Report # 46794ES

TEST REPORT SUMMARY

(Short Report)

CLIENT:	IPC INTERNATIONAL INC 3000 Lakeside Drive Suite 105N Bannockburn, IL 60015 Attention: Mr. Randy Cherry Phone: 1-847-597-2806
REFERENCE:	IPC-4101E-WAM1/126, 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:	EM-371(Z)
SPECIFICATION:	IPC-4101E-WAM1/126
TEST RESULTS:	The specimens were tested by the indicated test methods within this report. The actual detailed test results are enclosed.
DATE OF REPORT:	25 June 2025
REPORT No.:	46794E

"INTEGRITY, HONESTY AND KNOWLEDGE"

MICROTEK（CHANGZHOU）PRODUCT SERVICES CO., LTD
NO.19 XINKE ROAD • ELECTRONIC-TECHNOLOGY • CHANGZHOU, JIANGSU, CHINA 213031 •
Tel: 86 519 85487818 •Email: microtek@thetestlab.cn • WWW.THETESTLAB.CN

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 at 1 MHz, 1 GHz	Pass	Pass
Loss Tangent at 1 MHz, 1 GHz	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
Chemical Resistance	Report Only	Report Only
Metal Surfaces Cleanability	--	Report Only
Pressure Cooker Test	--	Report Only

Peel Strength

REFERENCE

Customer Technical Requirement
IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 2.4.8C Peel Strength of Matallic Clad Laminates
IPC-TM-650 2.4.8.3A Peel Strength of Matallic Clad Laminates at Elevated

RESULTS

Table 1 Peel Strength After Thermal StressThin

Sample Designation	CCL		Sample Identification	EM-371 (Z)
Test Date	2025-06-17		Ambient	24 ℃, 55 %RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
46794-2-1	1.63			
46794-2-2	1.63			
46794-2-3		1.65		
46794-2-4		1.68		
46794-2-5			1.64	
46794-2-6			1.68	
46794-2-7				1.66
46794-2-8				1.67
Average	1.63	1.67	1.66	1.66
Requirement	⩾0.80			

Table 2 Peel Strength After Thermal StressThick

Sample Designation	CCL		Sample Identification	EM-371 (Z)
Test Date	2025-06-17		Ambient	24 ℃, 55 %RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
46794-28-1	1.65			
46794-28-2	1.68			
46794-28-3		1.68		
46794-28-4		1.70		
46794-28-5			1.70	
46794-28-6			1.71	
46794-28-7				1.72
46794-28-8				1.74
Average	1.67	1.69	1.71	1.73
Requirement	⩾1.05			

Table 3 Peel StrengthAt Elevated Temperature Thin

Sample Designation	CCL		Sample Identification	EM-371 (Z)
Test Date	2025-06-21		Ambient	23 ℃, 53 %RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
46794-2-9	1.34			
46794-2-10	1.33			
46794-2-11		1.35		
46794-2-12		1.31		
46794-2-13			1.35	
46794-2-14			1.36	
46794-2-15				1.32
46794-2-16				1.33
Average	1.33	1.33	1.36	1.32
Requirement	⩾0.70			

Table 4 Peel Strength At Elevated Temperature Thick

Sample Designation	CCL		Sample Identification	EM-371 (Z)
Test Date	2025-06-21		Ambient	23 ℃, 53 %RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
46794-28-9	1.37			
46794-28-10	1.39			
46794-28-11		1.39		
46794-28-12		1.40		
46794-28-13			1.36	
46794-28-14			1.38	
46794-28-15				1.36
46794-28-16				1.37
Average	1.38	1.39	1.37	1.37
Requirement	⩾0.70			

Table 5 Peel Strength After Process Solution Thin

Sample Designation	CCL		Sample Identification	EM-371 (Z)
Test Date	2025-06-19		Ambient	24 ℃, 55 %RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
46794-3-1	1.68			
46794-3-2	1.68			
46794-3-3		1.70		
46794-3-4		1.69		
46794-3-5			1.69	
46794-3-6			1.68	
46794-3-7				1.72
46794-3-8				1.73
Average	1.68	1.69	1.69	1.72
Requirement	⩾0.55			

