



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/140, IPC-TM-650 2.4.8C, 2.4.8.3A, 2.5.17.1A, 2.6.2.1A,
2.5.6B, 2.5.5.9, 2.4.4B, 2.5.1B, 2.4.13.1, 2.5.6.2A, 2.4.25D, 2.4.24.6,
2.4.24C, 2.4.24.1, 2.3.41, 2.4.39A, 2.3.4.2, 2.3.1.1, 2.6.16, UL94, IPC
J-STD-003C, Customer Technical Requirement

TEST ITEM: Peel Strength, Volume Resistivity, Surface Resistivity, Moisture
Absorption, Dielectric Breakdown, Permittivity at 1 MHz, Loss
Tangent at 1 MHz, Flexural Strength, Arc Resistance, Thermal Stress,
Electric Strength, Vertical Burning Test, Glass Transition Temperature
and Cure Factor (DSC), Decomposition Temperature (Td), Z-CTE
(TMA), Time to Delamination (T260,T288,T300), Halogen Content,
Dimensional Stability, Solderability, Chemical Resistance, Metal
Surfaces Cleanability, Pressure Cooker Test

SAMPLE: CCL

TEST MATERIAL: IS550H

SPECIFICATION: IPC-4101E/140

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

DATE OF REPORT: 14 May 2021

REPORT No: 29694E



"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 Test	Pass	Pass
Glass Transition Temperature and Cure Factor (DSC)	--	Pass
Decomposition Temperature (Td)	--	Pass
Z-CTE (TMA)	--	Pass
Time to Delamination (T260,T288,T300)	--	Pass
Halogen Content	Pass	Pass
Dimensional Stability	Pass	Pass
Solderability	Pass	Pass
Chemical Resistance	Report Only	Report Only
Metal Surfaces Cleanability	Report Only	Report Only
Pressure Cooker Test	--	Report Only



Peel Strength

REFERENCE

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

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

RESULTS

Table 1 Peel Strength Thin (After Thermal Stress)

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-05-03	Ambient	24°C, 49%RH	
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Bottom Lengthwise	Top Crosswise	Bottom Lengthwise
29694-2-1	1.03			
29694-2-2	1.01			
29694-2-3		1.12		
29694-2-4		1.09		
29694-2-5			1.04	
29694-2-6			1.01	
29694-2-7				1.08
29694-2-8				1.15
Average	1.02	1.11	1.03	1.11
Requirement	≥0.80			

Table 2 Peel Strength Thick (After Thermal Stress)

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-05-03	Ambient	24°C, 49%RH	
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Bottom Lengthwise	Top Crosswise	Bottom Lengthwise
29694-4-1	1.47			
29694-4-2	1.49			
29694-4-3		1.47		
29694-4-4		1.50		
29694-4-5			1.49	
29694-4-6			1.49	
29694-4-7				1.66
29694-4-8				1.63
Average	1.48	1.48	1.49	1.64
Requirement	≥1.05			

**Table 3 Peel Strength Thin (At Elevated Temperature)**

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-05-06	Ambient	24°C, 49%RH	
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Bottom Lengthwise	Top Crosswise	Bottom Lengthwise
29694-2-9	1.04			
29694-2-10	1.03			
29694-2-11		1.09		
29694-2-12		1.06		
29694-2-13			1.08	
29694-2-14			1.06	
29694-2-15				1.09
29694-2-16				1.07
Average	1.03	1.07	1.07	1.08
Requirement	≥0.70			

Table 4 Peel Strength Thick (At Elevated Temperature)

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-05-06	Ambient	24°C, 49%RH	
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Bottom Lengthwise	Top Crosswise	Bottom Lengthwise
29694-4-9	1.33			
29694-4-10	1.31			
29694-4-11		1.34		
29694-4-12		1.35		
29694-4-13			1.37	
29694-4-14			1.37	
29694-4-15				1.45
29694-4-16				1.46
Average	1.32	1.34	1.37	1.46
Requirement	≥0.70			

**Table 5 Peel Strength Thin (After Process Solutions)**

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-05-07	Ambient	24°C, 48%RH	
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Bottom Lengthwise	Top Crosswise	Bottom Lengthwise
29694-2-17	1.20			
29694-2-18	1.18			
29694-2-19		1.24		
29694-2-20		1.20		
29694-2-21			1.11	
29694-2-22			1.09	
29694-2-23				1.22
29694-2-24				1.15
Average	1.19	1.22	1.10	1.18
Requirement	≥0.55			

