IPC/JEDEC J-STD-033D
April 2018

Supersedes IPC/JEDEC J-STD-033C-1
August 2014

JOINT INDUSTRY STANDARD

Handling, Packing, Shipping and Use of Moisture, Reflow, and Process Sensitive Devices

Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Full document details: IPC IPC/JEDEC J-STD-033D 2018

Licensee=/, User=,
Not for Resale,

Notice

JEDEC and IPC Standards and Publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards and Publications shall not in any respect preclude any member or nonmember of JEDEC or IPC from manufacturing or selling products not conforming to such Standards and Publications, nor shall the existence of such Standards and Publications preclude their voluntary use by those other than JEDEC and IPC members, whether the standard is to be used either domestically or internationally.

Recommended Standards and Publications are adopted by JEDEC and IPC without regard to whether their adoption may involve patents on articles, materials, or processes. By such action, JEDEC and IPC do not assume any liability to any patent owner, nor do they assume any obligation whatever to parties adopting the Recommended Standard or Publication. Users are also wholly responsible for protecting themselves against all claims of liabilities for patent infringement.

The material in this joint standard was developed by the JEDEC JC-14.1 Committee on Reliability Test Methods for Packaged Devices and the IPC Plastic Chip Carrier Cracking Task Group (B-10a)

For Technical Information Contact:

JEDEC
Solid State Technology Association
3103 North 10th Street, Suite 240-S
Arlington, VA 22201-2107
Tel 703 907.0026
Fax 703 907.7501

IPC
3000 Lakeside Drive, Suite 105N
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

Please use the Standard Improvement Form shown at the end of this document.

©Copyright 2018. JEDEC Solid State Technology Association, Arlington, Virginia, and IPC, Bannockburn, Illinois, USA. All rights reserved under both international and Pan-American copyright conventions. *Any copying, scanning or other reproduction of these materials without the prior written consent of the copyright holder is strictly prohibited and constitutes infringement under the Copyright Law of the United States.*

Documents
Document Sharing Hub

Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: IPC IPC/JEDEC J-STD-033D 2018

IPC/JEDEC J-STD-033D

Handling, Packing, Shipping and Use of Moisture, Reflow, and Process Sensitive Devices

A joint standard developed by the JEDEC JC-14.1 Committee on Reliability Test Methods for Packaged Devices and the B-10a Plastic Chip Carrier Cracking Task Group of IPC

Supersedes:

IPC/JEDEC J-STD-033C-1 - August 2014
IPC/JEDEC J-STD-033C - February 2012
IPC/JEDEC J-STD-033B.1 includes Amendment 1 - January 2007
IPC/JEDEC J-STD-033B - October 2005
IPC/JEDEC J-STD-033A - July 2002
IPC/JEDEC J-STD-033 - April 1999
JEDEC JEP124
IPC-SM-786A -January 1995
IPC-SM-786 - December 1990

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

Contact:

JEDEC
Solid State Technology Association
3103 North 10th Street, Suite 240-S
Arlington, VA 22201-2107
Tel 703 907.0026
Fax 703 907.7501

IPC
3000 Lakeside Drive, Suite 105 N
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

Documents
Document Sharing Hub

Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: IPC IPC/JEDEC J-STD-033D 2018

This Page Intentionally Left Blank

Documents
Document Sharing Hub

Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Full document details: IPC IPC/JEDEC J-STD-033D 2018

Licensee=/, User=,
Not for Resale,

Acknowledgment

Any document involving a complex technology draws material from a vast number of sources across many continents. While the principal members of the Plastic Chip Carrier Cracking Task Group (B-10a) of the Packaged Electronic Components Committee (B-10) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