Table 6 Peel Strength After Process Solution Thick

Sample Designation	CCL		Sample Identification	EM-371 (Z)
Test Date	2025-06-19		Ambient	24 ℃, 55 %RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
46794-29-1	1.70			
46794-29-2	1.69			
46794-29-3		1.69		
46794-29-4		1.68		
46794-29-5			1.71	
46794-29-6			1.69	
46794-29-7				1.71
46794-29-8				1.75
Average	1.70	1.69	1.70	1.73
Requirement	⩾0.80			

Table 7 Peel Strength Low Profile Copper Foil Thin

Sample Designation	CCL		Sample Identification	EM-371 (Z)
Test Date	2025-06-11~2025-06-12		Ambient	23 ℃, 54 %RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
46794-49-1	1.32			
46794-49-2	1.32			
46794-49-3		1.27		
46794-49-4		1.28		
46794-49-5			1.24	
46794-49-6			1.24	
46794-49-7				1.26
46794-49-8				1.27
Average	1.32	1.28	1.24	1.26

Table 8 Peel Strength Low Profile Copper Foil Thick

Sample Designation	CCL		Sample Identification	EM-371 (Z)
Test Date	2025-06-11~2025-06-12		Ambient	23 ℃, 54 %RH
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Top Lengthwise	Bottom Crosswise	Bottom Lengthwise
46794-52-1	1.28			
46794-52-2	1.28			
46794-52-3		1.29		
46794-52-4		1.29		
46794-52-5			1.33	
46794-52-6			1.31	
46794-52-7				1.30
46794-52-8				1.31
Average	1.28	1.29	1.32	1.31

Report # 46794ES

Volume and Surface Resistivity

REFERENCE

Customer Technical Requirement
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

RESULTS

Table 9 Volume and Surface resistivity Humidity Conditioning Thin

Sample Designation	CCL		Sample Identification	EM-371(Z)	
Test Date	2025-06-19~2025-06-23		Ambient	23 ℃, 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)
46794-8-1	0.0391	2.9E+04	9.1E+06	2.4E+04	3.1E+06
46794-8-2	0.0390	4.6E+04	1.4E+07	3.7E+04	4.9E+06
46794-8-3	0.0393	3.4E+04	1.1E+07	3.8E+04	5.0E+06
Average		/	1.1E+07	/	4.3E+06
Requirement		/	$\geqslant 10^4$	/	$\geqslant 10^6$

Table 10 Volume and Surface Resistivity at Elevated Temperature Humidity Thin

Sample Designation	CCL		Sample Identification	EM-371(Z)	
Test Date	2025-06-23~2025-06-24		Ambient	25 ℃, 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)
46794-9-1	0.0393	7.9E+05	2.5E+08	5.6E+05	7.4E+07
46794-9-2	0.0392	8.7E+05	2.8E+08	6.1E+05	8.0E+07
46794-9-3	0.0395	6.9E+05	2.2E+08	6.0E+05	7.9E+07
Average		/	2.5E+08	/	7.8E+07
Requirement		/	$\geqslant 10^3$	/	$\geqslant 10^3$

Table 11 Volume and Surface Resistivity Humidity Conditioning Thick

Sample Designation	CCL		Sample Identification	EM-371(Z)	
Test Date	2025-06-11~2025-06-18		Ambient	22 °C, 50% 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)
46794-35-1	0.0980	1.2E+05	3.4E+06	3.2E+05	8.4E+07
46794-35-2	0.0977	1.3E+05	3.7E+06	4.0E+05	1.1E+08
46794-35-3	0.0978	9.6E+04	2.7E+06	2.9E+05	7.6E+07
Average		/	3.3E+06	/	8.8E+07
Requirement		/	$\geqslant 10^4$	/	$\geqslant 10^4$

Table 12 Volume and Surface Resistivity at Elevated Temperature Humidity Thick

Sample Designation	CCL		Sample Identification	EM-371(Z)	
Test Date	2025-06-23~2025-06-24		Ambient	25 ℃, 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)
46794-36-1	0.0975	1.6E+06	4.5E+07	5.3E+05	1.4E+08
46794-36-2	0.0970	1.9E+06	5.4E+07	6.3E+05	1.7E+08
46794-36-3	0.0973	2.2E+06	6.1E+07	5.1E+05	1.3E+08
Average		/	5.3E+07	/	1.5E+08
Requirement		/	$\geqslant 10^3$	/	$\geqslant 10^3$