Table 6 Peel Strength Thick (After Process Solutions)

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-05-07	Ambient	24°C, 48%RH	
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Bottom Lengthwise	Top Crosswise	Bottom Lengthwise
29694-4-17	1.42			
29694-4-18	1.45			
29694-4-19		1.55		
29694-4-20		1.55		
29694-4-21			1.66	
29694-4-22			1.68	
29694-4-23				1.74
29694-4-24				1.77
Average	1.44	1.55	1.67	1.76
Requirement	≥0.55			

**Table 7 Peel Strength Thin (Low Profile Copper Foil)**

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-05-03	Ambient	24°C, 49%RH	
Sample No.	Peel Strength (N/mm)			
	Top Lengthwise	Bottom Crosswise	Top Lengthwise	Bottom Crosswise
29694-1-1	1.05			
29694-1-2	0.98			
29694-1-3		0.98		
29694-1-4		1.02		
29694-1-5			1.10	
29694-1-6			1.08	
29694-1-7				1.05
29694-1-8				1.07
Average	1.02	1.00	1.09	1.06
Requirement	≥0.70			

Table 8 Peel Strength Thick (Low Profile Copper Foil)

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-05-03	Ambient	24°C, 49%RH	
Sample No.	Peel Strength (N/mm)			
	Top Crosswise	Bottom Lengthwise	Top Crosswise	Bottom Lengthwise
29694-3-1	1.28			
29694-3-2	1.26			
29694-3-3		1.31		
29694-3-4		1.31		
29694-3-5			1.27	
29694-3-6			1.27	
29694-3-7				1.28
29694-3-8				1.30
Average	1.27	1.31	1.27	1.29
Requirement	≥0.70			



Volume and Surface Resistivity

REFERENCE

IPC-4101E 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 Thin (Humidity Conditioning: 96h)

Sample Designation	CCL		Sample Identification	IS550H	
Test Date	2021-05-02~2021-05-06		Ambient	(23~24) °C, (48~51)% 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)
29694-8-1	0.0135	6.0E+04	1.9E+07	3.0E+05	1.1E+08
29694-8-2	0.0137	5.4E+04	1.7E+07	3.6E+05	1.4E+08
29694-8-3	0.0136	5.8E+04	1.9E+07	3.4E+05	1.3E+08
Average		/	1.8E+07	/	1.3E+08
Requirement		/	$\geq 10^4$	/	$\geq 10^6$

Table 10 Volume and Surface resistivity Thick (Humidity Conditioning: 160 h)

Sample Designation	CCL		Sample Identification	IS550H	
Test Date	2021-04-29~2021-05-06		Ambient	(23~24) °C, (48~51)% RH	
Sample No.	Average Thickness T	Surface Resistance R'	Surface Resistivity $r'=RP/D_4$	Volume Resistance R	Volume Resistivity $r=RA/T$
	(cm)	(MΩ)	(MΩ)	(MΩ)	(MΩ·cm)
29694-20-1	0.0817	4.0E+05	1.1E+07	4.0E+05	1.3E+08
29694-20-2	0.0819	3.6E+05	1.0E+07	3.6E+05	1.1E+08
29694-20-3	0.0821	2.7E+05	7.6E+06	3.0E+05	9.4E+07
Average		/	9.7E+06	/	1.1E+08
Requirement		/	$\geq 10^4$	/	$\geq 10^4$



Table 11 Volume and Surface resistivity Thin (At Elevated Temperature)

Sample Designation	CCL		Sample Identification	IS550H	
Test Date	2021-04-28~2021-04-29		Ambient	(23~25) °C, (47~48)% RH	
Sample No.	Average Thickness T	Surface Resistance R'	Surface Resistivity $r'=RP/D_4$	Volume Resistance R	Volume Resistivity $r=RA/T$
	(cm)	(MΩ)	(MΩ)	(MΩ)	(MΩ·cm)
29694-9-1	0.0138	2.5E+06	8.1E+08	4.0E+06	1.5E+09
29694-9-2	0.0139	3.0E+06	9.7E+08	4.8E+06	1.8E+09
29694-9-3	0.0137	2.8E+06	9.0E+08	5.0E+06	1.9E+09
Average		/	8.9E+08	/	1.7E+09
Requirement		/	$\geq 10^3$	/	$\geq 10^3$

