CSP Requirements Being Addressed by IPC Flexible Circuits Standards

IPC International Symposium on Flexible Circuits and Chip Scale Packaging
Oct. 28, 2004

Thomas F. Gardeski

Global Technical Representative

DuPont Electronics and Communications Technologies

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

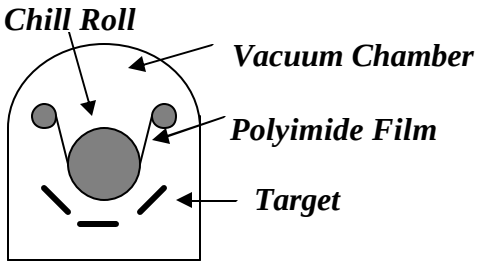
IPC - FC - 4204
Flexible Metal Clad Dielectrics for Use in Fabrication of Flexible Printed Circuits

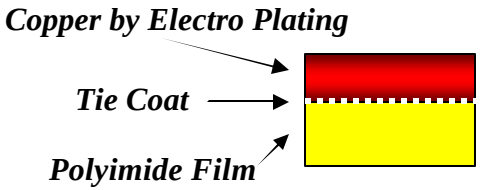
- 4204-11 - Copper Clad Adhesiveless Polyimide
- 4204-18 - Deposited Copper Clad Polyimide-Adhesiveless
- 4204-24 - Copper Clad Liquid Crystal Polymer Adhesiveless

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

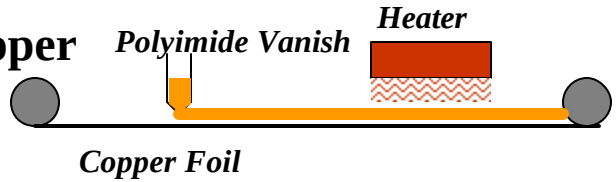
Typical Adhesiveless Laminate Technology

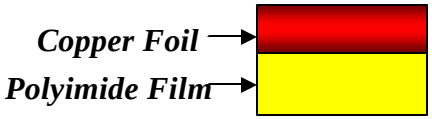
- **Sputter and Plate**



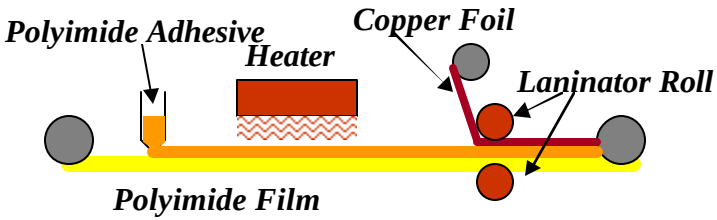


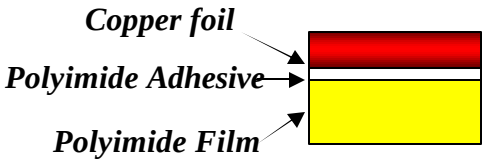
- **Cast on Copper**





- **Laminate**





Revision Date: May 2002

Specification Sheet

Specification Sheet # : **IPC-4204/11**
Supercedes : **IPC-FC-241/11, IPC-241/19**
Material Type : **Copper Clad Adhesiveless Polyimide**
Material Designation : **E1E__O0 CU-__ __ __ __/__ __ __**