Report # 46794ES

Moisture Absorption

REFERENCE

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

RESULTS

Table 13 Moisture Absorption

Sample Designation	CCL		Sample Identification	EM-371(Z)
Test Date	2025-06-10~2025-06-18		Ambient	25 °C, (51~64)% RH
Sample No.	mass(g)		increasing weight percent of mass(%)	
	m_1	m_2		
46794-26-10	4.9711	4.9783	0.14	
46794-26-11	5.0037	5.0106	0.14	
46794-26-12	4.9996	5.0069	0.15	
Average			0.14	
Requirement			≤0.5	

Report # 46794ES

Dielectric Breakdown

REFERENCE

Customer Technical Requirement
IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 2.5.6B Dielectric Breakdown of Rigid Printed Wiring Material

RESULTS

Table 14 Dielectric Breakdown

Sample Designation		CCL	Sample Identification	EM-371(Z)
Test Date		2025-06-10~2025-06-12	Ambient	22 °C, 52% RH
Sample No.		Thickness (mm)	Voltage (kV)	Minimum Voltage (kV)
46794-38-1	Machine direction	0.966	46.0+N.B	46+N.B
46794-38-2		0.965	46.1+N.B	
46794-38-3	Transverse direction	0.967	46.6+N.B	
46794-38-4		0.967	46.0+N.B	
Requirement				≥40

Report # 46794ES

Permittivity and Loss Tangent

REFERENCE

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

RESULTS

Table 15 Permittivity and Loss Tangent

Sample Designation	CCL		Sample Identification	EM-371(Z)
Test Date	2025-06-10~2025-06-13		Ambient	22 °C, 66% RH
Sample No.	Test Frequency	Sample Thickness (mm)	Permittivity	Loss Tangent
46794-1-1	1 MHz	0.397	4.9	0.011
46794-1-2		0.395	5.0	0.011
46794-1-3		0.398	4.9	0.010
Average		0.397	4.9	0.011
Requirement			≤5.4	≤0.035
46794-26-1	1 MHz	0.969	5.1	0.008
46794-26-2		0.970	5.1	0.009
46794-26-3		0.959	5.1	0.009
Average		0.966	5.1	0.009
Requirement			≤5.4	≤0.035
46794-1-4	1 GHz	0.394	4.7	0.013
46794-1-5		0.396	4.7	0.014
46794-1-6		0.396	4.7	0.013
Average		0.395	4.7	0.013
Requirement			≤5.2	≤0.035
46794-26-4	1 GHz	0.972	4.8	0.011
46794-26-5		0.970	4.9	0.012
46794-26-6		0.975	4.8	0.011
Average		0.972	4.8	0.011
Requirement			≤5.2	≤0.035

Flexural Strength

REFERENCE

Customer Technical Requirement
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)

RESULTS

Table 16 Flexural Strength Test

Sample Designation	CCL		Sample Identification		EM-371 (Z)		
Test Date	2025-06-11		Ambient		23 ℃, 54 %RH		
Sample No.	Span	Load	Width	Thickness	Flexural Strength S	Average	Requirement
	L	P	b	d			
	(mm)	(N)	(mm)	(mm)	(N/mm^2)	(N/mm^2)	(N/mm^2)
46794-31-1 (Length Direction)	25.40	288.474	25.62	0.967	459	457	⩾415
46794-31-2 (Length Direction)		286.974	25.60	0.969	455		
46794-31-3 (Cross Direction)		368.416	25.57	0.972	581	582	⩾345
46794-31-4 (Cross Direction)		367.858	25.52	0.970	584		

Arc Resistance

REFERENCE

Customer Technical Requirement
IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 2.5.1B Arc Resistance of Printed Wiring Material

RESULTS

Table 17 Arc Resistance

Sample Designation		CCL	Sample Identification	EM-371(Z)	
Test Date		2025-06-10~2025-06-12	Ambient	23 °C, 49% RH	
Sample No.		Thickness (mm)	Times (s)	Average (s)	Requirement (s)
46794-10-1	Thin	0.394	171	177	⩾60
46794-10-2		0.394	180		
46794-10-3		0.396	181		
46794-38-6	Thick	0.963	181	181	
46794-38-7		0.966	181		
46794-38-8		0.964	181		

