



TEST REPORT SUMMARY

(Short Report)

CLIENT: IPC Validation Services
3000 Lakeside Drive Suite 105N Bannockburn, IL 60015
Attention: Mr. Randy Cherry
Phone: 1-847-597-2806

REFERENCE: IPC-4101E-WAM1/102, IPC-TM-650 2.3.1.1, 2.3.4.2A, 2.4.4B,
2.4.8C, 2.4.8.3A, 2.4.13.1, 2.4.24C, 2.4.24.1, 2.4.24.6, 2.4.25D,
2.4.39, 2.5.1B, 2.5.5.9, 2.5.6B, 2.5.6.2A, 2.5.17.1A, 2.6.2.1A, 2.6.16,
UL94, Customer Technical Requirements

TEST ITEM: Peel Strength, Volume Resistivity, Surface Resistivity, Moisture
Absorption, Dielectric Breakdown, Permittivity and Loss Tangent,
Flexural Strength, Arc Resistance, Thermal Stress, Electric Strength,
Vertical Burning Test, Glass Transition Temperature, Decomposition
Temperature, Z-Axis CTE (TMA), Time to Delamination,
Dimensional Stability, Solderability, Chemical Resistance, Metal
Surface Cleanability, Pressure Cooker Test

SAMPLE: CCL

TEST MATERIAL: TU-933+

SPECIFICATION: IPC-4101E-WAM1/102

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 August 2022

REPORT No.: 34527E



"INTEGRITY, HONESTY AND KNOWLEDGE"

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SUMMARIZED TEST RESULTS:

<u>Test Item</u>	<u>Thin</u>	<u>Thick</u>
Peel Strength	Pass	Pass
Volume Resistivity	Pass	Pass
Surface Resistivity	Pass	Pass
Moisture Absorption	--	Pass
Dielectric Breakdown	--	Pass
Permittivity at 1 MHz	Pass	Pass
Loss Tangent at 1 MHz	Pass	Pass
Flexural Strength	--	Pass
Arc Resistance	Pass	Pass
Thermal Stress	Pass	Pass
Electric Strength	Pass	--
Vertical Burning	Pass	Pass
Glass Transition Temperature	--	Pass
Decomposition Temperature	--	Pass
Z-Axis CTE (TMA)	--	Pass
Time to Delamination	--	Pass
Dimensional Stability	Pass	Pass
Solderability	Pass	Pass
Chemical Resistance	Report Only	Report Only
Metal Surfaces Cleanability	--	Report Only
Pressure Cooker Test	--	Report Only



Peel Strength

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 Method 2.4.8C Peel Strength of Matallic Clad Laminates

IPC-TM-650 Method 2.4.8.3A Peel Strength of Matallic Clad Laminates at Elevated Customer Technical Requirements

RESULTS

Table 1 Peel Strength After Thermal Stress Thin

Sample Designation	CCL			Sample Identification	TU-933+
Test Date	2022-07-16			Ambient	24°C, 48%RH
Sample No.	Peel Strength (N/mm)				
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise	
34527-1-1-1	0.78				
34527-1-1-2	0.80				
34527-1-1-3		0.77			
34527-1-1-4		0.78			
34527-1-1-5			0.82		
34527-1-1-6			0.83		
34527-1-1-7				0.79	
34527-1-1-8				0.80	
Average	0.79	0.78	0.82	0.80	
Requirement	≥0.70				



Table 2 Peel Strength After Thermal Stress Thick

Sample Designation	CCL		Sample Identification	TU-933+
Test Date	2022-08-14		Ambient	25°C, 49%RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
34527-102-1-1	1.10			
34527-102-1-2	1.12			
34527-102-1-3		1.12		
34527-102-1-4		1.08		
34527-102-1-5			1.11	
34527-102-1-6			1.12	
34527-102-1-7				1.09
34527-102-1-8				1.09
Average	1.11	1.10	1.12	1.09
Requirement	≥0.70			

