



*The Institute for
Interconnecting
and Packaging
Electronic Circuits*

IPC-9501

PWB Assembly Process Simulation for Evaluation of Electronic Components (Preconditioning IC Components)

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2215 Sanders Road
Northbrook, Illinois
60062-6135

Tel 847 509.9700
Fax 847 509.9798
URL: <http://www.ipc.org>

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

Contact:

IPC
2215 Sanders Road
Northbrook, Illinois
60062-6135
Tel 708 509.9700
Fax 708 509.9798

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Assembly & Joining Processes Committee

Chairman
Jim Reed
T.I.

Component & Process Compatibility Task Group

Chairman
E. Lon Smith
AT&T

Technical Liaison of the IPC Board of Directors

Carl McCormick
Group Technologies

Component & Process Compatibility Task Group

Aoki, Ed, Hewlett-Packard
Candella, Joseph, Senior Systems Technology Inc.
Cash, Alan, Northrop Grumman Corporation
Croce, Samuel, Litton Aero Products Division
Dayaneni, Rao, Hewlett Packard Laboratories
DiFranza, Michele, The Mitre Corp.
Engelmaier, Werner, Engelmaier Assoc.
Franck, Donald, DOVatron International
Grosskopf, Curtis, IBM Corporation
Harris, Mark, EMPF
Hillman, David, Rockwell International
Hymes, Les, Les Hymes Associates

Jones, Sue, Wilcox Electric Inc.
Kwoka, Mark, Harris Corp.
Lambert, Leo, Digital Equipment Corp.
Lindemann, Mike, Electronic Assembly, Inc.
Martin, Charles, Hewlett Packard Laboratories
McCullen, Jack, Intel Corporation
Munson, Terry, CSL Inc.
Nickell, Roger, U.S. Navy
Okamoto, Ray, Lockheed Martin
Pitsch, Tim, Electronic Assembly Corp.
Pope, Elaine, Intel Corporation
Ray, Urmi, AT&T Bell Laboratories
Robertson, David, Pace Inc.
Rosser, Jerald, Hughes Aircraft Co.
Rudy, Donald, AT&T Bell Laboratories

Schoenthaler, David, AT&T Bell Laboratories
Seppanen, Gordon, Honeywell Inc.
Servais, Gerald, Delco Electronics
Siy, Alfredo, Tandem Computers Inc.
Smith, E. Lon, AT&T Bell Laboratories
Sohn, John, AT&T Bell Laboratories
Taylor, Ralph, Lockheed Martin Corporation
Testani, Michael, DOVatron International
Viano, Ronald, Senior Systems Technology Inc.
Virmani, Nick, Unisys Corp.
Weiler, Peter, National Semiconductor
Yaeger, Erin, Ney Ultrasonic Inc.
Yang, Cheng-Ming, AT&T Microelectronics

Table of Contents

1.0 SCOPE	1
2.0 APPLICABLE DOCUMENTS	1
2.1 Institute for Interconnecting and Packaging Electronic Circuits (IPC)	1
2.2 Joint Industry Standards	1
2.3 Electronic Industries Association	1
2.4 Military	1
3.0 TERMS AND DEFINITIONS	1
4.0 APPLICATIONS AND OBJECTIVES	2
5.0 APPARATUS	2
6.0 REQUIREMENTS	2
7.0 RECOMMENDATIONS	4
8.0 COMPONENT CLASSIFICATION	4
9.0 COMPONENT PROCESS PRECONDITIONING PROCEDURES	4
9.1 Moisture Preconditioning	5
9.2 Component Mounting	5
9.3 First Soldering Process Exposure	5
9.4 Aliphatic or Terpene Hydrocarbon Cleaning	6
9.5 Second Soldering Process Exposure	6
9.6 Water Soluble Flux Exposure	6
9.7 Third Soldering Process Exposure	6
9.8 Aqueous Detergent/DI Water Total Immersion Cleaning	6
10.1 Moisture Exposure	6
10.2 Component Mounting	7
10.3 Soldering Process Exposure	7
10.4 Chemical Exposure	11
10.5 Criteria	11
11.0 SOLDERING PROCESS COMPATIBILITY MATRIX	12