Table 12 Volume and Surface resistivity Thick (At Elevated Temperature)

Sample Designation	CCL		Sample Identification	IS550H	
Test Date	2021-04-28~2021-04-29		Ambient	(23~25) °C, (47~48)% RH	
Sample No.	Average Thickness T	Surface Resistance R'	Surface Resistivity $r'=RP/D_4$	Volume Resistance R	Volume Resistivity $r=RA/T$
	(cm)	(MΩ)	(MΩ)	(MΩ)	(MΩ·cm)
29694-21-1	0.0823	4.6E+06	1.3E+08	5.2E+06	1.6E+09
29694-21-2	0.0819	5.0E+06	1.4E+08	4.8E+06	1.5E+09
29694-21-3	0.0820	5.4E+06	1.5E+08	5.6E+06	1.8E+09
Average		/	1.4E+08	/	1.6E+09
Requirement		/	$\geq 10^3$	/	$\geq 10^3$



Moisture Absorption

REFERENCE

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

RESULTS

Table 13 Moisture Absorption Thick

Sample Designation	CCL		Sample Identification	IS550H
Test Date	2021-04-28~2021-04-29		Ambient	(23~24)°C, (49~57)% RH
Sample No.	mass(g)		increasing weight percent of mass(%)	
	m ₁	m ₂		
29694-25-1	3.9337	3.9391	0.14	
29694-25-2	3.9128	3.9181	0.14	
29694-25-3	3.9428	3.9482	0.14	
Average			0.14	
Requirement			≤0.8	



Dielectric Breakdown

REFERENCE

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

RESULTS

Table 14 Dielectric Breakdown Thick

Sample Designation		CCL	Sample Identification	IS550H
Test Date		2021-04-28~2021-04-30	Ambient	25 °C, 60% RH
Sample No.		Thickness (mm)	Voltage (kV)	Minimum Voltage (kV)
29694-22-1	Machine direction	0.814	43.2+N.B	43+N.B
29694-22-2		0.815	42.9+N.B	
29694-22-3	Transverse direction	0.817	43.1+N.B	
29694-22-4		0.814	42.8+N.B	
Requirement				≥40



Permittivity and Loss Tangent

REFERENCE

IPC-TM-650 Method 2.5.5.9 Permittivity and Loss Tangent, Parallel Plate, 1MHz to 1.5 GHz

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

RESULTS

Table15 Permittivity and Loss Tangent

Sample Designation	CCL		Sample Identification	IS550H
Test Date	2021-04-28~2021-04-29		Ambient	25 °C, 50% RH
Sanple No.	Test Frequency	Thickness(mm)	Permittivity	Loss Tangent
29694-13-1	1MHz	0.136	3.9	0.010
29694-13-2		0.136	4.0	0.010
29694-13-3		0.137	4.0	0.010
Average			4.0	0.010
Requirement			≤5.6	≤0.035
29694-25-4	1MHz	0.806	4.9	0.007
29694-25-5		0.804	4.8	0.007
29694-25-6		0.805	4.8	0.007
Average			4.8	0.007
Requirement			≤5.6	≤0.035



Flexural Strength

REFERENCE

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

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

RESULTS

Table 16 Flexural Strength Test

Sample Designation	CCL		Sample Identification		IS550H		
Test Date	2021-04-29		Ambient		23°C, 48%RH		
Sample No.	Span	Width	Thickness	Load	Flexural Strength $S=3PL/2bd^2$	Average	Requirement
	L	b	d	P			
	(mm)	(mm)	(mm)	(N)			
29694-25-32 (Cross Direction)	15.90	25.75	0.819	304.943	421	420	≥345
29694-25-33 (Cross Direction)		25.40	0.818	298.622	419		
29694-25-34 (Length Direction)		25.67	0.815	408.897	572	572	≥415
29694-25-35 (Length Direction)		25.48	0.816	407.524	573		



Arc Resistance

REFERENCE

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

RESULTS

Table 17 Arc Resistance Thin

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-04-28~2021-04-30	Ambient	25 °C, 49% RH	
Sample No.	Thickness	Times	Average	Requirement
	(mm)	(s)	(s)	(s)
29694-11-1	0.138	181	181	≥60
29694-11-2	0.136	181		
29694-11-3	0.137	181		

