



CHAPTER 12 DRY PACKING

Introduction

Testing for Moisture Sensitivity

Dry Packing Process and Materials

Handling Dry Packed Products

Storing Dry Packed Products

AMD's Moisture Sensitive Products by Package Type

INTRODUCTION

In designing packing materials and methodologies, AMD is sensitive to the susceptibility of some packages to moisture-induced damage. The risk of this is greatest when using plastic encapsulation materials, as plastic is naturally permeable to moisture. The moisture in the package will increase or decrease to reach the relative humidity (RH) of the surrounding environment.

Controlling the moisture level in the package body is, therefore, critical in reducing the risk of moisture-induced damage. Such damage may include internal delamination of the package materials from the die and/or lead-frame/substrate or internal cracks. External cracking may also occur when components are exposed to the high temperatures and steep temperature gradients used in reflow board assembly techniques. Moisture in the package rapidly heats and vaporizes and, if there is sufficient steam due to the moisture in the package having reached a critical level, it will fracture the package to escape. This phenomenon is known as the “popcorn effect.”



Figure 12.1 Moisture-sensitive product is first baked to remove excess moisture and then packed in a dry pack bag (shown in the box) with desiccant and a humidity indicator card.

TESTING FOR MOISTURE SENSITIVITY

To better classify the moisture sensitivity of its products, AMD has adopted the IPC/JEDEC joint standard J-STD-020B. The industry has also adopted this as the standard process by which to determine the moisture sensitivity of IC components.

IPC/JEDEC Standard J-STD-020B. This test standard defines six different moisture sensitivity levels, referred to as level 1, level 2, through to level 6 (shown in *Figure 12.2 on page 12-3*). Each higher level denotes a higher level of sensitivity. Product that fails the level 1 flow is then tested at a higher level until it passes. Specific process steps in each flow subject the product to conditions designed to simulate the environment of an end-use application. Subsequent electrical testing and inspection steps determine if the device was damaged during the environmental stress steps.

The only difference between each J-STD-020B flow is the parameters of the moisture soak step (also known as preconditioning). These parameters are designed to allow the component to absorb as much moisture as it can, given its package size. The purpose of the testing is to determine the safe environmental conditions for product exposure.

Once it is determined that the product is moisture sensitive (i.e., it fails the level 1 flow), AMD dry packs the product for storage and shipment. This is done regardless of the type of product carrier used (e.g., tubes, trays, reels, etc.). Dry packing protects the product from environmental moisture by maintaining the interior of the moisture barrier bag at 10 percent RH or less. This is in compliance to the requirements delineated in IPC/JEDEC Standard J-STD-033.

Moisture Sensitivity Levels

Level	Floor Life		Standard Soak Requirements	
	Time	Conditions	Time (hours)	Conditions
1	Unlimited	$\leq 30^{\circ}/85\% \text{ RH}$	168 +5/-0	85°C/85% RH
2	1 year	$\leq 30^{\circ}/60\% \text{ RH}$	168 +5/-0	30°C/60% RH
2a	4 weeks	$\leq 30^{\circ}/60\% \text{ RH}$	696 +5/-0 ¹	30°C/60% RH
3	168 hours	$\leq 30^{\circ}/60\% \text{ RH}$	192 +5/-0 ¹	30°C/60% RH
4	72 hours	$\leq 30^{\circ}/60\% \text{ RH}$	96 +5/-0 ¹	30°C/60% RH
5	48 hours	$\leq 30^{\circ}/60\% \text{ RH}$	72 +5/-0 ¹	30°C/60% RH
5a	24 hours	$\leq 30^{\circ}/60\% \text{ RH}$	48 +5/-0 ¹	30°C/60% RH
6	Time on Label	$\leq 30^{\circ}/60\% \text{ RH}$	Time on Label	30°C/60% RH

Notes:

- 1 The standard soak time includes a default value of 24 hours for manufacturer's exposure time (MET) between bake and bag and includes the maximum time allowed out of the bag at the distributor's facility.

If the actual MET is less than 24 hours the soak time may be reduced. For soak conditions of 30°C/60% RH the soak time is reduced by 1 hour for each hour the MET is less than 24 hours. For soak conditions of 60°C/60% RH, the soak time is reduced by 1 hour for each 5 hours the MET is less than 24 hours.

If the actual MET is greater than 24 hours the soak time must be increased. If soak conditions are 30°C/60% RH, the soak time is increased 1 hour for each hour that the actual MET exceeds 24 hours. If soak conditions are 60°C/60% RH, the soak time is increased 1 hour for each 5 hours that the actual MET exceeds 24 hours.