Figures

Figure 1	Application of IPC-9501	3
Figure 2	Infrared/Convection Reflow Thermal Profile	8
Figure 3	Wave Solder Thermal Profile (TH Components)	9
Figure 4	Wave Solder Thermal Profile (SM Components)	10

Tables

Table 1:	Moisture Sensitivity Floor Life Levels	4
Table 2:	Soldering Process Compatibility Levels	5
Table 3:	Chemical Compatibility Levels	5

PWB Assembly Process Simulation for Evaluation of Electronic Components (Preconditioning IC Components)

1.0 SCOPE

This document describes manufacturing process simulations for use with applicable component specifications to assure that electronic components can meet expected reliability requirements after exposure to assembly factory processes. It is not intended as an assembly production specification or a stand alone qualification document. The procedure consists of a set of assembly process simulations which can be performed by either the component user or manufacturer prior to reliability testing as specified in the applicable component qualification and reliability monitoring documents. The simulations include alternative conditions depending on the component type, physical characteristics and anticipated use.

It is expected that a single component would be evaluated for a subset of the alternative conditions. For example, large integrated circuit (IC) packages (e.g., PQFP's) might be qualified utilizing the lower of two reflow temperature ranges while smaller packages, which typically become much hotter during infrared or convection reflow, might be qualified for the higher range. Similarly, components with physical characteristics which prohibit total immersion cleaning would not be evaluated for this type of cleaning process.

Unless otherwise specified, this document applies to both surface-mount (SM) reflowed components and through-hole (TH) discrete and IC components, which are wave soldered or reflowed. For wave solder of SM ICs, user and supplier should work together to identify appropriate procedures. The document is intended to complement other industry documents, such as JESD22-A113 and IPC-SM-786 which define moisture sensitivity levels and surface mount ICs for a specific set of process conditions.

2.0 APPLICABLE DOCUMENTS

2.1 Institute for Interconnecting and Packaging Electronic Circuits (IPC)¹

IPC-AC-62 Aqueous Cleaning Handbook

1IPC-OI-645 Standard for Visual Optical Inspection Aids

IPC-TM-650 Test Method Manual

TM-2.6.9.1 Test to Determine Sensitivity of Electronic Components to Ultrasonic Energy

TM-2.6.20 Assessment of Plastic Encapsulated Electronic Components for Susceptibility to Moisture/Reflow Induced Damage

IPC-SM-786 Procedures for Characterizing and Handling of Moisture/Reflow Sensitive ICs

IPC-SM-817 General Requirements for Dielectric Surface Mounting Adhesives

2.2 Joint Industry Standards^{1,2}

J-STD-002 Solderability Tests for Component Leads, Terminations, Lugs, Terminals, and Wires

ANSI-EIA-625 Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices

2.3 Electronic Industries Association²

EIA-541 Packaging Material Standards for ESD Sensitive Items

JESD22-A113 Preconditioning of Plastic Surface Mount Devices Prior to Reliability Testing

JESD 42 Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices

2.4 Military³

MIL-STD-1686 Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices)

MIL-HDBK-263 Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)

MIL-HDBK-773 Electrostatic Discharge Protective Packaging

3.0 TERMS AND DEFINITIONS

MET = Manufacturer's Exposure Time: The compensation factor which accounts for the time after bake that the component manufacturer requires to process the components prior to bag seal. It also includes a default amount of time to account for shipping and handling.

1. Application for copies should be addressed to: IPC, 2215 Sanders Road, Northbrook, IL 60062.

2. Electronic Industries Association, 2500 Wilson Boulevard, Arlington, VA 22201-3834.

3. DoD Standardization Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094



Spike = (Molten solder temperature) — (The TH component lead temperature just prior to entering the solder wave). This parameter is also referred to sometimes as the “ ΔT ” or thermal shock.

4.0 APPLICATIONS AND OBJECTIVES

The objectives of the document are to

- minimize cost of component qualification by establishing a standardized set of assembly process simulations for use as part of component qualification.
- facilitate the development and manufacture of robust components by establishing a set of targets for Component/assembly process compatibility.