Table 18 Arc Resistance Thick

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-04-28~2021-04-30	Ambient	25 °C, 49% RH	
Sample No.	Thickness	Times	Average	Requirement
	(mm)	(s)	(s)	(s)
29694-22-5	0.814	185	185	≥60
29694-22-6	0.813	184		
29694-22-7	0.811	185		



Thermal Stress

REFERENCE

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

RESULTS

Table19 Thermal Stress Thin

Sample Designation	CCL	Sample Identification	IS550H
Test Date	2021-04-28	Ambient	25 °C, 49% RH
Sample No.	Sample Description	Test result	
29694-14-17	Top etched	No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-18		No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-19		No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-20	Bottom etched	No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-21		No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-22		No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-11	Top unetched	No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-12		No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-13		No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-14	Bottom unetched	No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-15		No evidence of blistering, delamination, wrinkling and cracking.	
29694-14-16		No evidence of blistering, delamination, wrinkling and cracking.	
Requirement		No evidence of blistering, delamination, wrinkling and cracking.	



Table20 Thermal Stress Thick

Sample Designation	CCL	Sample Identification	IS550H
Test Date	2021-04-28	Ambient	25 °C, 49% RH
Sample No.	Sample Description	Test result	
29694-22-21	Top etched	No evidence of blistering, delamination, wrinkling and cracking.	
29694-22-22		No evidence of blistering, delamination, wrinkling and cracking.	
29694-22-23		No evidence of blistering, delamination, wrinkling and cracking.	
29694-22-24		No evidence of blistering, delamination, wrinkling and cracking.	
29694-22-25	Bottom etched	No evidence of blistering, delamination, wrinkling and cracking.	
29694-22-26		No evidence of blistering, delamination, wrinkling and cracking.	
29694-26-1	Top unetched	No evidence of blistering, delamination, wrinkling and cracking.	
29694-26-2		No evidence of blistering, delamination, wrinkling and cracking.	
29694-26-3		No evidence of blistering, delamination, wrinkling and cracking.	
29694-26-4	Bottom unetched	No evidence of blistering, delamination, wrinkling and cracking.	
29694-26-5		No evidence of blistering, delamination, wrinkling and cracking.	
29694-26-6		No evidence of blistering, delamination, wrinkling and cracking.	
Requirement		No evidence of blistering, delamination, wrinkling and cracking.	



Electric Strength

REFERENCE

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

RESULTS

Table 21 Electric Strength

Sample Designation	CCL	Sample Identification	IS550H
Test Date	2021-04-28~2021-04-30	Ambient	25 °C, 60% RH
Sample No.	Average Thickness (mm)	Voltage (kV)	Electric Strength (kV/mm)
29694-30-1	0.198	10.6	53.54
29694-30-2	0.199	10.7	53.77
29694-30-3	0.201	10.8	53.73
Average			54
Requirement			≥30



Vertical Burning Test; V-0, V-1 or V-2

REFERENCE

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

RESULTS

Table 22 Vertical Burning Test Thin

Sample Designation		CCL		Sample Identification			IS550H		
Test Date		2021-04-28~2021-05-06		Ambient			23 °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:	29694-10-11	0.137	0	0	0	0	0	No	No
48 Hours	29694-10-12	0.139	0	0	0	0	0	No	No
(23±2) °C	29694-10-13	0.138	0	0	0	0	0	No	No
(50±5)% RH	29694-10-14	0.136	0	0	0	0	0	No	No
	29694-10-15	0.137	0	0	0	0	0	No	No
	Avg:	0.137	Max: 0			Sum: 0	Max: 0	Pass	Pass
Condition B:	29694-10-16	0.138	0	0	0	0	0	No	No
24 Hours	29694-10-17	0.137	0	0	0	0	0	No	No
(125±2) °C	29694-10-18	0.136	0	0	0	0	0	No	No
	29694-10-19	0.135	0	0	0	0	0	No	No
Results	29694-10-20	0.137	0	0	0	0	0	No	No
V-0	Avg:	0.137	Max: 0			Sum: 0	Max: 0	Pass	Pass
Requirement	V-0								