Figure 12.2 Moisture sensitivity levels as defined in IPC/JEDEC J-STD-020B.

DRY PACKING PROCESS AND MATERIALS

The first step in the dry pack process is to remove any moisture buildup in the package by baking the finished product for 4.5 to 16 hours, depending on the package type, at 125°C ± 5°C. While baking, the product is in a device carrier made of materials that can withstand the high temperature, such as a *metal* tube or *bakable* tray. Within 24 hours after baking, the product is sealed in a moisture barrier bag.

AMD's dry packing process and materials meet the requirements defined in IPC/JEDEC J-STD-033A.

Moisture Barrier Bag. The moisture barrier bag that AMD uses is in compliance with IPC/JEDEC J-STD-033A. It is designed with three laminated layers, consisting of:

- An inner layer of nylon, which has a static-dissipative coating
- A second layer of aluminum foil
- A third layer of polyethylene, which has a static-dissipative coating

AMD's moisture barrier bag meets the requirements specified in MIL-PRF-81705D, Type I, Class 1 for flexibility, ESD protection, mechanical strength, and puncture resistance. Furthermore, the bag complies with the drop test requirements defined in ASTM D 4169-94 and the water vapor transmission rate defined in ASTM F-1249.

All bags are coated with antistatic material to provide ESD protection on all surfaces and to comply with the requirements set forth in EIA 625.

Humidity Indicator Card. A card that has humidity-sensitive elements that turn from blue to pink whenever the specific RH level is exceeded (see *Figure 12.3*) is included in each moisture barrier bag. The card can be reused if all the humidity-sensitive elements are blue. If one has turned pink, bake the card at $125^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 15 minutes. The humidity indicator cards used by AMD meet the standards specified in MIL-I-18835.

Desiccant. Also included in the moisture barrier bag are desiccant pouches, the quantity of which depends upon the size of the bag used. The desiccant that AMD uses exceeds the rigid standards of Military Specification D-3464D, Type II. It is a molecular sieve desiccant packed in Tyvek™, spun-bonded, polyolefin type II pouches.

Testing confirms that desiccant pouches placed in the bag greatly reduce the presence of moisture. The desiccant pouches help to maintain the environment in the bag at no greater than 10 percent RH, thus protecting the devices during shipment and storage for at least 12 months.

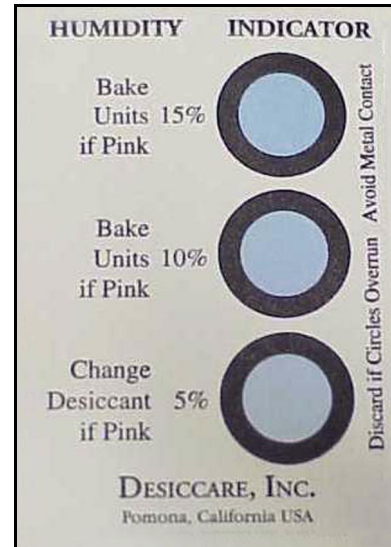


Figure 12.3 A humidity indicator card is included in the moisture barrier bag.

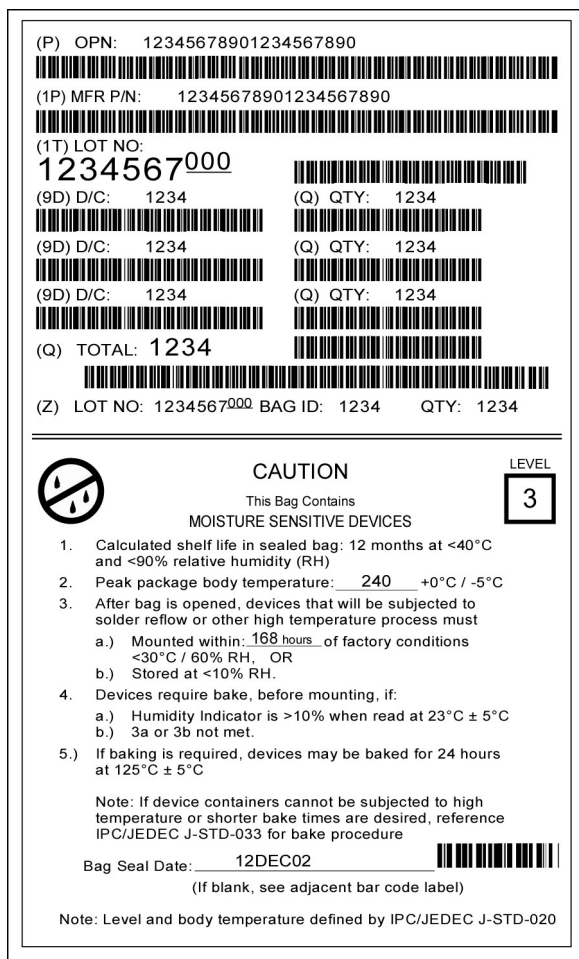


Figure 12.4 A moisture barrier label (an example for level 3 sensitive product shown here) is applied to the outside of the dry pack bag.