The use of this document is illustrated in Figure 1, which shows typical steps and decision points in flow chart form. The document does not replace documents such as IPC-SM-786 which defines levels of moisture sensitivity or component specific documents which define functional and reliability testing requirements and is not an assembly production document. The intent is to utilize procedures established by documents such as JESD22-A113 and IPC-SM-786 as much as possible and, in addition, to provide recommended procedures for simulating process conditions not covered by these documents. Future revisions of this document may refer to other classification documents as they become available. A standard set of process preconditioning steps is defined from which an appropriate subset can be selected for verifying the capability of a component to survive specific assembly factory process conditions.

The processes simulated include

- component storage and use in specific environments.
- wave and reflow soldering of both surface-mount and through-hole components.
- exposure to corrosive fluxes (water soluble).
- exposure to the currently most prevalent cleaning materials.

The recommended conditions provide for evaluation of parts for the stresses of board assembly processes. The repetitive solder steps take into account the existence of multiple solder steps and repair operations in typical factories. The recommended sequence provides for evaluation with several flux and cleaning materials in a single test. Processes for which specific components will not be qualified because of known failure mechanisms should be omitted from the sequence.

Qualification for rework is assumed to be done as part of the three replications of the soldering operation. Users must recognize that when any component is certified to one of the classifications in this document at no time in the manufacturing process, including rework, shall the component body temperature be raised above the certified temperature.

5.0 APPARATUS

The following equipment is used in the process exposures described in this document:

5.1 Temperature-Humidity chamber(s) capable of operating at $85\pm 2^\circ\text{C}/85\pm 3\%$ RH, $85\pm 2^\circ\text{C}/60\pm 3\%$ RH, and $30\pm 2^\circ\text{C}/60\pm 3\%$ RH.

5.2 Infrared (IR)/convection solder reflow equipment capable of heating the top side of components to temperatures between 220 and 245°C with a ramp-up and ramp-down rate which shall be 0 to 6°C per second. The actual ramp rate may depend on component type.

5.3 Vapor phase reflow chamber capable of operating from 217 to 220°C . The chamber must be capable of both heating the components without collapsing the vapor blanket and recondensing the vapor to minimize loss of the vapor phase soldering liquid. The vapor phase soldering fluid must vaporize at $217 (+3, -0)^\circ\text{C}$.

5.4 Since flux application is intended to simulate actual processing, flux may be applied by spray, immersion, brushing, or other appropriate method.

5.5 Wave solder or benchtop “solder pot” type equipment capable of preheating the bottom side of a test board to 125°C (minimum), heating the solder pot temperature to $260\pm 5^\circ\text{C}$ at the surface of molten solder, and keeping a component in molten solder for 10 seconds (minimum). If this equipment is not capable of maintaining upper component surface temperature above 180°C for at least 10 seconds during the soldering process, an oven capable of maintaining a temperature of $185\pm 5^\circ\text{C}$ is also needed.

5.6 Cleaning equipment capable of either spraying or immersing components with agitated aliphatic or terpene hydrocarbon at room temperature, aqueous detergent up to 65°C , and DI water up to 65°C .

5.7 Appropriate inspection and test equipment capable of performing requirements of the applicable component specification document.

5.8 Oven capable of operating at $125 (+5, -0)^\circ\text{C}$.

5.9 Temperature cycle chamber capable of operating as a minimum over the range of -40°C to $+60^\circ\text{C}$. The chamber used shall be capable of providing and controlling the specified temperatures in the working zones when the chamber is loaded with a maximum load. Worst-case load temperature shall be continually monitored during test by indicators or recorders reading the monitoring sensor(s). Direct heat conduction to specimens shall be minimized.