Plastic Chip Carrier Cracking Task Group

Chairman
Steven R. Martell
Nordson Sonoscan

JEDEC JC 14.1 Committee

Chairman
Ife Hsu
Intel Corporation

Joint Moisture Classification Working Group Members

Joseph Kane, BAE Systems Platform Solutions
Mudasir Ahmad, Cisco
Robert DiMaggio, Clariant
Mark Reese, Clariant
Francis Classe, Cypress
Chris Brigham, Evans Analytical Group
Mark Burns, Global Foundries
Shi Dan Bing, Huawei
Guo Fujan, Huawei
Jiao Huifang, Huawei
Russ Lewis, Hewlett-Packard
Curtis Grosskopf, IBM Corporation
Andreas Preussger, Infineon
Dennis Cerney, Infineon
Ife Hsu, Intel Corporation
Alan Lucero, Intel
Gautam Verma, Intel
Ken McGhee, JEDEC
Perry Keller, Keysight
Ash Kumar, Microchip
Dongie Xie, Nvidia
Bob Knoell, NXP Semiconductors
Nicholas Lycoudes, NXP Semiconductors
Stevan Hunter, On Semi
Mumtaz Bora, Peregrine Semiconductor
Richard Iodice, Raytheon Company
Jinhwan Kim, Samsung
Heon Sang Lim, Samsung
Mian Quddus, Samsung
Michelle Ogihara, Seika Machinery Inc.
Steven Martell, Sonoscan Inc.
James Berry, Texas Instruments
Larry Ting, Texas Instruments
Stephen Tisdale, Tisdale Environmental Consulting
Bruce Hughes, US Army

Additionally, we would like to express our appreciation to the JEITA members for their support in improving J-STD-033 rev D.

In Memorium

The Joint Committee would like to especially acknowledge Jack T. McCullen and Richard L. Shook for their outstanding contributions and leadership in the development of J-STD-033.

Documents
Document SharingHub

Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: IPC IPC/JEDEC J-STD-033D 2018

This Page Intentionally Left Blank

Documents
Document Sharing Hub

Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Full document details: IPC IPC/JEDEC J-STD-033D 2018

Licensee=/, User=,
Not for Resale,

Table of Contents

1 FOREWORD . . . 1
1.1 Purpose . . . 1
1.2 Scope . . . 1
1.3 Assembly Processes . . . 1
1.3.1 Mass Reflow . . . 1
1.3.2 Localized Heating . . . 1
1.3.3 Socketed Devices . . . 1
1.3.4 Point-to-Point Soldering . . . 1
1.3.5 Aqueous Cleaning . . . 1
1.4 Reliability . . . 2
1.5 Terms and Definitions . . . 2
1.5.1 Active Desiccant . . . 2
1.5.2 Bar Code Label . . . 2
1.5.3 Bulk Reflow . . . 2
1.5.4 Carrier . . . 2
1.5.5 Desiccant . . . 2
1.5.6 Floor Life . . . 2
1.5.7 Humidity Indicator Card (HIC) . . . 2
1.5.8 Manufacturer's Exposure Time (MET) . . . 2
1.5.9 Moisture-Barrier Bag (MBB) . . . 2
1.5.10 Moisture-Sensitive Identification (MSID) . . . 2
1.5.11 Moisture-Sensitivity Level (MSL) . . . 2
1.5.12 Rework . . . 2
1.5.13 Process-Sensitivity Level (PSL) . . . 2
1.5.14 Shelf Life (of a device in a sealed MBB) . . . 2
1.5.15 SMD . . . 3
1.5.16 Solder Reflow . . . 3
1.5.17 Water Vapor Transmission Rate (WVTR) . . . 3

2 APPLICABLE DOCUMENTS (Normative) . . . 3
2.1 American Society for Testing and Materials (ASTM) . . . 3
2.2 Electronic Industries Alliance (ECIA, JEDEC) . . . 3
2.3 IPC Standards . . . 3
2.4 Joint Industry Standards . . . 3
2.5 Department of Defense . . . 3