Dry Pack Labels. Figure 12.4 shows an example of the label that is applied to the outside of every moisture barrier bag. The label identifies the contents of the bag by specifying the ordering part number (OPN), manufacturing part number, lot number, product date code(s), and quantity per date code. It also specifies the date the bag was sealed, as well as product handling guidelines.

In the example shown in *Figure 12.4*, the product is rated at a level 3 sensitivity. This rating level as shown in the top right corner, as well as the corresponding out-of-bag time stated in item 3a (168 hours in this example) and the peak package body temperature stated in item 2 (240°C in this example), varies to reflect the specific product in the bag.

A small moisture-sensitive ID label is also applied to the outside of the box in which the dry-packed parts are packed (see *Figure 12.5 on page 12-5*).

Handling Dry Packed Products. When the moisture barrier bag is opened, the desired quantity of units should be removed and the bag resealed within one hour. If the bag is left open longer than an hour, the desiccant should be replaced with dry desiccant.

Once the moisture barrier bag is opened, the total exposure time to the factory environment, prior to mounting the parts onto a circuit board, should not exceed the recommended time specified on the dry pack caution label (see item 3a in *Figure 12.4*).



Figure 12.5 A moisture-sensitive ID label is applied to the outside of the box in which the dry-packed parts are packed.

This out-of-bag time varies depending upon the moisture-sensitivity rating for the product and is based upon assumptions made about the factory environment to which the product is exposed. Adjustments should be made to the out-of-bag time if the factory environment is harsher than that which is specified on the dry pack caution label (e.g., a higher RH level).

Baking of the product is required if (1) the out-of-bag time from initial exposure to board mounting is exceeded; (2) the out-of-bag product has been stored at an RH of 10% or greater; or (3) the humidity indicator card is greater than 10% when read at $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$.

If shipped in high-temperature carriers such as *metal* tubes or *bakable* trays, the product may be baked at $125^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 24 hours before use. Refer to IPC/JEDEC J-STD-033 for the bake procedure if the device carrier cannot withstand this high temperature. The *trays* in which AMD ships all plastic packages can withstand the 125°C temperature.

STORING DRY PACKED PRODUCTS

Product in sealed moisture barrier bags should be stored in an environment with the temperature less than 40°C and the relative humidity less than 90 percent.

If the moisture barrier bag has been opened, within one hour, reseal the bag containing the device(s), the desiccant pouches, and the humidity card.

If the bag is not resealed, the devices can be stored indefinitely in a dry storage chamber that is maintained at a 5 percent RH level or less. The dry storage chamber and its shelves should be grounded.

A summary of AMD's moisture-sensitive products (i.e., rated *above* level 1) is shown on *page 12-6*. Dry packing is available for other packages upon request only.

Because the moisture sensitivity of products in the same package and leadcount may vary due to the different die-size-to-package-size ratios, customers should rely on the dry pack label for information specific to the product contained within.

AMD's Moisture Sensitive Products by Package Type

Package Type	Ballcount/Leadcount	JEDEC Level	Out-of-Bag Time
LQFP (PDL, PQL)	All	3	168 hrs
OBGA, flipchip (OBF, OLF)	All	4	72 hrs
PBGA (BGA, BGD, BGT, LBA, LBB)	BGA, BGD, BGT (all ballcounts)	4	72 hrs
	LBA 176, LBA 399, LBA 424, LBB 324	3	168 hrs
PLCC (PL, PLH)	032	2	1 year
	≥ 044	3	168 hrs
PQFP Metric (PDE, PDH, PQR, PRH)	144, 208	4	72 hrs
	All others	3	168 hrs
PQFP English (PQB)	100, 132	3	168 hrs
SOIC (SO, SOW)	SO 044	3	168 hrs
	SOW 028	2	1 year
SSOP (SSO)	056	3	168 hrs
TQFP (PQT)	All	3	168 hrs

Notes:

- 1 The factory environment for all packages is $\leq 30^{\circ}\text{C}$, 60% RH.