Strength at Elevated Temperature			
Length Direction	Average of two specimens	72.465	
Requirement		$\geq 45,110$	Pass

Arc Resistance

Reference:

IPC-TM-650 Method 2.5.1 Arc Resistance of Printed Wiring Material
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 17 Arc Resistance

Arc Resistance Thin Requirement	Average of three specimens	179	
		≥ 120	Pass
Arc Resistance Thick Requirement	Average of three specimens	148	
		≥ 120	Pass

Thermal Stress

Reference:

IPC-TM-650 Method 2.4.13.1 Thermal Stress of Laminates
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 18 Thermal Stress

Thermal Stress Thin Etched A Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thin Etched B Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thick Etched A Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thick Etched B Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thin Un-Etched A Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thin Un-Etched B Side	No obvious blister, delamination or damage	Pass

Thermal Stress Thick Un-Etched A Side	No obvious blister, delamination or damage	Pass
Thermal Stress Thick Un-Etched B Side	No obvious blister, delamination or damage	Pass

Electric Strength

Reference:

IPC-TM-650 Method 2.5.6.2 Electric Strength
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 19 Electric Strength

Electric Strength Thin Requirement	Average of three specimens	59	
		≥ 30	Pass

Flammability Vertical Burning

Reference:

UL94 Section 8 50W (20mm) Vertical Burning Test; V-0, V-1, V-2
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 19 Vertical Burning Test Thin

The specimens were tested by the methods given above.
 The flammability Classification Condition A of specimens is V-0
 The flammability Classification Condition A of specimens is V-0
 The specimens pass.

Table 20 Vertical Burning Test Thick

The specimens were tested by the methods given above.
 The flammability Classification Condition A of specimens is V-0
 The flammability Classification Condition A of specimens is V-0
 The specimens pass.

Glass Transition Temperature

Reference:

IPC-TM-650 Method 2.4.25 Glass Transition Temperature and Cure Factor by DSC
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 22 Glass Transition Temperature

Glass Transition Temperature	253°C	
Requirement	$\geq 200^{\circ}\text{C}$	Pass

Decomposition Temperature

Reference:

IPC-TM-650 Method 2.4.24.6 Decomposition Temperature of Laminate Material Using TGA
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 23 Decomposition Temperature

Glass Transition Temperature 5% Weight Loss	N/A
Requirement	<u>N/A for SS40</u>

Z-Axis CTE (TMA)

Reference:

IPC-TM-650 Method 2.4.24. Glass Transition Temperature and Z-Axis Expansion by TMA
IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 24 Z-Axis CTE (TMA)

X-Axis CTE	Average of two specimens	14.6
		<u>N/A for SS40</u>

Y-Axis CTE	Average of two specimens	12.9 <u>N/A for SS40</u>
Z-Axis CTE	Average of two specimens	47 <u>N/A for SS40</u>
Z-Axis Expansion 50-260	Average of two specimens	1.24 <u>N/A for SS40</u>

Time to Delamination

Reference:

IPC-TM-650 Method 2.4.24.1 Time to Delamination (TMA Method)
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 25 Time to Delamination (TMA)

Delamination T260	Average of two specimens Requirement	60+ <u>N/A for SS40</u>
Delamination T288	Average of two specimens Requirement	21 <u>N/A for SS40</u>
Delamination T300	Average of two specimens Requirement	7.6 <u>N/A for SS40</u>

Dimensional Stability

Reference:

IPC-TM-650 Method 2.4.39 Dimensional Stability, Glass Reinforced Thin Laminates
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 26 Dimensional Stability Thin

Dimensional Stability Bake Thin	Average of three specimens
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	Machine direction	-0.07	
	Requirement	-0.3 to +0.3	Pass
Dimensional Stability Stress Thin	Average of three specimens		
	Cross direction	-0.15	
	Requirement	-0.3 to +0.3	Pass

Table 27 Dimensional Stability Thick

Dimensional Stability Bake Thick	Average of three specimens		
	Machine direction	-0.13	
	Requirement	-0.3 to +0.3	Pass
Dimensional Stability Stress Thick	Average of three specimens		
	Cross direction	-0.14	
	Requirement	-0.3 to +0.3	Pass

Solderability (Edge Dip Test)

Reference:

IPC-J-STD-003C; Method 4.2.1 Edge Dip Test

IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 28 Solderability

Solderability Thin	Sample surface exhibited good wetting	Pass
Solderability Thick	Sample surface exhibited good wetting	Pass

Chemical Resistance

Reference:

IPC-TM-650 Method 2.3.4.2 Chemical Resistance of Laminates, Prepreg and Coated Foil Products by Solvent Exposure.

IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 29 Chemical Resistance

Chemical Resistance Thin	Average of three specimens	
	Weight increase (Check & Record)	
Requirement	Appearance after bake	No Requirement for SS40
Requirement	Appearance after solvent	No Requirement for SS40
Chemical Resistance Thick	Average of three specimens	
	Weight increase (Check & Record)	
Requirement	Appearance after bake	No Requirement for SS40
Requirement	Appearance after solvent	No Requirement for SS40

Metal Surface Cleanability

Reference:

IPC-TM-650 Method 2.3.1.1 Chemical Cleaning of Metal-Clad Laminate
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 29 Metal Surface Cleanability

Metal Surface Cleanability	Three specimens	
Requirement	The metal cladding on the test specimen shall be cleaned to a uniform matte finish. Deionized or distilled water poured on the surface does not bead or form puddles.	Pass

Pressure Cooker Test

Reference:

IPC-TM-650 Method 2.6.16 Pressure Vessel Method for Glass Epoxy Laminate Integrity
 IPC-4101E/40 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 30 Pressure Cooker Test

Pressure Cooker Test	Five specimens
Requirement	The samples shall have no measles,

CERTIFICATE OF CONFORMANCE

Arlon Electronic Materials Division certifies that the test equipment used complies with the requirements of correlation criterion and that data contained in this report is accurate within the tolerance limitation of the equipment.

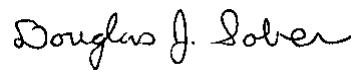
The report is invalid without the signature of the reviewer and the approver.

Reviewed by:



John Wright
17 February 2023

Approved by:



For IPC
25 March 2023