3 DRY PACKING . . . 3
3.1 Requirements . . . 3
3.2 Drying of SMD Packages and Carrier Materials Before Being Sealed in MBBs . . . 4
3.2.1 Drying Requirements - Levels 2a - 5a . . . 4
3.2.2 Drying Requirements for Carrier Materials . . . 4
3.2.3 Drying Requirements . . . 4
3.2.4 Excess Time Between Bake and Bag . . . 4
3.3 Dry Pack . . . 4
3.3.1 Description . . . 4
3.3.2 Materials . . . 4
3.3.3 Labels . . . 6
3.3.4 Moisture Barrier Bag Sealing . . . 7
3.3.5 Dry-Pack Precautions . . . 7
3.3.6 Shelf Life . . . 8

4 DRYING . . . 8
4.1 Post Exposure to Factory Ambient . . . 10
4.1.1 Any Duration Exposure . . . 10
4.1.2 Short Duration Exposure . . . 10
4.2 General Considerations for Baking . . . 11
4.2.1 High Temperature Carriers . . . 11
4.2.2 Low Temperature Carriers . . . 11
4.2.3 Paper and Plastic Container Items . . . 11
4.2.4 Bakeout Times . . . 11
4.2.5 ESD Protection . . . 11
4.2.6 Reuse of Carriers . . . 11
4.2.7 Solderability Limitations . . . 11

5 USE . . . 11
5.1 Incoming Bag Inspection . . . 11
5.1.1 Upon Receipt . . . 11
5.1.2 Device Inspection . . . 12
5.2 Floor Life . . . 12
5.3 Safe Storage . . . 12
5.3.1 Dry Pack . . . 12
5.3.2 Shelf Life . . . 12
5.3.3 Dry Atmosphere Cabinet . . . 12
5.4 Reflow . . . 12
5.4.1 Opened MBB . . . 12
5.4.2 Reflow Temperature Extremes . . . 12
5.4.3 Additional Thermal Profile Parameters . . . 13
5.4.4 Multiple Reflow . . . 13
5.4.5 Maximum Reflow Passes . . . 13
5.5 Drying Indicators . . . 13
5.5.1 Excess Humidity in Dry Pack . . . 13
5.5.2 Floor Life or Ambient Temperature/Humidity Exceeded . 13
5.5.3 Level 6 SMD Packages . . . 13

6 BOARD REWORK . . . 13
6.1 Device Removal, Rework and Remount . . . 13
6.1.1 Removal for Failure Analysis . . . 14
6.1.2 Removal and Remount . . . 14
6.2 Baking of Populated Boards . . . 14

Documents Document Sharing Hub
Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: IPC IPC/JEDEC J-STD-033D 2018

7 DERATING DUE TO FACTORY ENVIRONMENTAL CONDITIONS 14

APPENDIX A Test Method for Reversible (Type 1) RH Spots on a Humidity Indictor Card (HIC) used with Electronic Device Packaging 16

APPENDIX B Derivation of Bake Tables 17

APPENDIX C Desiccant Unit Absorption Capacity Test Method for Verification 18

APPENDIX D Changes in J-STD-033D 19

Figures

Figure 3-1 Typical Dry-Pack Configuration for Moisture-Sensitive SMD Packages in Shipping Tubes 4

Figure 3-2A Humidity Indicator Card (HIC) – Type 1 5

Figure 3-2B Humidity Indicator Card (HIC) – Type 2 5

Figure 3-3 Moisture-Sensitive Identification Label (Examples) 6

Figure 3-4A Caution Label (Examples with MSL only) 7

Figure 3-4B Caution Label (Examples with MSL and PSL) . . . 7

Figure 3-5 MBB with No Evacuation (Example) 8

Figure 3-6 MBB with Recommended Light Air Evacuation (Example) 8

Figure 3-7 MBB with Too Much (Full) Evacuation (Example) 8

Figure A-1 Photo of Testing Apparatus 16

Tables

Table 3-1 Dry-Packing Requirements 4

Table 3-2 Typical Reversible (Type 1) HIC Spot Compliance 6

Table 4-1 Reference Conditions for Drying Mounted or Unmounted SMD Packages 9

Table 4-2 Supplier Bake: Default Baking Times Used Prior to Dry Pack 10

Table 4-3 Resetting or Pausing the Floor-Life Clock at User Site 10

Table 5-1 Moisture Classification Level (MSL) and Floor Life per J-STD-020 12

Table 7-1 Recommended Equivalent Total Floor Life (days) @ 20 °C, 25 °C & 30 °C, 35 °C For ICs with Novolac, Biphenyl and Multifunctional Epoxies (Reflow at same temperature at which the device was classified) Maximum Percent Relative Humidity 15