Table 3 Peel Strength At Elevated Temperature Thin

Sample Designation	CCL		Sample Identification	TU-933+
Test Date	2022-08-15		Ambient	25°C, 49%RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
34527-100-1-1	0.84			
34527-100-1-2	0.85			
34527-100-1-3		0.79		
34527-100-1-4		0.81		
34527-100-1-5			0.73	
34527-100-1-6			0.76	
34527-100-1-7				0.72
34527-100-1-8				0.72
Average	0.84	0.80	0.75	0.72
Requirement	≥0.70			



Table 4 Peel Strength At Elevated Temperature Thick

Sample Designation	CCL		Sample Identification	TU-933+
Test Date	2022-08-15		Ambient	25°C, 49%RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
34527-102-2-1	0.85			
34527-102-2-2	0.88			
34527-102-2-3		0.93		
34527-102-2-4		0.95		
34527-102-2-5			0.89	
34527-102-2-6			0.89	
34527-102-2-7				0.81
34527-102-2-8				0.83
Average	0.87	0.94	0.89	0.82
Requirement	≥0.70			

Table 5 Peel Strength After Process Solution Thin

Sample Designation	CCL		Sample Identification	TU-933+
Test Date	2022-07-19		Ambient	24°C, 48%RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
34527-2-1-1	0.86			
34527-2-1-2	0.85			
34527-2-1-3		0.87		
34527-2-1-4		0.85		
34527-2-1-5			0.83	
34527-2-1-6			0.80	
34527-2-1-7				0.85
34527-2-1-8				0.86
Average	0.85	0.86	0.82	0.85
Requirement	≥0.70			



Table 6 Peel Strength After Process Solution Thick

Sample Designation	CCL		Sample Identification	TU-933+
Test Date	2022-08-14		Ambient	25°C, 49%RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
34527-103-1-1	1.21			
34527-103-1-2	1.21			
34527-103-1-3		1.21		
34527-103-1-4		1.24		
34527-103-1-5			1.17	
34527-103-1-6			1.17	
34527-103-1-7				1.21
34527-103-1-8				1.12
Average	1.21	1.22	1.17	1.17
Requirement	≥0.70			

Table 7 Peel Strength Low Profile Copper Foil Thin

Sample Designation	/		Sample Identification	/
Test Date	/		Ambient	/
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
No Requirement				



Table 8 Peel Strength Low Profile Copper Foil Thick

Sample Designation	/	Sample Identification	/	
Test Date	/	Ambient	/	
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
No Requirement				



Volume and Surface Resistivity

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 2.5.17.1A Volume and Surface Resistivity of Dielectric Materials
Customer Technical Requirements

RESULTS

Table 9 Volume and Surface resistivity Humidity Conditioning Thin

Sample Designation	CCL		Sample Identification	TU-933+	
Test Date	2022-07-14~2022-07-18		Ambient	25 °C, 52% RH	
Sample No.	Average Thickness T	Surface Resistance R'	Surface Resistivity $r=R'P/D_4$	Volume Resistance R	Volume Resistivity $r=RA/T$
	(cm)	(MΩ)	(MΩ)	(MΩ)	(MΩ·cm)
34527-3-1	0.0132	1.6E+06	5.2E+08	9.0E+05	3.5E+08
34527-3-2	0.0133	1.4E+06	4.5E+08	7.5E+05	2.9E+08
34527-3-3	0.0132	1.2E+06	3.9E+08	8.0E+05	3.1E+08
Average	/	/	4.5E+08	/	3.2E+08
Requirement	/	/	$\geq 10^5$	/	$\geq 10^6$



Table 10 Volume and Surface Resistivity at Elevated Temperature Humidity Thin

Sample Designation	CCL		Sample Identification	TU-933+	
Test Date	2022-07-19~2022-07-20		Ambient	25 °C, 53% RH	
Sample No.	Average Thickness T	Surface Resistance R'	Surface Resistivity $r'=R'P/D_4$	Volume Resistance R	Volume Resistivity $r=RA/T$
	(cm)	(MΩ)	(MΩ)	(MΩ)	(MΩ·cm)
34527-4-1	0.0132	3.0E+05	9.7E+07	2.5E+05	9.8E+07
34527-4-2	0.0133	2.5E+05	8.1E+07	2.5E+05	9.7E+07
34527-4-3	0.0132	2.0E+05	6.4E+07	1.8E+05	7.0E+07
Average		/	8.1E+07	/	8.9E+07
Requirement		/	$\geq 10^5$	/	$\geq 10^6$

