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Printed Board Handling and Storage Guidelines

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Association Connecting Electronics Industries



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Developed by the Printed Board Storage and Handling Subcommittee
(D-35) of the Rigid Printed Board Committee (D-30) of IPC

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

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Acknowledgment

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Printed Board Handling and Storage Guidelines

1 INTRODUCTION

1.1 Background Historically, the printed board industry has relied on military specifications and guidelines to define packaging methods to preserve the quality and reliability of printed boards during shipment and storage. However, many of these documents are obsolete, incomplete, do not address Pb-free assembly processes, or do not cover newer laminates or final finishes.

1.2 Scope This document provides suggestions for proper handling, packaging materials and methods, environmental conditions, and storage for printed boards. These guidelines are intended to protect printed boards from contamination, physical damage, solderability degradation, electrostatic discharge (ESD) (when necessary), and moisture uptake. Moisture absorbed in printed board laminates expands at soldering temperatures, and in some cases, the resulting vapor pressure can cause internal delamination or excessive strain on plated-hole walls and other structures. This is especially challenging with the higher temperatures used for Pb-free soldering.

This document covers all phases from the manufacture of the bare printed board, through delivery, receiving, stocking, assembly, and soldering. As a guideline, this information is to be used with, and is secondary to, established requirements in such documents as the IPC-4550 series for final finishes.

1.3 Application The target audience includes those involved in all phases of printed board design, manufacture, assembly, shipping, storage, and possible warranty activities. Information herein has been supplied for all of these functions.

1.4 Terms and Definitions The definition of all terms used herein are as specified in IPC-T-50 and as defined in 1.4.1 through 1.4.6.

1.4.1 Humidity Indicator Card (HIC) An indicator of relative humidity in the form of a card with printed deposits of moisture-sensitive chemicals, usually as round dots arranged in sequence, each changing color at a higher relative humidity. Color will change (depending on the chemicals, either from blue to pink or from brown to azure) when humidity exceeds the value printed on the dot. When humidity decreases, color will change back (to blue or brown).

1.4.2 Moisture Barrier Bag (MBB) A bag designed to restrict the transmission of water vapor and used to pack moisture sensitive devices. An MBB is made of material with a low Water Vapor Transmission Rate (WVTR) (see 4.2.1). An MBB includes a metallized layer (aluminum), making the bag appear shiny and opaque.

1.4.3 Subcomposite In sequential lamination, a structure composed of more than two layers that have been laminated together, and which will subsequently be laminated with other layers into a complete printed board.

1.4.4 Water Vapor Transmission Rate (WVTR) A measure of the permeability of plastic film or metallized plastic film material to moisture, an important rating for moisture barrier bags (MBBs).

1.4.5 Sulfur Free Materials that are unlikely to express corrosive sulfur compounds like H_2S or SO_2 .

1.4.6 Dry Packaging Packaging that consists of desiccant material and a Humidity Indicator Card (HIC) sealed with the printed boards inside a Moisture Barrier Bag (MBB) (See 4.3.1).

1.5 Revision Level Changes Changes incorporated into the current revision of this standard are indicated throughout by gray shading of the relevant subsection(s). Changes to a figure or table are indicated by gray shading of the figure or table header and applicable content.

2 APPLICABLE DOCUMENTS

2.1 IPC¹

IPC-HDBK-001 Handbook and Guide to Supplement J-STD-001

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

IPC-A-311 Process Controls for Phototool Generation and Use

IPC-TR-585 Time, Temperature and Humidity Stress of Final Board Finish Solderability

IPC-TM-650 Test Methods Manual²

2.6.27 Thermal Stress, Convection Reflow Assembly Simulation

2.6.28 Moisture Content and/or Moisture Absorption Rate, (Bulk) Printed Board

IPC-2221 Generic Standard on Printed Board Design

IPC-4552 Specification for Electroless Nickel/Immersion Gold (ENIG) Plating for Printed Circuit Boards

IPC-4553 Specification for Immersion Silver Plating for Printed Boards

IPC-4554 Specification for Immersion Tin Plating for Printed Circuit Boards

IPC-4556 Specification for Electroless Nickel/Electroless Palladium/Immersion Gold Plating for Printed Circuit Boards

IPC-5704 Cleanliness Requirements for Unpopulated Printed Boards

IPC-6012 Qualification and Performance Specification for Rigid Printed Boards

IPC-7092 Design and Assembly Process Implementation for Embedded Components

NCMS Solderability Component Long Term Storage Report - “Moisture Measurement in PCB’s and Impact of Design on Desorption Behaviour”

