



TEST REPORT

(Self-Tested Data)

CLIENT: IPC Validation Services
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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 85HP

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: 20 May 2021

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/41 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 | 0.92 | |
| Side B Cross-Wise and Length-Wise Average | 0.91 | |
| Requirement | ≥ 0.70 | Pass |

Table 2 Peel Strength After Thermal Stress Thick

| | | |
|---|-------------|------|
| Side A Cross-Wise and Length-Wise Average | 1.16 | |
| Side B Cross-Wise and Length-Wise Average | 1.18 | |
| Requirement | ≥ 0.80 | Pass |

Table 3 Peel Strength At Elevated Temperature Thin

| | | |
|---|-------------|------|
| Side A Cross-Wise and Length-Wise Average | 0.93 | |
| Side B Cross-Wise and Length-Wise Average | 0.89 | |
| Requirement | ≥ 0.60 | Pass |

Table 4 Peel Strength At Elevated Temperature Thick

| | | |
|---|-------------|------|
| Side A Cross-Wise and Length-Wise Average | 0.90 | |
| Side B Cross-Wise and Length-Wise Average | 0.89 | |
| Requirement | ≥ 0.70 | Pass |

Table 5 Peel Strength After Process Solutions Thin

| | | |
|---|-------------|------|
| Side A Cross-Wise and Length-Wise Average | 0.98 | |
| Side B Cross-Wise and Length-Wise Average | 1.09 | |
| Requirement | ≥ 0.60 | Pass |

Table 6 Peel Strength After Process Solutions Thick

| | | |
|---|-------------|------|
| Side A Cross-Wise and Length-Wise Average | 0.97 | |
| Side B Cross-Wise and Length-Wise Average | 0.98 | |
| Requirement | ≥ 0.70 | Pass |

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/41 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 | 8.3E+04 | |
| Requirement C-96/35/90 | | $\geq 6.00 \text{ E}+04$ | Pass |
| Surface Resistivity | Average of three specimens | 7.8E+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 | 3.5E+08 | |
| Requirement 125°C | | $\geq 6.00 \text{ E}+04$ | Pass |
| Surface Resistivity | Average of three specimens | 2.2E+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 | 3.3E+07 | |
| Requirement after moisture | | $\geq 1.00 \text{ E}+06$ | Pass |

| | | | |
|----------------------------|----------------------------|--------------------------|------|
| Surface Resistivity | Average of three specimens | 3.4E+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 | 1.21E+09 | |
| Requirement 125°C | | $\geq 1.00 \text{ E}+06$ | Pass |
| Surface Resistivity | Average of three specimens | 3.19E+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/41 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 | 0.98 | |
| Requirement | | | ≤ 1.0 | Pass |

Dielectric Breakdown

Reference:

IPC-TM-650 Method 2.5.6 Dielectric Breakdown
 IPC-4101E/41 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 14 Dielectric Breakdown

| | | | |
|-----------------|---------------------------|-----------|------|
| Minimum Voltage | Average of four specimens | 45+N.B. | |
| 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/41 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 | 3.8 ≤ 5.4 | Pass |
| Loss Tangent @ 1 MHz Thin Requirement | Average of three specimens | 0.015 ≤ 0.035 | Pass |
| Permittivity @ 1 MHz Thick Requirement | Average of three specimens | 3.8 ≤ 5.4 | Pass |
| Loss Tangent @ 1 MHz Thick Requirement | Average of three specimens | 0.013 ≤ 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/41 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 16 Flexural Strength

| | | | |
|--|--------------------------|--------------------|------|
| Flexural Strength Length Direction Requirement | Average of two specimens | 61,643 ≥ 60,190 | Pass |
| Flexural Strength Cross Direction | Average of two specimens | 48,279 | |

| | | | |
|---|--------------------------|---------------|------|
| Requirement | | $\geq 47,140$ | Pass |
| Flexural Strength at Elevated Temperature | | | |
| Length Direction | Average of two specimens | 46,439 | |
| Requirement | | $\geq 45,110$ | Pass |