Table 23 Vertical Burning Test Thick

Sample Designation		CCL		Sample Identification			IS550H		
Test Date		2021-04-28~2021-05-06		Ambient			23 °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:	29694-22-31	0.809	3	0	0	3	0	No	No
48 Hours	29694-22-32	0.811	2	0	0	2	0	No	No
(23±2) °C	29694-22-33	0.812	3	0	0	3	0	No	No
(50±5)% RH	29694-22-34	0.814	2	0	0	2	0	No	No
	29694-22-35	0.815	2	0	0	2	0	No	No
	Avg:	0.812	Max: 3			Sum: 12	Max: 0	Pass	Pass
Condition B:	29694-22-36	0.805	0	4	0	4	4	No	No
24 Hours	29694-22-37	0.809	6	0	0	6	0	No	No
(125±2) °C	29694-22-38	0.814	2	2	0	4	2	No	No
	29694-22-39	0.812	3	0	0	3	0	No	No
Results	29694-22-40	0.809	4	0	0	4	0	No	No
V-0	Avg:	0.810	Max: 6			Sum: 21	Max: 4	Pass	Pass
Requirement	V-0								



Glass Transition Temperature and Cure Factor (DSC)

REFERENCE

IPC-4101E 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 24 Glass Transition Temperature And Cure Factor (DSC)

Sample Designation	CCL	Sample Identification	IS550H
Test Date	2021-05-12	Ambient	26 °C, 55% RH
Sample No.	29694-27-1		
Element	Measurement (°C)		Requirement
Tg1	200.55		≥170
Tg2	201.22		
Cure Factor ΔT_g	0.67		/



Decomposition Temperature (Td)

REFERENCE

IPC-4101E 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

RESULTS

Table 25 Decomposition Temperature (Td)

Sample Designation:	CCL	Sample Identification	IS550H
Test Date:	2021-04-28~2021-04-29	Ambient:	24 °C, 49% RH
Sample Number	Decomposition temperature (°C)		
	mass loss at 2%	mass loss at 5%	
29694-25-7	374.09	410.08	
Requirement	/	≥340	

**Z-CTE (TMA)****REFERENCE**

IPC-4101E 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

RESULTS**Table 26 Z-CTE (TMA)**

Sample Designation	CCL		Sample Identification	IS550H
Test Date	2021-05-06		Ambient	23 °C, 50% RH
Sample Number	Z-CTE(ppm/°C)			PTE (%)
	(50~100)°C	(210~260)°C	(50~260)°C	(50~260)°C
29694-31-1	41.68	226.8	112.6	2.36
29694-31-2	41.55	227.6	113.8	2.39
Requirement	≤60	≤300	/	≤3.0



Time to Delamination

REFERENCE

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

RESULTS

Table 27 Time to Delamination

Sample Designation	CCL	Sample Identification	IS550H	
Test Date	2021-04-29~2021-04-30	Ambient	25 °C, 50% RH	
Sample No.	Test Item	Time of Reversible Event (min)	Time of Delaminate (min)	Requirement
29694-25-8	T260	/	>30	≥30
29694-25-9		/	>30	
29694-25-10	T288	/	>5	≥5
29694-25-11		/	>5	
29694-25-12	T300	/	>2	≥2
29694-25-13		/	>2	



Halogen Content

REFERENCE

IPC-4101E Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC-TM-650 method 2.3.41 Test Method for Total Halogen Content in Base Materials

RESULTS

Table 28 Halogen Content Thin

Sample Designation	CCL	Sample Identification	IS550H
Test Date	2021-04-28	Ambient	23 °C, 50% RH
Sample No.	Halogen Content (ppm)		
	Cl ⁻	Br ⁻	Cl ⁻ +Br ⁻
29694-13-4	463	N.D	463
29694-13-5	451	N.D	451
29694-13-6	450	N.D	450
29694-13-7	446	N.D	446
29694-13-8	437	N.D	437
Average	449	N.D	449
Requirement	≤900	≤900	≤1500

Table 29 Halogen Content Thick

Sample Designation	CCL	Sample Identification	IS550H
Test Date	2021-04-28	Ambient	23 °C, 50% RH
Sample No.	Halogen Content (ppm)		
	Cl ⁻	Br ⁻	Cl ⁻ +Br ⁻
29694-25-14	553	N.D	553
29694-25-15	532	N.D	532
29694-25-16	588	N.D	588
29694-25-17	550	N.D	550
29694-25-18	532	N.D	532
Average	551	N.D	551
Requirement	≤900	≤900	≤1500