Table 11 Volume and Surface Resistivity Humidity Conditioning Thick

Sample Designation	CCL		Sample Identification	TU-933+	
Test Date	2022-07-14~2022-07-21		Ambient	23 °C, 53% RH	
Sample No.	Average Thickness T	Surface Resistance R'	Surface Resistivity $r'=R'P/D_4$	Volume Resistance R	Volume Resistivity $r=RA/T$
	(cm)	(MΩ)	(MΩ)	(MΩ)	(MΩ·cm)
34527-23-1	0.0519	6.0E+05	1.7E+07	4.0E+05	2.0E+08
34527-23-2	0.0520	7.0E+05	2.0E+07	4.8E+05	2.4E+08
34527-23-3	0.0521	5.8E+05	1.6E+07	4.4E+05	2.2E+08
Average		/	1.8E+07	/	2.2E+08
Requirement		/	$\geq 10^5$	/	$\geq 10^6$



Table 12 Volume and Surface Resistivity at Elevated Temperature Humidity Thick

Sample Designation	CCL		Sample Identification	TU-933+	
Test Date	2022-07-14~2022-07-15		Ambient	24 °C, 48% RH	
Sample No.	Average Thickness T	Surface Resistance R'	Surface Resistivity $r'=R'P/D_4$	Volume Resistance R	Volume Resistivity $r=RA/T$
	(cm)	(MΩ)	(MΩ)	(MΩ)	(MΩ·cm)
34527-24-1	0.0518	1.0E+06	2.8E+07	7.0E+05	3.5E+08
34527-24-2	0.0519	2.0E+06	5.6E+07	9.0E+05	4.4E+08
34527-24-3	0.0518	1.4E+06	4.0E+07	8.0E+05	4.0E+08
Average		/	4.1E+07	/	4.0E+08
Requirement		/	$\geq 10^5$	/	$\geq 10^6$



Moisture Absorption

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
 IPC-TM-650 Method 2.6.2.1A Water Absorption, Metal Clad Plastic Laminates
 Customer Technical Requirements

RESULTS

Table 13 Moisture Absorption

Sample Designation	CCL		Sample Identification	TU-933+
Test Date	2022-07-07~2022-07-14		Ambient	28 °C, (50~54)% RH
Sample No.	mass(g)		increasing weight percent of mass(%)	
	m ₁	m ₂		
34527-26-4	2.1073	2.1102	0.14	
34527-26-5	2.1072	2.1102	0.14	
34527-26-6	2.1088	2.1119	0.15	
Average			0.14	
Requirement			≤0.2	



Dielectric Breakdown

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 Method 2.5.6B Dielectric Breakdown of Rigid Printed Wiring Material
Customer Technical Requirements

RESULTS

Table 14 Dielectric Breakdown

Sample Designation		CCL	Sample Identification	TU-993+
Test Date		2022-07-10~2022-07-12	Ambient	25 °C, 50% RH
Sample No.		Thickness (mm)	Voltage (kV)	Minimum Voltage (kV)
34527-27-1	Machine direction	0.517	43.2+N.B	43+N.B
34527-27-2		0.516	42.8+N.B	
34527-27-3	Transverse direction	0.518	43.5+N.B	
34527-27-4		0.517	42.7+N.B	
Requirement				≥40



Permittivity and Loss Tangent

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
 IPC-TM-650 Method 2.5.5.9 Permittivity and Loss Tangent, Parallel Plate, 1MHz to 1.5GHz
 Customer Technical Requirements