6.0 REQUIREMENTS

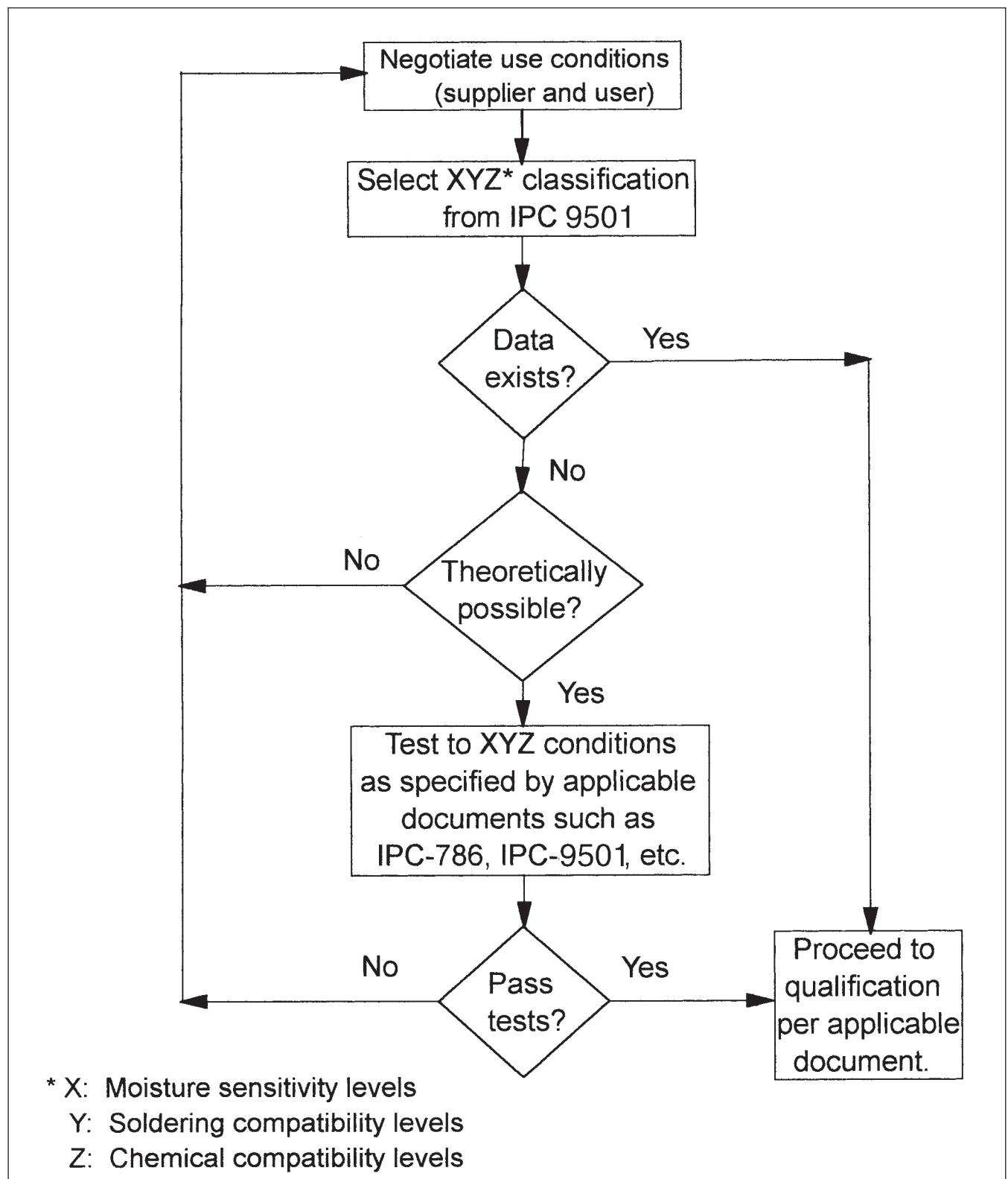


Figure 1 Application of IPC-9501

6.1 Components used in tests shall have completed all normal manufacturing processes prior to shipment, such as labelling, marking, burn-in, etc. and meet incoming requirements such as solderability per J-STD-002 and electrical performance according to device specifications.

6.2 Handling and processing precautions for ESD sensitive components such as described in EIA-541, JESD-42, or MIL-STD-1686 shall be followed at all steps on all parts processed per this specification.



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