Documents
Document Sharing Hub

Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: IPC IPC/JEDEC J-STD-033D 2018

Handling, Packing, Shipping and Use of Moisture, Reflow, and Process Sensitive Devices

1 FOREWORD

The advent of surface mount devices (SMDs) introduced a new class of quality and reliability concerns regarding damage such as "cracks and delamination" from the solder reflow process. This document describes the standardized levels of floor-life exposure for moisture/reflow sensitive SMDs along with the handling, packing and shipping requirements necessary to avoid moisture/reflow related failures. Companion documents J-STD-020, J-STD-075 and JEP113 define the classification procedure and the labeling requirements, respectively.

For moisture sensitivity, moisture from atmospheric humidity enters permeable packaging materials by diffusion. Assembly processes used to solder SMDs to printed circuit boards (PCBs) expose the entire package body to temperatures higher than 200 °C. During solder reflow, the combination of rapid moisture expansion, materials mismatch, and material interface degradation can result in cracking and/or delamination of critical interfaces within the device.

Typical solder reflow processes of concern for all devices are convection, convection/IR, infrared (IR), vapor phase (VPR), hot air rework tools, and wave solder, including full immersion.

Non-semiconductor devices may exhibit additional process sensitivities beyond moisture sensitivity such as thermal sensitivity, flux sensitivity or cleaning process sensitivity.

1.1 Purpose The purpose of this document is to provide manufacturers and users with standardized methods for handling, packing, shipping, and use of moisture/reflow and process sensitive devices that have been classified to the levels defined in J-STD-020 or J-STD-075. These methods are provided to avoid damage from moisture absorption and exposure to solder reflow temperatures that can result in yield and reliability degradation. By using these procedures, safe and damage-free reflow can be achieved. The dry-packing process defined herein provides a minimum shelf life of 12 months from the seal date.

1.2 Scope This standard applies to all devices subjected to bulk solder reflow processes during PCB assembly, including plastic encapsulated packages, process sensitive devices and other moisture sensitive devices made with moisture-permeable materials (epoxies, silicones, etc.) that are exposed to the ambient air.

1.3 Assembly Processes

1.3.1 Mass Reflow This standard applies to bulk solder reflow assembly by convection, convection/IR, infrared (IR), and vapor phase (VPR) processes. It does not apply to bulk solder reflow processes that immerse the device bodies in molten solder (e.g., wave soldering bottom mounted devices). Such processes are not allowed for many SMDs and are not covered by the device qualifications standards used as a basis for this document.

1.3.2 Localized Heating This standard also applies to moisture/reflow sensitive SMD packages that are removed or attached singly by local ambient heating, i.e., "hot air rework." See Clause 6.

1.3.3 Socketed Devices

This standard does not apply to SMD packages that are socketed and not exposed to solder reflow temperatures during either bulk reflow or rework of adjacent devices. Such SMD packages are not at risk and do not require moisture precautionary handling.

1.3.4 Point-to-Point Soldering This standard does not apply to SMD packages in which only the leads are heated to reflow the solder, e.g., hand-soldering, hot bar attach of gull wing leads, and through hole by wave soldering. The heat absorbed by the package body from such operations is typically much lower than for bulk surface mount reflow or hot air rework and moisture precautionary measures are typically not needed.