RESULTS

Table 15 Permittivity and Loss Tangent

Sample Designation	CCL		Sample Identification	TU-933+
Test Date	2022-07-07~2022-07-14		Ambient	25 °C, 49% RH
Sample No.	Test Frequency	Sample Thickness (mm)	Permittivity	Loss Tangent
34527-6-1	1 MHz	0.136	3.2	0.002
34527-6-2		0.137	3.1	0.002
34527-6-3		0.135	3.2	0.002
Average		0.136	3.2	0.002
Requirement			≤4.3	≤0.007
34527-26-7	1 MHz	0.520	3.4	0.001
34527-26-8		0.520	3.3	0.001
34527-26-9		0.521	3.3	0.001
Average		0.520	3.3	0.001
Requirement			≤4.3	≤0.007



Flexural Strength

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 2.4.4B Flexural Strength of Laminates (at Ambient Temperature)

Customer Technical Requirement

RESULTS

Table 16 Flexural Strength Test

Sample Designation	CCL		Sample Identification		TU-933+		
Test Date	2022-07-18		Ambient		24°C, 49%RH		
Sample No.	Span	Load	Width	Thickness	Flexural Strength S	Average	Requirement
	L	P	b	d			
	(mm)	(N)	(mm)	(mm)			
34527-28-1 (Length Direction)	15.90	109.442	25.98	0.520	372	367	≥345
34527-28-2 (Length Direction)		105.538	25.77	0.519	363		
34527-28-3 (Cross Direction)		96.556	25.01	0.516	346	346	≥345
34527-28-4 (Cross Direction)		99.416	25.85	0.515	346		



Arc Resistance

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 Method 2.5.1B Arc Resistance of Printed Wiring Material
Customer Technical Requirements

RESULTS

Table 17 Arc Resistance

Sample Designation	CCL	Sample Identification	TU-933+	
Test Date	2022-07-10~2022-07-12	Ambient	25 °C, 49% RH	
Sample No.	Thickness	Times	Average	Requirement
	(mm)	(s)	(s)	(s)
34527-7-1	0.132	139	138	≥60
34527-7-2	0.133	134		
34527-7-3	0.131	140		
34527-29-1	0.517	180	180	
34527-29-2	0.516	180		
34527-29-3	0.518	180		



Thermal Stress

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 Method 2.4.13.1 Thermal Stress of Laminates

Customer Technical Requirements

RESULTS

Table 18 Thermal Stress

Sample Designation	CCL		Sample Identification	TU-933+
Test Date	2022-07-12		Ambient	25 °C, 47%RH
Sample No.			Test result	
34527-8-1	Etched	Top	Thin	No evidence of blistering, delamination, wrinkling and cracking
34527-8-2				No evidence of blistering, delamination, wrinkling and cracking
34527-8-3				No evidence of blistering, delamination, wrinkling and cracking
34527-8-4		Bottom		No evidence of blistering, delamination, wrinkling and cracking
34527-8-5				No evidence of blistering, delamination, wrinkling and cracking
34527-8-6				No evidence of blistering, delamination, wrinkling and cracking
34527-30-1	Etched	Top	Thick	No evidence of blistering, delamination, wrinkling and cracking
34527-30-2				No evidence of blistering, delamination, wrinkling and cracking
34527-30-3				No evidence of blistering, delamination, wrinkling and cracking
34527-30-4		Bottom		No evidence of blistering, delamination, wrinkling and cracking
34527-30-5				No evidence of blistering, delamination, wrinkling and cracking
34527-30-6				No evidence of blistering, delamination, wrinkling and cracking
34527-9-1	Unetched	Top	Thin	No evidence of blistering, delamination, wrinkling and cracking
34527-9-2				No evidence of blistering, delamination, wrinkling and cracking
34527-9-3				No evidence of blistering, delamination, wrinkling and cracking
34527-9-4		Bottom		No evidence of blistering, delamination, wrinkling and cracking
34527-9-5				No evidence of blistering, delamination, wrinkling and cracking
34527-9-6				No evidence of blistering, delamination, wrinkling and cracking
34527-31-1	Unetched	Top	Thick	No evidence of blistering, delamination, wrinkling and cracking
34527-31-2				No evidence of blistering, delamination, wrinkling and cracking
34527-31-3				No evidence of blistering, delamination, wrinkling and cracking
34527-31-4		Bottom		No evidence of blistering, delamination, wrinkling and cracking
34527-31-5				No evidence of blistering, delamination, wrinkling and cracking
34527-31-6				No evidence of blistering, delamination, wrinkling and cracking