Thermal Stress

REFERENCE

Customer Technical Requirement
IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 2.4.13.1 Thermal Stress of Laminates

RESULTS

Table 18 Thermal Stress

Sample Designation	CCL			Sample Identification	EM-371(Z)
Test Date	2025-06-10			Ambient	25 °C, 53%RH
Sample No.				Test result	
46794-12-1	Etched	Top	Thin	No evidence of blistering, delamination, wrinkling and cracking	
46794-12-2				No evidence of blistering, delamination, wrinkling and cracking	
46794-12-3				No evidence of blistering, delamination, wrinkling and cracking	
46794-12-4		Bottom		No evidence of blistering, delamination, wrinkling and cracking	
46794-12-5				No evidence of blistering, delamination, wrinkling and cracking	
46794-12-6				No evidence of blistering, delamination, wrinkling and cracking	
46794-15-1	Unetched	Top		No evidence of blistering, delamination, wrinkling and cracking	
46794-15-2				No evidence of blistering, delamination, wrinkling and cracking	
46794-15-3				No evidence of blistering, delamination, wrinkling and cracking	
46794-15-4		Bottom		No evidence of blistering, delamination, wrinkling and cracking	
46794-15-5				No evidence of blistering, delamination, wrinkling and cracking	
46794-15-6				No evidence of blistering, delamination, wrinkling and cracking	
46794-40-1	Etched	Top	Thick	No evidence of blistering, delamination, wrinkling and cracking	
46794-40-2				No evidence of blistering, delamination, wrinkling and cracking	
46794-40-3				No evidence of blistering, delamination, wrinkling and cracking	
46794-40-4		Bottom		No evidence of blistering, delamination, wrinkling and cracking	
46794-40-5				No evidence of blistering, delamination, wrinkling and cracking	
46794-40-6				No evidence of blistering, delamination, wrinkling and cracking	
46794-44-1	Unetched	Top		No evidence of blistering, delamination, wrinkling and cracking	
46794-44-2				No evidence of blistering, delamination, wrinkling and cracking	
46794-44-3				No evidence of blistering, delamination, wrinkling and cracking	
46794-44-4		Bottom		No evidence of blistering, delamination, wrinkling and cracking	
46794-44-5				No evidence of blistering, delamination, wrinkling and cracking	
46794-44-6				No evidence of blistering, delamination, wrinkling and cracking	

Electric Strength

REFERENCE

Customer Technical Requirement
IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 2.5.6.2A Electric Strength of Printed Wiring Material

RESULTS

Table 19 Electric Strength

Sample Designation	CCL	Sample Identification	EM-371(Z)
Test Date	2025-06-10~2025-06-12	Ambient	22 °C, 52% RH
Sample No.	Average Thickness (mm)	Voltage (kV)	Electric Strength (kV/mm)
46794-12-7	0.394	14.78	37.51
46794-12-8	0.395	15.00	37.97
46794-12-9	0.392	14.74	37.60
Average			38
Requirement			≥30

Report # 46794ES

Vertical Burning Test

REFERENCE

Customer Technical Requirement
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

RESULTS

Table 20 Vertical Burning Test Thin

Sample Designation		CCL			Sample Identification		EM-371(Z)		
Test Date		2025-06-10~2025-06-17			Ambient		22 °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: 48 Hours (23±2) °C (50±10)% RH	46794-11-1	0.391	1	0	0	1	0	No	No
	46794-11-2	0.390	1	0	0	1	0	No	No
	46794-11-3	0.389	0	0	0	0	0	No	No
	46794-11-4	0.391	0	0	0	0	0	No	No
	46794-11-5	0.391	0	0	0	0	0	No	No
	Avg:	**0.390**	**Max: 1**			**Sum: 2**	**Max: 0**	**Pass**	**Pass**
Condition B: 24 Hours (125±2) °C	46794-11-6	0.389	0	0	0	0	0	No	No
	46794-11-7	0.390	0	0	0	0	0	No	No
	46794-11-8	0.391	0	0	0	0	0	No	No
	46794-11-9	0.391	0	0	0	0	0	No	No
	46794-11-10	0.390	0	0	0	0	0	No	No
	Avg:	**0.390**	**Max: 0**			**Sum: 0**	**Max: 0**	**Pass**	**Pass**
Results	V-0								
Requirement	V-0								