2.2 Joint Industry Standards³

J-STD-001 Requirements for Soldered Electrical and Electronic Assemblies

IPC/JEDEC J-STD-033 Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices

IPC/JEDEC J-STD-609 Marking and Labeling of Components, PCBs and PCBA's to Identify Lead (Pb), Lead- Free (Pb-Free) and Other Attributes

2.3 Electrostatic Discharge Association (ESD)⁴

ANSI/ESD S8.1 Protection of Electrostatic Discharge Susceptible Items - Symbols - ESD Awareness

ANSI/ESD S20.20 Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

2.4 Europa⁵

DIRECTIVE 2011/65/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)

1. www.ipc.org

2. Current and revised IPC Test Methods are available on the IPC Web site (www.ipc.org/html/testmethods.htm)

3. www.ipc.org

4. www.esda.org

5. www.ec.europa.eu

2.5 SAE International⁶

SAE AS9100 Quality Management Systems - Requirements for Aviation, Space and Defense Organizations

SAE AS9102 Aerospace First Article Inspection Requirement

2.6 International Organization for Standardization⁷

ISO 9001 Quality Management Systems - Requirements

2.7 ASTM⁸

ASTM F1249 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

3 PRINTED BOARD FABRICATION AND PACKAGING (HANDLING)

3.1 Printed Board Materials All materials incorporated into printed boards should be protected from environmental, handling and storage damage. Manufacturers should have documented procedures that outline these preventive practices. Quality System specifications ISO 9001 and SAE AS9100 require these procedures. Customers often flow down these requirements to suppliers in purchasing documents as well. Sample specifications for flow-down of packaging requirements for finished printed boards are included as Appendix A.

3.1.1 Bonding Materials, Prepreg and Resin Coated Foils These materials are sensitive to damage from exposure to moisture, humidity and ultraviolet light, as well as physical damage. They should be protected starting from material manufacture and storage, through transportation to the User, to receipt and storage within the User's facility. In many cases, these materials are supplied in sealed bags (or dry pack MBBs) and used in an environment where the temperature and humidity are controlled within limits specified by the material manufacturers. MBBs containing prepreg should be vacuum sealed for ease of handling. Guidelines for handling and storage of prepreps (and resin coated foils) are:

- Handle prepreg by the edges using clean latex or nitrile gloves.
- Store sealed bags of prepreg flat and in a cool, dry environment ($< 23\text{ }^{\circ}\text{C}$ [$73\text{ }^{\circ}\text{F}$], $< 50\%$ RH). Manufacturers may recommend refrigeration for some prepreg.
- Reseal opened bags of unused prepreg (using clips or heat seals as shown in Figure 3-1) or return to dry storage.
- In cases where the storage temperature is significantly below room temperature, allow prepreg to acclimate to ambient conditions prior to layup. Keep prepreg in a sealed package during the stabilization period to prevent moisture condensation.
- Do not fold prepreg.
- Use of temperature and humidity recorders are a common control process for storage and use locations, and may also be used during transportation of these materials. Please refer to the material manufacturer's recommendations.

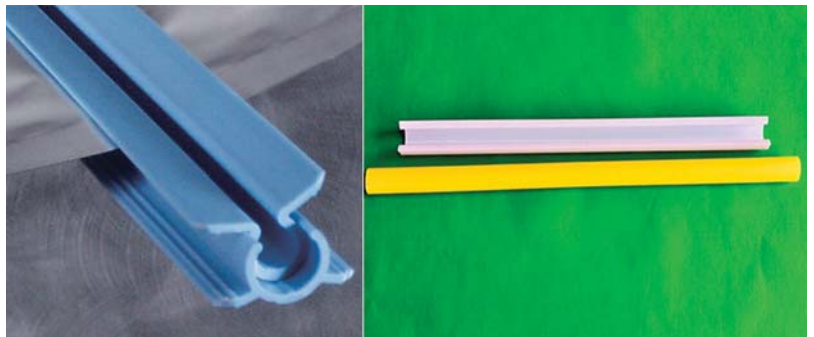


Figure 3-1 Examples of Clips used for Resealing Opened Bags

3.1.2 Copper Clad Laminates

3.1.2.1 Handling and Foreign Object Concerns The infrastructure of the manufacturing location, as well as the equipment used to manufacture these materials, should be designed and controlled to prevent damage and the introduction of detrimental foreign materials. Boxes, trays, and carts should be designed to protect these materials during transportation and

6. www.standards.sae.org

7. www.iso.org

8. www.astm.org