Electric Strength

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 Method 2.5.6.2A Electric Strength of Printed Wiring Material

Customer Technical Requirements

RESULTS

Table 19 Electric Strength

Sample Designation	CCL	Sample Identification	TU-933+
Test Date	2022-07-10~2022-07-12	Ambient	25 °C, 50% RH
Sample No.	Average Thickness (mm)	Voltage (kV)	Electric Strength (kV/mm)
34527-10-1	0.132	10.4	78.79
34527-10-2	0.133	10.1	75.94
34527-10-3	0.132	9.8	74.24
Average			76
Requirement			≥30



Vertical Burning Test

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

UL94 STANDARD FOR SAFETY Tests for Flammability of Plastic Materials for Parts in Devices and Appliances Section 8 50W (20 mm) Vertical Burning Test; V-0, V-1, or V-2

Customer Technical Requirements

RESULTS

Table 20 Vertical Burning Test Thin

Sample Designation		CCL		Sample Identification			TU-933+		
Test Date		2022-07-14~2022-07-20		Ambient			25 °C, 51% RH		
Pre-conditioning	Sample No.	Sample Thk (mm)	Afterflames (s)		Afterglow (s)	Sum of after flames (s)	Sum of afterflame and afterglow (s)	Did samples burn to the clamp?	Did the cotton ignite?
			(t ₁)	(t ₂)	(t ₃)	(t ₁ + t ₂)	(t ₂ + t ₃)		
Condition A:	34527-11-1	0.134	0	0	0	0	0	No	No
48 Hours	34527-11-2	0.135	0	0	0	0	0	No	No
(23±2) °C	34527-11-3	0.134	0	0	0	0	0	No	No
(50±10)% RH	34527-11-4	0.137	0	0	0	0	0	No	No
	34527-11-5	0.134	0	0	0	0	0	No	No
	Avg:	0.135	Max: 0			Sum: 0	Max: 0	Pass	Pass
Condition B:	34527-11-6	0.133	0	0	0	0	0	No	No
24 Hours	34527-11-7	0.134	0	0	0	0	0	No	No
(125±2) °C	34527-11-8	0.135	0	0	0	0	0	No	No
	34527-11-9	0.133	0	0	0	0	0	No	No
Results	34527-11-10	0.134	0	0	0	0	0	No	No
V-0	Avg:	0.134	Max: 0			Sum: 0	Max: 0	Pass	Pass
Requirement	V-0								



Table 21 Vertical Burning Test Thick

Sample Designation		CCL			Sample Identification		TU-933+		
Test Date		2022-07-14-2022-07-20			Ambient		25 °C, 51% RH		
Pre-conditioning	Sample No.	Sample Thk (mm)	Afterflames (s)		Afterglow (s)	Sum of after flames (s)	Sum of afterflame and afterglow (s)	Did samples burn to the clamp?	Did the cotton ignite?
			(t ₁)	(t ₂)					
Condition A:	34527-32-1	0.518	6	0	0	6	0	No	No
48 Hours	34527-32-2	0.521	7	0	0	7	0	No	No
(23±2) °C	34527-32-3	0.519	7	0	0	7	0	No	No
(50±10)% RH	34527-32-4	0.521	6	0	0	6	0	No	No
	34527-32-5	0.517	6	0	0	6	0	No	No
	Avg:	0.519	Max: 7			Sum: 32	Max: 0	Pass	Pass
Condition B:	34527-32-6	0.518	5	0	0	5	0	No	No
24 Hours	34527-32-7	0.521	6	0	0	6	0	No	No
(125±2) °C	34527-32-8	0.517	5	0	0	5	0	No	No
	34527-32-9	0.518	6	0	0	6	0	No	No
Results	34527-32-10	0.519	6	0	0	6	0	No	No
V-0	Avg:	0.519	Max: 6			Sum: 28	Max: 0	Pass	Pass
Requirement	V-0								