Table 21 Vertical Burning Test Thick

Sample Designation		CCL			Sample Identification		EM-371(Z)		
Test Date		2025-06-10~2025-06-17			Ambient		22 °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: 48 Hours (23±2) °C (50±10)% RH	46794-37-1	0.965	0	0	0	0	0	No	No
	46794-37-2	0.963	1	0	0	1	0	No	No
	46794-37-3	0.968	0	0	0	0	0	No	No
	46794-37-4	0.969	0	0	0	0	0	No	No
	46794-37-5	0.968	0	0	0	0	0	No	No
	Avg:	**0.967**	**Max: 1**			**Sum: 1**	**Max: 0**	**Pass**	**Pass**
Condition B: 24 Hours (125±2) °C	46794-37-6	0.971	1	0	0	1	0	No	No
	46794-37-7	0.969	3	0	0	3	0	No	No
	46794-37-8	0.968	1	0	0	1	0	No	No
	46794-37-9	0.966	0	3	0	3	3	No	No
	46794-37-10	0.966	0	0	0	0	0	No	No
	Avg:	**0.968**	**Max: 3**			**Sum: 8**	**Max: 3**	**Pass**	**Pass**
Results	V-0								
Requirement	V-0								

Glass Transition Temperature

REFERENCE

Customer Technical Requirement
IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 2.4.25D Glass Transition Temperature and Cure Factor by DSC

RESULTS

Table 22 Glass Transition Temperature

Sample Designation	CCL	Sample Identification	EM-371(Z)
Test Date	2025-06-13~2025-06-16	Ambient	25 ℃, 66% RH
Sample Number	46794-27-1		
Element	Measurement (℃)		Requirement
Tg1	188.56		≥170
Tg2	194.45		/
Cure Factor △Tg	5.89		/

Decomposition Temperature

REFERENCE

Customer Technical Requirement
IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 2.4.24.6 Decomposition Temperature (Td) of Laminate Material Using TGA

RESULTS

Table 23 Decomposition Temperature

Sample Designation	CCL	**Sample Identification**	EM-371(Z)
Test Date	2025-06-17~2025-06-19	**Ambient**	25 ℃, 58% RH
Sample Number	**Decomposition temperature (℃)**		
	mass loss at 5%		
46794-26-7	360.56		
Requirement	≥340		

Z-Axis CTE (TMA)

REFERENCE

Customer Technical Requirement
IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 2.4.24C Glass Transition Temperature and Z-Axis Thermal Expansion by TMA

RESULTS

Table 24 Z-Axis CTE（TMA）

Sample Designation	CCL		Sample Identification	EM-371(Z)	
Test Date	2025-06-15~2025-06-16		Ambient	25 ℃, 66% RH	
Sample Number	Z-CTE(μm/m·℃)			PTE（%）	Tg(℃)
	(50~100)℃	(220~260)℃	(50~260)℃	(50~260)℃	
46794-26-8	34.70	176.1	84.95	1.78	184.44
46794-26-9	33.08	166.5	81.30	1.71	184.47
Requirement	≤60	≤300	/	≤3.0	≥170

Time to Delamination

REFERENCE

Customer Technical Requirement
IPC-4101E-WAM1 Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 2.4.24.1 Time to Delamination (TMA Method)

RESULTS

Table 25 Time to Delamination

Sample Designation	CCL	Sample Identification	EM-371(E)	
Test Date	2025-06-14~2025-06-15	Ambient	25 ℃, 64% RH	
Sample No.	Test Item	Time of Reversible Event (min)	Time of Delaminate (min)	Requirement (min)
46794-27-2	T260	/	＞30	⩾30
46794-27-3		/	＞30	
46794-27-4	T288	/	＞15	⩾15
46794-27-5		/	＞15	
46794-27-6	T300	/	＞2	⩾2
46794-27-7		/	＞2	

Report # 46794ES

Dimensional Stability

REFERENCES

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

RESULTS

Table 26 Dimensional Stability Thin

Sample Designation	CCL		Sample Identification		EM-371 (Z)			
Test Date	2025-05-30~2025-06-18		Ambient		24 ℃, (51~53)% RH			
Sample No.	After Bake Process (ppm)				After Thermal Stress Process (ppm)			
	MD		TD		MD		TD	
46794-5	153	270	208	114	81	246	185	91
46794-6	185	220	134	118	129	159	79	36
46794-7	149	173	138	205	105	173	122	138
Average	192		153		149		108	
Requirement	-300~300							