1.3.5 Aqueous Cleaning For non-cavity SMDs typical short term aqueous cleaning processes will not impact the floor life (internal moisture content). Special consideration should be given to non-hermetic cavity packages.

Documents
Document Sharing Hub
Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: IPC IPC/JEDEC J-STD-033D 2018

1.4 Reliability The methods set forth in this specification ensure that an adequate SMD package reliability can be achieved during and after the PCB assembly operation, when the SMD packages are evaluated and verified by J-STD-020, J-STD-075, and/or by JESD22-A113 plus environmental reliability testing.

Note: This specification does not address or ensure solder joint reliability of external interconnects for attached devices.

1.5 Terms and Definitions

1.5.1 Active Desiccant Desiccant that is either fresh (new) or has been baked according to the manufacturer's recommendations to renew it to original specifications.

1.5.2 Bar Code Label A label that includes information in a code consisting of parallel bars and spaces or a 2-D matrix format.

Note: For the purpose of this standard, the bar code label is on the lowest-level shipping container and includes information that describes the product, e.g., part number, quantity, lot information, supplier identification, and moisture-sensitivity level.

1.5.3 Bulk Reflow Reflow of multiple devices with simultaneous attachment by an infrared (IR), convection/IR, convection, or vapor phase reflow (VPR) process.

1.5.4 Carrier A pocket tape, tray, tube, or other container used to store and transport packaged devices.

1.5.5 Desiccant An absorbent material used to maintain a low relative humidity.

1.5.6 Floor Life The allowable time period after removal of moisture-sensitive devices from a moisture-barrier bag, dry storage, or dry bake and before the solder process.

1.5.7 Humidity Indicator Card (HIC) A card on which a moisture-sensitive chemical is applied as a spot that will make a significant, perceptible change when the indicated relative humidity is exceeded.

Note 1: Two types of HICs have been defined.

Type 1 HIC (reversible) For reversible spots the change is temporary and occurs as a change in color (hue), typically from blue (dry) to pink (wet). A perceptible change will be seen if the humidity threshold is only momentarily surpassed.

Type 2 HIC (nonreversible) For nonreversible spots the change is not temporary and can be a spot color migration outside of the spot border or some other nonreversible indicator. A nonreversible HIC includes at least a 60% RH indicator spot, but can have other nonreversible RH% indicators that do not revert after exposure to a humidity threshold.

Note 2: The HIC is packed inside the moisture-barrier bag, along with a desiccant, to aid in determining the level of moisture to which the moisture-sensitive devices have been subjected. Type 1 and Type 2 HICs that have been exposed to 60% or greater RH will no longer be considered accurate.

1.5.8 Manufacturer's Exposure Time (MET) The maximum cumulative time after bake that devices may be exposed to ambient conditions prior to shipment to end user.

1.5.9 Moisture-Barrier Bag (MBB) A bag designed to restrict the transmission of water vapor and used to pack moisture-sensitive devices.

1.5.10 Moisture-Sensitive Identification (MSID) A symbol indicating that the contents are moisture-sensitive.

1.5.11 Moisture-Sensitivity Level (MSL) A rating indicating a device's susceptibility to damage due to absorbed moisture when subjected to reflow soldering as defined in J-STD-020.

1.5.12 Rework The removal of a device for scrap, reuse, or failure analysis; the replacement of an attached device; or the heating and repositioning of a previously attached device.

1.5.13 Process-Sensitivity Level (PSL) A rating used to identify a device that is solder-process-sensitive because the device cannot be used in one or more of the base solder process conditions defined in J-STD-075.

1.5.14 Shelf Life (of a device in a sealed MBB) The allowable time that a dry-packed moisture or reflow-sensitive device can be stored in an unopened moisture-barrier bag (MBB).

Documents
Document Sharing Hub
Copyright Association Connecting Electronics Industries
Provided by IHS Markit under license with IPC
No reproduction or networking permitted without license from IHS
Licensee=/, User=,
Not for Resale,
Full document details: IPC IPC/JEDEC J-STD-033D 2018