Glass Transition Temperature

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 Method 2.4.25D Glass Transition Temperature and Cure Factor by DSC

Customer Technical Requirement

RESULTS

Table 22 Glass Transition Temperature

Sample Designation	CCL	Sample Identification	TU-933+
Test Date	2022-07-07~2022-07-13	Ambient	28 °C, 50% RH
Sample Number	34527-37-7		
Element	Measurement (°C)		Requirement
Tg1	/		/
Tg2	/		/
Cure Factor ΔTg	/		/



Decomposition Temperature

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 method 2.4.24.6 Decomposition Temperature (Td) of Laminate Material Using TGA

Customer Technical Requirements

RESULTS

Table 23 Decomposition Temperature

Sample Designation	CCL	Sample Identification	TU-933+
Test Date	2022-07-07~2022-07-11	Ambient	28 °C, 56% RH
Sample Number	Decomposition temperature (°C)		
	mass loss at 2%	mass loss at 5%	
34527-26-3	394.17	413.39	
Requirement	/	≥340	



Z-Axis CTE (TMA)

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 Method 2.4.24C Glass Transition Temperature and Z-Axis Thermal Expansion by TMA

Customer Technical Requirements

RESULTS

Table 24 Z-Axis CTE (TMA)

Sample Designation	CCL		Sample Identification	TU-933+	
Test Date	2022-07-07~2022-07-09		Ambient	28 °C, 50% RH	
Sample Number	Z-CTE($\mu\text{m}/\text{m}\cdot^{\circ}\text{C}$)			PTE (%)	Tg($^{\circ}\text{C}$)
	(50~100) $^{\circ}\text{C}$	(210~260) $^{\circ}\text{C}$	(50~260) $^{\circ}\text{C}$	(50~260) $^{\circ}\text{C}$	
34527-26-1	44.84	169.2	88.71	1.86	205.11
34527-26-2	44.97	184.3	97.09	2.04	206.39
Requirement	≤ 45	≤ 260	/	≤ 2.8	≥ 185



Time to Delamination

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM-650 Method 2.4.24.1 Time to Delamination (TMA Method)

Customer Technical Requirements

RESULTS

Table 25 Time to Delamination

Sample Designation	CCL	Sample Identification	TU-933+	
Test Date	2022-07-07~2022-07-10	Ambient	28 °C, 50% RH	
Sample No.	Test Item	Time of Reversible Event (min)	Time of Delaminate (min)	Requirement (min)
34527-37-1	T260	/	>60	≥30
34527-37-2		/	>60	
34527-37-3	T288	/	>15	≥15
34527-37-4		/	>15	
34527-37-5	T300	/	>2	≥2
34527-37-6		/	>2	



Dimensional Stability

REFERENCES

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
 IPC-TM-650 Method 2.4.39A Dimensional Stability, Glass Reinforced Thin Laminates
 Customer Technical Requirement

RESULTS

Table 26 Dimensional Stability Thin

Sample Designation	CCL		Sample Identification	TU-933+				
Test Date	2022-07-28~2022-08-01		Ambient	23°C, 49% RH				
Sample No.	After Bake Process (ppm)				After Thermal Stress Process (ppm)			
	MD		TD		MD		TD	
34527-39	-128	-88	-235	-55	-184	-225	-263	-79
34527-40	-160	-145	-90	-63	-249	-229	-161	-169
34527-41	-84	-128	-78	-94	-140	-168	-67	-98
Requirement	-300~300							

Table 27 Dimensional Stability Thick

Sample Designation	CCL		Sample Identification	TU-933+				
Test Date	2022-07-18~2022-07-20		Ambient	(23~25)°C, 49% RH				
Sample No.	After Bake Process (ppm)				After Thermal Stress Process (ppm)			
	MD		TD		MD		TD	
34527-33	-141	-181	-235	-146	-149	-225	-232	-118
34527-34	-241	-48	-240	-126	-213	-97	-267	-260
34527-35	-128	-120	-247	-83	-116	-157	-192	-173
Requirement	-300~300							