Table 27 Dimensional Stability Thick

Sample Designation	CCL		Sample Identification		EM-371 (Z)			
Test Date	2025-05-30~2025-06-18		Ambient		24 ℃, (51~53)% RH			
Sample No.	After Bake Process (ppm)				After Thermal Stress Process (ppm)			
	MD		TD		MD		TD	
46794-32	157	177	161	138	173	76	63	59
46794-33	133	129	153	189	121	76	35	63
46794-34	197	149	169	213	165	113	75	99
Average	157		171		121		66	
Requirement	-300~300							

Report # 46794ES

Solderability

REFERENCE

Customer Technical Requirement
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

RESULTS

Table 28 Solderability Thin

Sample Designation	/	Sample Identification	/
Test Date	/	Ambient	/
Sample No.	Test result		
No Requirement			

Table 29 Solderability Thick

Sample Designation	CCL	Sample Identification	EM-371(Z)
Test Date	2025-06-04	Ambient	25 °C, 51% RH
Sample No.	Test result		
46794-43-1	Sample surface exhibits good wetting		
46794-43-2	Sample surface exhibits good wetting		
46794-43-3	Sample surface exhibits good wetting		

Report # 46794ES

Chemical Resistance

REFERENCE

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

RESULTS

Table 30 Chemical Resistance

Sample Designation	CCL			Sample Identification	EM-371(Z)	
Test Date	2025-06-23			Ambient	25 °C, 52% 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
46794-1-7	0.392	1992.8	1998.6	5.8	no any change	no any change
46794-1-8	0.390	1983.1	1992.1	9.0	no any change	no any change
46794-1-9	0.395	1997.2	2005.8	8.6	no any change	no any change
Average				7.8	/	
46794-26-10	0.963	4968.2	4980.9	12.7	no any change	no any change
46794-26-11	0.959	5000.6	5013.5	12.9	no any change	no any change
46794-26-12	0.962	4996.6	5008.2	11.6	no any change	no any change
Average				12.4	/	

Report # 46794ES

Metal Surface Cleanablility

REFERENCE

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

RESULTS

Table 31 Metal Surface Cleanability

Sample Designation	CCL	Sample Identification	EM-371(Z)
Test Date	2025-06-23~2025-06-24	Ambient	20 °C, 50% RH
Sample Number	Test Result		
46794-27-1	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.		
46794-27-2	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.		
46794-27-3	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.		

Report # 46794ES

Pressure Cooker Test

REFERENCE

Customer Technical Requirement
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

RESULTS

Table 32 Pressure Cooker Test

Sample Designation	CCL	Sample Identification	EM-371(Z)
Test Date	2025-06-23	Ambient	23 °C, 52% RH
Sample No.	Test result		
46794-39-1	Grade 5: The sample have no measles, blisters, or surface erosion.		
46794-39-2	Grade 5: The sample have no measles, blisters, or surface erosion.		
46794-39-3	Grade 5: The sample have no measles, blisters, or surface erosion.		
46794-39-4	Grade 5: The sample have no measles, blisters, or surface erosion.		
46794-39-5	Grade 5: The sample have no measles, blisters, or surface erosion.		

Report # 46794ES

CERTIFICATE OF CONFORMANCE

Microtek (Changzhou) Laboratories certifies that the test equipment used complies with the calibration requirements of correlation criterion and that the data contained in this report is accurate within the tolerance limitation of this equipment.

The test report is invalid without the signature of the approver and the stamp of "Special Seal for Test Report". This report has been CA certified, and will be invalid if altered or tampered with. The partial replication of it is invalid, too.

The authenticity of report should be subject to its authorized electronic report that has been CA certified. The test results in this report are only responsible for the tested samples.

The report shall not be reproduced, except in full, without the written approval of Microtek (Changzhou) Laboratories.

Thank you for selecting Microtek (Changzhou) Laboratories for your testing requirements.

Edited by:	Reviewed by:	Approved by:
Liu Dengping	Celina Gu	Jesse Yan
Liu Dengping	Celina Gu	Jesse Yan
Date: 2025-06-25	Date: 2025-06-26	Date: 2025-06-26