Arc Resistance

Reference:

IPC-TM-650 Method 2.5.1 Arc Resistance of Printed Wiring Material
 IPC-4101E/41 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 17 Arc Resistance

| | | | |
|----------------------------------|----------------------------|------------|------|
| Arc Resistance Thin Requirement | Average of three specimens | 180 | |
| | | ≥ 120 | Pass |
| Arc Resistance Thick Requirement | Average of three specimens | 181 | |
| | | ≥ 120 | Pass |

Thermal Stress

Reference:

IPC-TM-650 Method 2.4.13.1 Thermal Stress of Laminates
 IPC-4101E/41 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/41 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 19 Electric Strength

| | | | |
|------------------------------------|----------------------------|-----------|------|
| Electric Strength Thin Requirement | Average of three specimens | 73 | |
| | | ≥ 30 | Pass |

Flammability Vertical Burning

Reference:

UL94 Section 8 50W (20mm) Vertical Burning Test; V-0, V-1, V-2
 IPC-4101E/41 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 HB
 The flammability Classification Condition A of specimens is HB
 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 HB

The flammability Classification Condition A of specimens is HB
The specimens pass.

Glass Transition Temperature

Reference:

IPC-TM-650 Method 2.4.25 Glass Transition Temperature and Cure Factor by DSC
IPC-4101E/41 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 22 Glass Transition Temperature

| | | |
|------------------------------|---------|------|
| Glass Transition Temperature | 255°C | |
| Requirement | ≥ 250°C | Pass |

Decomposition Temperature

Reference:

IPC-TM-650 Method 2.4.24.6 Decomposition Temperature of Laminate Material Using TGA
IPC-4101E/41 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/41 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 <u>N/A for SS41</u> |
| Y-Axis CTE | Average of two specimens | 14 <u>N/A for SS41</u> |
| Z-Axis CTE | Average of two specimens | 40 <u>N/A for SS41</u> |
| Z-Axis Expansion 50-260 | Average of two specimens | 1.5 <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/41 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 | 60+ <u>N/A for SS41</u> |
| Delamination T300 | Average of two specimens Requirement | 60+ <u>N/A for SS41</u> |

Dimensional Stability**Reference:**

IPC-TM-650 Method 2.4.39 Dimensional Stability, Glass Reinforced Thin Laminates
 IPC-4101E/41 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:**Table 26 Dimensional Stability Thin**

| | | |
|-----------------------------------|----------------------------|----------|
| Dimensional Stability Bake Thin | Average of three specimens | |
| | Machine direction | -181~163 |
| | Requirement | -300~300 |
| Dimensional Stability Stress Thin | Average of three specimens | |
| | Cross direction | -190~133 |
| | Requirement | -300~300 |

Table 27 Dimensional Stability Thick

| | | |
|------------------------------------|----------------------------|----------|
| Dimensional Stability Bake Thick | Average of three specimens | |
| | Machine direction | -234~163 |
| | Requirement | -300~300 |
| Dimensional Stability Stress Thick | Average of three specimens | |
| | Cross direction | -222~179 |
| | Requirement | -300~300 |

Solderability (Edge Dip Test)**Reference:**

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

IPC-4101E/41 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.

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/41 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/41 Specification for Base Materials for Rigid and Multilayer Printed Board

Results:

Table 30 Pressure Cooker Test

| | | |
|----------------------------------|--|------|
| Pressure Cooker Test Requirement | Five specimens The samples shall have no measles, blisters or surface erosion | Pass |
|----------------------------------|--|------|

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.

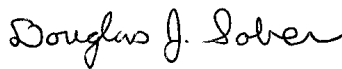
The report is invalid without the signature of the reviewer and the approver.

Reviewed by:



John Wright
Quality Manager

Approved by:



For IPC