Solderability

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC J-STD-003C Solderability Tests for Printed Boards Section 4.2.1 Edge Dip Test
Customer Technical Requirements

RESULTS

Table 28 Solderability

Sample Designation	CCL	Sample Identification	TU-933+
Test Date	2022-07-12	Ambient	25 °C, 49% RH
Sample No.		Test result	
34527-15-1	Thin	Sample surface exhibits good wetting	
34527-15-2		Sample surface exhibits good wetting	
34527-15-3		Sample surface exhibits good wetting	
34527-36-1	Thick	Sample surface exhibits good wetting	
34527-36-2		Sample surface exhibits good wetting	
34527-36-3		Sample surface exhibits good wetting	



Chemical Resistance

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
 IPC-TM-650 Method 2.3.4.2A Chemical Resistance of Laminates, Prepreg, and Coated Foil Products, by Solvent Exposure
 Customer Technical Requirements

RESULTS

Table 29 Chemical Resistance

Sample Designation	CCL			Sample Identification	TU-933+	
Test Date	2022-07-07~2022-07-14			Ambient	28 °C, 54% RH	
Sample No.	Thickness (mm)	Weight (mg)		Increase Weight (mg)	Appearance Inspection	
		W ₁	W ₂	W ₂ -W ₁	After Bake	After Immerse in the Solvent
34527-6-4	0.136	547.4	571.7	24.3	no any change	no any change
34527-6-5	0.137	530.5	555.6	25.1	no any change	no any change
34527-6-6	0.136	539.8	567.2	27.4	no any change	no any change
Average				25.6	/	
34527-26-10	0.521	2155.8	2177.2	21.4	no any change	no any change
34527-26-11	0.521	2146.0	2169.9	23.9	no any change	no any change
34527-26-12	0.522	2171.8	2194.6	22.8	no any change	no any change
Average				22.7	/	



Metal Surface Cleanability

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
 IPC-TM-650 Method 2.3.1.1 Chemical Cleaning of Metal-Clad Laminate
 Customer Technical Requirements

RESULTS

Table 30 Metal Surface Cleanability

Sample Designation	CCL	Sample Identification	TU-933+
Test Date	2022-07-07~2022-07-15	Ambient	28 °C, 50% RH
Sample Number	Test Result		
34527-37-8	The metal cladding on the test specimen shall be cleaned to a uniform matte finish. Deionized or distilled water poured on the metal surface does not bead or form puddles.		
34527-37-9	The metal cladding on the test specimen shall be cleaned to a uniform matte finish. Deionized or distilled water poured on the metal surface does not bead or form puddles.		
34527-37-10	The metal cladding on the test specimen shall be cleaned to a uniform matte finish. Deionized or distilled water poured on the metal surface does not bead or form puddles.		
Requirements	The metal cladding on the test specimen shall be cleaned to a uniform matte finish. Deionized or distilled water poured on the metal surface does not bead or form puddles.		



Pressure Cooker Test

REFERENCE

IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards

IPC-TM 650 2.6.16 Pressure Vessel Method for Glass Epoxy Laminate Integrity
Customer Technical Requirements

RESULTS

Table 31 Pressure Cooker Test

Sample Designation	CCL	Sample Identification	TU-933+
Test Date	2022-07-14	Ambient	25 °C, 50% RH
Sample No.	Test result		
34527-38-1	Grade 5: The sample have no measles, blisters, or surface erosion.		
34527-38-2	Grade 5: The sample have no measles, blisters, or surface erosion.		
34527-38-3	Grade 5: The sample have no measles, blisters, or surface erosion.		
34527-38-4	Grade 5: The sample have no measles, blisters, or surface erosion.		
34527-38-5	Grade 5: The sample have no measles, blisters, or surface erosion.		



Report # 34527ES

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