Dimensional Stability

REFERENCES

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

RESULTS

Table 30 Dimensional Stability Thin

Sample Designation	CCL				Sample Identification	IS550H			
Test Date	2021-04-27~2021-04-30				Ambient	(22~23)°C, (48~51)% RH			
Sample No.	After Bake Process (ppm)				After Thermal Stress Process (ppm)				
	MD		TD		MD		TD		
29694-5	-174	-130	-114	-217	-262	-206	-169	-265	
29694-6	-193	-153	-138	-102	-217	-245	-236	-256	
29694-7	-104	-125	-110	-114	-265	-226	-224	-205	
Requirement	-300~300								

Table 31 Dimensional Stability Thick

Sample Designation	CCL				Sample Identification	IS550H			
Test Date	2021-04-27~2021-04-30				Ambient	(22~23)°C, (48~51)% RH			
Sample No.	After Bake Process (ppm)				After Thermal Stress Process (ppm)				
	MD		TD		MD		TD		
29694-17	64	4	71	-4	40	-32	47	-23	
29694-18	-4	32	59	-91	-57	-65	8	-55	
29694-19	69	24	55	63	24	8	8	-28	
Requirement	-300~300								



Solderability (Edge Dip Test)

REFERENCE

IPC-4101E Specification for Base Materials for Rigid and Multilayer Printed Boards
IPC J-STD-003C 4.2.1 Edge Dip Test

RESULTS

Table 32 Solderability (Edge Dip Test)

Sample Designation	CCL	Sample Identification	See the table below
Test Date	2021-04-29	Ambient	25 °C, 47% RH
Sample No.	Sample Identification	Test result	
29694-14-1	IS550H (Thin)	Sample surface exhibits good wetting	
29694-14-2		Sample surface exhibits good wetting	
29694-14-3		Sample surface exhibits good wetting	
29694-26-7	IS550H (Thick)	Sample surface exhibits good wetting	
29694-26-8		Sample surface exhibits good wetting	
29694-26-9		Sample surface exhibits good wetting	



Chemical Resistance

REFERENCE

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

RESULTS

Table 33 Chemical Resistance

Sample Designation	CCL		Sample Identification	IS550H		
Test Date	2021-05-06		Ambient	23 °C, 50% 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
29694-13-9	0.134	606.2	607.2	1.0	no any change	no any change
29694-13-10	0.136	612.2	613.1	0.9	no any change	no any change
29694-13-11	0.136	608.4	609.5	1.1	no any change	no any change
Average				1.0	/	
29694-25-19	0.81	3944.7	3946.5	1.8	no any change	no any change
29694-25-20	0.811	3958.2	3960.2	2.0	no any change	no any change
29694-25-21	0.812	3942.5	3944.5	2.0	no any change	no any change
Average				1.9	/	



Metal Surface Cleanability

REFERENCE

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

RESULTS

Table 34 Metal Surface Cleanability Thin

Sample Designation	CCL	Sample Identification	IS550H
Test Date	2021-05-07	Ambient	26 °C, 51% RH
Sample Number	Test Result		
29694-13-12	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.		
29694-13-13	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.		
29694-13-14	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.		

Table 35 Metal Surface Cleanability Thick

Sample Designation	CCL	Sample Identification	IS550H
Test Date	2021-05-07	Ambient	26 °C, 51% RH
Sample Number	Test Result		
29694-27-2	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.		
29694-27-3	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.		
29694-27-4	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 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 36 Pressure Cooker Test

Sample Designation	CCL	Sample Identification	IS550H
Test Date	2021-04-30	Ambient	24 °C, 49% RH
Sample No.	Test result		
29694-24-1	Grade 5: The sample have no measles, blisters, or surface erosion.		
29694-24-2	Grade 5: The sample have no measles, blisters, or surface erosion.		
29694-24-3	Grade 5: The sample have no measles, blisters, or surface erosion.		
29694-24-4	Grade 5: The sample have no measles, blisters, or surface erosion.		
29694-24-5	Grade 5: The sample have no measles, blisters, or surface erosion.		

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