



IPC-4103B

Specification for Base Materials for High Speed/ High Frequency Applications

Developed by the High Speed/High Frequency Base Materials
Subcommittee (D-23) of the High Speed/High Frequency Committee
(D-20) of IPC

Supersedes:

IPC-4103A-WAM1 -

January 2014

IPC-4103A - December 2011

IPC-4103 - January 2002

IPC-L-125A - July 1992

IPC-L-125

Users of this publication are encouraged to participate in the
development of future revisions.

Contact:

IPC

Table of Contents

1 GENERAL	1	3.1.1 Qualification Assessment	7
1.1 Scope	1	3.1.2 Quality Conformance Testing	7
1.2 Type Designation	1	3.1.3 Manufacturers Quality System	7
1.2.1 Specification Sheets	2	3.1.4 Process Control Testing	7
1.2.1.1 Legacy Specification Sheets	2	3.1.5 Self Declaration	7
1.2.1.2 New Format Specification Sheets	2	3.1.6 Quality Assessment Data	8
1.2.2 Dielectric Permittivity Range	2	3.1.7 Sample Qualification	8
1.2.3 Dielectric Permittivity Tolerance	2	3.1.8 Production Data	8
1.2.4 Nominal Laminate Thickness	2	3.1.9 Customer Test Data	8
1.2.5 Thickness Tolerance, Laminate	2	3.1.10 Internal Assessment	8
1.2.6 Metal Foil Indentations	2	3.1.11 Individual Customer Audit	8
1.2.7 Metal Cladding Type and Nominal Weight or Thickness of Metal Cladding	2	3.1.12 Independent Third Party Assessment	8
1.2.7.1 Metallic Cladding Designators	3	3.2 Specification Sheets	8
1.2.7.2 Copper Foil Weights and Thickness	3	3.3 Manufacturers Quality Profile	8
1.2.8 Test Frequency	4	3.4 Qualification Testing	8
1.2.9 Dielectric Loss Tangent	4	3.5 Verification of Manufacturer's Quality System	8
1.2.10 Resin	4	3.6 Conflict	8
1.2.11 Filler	4	3.7 Materials	8
1.2.12 Reinforcement	4	3.7.1 Metal Cladding	8
1.2.13 Bonding Layer Reinforcement Style	4	3.7.2 Reinforcement Fabric	9
1.2.14 Bonding Layer Parameters	4	3.7.2.1 Other Reinforcement Types	9
1.2.15 Color	4	3.7.3 Resin System	9
1.2.15.1 Contrast Agents	4	3.7.4 Fillers	9
1.3 Dimensions and Tolerances	4	3.8 General Requirements/Acceptability	9
1.4 Interpretation	5	3.8.1 Fabricated Sheets and Panels	9
1.5 Terms and Definitions	5	3.8.1.1 Fabricated Laminate Sheet Material	9
1.5.1 As Agreed Between User and Supplier (AABUS)	5	3.8.1.2 Fabricated Laminate Panels Material	9
1.6 Revision Level Changes	5	3.8.1.3 Fabricated Bonding Layer Panels	9
2 APPLICABLE DOCUMENTS	5	3.8.1.4 Fabricated Bonding Layer Rolls	9
2.1 IPC	5	3.8.2 Inspection Lot	9
2.2 Joint Industry Standards	6	3.8.2.1 Inspection Lot Laminate	9
2.3 National Conference of Standards Laboratories	6	3.8.2.2 Inspection Lot Bonding Layer	9
2.4 Federal Specifications	6	3.8.2.3 Preparation of Samples	9
2.5 ASTM	7	3.8.2.4 Etching Process and Etching Removal for Copper Clad Specimens	9
2.6 International Standards	7	3.8.2.5 Standard Laboratory Conditions	10
2.7 MIL Specification	7	3.8.3 Visual Properties	10
2.8 International Electrotechnical Comission (IEC)	7	3.8.3.1 Laminate Visual Properties	10
3 REQUIREMENTS	7	3.8.3.1.1 Metal Foil Indentations	10
3.1 General	7	3.8.3.1.2 Wrinkles	10
		3.8.3.1.3 Scratches	10
		3.8.3.1.4 Appearance of NonClad Surfaces	10