Property to be tested	Requirement				Units	Test Method	Reference Paragraph
1. Wrinkles, Creases, Streaks and Scratches	Pass				—	Visual	3.5.2
2. Inclusions	Pass				—	Visual ASTM D-149	3.5.3
3. Voids	Pass				—	IPC-TM-650, Method 2.1.13	3.5.4
4. Holes, Tears and Delaminations	Pass				—	Visual	3.5.5
5. Pits and Dents	Pass				—	Visual	3.5.6
6. Dimensional Stability, maximum	0.20 0.20				%	IPC-TM-650, Method 2.2.4, Method B Method C	3.7.1
7. Peel Strength, minimum						IPC-TM-650, Method 2.4.9	
As Received	525 [2.998] t1		1050 [5.9957] t2		N/m width [lb/in width]	Method A	3.7.2.1
As Received	525 [2.998] t1		1050 [5.9957] t2			Method B	3.7.2.1
After Solder Float	525 [2.998] t1		1050 [5.9957] t2			Method D	3.7.2.2
After Temperature Cycling	525 [2.998] t1		1050 [5.9957] t2			Method F	3.7.2.3
8. Initiation Tear Strength, minimum	500 [17.64]				g [oz]	IPC-TM-650, Method 2.4.16	3.7.3
9. Propagation Tear Strength, minimum	1 [0.035] t3	4 [0.14] t5	15 [0.529] t11	25 [0.882] t12	g [oz]	IPC-TM-650, Method 2.4.17.1	3.7.4
10. Flexural Endurance, minimum	1000 t9		N/A t10		cycle	IPC-TM-650, Method 2.4.3	3.7.5
11. Low Temperature Flexibility, 5 cycles	Pass				—	IPC-TM-650, Method 2.6.18	3.7.6
12. Chemical Resistance, minimum	80				%	IPC-TM-650, Method 2.3.2, Method A	3.8.1
13. Solder Float*	N/A Pass				—	IPC-TM-650, Method 2.4.13 Method A Method B	3.8.2
14. Solderability	Pass				—	J-STD-003, Test A	3.8.3
15. Dielectric Constant, maximum (at 1 MHz)*	4.0				—	IPC-TM-650, Method 2.5.5.3	3.9.1
16. Dissipation Factor, maximum (at 1 MHz)*	0.010				—	IPC-TM-650, Method 2.5.5.3	3.9.2
17. Volume Resistivity** (Damp Heat), minimum	10^6				MΩ-cm	IPC-TM-650, Method 2.5.17	3.9.3
18. Surface Resistance** (Damp Heat), minimum	10^6				MΩ	IPC-TM-650, Method 2.5.17	3.9.4
19. Dielectric Strength, minimum	78.74 [2000.0]				V/µm [V/mil]	ASTM-D-149	3.9.5
20. Fungus Resistance	Non-nutrient				—	IPC-TM-650, Method 2.6.1	3.10.1
21. Moisture Absorption, maximum	3.0				%	IPC-TM-650, Method 2.6.2	3.10.2
22. Flammability, minimum	***				—	UL-94	3.10.3
23. Service Temperature	DBD				°C [°F]	IPC-TM-650, Method 2.6.21	3.10.4
24. Moisture and Insulation Resistance, minimum	10^6				MΩ	IPC-TM-650, Method 2.6.3.2	3.10.5

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Revision Date: May 2002

Specification Sheet

Specification Sheet # : **IPC-4204/18**
Supercedes : **IPC-FC-241/18, IPC-FC-241/12 and IPC-FC-241/21**
Material Type : **Deposited Copper Clad Polyimide-Adhesiveless**
Material Designation : **E1E_O0 CU-_ _ _ _/_ _ _**

