IPC-6013E

Qualification and Performance Specification for Flexible/Rigid-Flexible Printed Boards

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

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Qualification and Performance Specification for Flexible/Rigid-Flexible Printed Boards

1 SCOPE

1.1 Statement of Scope This specification covers qualification and performance requirements of flexible printed boards. The flexible printed board may be single-sided, double-sided, multilayer, or rigid-flex multilayer. All of these constructions may or may not include stiffeners, plated-through holes (PTHs), and blind/buried vias.

The flexible or rigid-flex printed board may contain build up High Density Interconnect (HDI) layers. The printed board may contain embedded active or passive circuitry with distributive capacitive planes, capacitive or resistive components conforming to IPC-6017.

The rigid section of the printed board may contain a metal core or external metal heat frame, which may be active or nonactive.

Revision level changes are described in 1.7.

1.2 Purpose The purpose of this specification is to provide requirements for qualification and performance of flexible printed boards designed to IPC-2221 and IPC-2223.

1.3 Performance Classification, Board Type, and Installation Usage

1.3.1 Classification This specification recognizes that flexible printed boards will be subject to variations in performance requirements based on end-use. These performance classes (Class 1, Class 2, and Class 3) are defined in IPC-6011.

1.3.2 Printed Board Type Performance requirements are established for the different types of flexible printed boards, classified as follows:

Type 1 - Single-sided flexible printed boards containing one conductive layer, with or without stiffeners.

Type 2 - Double-sided flexible printed boards containing two conductive layers with PTHs, with or without stiffeners.

Type 3 - Multilayer flexible printed boards containing three or more conductive layers with PTHs, with or without stiffeners.

Type 4 - Multilayer rigid and flexible material combinations containing three or more conductive layers with PTHs.

Type 5 - Flexible or rigid-flex printed boards containing two or more conductive layers without PTHs.

1.3.3 Installation Uses

Use A - Capable of withstanding flex during installation.

Use B - Capable of withstanding continuous flexing for the number of cycles as specified on the procurement documentation.

Use C - High temperature environment (over 105 °C [221 °F]).

Use D - UL Recognition. See UL 94 and UL 796F.

1.3.4 Selection for Procurement For procurement purposes, performance class and installation usage **shall** be specified in the procurement documentation.

The documentation **shall** provide sufficient information to the supplier so that the supplier can fabricate the flexible printed boards and ensure that the user receives the desired product. Information that should be included in the procurement documentation is to be in accordance with IPC-2611 and IPC-2614.

Note: If the drawing specifies the requirement in words, designators are not required.

The procurement documentation **shall** specify the thermal stress test method and the number of cycles (in relation to reflow profiles in IPC-TM-650, Method 2.6.27) to be used to meet the requirement of 3.6.1. Selection **shall** be from those depicted in 3.6.1.1, 3.6.1.2, 3.6.1.3 and 3.6.1.4. If not specified (see 5.1), the default **shall** be per Table 1-1.

During the selection process, the user should take into consideration the following when determining the appropriate thermal stress test method:

- Wave solder, selective solder, hand solder assembly processes (see 3.6.1.1)
- Conventional SnPb reflow processes (see 3.6.1.2)
- Lead-free reflow processes (see 3.6.1.3 and 3.6.1.4)

IPC-6016, a sectional performance specification for HDI printed boards, was canceled by the IPC. Relevant HDI conformance and acceptance criteria has been transferred to this revision of this specification.

The addition of IPC-2221 Appendix A conformance coupons (beginning with Revision B of the design standard) by the printed board manufacturer to the manufacturing panel **shall** be AABUS.

1.3.4.1 Selection (Default) The procurement documentation **shall** specify those requirements that are a result of the selection process within this specification. This includes all references to "AABUS". If the requirement selection is not made in accordance with the procurement documentation, Ordering Data (see 5.1), Customer Drawing and/or supplier control plan (SCP), then the default requirements in Table 1-1 **shall** apply.

Table 1-1 Default Requirements

Category	Default Selection
Performance Class	Class 2
Installation Usage	Use A
Material	Fabricator defined
Final Finish	Finish X (Electrodeposited tin lead, fused or solder coated) or alternate Finish ENIG allowed on designs (drawings) with Initial Release on or after January 01, 2021.
Minimum Starting Foil	1/2 oz. for all internal and external layers. For plated HDI layers – ¼ oz. for all layers (internal or external)
Copper Foil Type	Fabricator defined
Plated Component Hole Diameter Tolerance	(±) 100 µm [3,937 µin]
Plated Via Hole Diameter Tolerance	(+) 80 µm [3,150 µin], (-) no requirement, (may be totally or partially plugged)
Non-plated Hole Diameter Tolerance	(±) 80 µm [3,150 µin]
Conductor Width tolerance	Class 2 requirements per para. 3.5.1
Conductor Spacing tolerance	Class 2 requirements per para. 3.5.2
Dielectric Separation	Minimum rigid dielectric spacing **shall** be 90 µm [3,543 µin]. Minimum flexible dielectric spacing **shall** be within 20% of the selected thickness
Lateral Conductor Spacing	100 µm [3,937 µin] minimum
Marking Ink	Contrasting color, nonconductive
Solder Mask	Not applied, if not specified
Solder Mask, specified	Class T of IPC-SM-840 if class not specified
Solderability Test	Per 3.3.6, Category 2 for SnPb and Category A for Pb-free of J-STD-003
Test Voltage, Isolation Resistance	Per IPC-9252
Qualification not specified	See IPC-6011
Profile tolerance	0.5 mm [0.0197 in] for all external edges
Thermal Stress Test	IPC-TM-650, Method 2.6.8, Condition A or, if utilizing polyester flexible material, Condition C per 3.6.1

1.3.5 Material, Plating Process and Final Finish

1.3.5.1 Laminate Material Laminate material is identified by numbers and/or letters, classes and types as specified by the appropriate specification listed in the procurement documentation.

1.3.5.2 Plating Process The copper plating process used to provide the main conductor in the holes is identified by a single number as follows:

1) Acid copper electroplating only
2) Pyrophosphate copper electroplating only
3) Acid and/or pyrophosphate copper electroplating