



# 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-4101/41

**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 SS41</u>
Z-Axis CTE	--	<u>N/A for SS41</u>
Time to Delamination	--	<u>N/A for SS41</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	$\geq 0.70$	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	$\geq 0.80$	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	$\geq 0.60$	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	$\geq 0.70$	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	$\geq 0.60$	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	$\geq 0.70$	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 SS41</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 SS41</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		$\leq 1.0$	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		$\geq 40$	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 ≥ 60,190	Pass
Flexural Strength Cross Direction Requirement	Average of two specimens	68,969 ≥ 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	
		$\geq 120$	Pass
Arc Resistance Thick Requirement	Average of three specimens	148	
		$\geq 120$	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	
		$\geq 30$	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	$\geq 250^\circ\text{C}$	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 SS41</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 SS41</u>

Y-Axis CTE	Average of two specimens	12.9 <u>N/A for SS41</u>
Z-Axis CTE	Average of two specimens	47 <u>N/A for SS41</u>
Z-Axis Expansion 50-260	Average of two specimens	1.24 <u>N/A for SS41</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 SS41</u>
Delamination T288	Average of two specimens Requirement	21 <u>N/A for SS41</u>
Delamination T300	Average of two specimens Requirement	7.6 <u>N/A for SS41</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 SS41
Requirement	Appearance after solvent	No Requirement for SS41
Chemical Resistance Thick	Average of three specimens	
	Weight increase (Check & Record)	
Requirement	Appearance after bake	No Requirement for SS41
Requirement	Appearance after solvent	No Requirement for SS41

## 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.

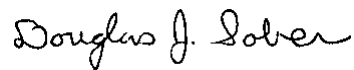
The report is invalid without the signature of the reviewer and the approver.

Reviewed by:



John Wright  
17 February 2023

Approved by:



For IPC  
25 March 2023