Property to be tested	Requirement				Units	Test Method	Reference Paragraph
1. Wrinkles, Creases, Streaks and Scratches	Pass				—	Visual	3.5.2
2. Inclusions	Pass				—	Visual ASTM D-149	3.5.3
3. Voids	Pass				—	IPC-TM-650, Method 2.1.13	3.5.4
4. Holes, Tears and Delaminations	Pass				—	Visual	3.5.5
5. Pits and Dents	Pass				—	Visual	3.5.6
6. Dimensional Stability, maximum	0.15 0.20				%	IPC-TM-650, Method 2.2.4, Method B Method C	3.7.1
7. Peel Strength, minimum As Received As Received After Solder Float After Temperature Cycling	350 [1.999] t1 525 [2.998] t1 438 [2.501] t1 438 [2.501] t1		700 [3.997] t2 1050 [5.9957] t2 700 [3.997] t2 700 [3.997] t2		N/m width [lb/in width]	IPC-TM-650, Method 2.4.9 Method A Method B Method D Method F	3.7.2.1 3.7.2.1 3.7.2.2 3.7.2.3
8. Initiation Tear Strength, minimum	100 [3.527] t3		500 [17.64] t4		g [oz]	IPC-TM-650, Method 2.4.16	3.7.3
9. Propagation Tear Strength, minimum	1 [0.035] t3	4 [0.14] t5	15 [0.529] t11	25 [0.882] t12	g [oz]	IPC-TM-650, Method 2.4.17.1	3.7.4
10. Flexural Endurance, minimum	1000				cycle	IPC-TM-650, Method 2.4.3	3.7.5
11. Low Temperature Flexibility, 5 cycles	N/A				—	IPC-TM-650, Method 2.6.18	3.7.6
12. Chemical Resistance, minimum	80				%	IPC-TM-650, Method 2.3.2, Method A	3.8.1
13. Solder Float	288 Pass				—	IPC-TM-650, Method 2.4.13 Method A Method B	3.8.2
14. Solderability	Pass				—	J-STD-003, Test A	3.8.3
15. Dielectric Constant, maximum (at 1 MHz)	3.5				—	IPC-TM-650, Method 2.5.5.3	3.9.1
16. Dissipation Factor, maximum (at 1 MHz)	0.012				—	IPC-TM-650, Method 2.5.5.3	3.9.2
17. Volume Resistivity (Damp Heat), minimum	10^8				MΩ-cm	IPC-TM-650, Method 2.6.17	3.9.3
18. Surface Resistance (Damp Heat), minimum	10^8				MΩ	IPC-TM-650, Method 2.6.17	3.9.4
19. Dielectric Strength, minimum	78.74 [2000.0]				V/mil [V/mil]	ASTM-D-149	3.9.5
20. Fungus Resistance	Non-nutrient				—	IPC-TM-650, Method 2.6.1	3.10.1
21. Moisture Absorption, maximum	4.0				%	IPC-TM-650, Method 2.6.2	3.10.2
22. Flammability, minimum	V-0				—	UL-94	3.10.3
23. Service Temperature	260				°C [°F]	IPC-TM-650, Method 2.6.21	3.10.4
24. Moisture and Insulation Resistance, minimum	10^8				MΩ	IPC-TM-650, Method 2.6.3.2	3.10.5

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Revision Date: May 2002

Specification Sheet

Specification Sheet # : **IPC-4204/24**
Supercedes : **N/A**
Material Type : **Copper Clad Liquid Crystal Polymer Adhesiveless**
Material Designation : **(TBD[1])1E__0**

Property to be tested	Requirement		Units	Test Method	Reference Paragraph
1. Wrinkles, Creases, Streaks and Scratches	Pass		—	Visual	3.5.2
2. Inclusions	Pass		—	Visual ASTM D-149	3.5.3
3. Voids	Pass		—	IPC-TM-650, Method 2.1.13	3.5.4
4. Holes, Tears and Delaminations	Pass		—	Visual	3.5.5
5. Pits and Dents	Pass		—	Visual	3.5.6
6. Dimensional Stability, maximum	0.15 0.20		%	IPC-TM-650, Method 2.2.4, Method B Method C	3.7.1
7. Peel Strength, minimum				IPC-TM-650, Method 2.4.9	
As Received	525 [2.998]	875 [4.996]	N/m width [lb/in width]	Method A	3.7.2.1
As Received				Method B	3.7.2.1
After Solder Float	525 [2.998]	875 [4.996]		Method D	3.7.2.2
After Temperature Cycling	525 [2.998]	875 [4.996]		Method F	3.7.2.3
8. Initiation Tear Strength, minimum	1400 [49.378]		g [oz]	IPC-TM-650, Method 2.4.16	3.7.3
9. Propagation Tear Strength, minimum	7 [0.25]		g [oz]	IPC-TM-650, Method 2.4.17.1	3.7.4
10. Flexural Endurance, minimum	<0.050 DBD	≥0.050 DBD	cycle	IPC-TM-650, Method 2.4.3	3.7.5
11. Low Temperature Flexibility, 5 cycles	Pass		—	IPC-TM-650, Method 2.6.18	3.7.6
12. Chemical Resistance, minimum	95		%	IPC-TM-650, Method 2.3.2, Method A	3.8.1
13. Solder Float	Pass		—	IPC-TM-650, Method 2.4.13 Method A Method B	3.8.2
14. Solderability	Pass		—	J-STD-003, Test A	3.8.3
15. Dielectric Constant, maximum* (at 1 MHz) (at 500 MHz) (at 1 GHz)	DBD 2.9 2.8		—	IPC-TM-650, Method 2.5.5.3 Method 2.5.5.5.1 Method 2.5.5.5.1	3.9.1
16. Dissipation Factor, maximum* (at 1 MHz) (at 500 MHz) (at 1 GHz)	DBD 0.004 0.003		—	IPC-TM-650, Method 2.5.5.3 Method 2.5.5.5.1 Method 2.5.5.5.1	3.9.2
17. Volume Resistivity* (Damp Heat), minimum	10^{12}		MΩ-cm	IPC-TM-650, Method 2.5.17	3.9.3
18. Surface Resistance* (Damp Heat), minimum	10^{10}		MΩ	IPC-TM-650, Method 2.5.17	3.9.4
19. Dielectric Strength, minimum	3500		V/µm [V/mil]	ASTM-D-149	3.9.5
20. Fungus Resistance	Pass		—	IPC-TM-650, Method 2.6.1	3.10.1
21. Moisture Absorption, maximum	0.05		%	IPC-TM-650, Method 2.6.2	3.10.2
22. Flammability, minimum	***		—	UL-94	3.10.3
23. Service Temperature	DBD		°C [°F]	IPC-TM-650, Method 2.6.21	3.10.4
24. Moisture and Insulation Resistance, minimum	DBD		MΩ	IPC-TM-650, Method 2.6.3.2	3.10.5