3.8.3.1.5	Surface Finish of Foil after Curing Except for Double Treat	11	3.9.2.3.2	Cure Percent	17
3.8.3.1.6	Surface and Subsurface Imperfections	11	3.9.2.3.3	Volatile Content	17
3.8.3.1.7	Laminate Inclusions	11	3.9.2.4	Thermal Conductivity of Bonding Layer Materials (Reference) [=] w/(m-°K) – (Optional)	17
3.8.3.2	Bonding Layer and Prepreg Layer Visual Inspection	11	3.10.1	Chemical Requirements, Laminate	17
3.8.3.2.1	Impregnation/Coating Imperfections	11	3.10.1.1	Flammability	17
3.8.4	Dimensional	11	3.10.1.2	Thermal Stress	18
3.8.4.1	Length and Width	12	3.10.1.3	Solderability	18
3.8.4.1.1	Length and Width, Laminate	12	3.10.1.4	Chemical Resistance (Optional)	18
3.8.4.1.2	Length and Width, Bonding Layers	12	3.10.1.5	Metal Surface Cleanability	18
3.8.4.1.3	Bonding Layer Roll Width	12	3.10.1.6	Glass Transition Temperature (Optional)	18
3.8.4.1.4	Bonding Layer Roll Length	12	3.10.1.7	Delta Glass Transition Temperature (Optional)	18
3.8.4.2	Thickness	12	3.10.1.8	Average Coefficient of Thermal Expansion (CTE) (Optional)	18
3.8.4.2.1	Thickness Class Laminates	12	3.10.2	Chemical Requirements, Bonding Layer	18
3.8.4.2.2	Thickness Tolerance Laminates	15	3.10.2.1	Flammability	18
3.8.4.3	Bow and Twist Laminate	15	3.10.2.2	Chemical Resistance (Optional)	18
3.8.4.3.1	Sheets and Panels with Both Dimensions ~300 mm [~11.81 in]	15	3.11	Electrical Requirements	18
3.8.4.3.2	Panel with One or Both Dimensions < 300 mm [< 11.81 in]	16	3.11.1	Electrical Requirements, Laminate	18
3.9	Physical Requirements	16	3.11.1.1	Dielectric Permittivity	18
3.9.1	Physical Requirements Laminate Materials ..	16	3.11.1.2	Dielectric Loss Tangent	19
3.9.1.1	Peel Strength	16	3.11.1.3	Volume Resistivity	19
3.9.1.1.1	Peel Strength after Thermal Stress	16	3.11.1.4	Surface Resistivity	19
3.9.1.1.2	Peel Strength at Elevated Temperature	16	3.11.1.5	Dielectric Breakdown	19
3.9.1.1.3	Peel Strength after Process Solutions (Optional)	16	3.11.1.6	Electric Strength	19
3.9.1.2	Dimensional Stability	16	3.11.2	Electrical Requirements, Bonding Layer	19
3.9.1.3	Flexural Strength	16	3.11.2.1	Dielectric Permittivity	19
3.9.1.4	Thermal Conductivity of Laminate Materials [=] w/(m-°K) – (Optional)	16	3.11.2.2	Dielectric Loss Tangent	19
3.9.2	Physical Requirements, Bonding Layer Materials	16	3.11.2.3	Electric Strength	19
3.9.2.1	Resin Content Method	16	3.12	Environmental Requirements	19
3.9.2.1.1	Resin Content Percent (by Burn-Off)	17	3.12.1	Environmental Requirements, Laminate	19
3.9.2.1.2	Resin Content Percent (by Treated Weight)	17	3.12.1.1	Moisture Absorption	19
3.9.2.1.3	Treated Weight Total	17	3.12.1.2	Fungus Resistance	19
3.9.2.2	Flow Parameter	17	3.12.2	Environmental Requirements, Bonding Layer	19
3.9.2.2.1	Resin Flow Percent	17	3.12.2.1	Fungus Resistance	19
3.9.2.2.2	Scaled Flow Thickness	17	3.13	Visual and Dimensional Requirements, Laminates	19
3.9.2.2.3	Resin Flow for No Flow Type Bonding Layers	17	3.13.1	Substitutability of Grades of Metal Foil Indentations	19
3.9.2.2.4	Rheological Flow	17	3.13.2	Substitutability of Classes of Thickness Tolerance	20
3.9.2.2.5	Delta H	17	3.13.3	Remarking of Substituted Laminates	20
3.9.2.3	Optional Tests	17	3.14	Marking	20
3.9.2.3.1	Gel Time	17	3.14.1	Marking, Laminates	20
			3.14.2	Marking Bonding Layer	20

3.14.3	Marking of Shipping Containers	20	6.2	Ordering Information	23
3.15	Workmanship	20	6.2.1	Ordering Data for Laminate Material	23
3.16	Material Safety	20	6.2.2	Ordering Data for Bonding Layer Material	24
3.17	Bonding Layer Shelf Life	20	6.3	New Materials	24
4	QUALITY ASSURANCE PROVISIONS	21			
4.1	Quality System	21			
4.2	Responsibility for Inspection	21			
4.2.1	Test Equipment and Inspection Facilities	21			
4.3	Qualification Testing	21			
4.3.1	Samples	21			
4.3.2	Frequency	21			
4.3.3	Laminator Qualification Profile	21			
4.3.4	Changes in Composition	21			
4.3.5	Qualification Data Retention	21			
4.4	Quality Conformance Inspection	21			
4.4.1	Frequency	21			
4.4.2	Acceptance Criteria	21			
4.4.3	Rejected Lots	22			
4.4.4	Conformance Data Retention	22			
4.4.5	Certificate of Conformance	22			
4.5	Statistical Process Control (SPC)	22			
5	PREPARATION FOR DELIVERY	23			
5.1	Packaging Materials	23			
5.2	Authorized Distributors	23			
6	NOTES	23			
6.1	End User Responsibilities	23			
6.1.1	Background Information	23			
6.1.2	AABUS Rational	23			
				Figures	
				Figure 3-1	Thickness Measurement
					15
					Tables
				Table 1-1	Conventional Laminate Example
					1
				Table 1-2	Enhanced Laminate Example
					1
				Table 1-3	Bonding Layer Example
					1
				Table 1-4	Copper Foil Weights and Thickness (Taken From IPC-4562)
					3
				Table 1-5	Bonding Layer Testing Parameters
					4
				Table 3-1	Point Value System for Metal Foil Indentations
					10
				Table 3-2	Permissible Variation in Length and Width of Laminates
					12
				Table 3-3	Reference Information and Testing Frequency of Laminates
					12
				Table 3-3a	Sample Size for Lot Size
					13
				Table 3-4	Reference Information and Testing Frequency of Bonding Layer Material
					14
				Table 3-5	Thickness Tolerance for Laminates in mm [in]
					15
				Table 3-6	Laminate Bow and Twist, Maximum Percentage
					16
				Table 3-7	Flammability Requirements
					18
				Table 3-8	Dielectric Permittivity Tolerance
					19
				Table 4-1	Quality Conformance Plan for Monthly, Quarterly and Annual Tests – Laminate
					22
				Table 4-2	Quality Conformance Plan for Monthly, Quarterly and Annual Tests – Bonding Layer
					22
				Table 6-1	Summary of Legacy Specification Sheets
					25
				Table 6-2	Summary of IPC-4103A Specification Sheets
					25

Specification for Base Materials for High Speed/High Frequency Applications

1 GENERAL

1.1 Scope This specification covers the requirements for high speed/high frequency performance plastic substrates to be used for fabrication of printed boards for microstrip, stripline, and high speed digital electrical and electronic circuits. This specification applies to the plastic substrate thickness defined in the specification sheets as measured over the dielectric only. As a general guideline, laminates controlled by this specification usually have a dissipation factor of less than 0.005.

1.2 Type Designation The following system identifies clad and unclad plastic laminate and bonding layer materials for conventional and enhanced part number call out. Conventional laminate part numbers reflect traditional specification values, and are consistent with the callouts in Table 1-1. Enhanced laminate part numbering would include the conventional part number in Table 1-1 as well as the enhanced information in Table 1-2. Bonding layer part numbers are covered in Table 1-3.

Table 1-1 provides an example for conventional laminate part numbers where IPC-4103 is referenced as follows: 4103AL001C11500C1/C1AA.

Table 1-1 Conventional Laminate Example

4103	A	L	001	C
Specification Number	Specification Revision	Material Designator (see 1.2.1)	Specification Sheet (see 1.2.1)	Dielectric Permittivity Range (see 1.2.2)
1	1500	C1/C1	A	A
Dielectric Permittivity Tolerance (see 1.2.3)	Nominal Laminate Thickness (see 1.2.4)	Metal Cladding Type and Nominal Weight/Thickness (see 1.2.7)	Thickness Tolerance (see 1.2.5)	Metal Foil Indentations (see 1.2.6)

Table 1-2 provides an example for enhanced laminate part numbers where IPC-4103 is referenced. In addition to the conventional Table 1-2, the following designators could be used to define an enhanced material part number such as: 4103AL001C11500C1/C1AAX1A1A.

Table 1-2 Enhanced Laminate Example

X	1	A	1	A
Test Frequency (see 1.2.8)	Dielectric Loss (see 1.2.9)	Resin (see 1.2.10)	Filler (see 1.2.11)	Reinforcement (see 1.2.12)

Table 1-3 provides an example for bonding layer part numbers where IPC-4103 is referenced as follows: 4103AB520CE1080BRCSVC1.

Table 1-3 Bonding Layer Example

4103	A	B	520	C
Specification Number	Specification Revision	Material Designator (see 1.2.1)	Specification Sheet (see 1.2.1)	Dielectric Permittivity Range (see 1.2.2)
E	1080	B	RC	SC
Reinforcement Type (see 1.2.13)	Reinforcement Style (see 1.2.13)	Resin System (see 1.2.10)	Resin Content Test Method (see 1.2.14)	Flow Parameter (see 1.2.14)
VC	1			
Optional Test (see 1.2.14)	Filler (see 1.2.11)			