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Considerations

- **Dimensional Stability Levels**
  - * Ordinary Performance
  - * High Performance
  - * Premium Performance
- **Reduced Contamination Limits**
  - * Inclusions
  - * Voids
  - * Surface Debris
- **Classes of Polyimide**
  - * High Modulus

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

JPCA Recommendations

- **Level of Performance by Dimensional Stability***

*Ordinary	+/- 0.2%
*High Performance	+/-0.15%
*Extra High Performance	+/-0.10%

*Measured after 30 min @ 150C

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Other Flex Standards Addressing CSP Applications

- **IPC - 4202** — **Flex Circuit Base Dielectric Materials**
- **IPC - 4203** — **Flex Circuit Cover Layer and Bond Ply**
- **IPC - 2223** — **Flex Circuit Design**
- **IPC - 6013** — **Flex Circuit Performance**

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

IPC Flexible Circuits Committee

Tom Gardeski, E.I. Du Pont de Nemours, General Chair

Nick Koop, MINCO, Vice Chair

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Flexible Circuits Committee

- **Flexible Circuits Base Materials Subcommittee**
  - **Clark Webster, AllFlex, Chair**
  - **Mike Musich, Chemitox Inc, Vice Chair**
- **New Specifications issued May 2002**
  - **Documents redesignated**
    - **IPC-FC-231 = IPC-4202**
    - **IPC-FC-232 = IPC-4203**
    - **IPC-FC-241 = IPC-4204**

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Flexible Circuits Committee

- **Flexible Circuits Design Standard Subcommittee**
  - **Bill Ortloff, B/C Engineering,Chair**
  - **Greg Clements, Kaneka, Vice Chair**

  - **IPC-2223 Design Standard**
    - **Published November 1998**
    - **Began work on Rev. A Feb. 2003**
    - **Near completion of Final Draft, expect to review in Anaheim in Feb.**

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Flexible Circuits Committee

- **Flexible Circuits Performance Specifications Subcommittee**
  - **Larry Dexter, ACT, Chair**
  - **Nick Koop, Minco, Vice-Chair**

☞ **IPC-6013 Performance Specification**
- **Published November 1998**
- **"A" revision issued Dec. 2003**
- **Working on revision B**

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Flexible Circuits Committee

- **Flex Test Method Committee**
  - **Rocky Hilburn, Gould Electronics, Chair**
  - **Ross Neu, E.I.Du Pont de Nemours, Vice-Chair**

☞ **Reviewing all test methods and working on updates/revisions as required**

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

Flexible Circuits Committee

- **UL 796F Task Group**
  - **Duane Mahnke, Rogers, Chair**
  - **Mike Beauchesne, ACT, Vice-Chair**

  - **Worked with UL in development of UL 796F**
    - **Chairs sit on UL STP**
    - **Comments from TG presented to STP**
    - **Report to TG on UL progress and issues**

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

The IPC Flexible Circuit Committee Welcomes New Members and Industry Input to Keep Our Standards in Keeping With Advancing Industry Requirements

IPC
ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES