



TECHNICAL REPORT

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Superseding GEIA-STD-0003

(R) Long Term Storage of Electronic Devices

RATIONALE

An extensive review of the first release of the Long Term Storage (LTS) document was accomplished to strengthen the document as a standard. The primary areas of enhancement were to the long term storage control requirements and the appendixes with guidelines for executing these requirements. Updating of the storage level protection was clarified to improve the decision flow to which primarily electronic devices are to be stored. Desiccant requirements were clarified and guidelines were added to assist in selecting the desiccant.

FOREWORD

Some electronic device users have the need to store electronic devices for long periods of time. Lifetime buys are commonly made to support production runs of assemblies that well exceed the production timeframe of its individual parts. This puts the user in a situation requiring appropriate storage of such parts to maintain the as-received solderability and minimize any other degradation effects to the part over time. Major degradation concerns are moisture, electrostatic fields, ultra violet light, large variations in temperature, air-borne contaminants, and out-gassing.

Warranties and sparing also present a challenge for the user or repair agency as some systems have been designated to be used for long periods of time, in some cases for up to 40 years or more. Some of the devices needed for repair of these systems will not be available from the original supplier for the lifetime of the system or the spare assembly may be built with the original production run but then require long term storage. This document was developed to provide a standard for storing electronic devices for long periods of time. This document is also intended to utilize consistent language in order to avoid conflicts with other industry standards (e.g., JEP160) and International standards (IED 62435-1,). See IPC/JEDEC J-STD-033 for storage of devices that are moisture sensitive but that do not need to be stored for long periods of time.

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1. SCOPE

1.1 Purpose

This document provides an industry standard for Long Term Storage (LTS) of electronic devices by drawing from the best long term storage practices currently known. LTS is defined as any device storage for more than 12 months but typically allows for much longer (years). While intended to address the storage of unpackaged semiconductors and packaged electronic devices, nothing in this standard precludes the storage of other items under the storage levels defined herein. This standard is not intended to address built-in failure mechanisms (e.g., tin whiskers, plating diffusion, and intermetallics) that would take place regardless of storage conditions

2. REFERENCES

2.1 Applicable Document

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 Military

MIL-PRF-27401	Propellant Pressurizing Agent, Nitrogen
MIL-PRF-81705	Barrier Materials, Flexible, Electrostatic Protective, Heat-Sealable.
MIL-D-3464	Military Specification, Desiccants, Activated, Bagged, Packaging Use and Static Dehumidification

2.1.2 Industry

JESD625	Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices. (Electronic Industries Alliance, JEDEC Solid State Technology Association)
IPC/JEDEC J-STD-033	Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices. (Electronic Industries Alliance, JEDEC Solid State Technology Association)
JEP160	Long Term Storage for Electronic Solid-State Wafers, Dice, and Devices. (Electronic Industries Alliance, JEDEC Solid State Technology Association)
JESD88	JEDEC Dictionary of Terms for Solid State Technology – 6 th Edition

2.1.3 International

IEC 62435-1	International Electrotechnical Commission – Electronic Components – Long-term storage of electronic semiconductor devices, Part 5 – Die & Wafer Storage
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2.2 Definitions

Sections 2.2.1 thru 2.2.11 provide definitions of specific terms used in this document. These terms plus any others used in the document follow the definitions provided in JESD88, the JEDEC Dictionary of Terms for Solid-State Technology.

2.2.1 PACKAGED ELECTRONIC DEVICES

Electronic devices are defined as any packaged electrical, electronic, electro-mechanical (EEE) item, or assemblies using such items.

2.2.2 UNPACKAGED SEMICONDUCTORS

Unpackaged semiconductors are semiconductor wafer or dice.

2.2.3 USER

The user of this long term storage standard may be any organization or entity who would store electronic devices or unpackaged semiconductors.

2.2.4 SUPPLIER

The device manufacturer, the distributor or the organization or entity who originally provided the part to be stored.

2.2.5 DRY N₂ ATMOSPHERE

A dry N₂ environments is that which is in accordance with MIL-PRF-27401, Type 1 Gas, and Grade C (99.995%).

2.2.6 DRY CABINET

Dry cabinet at 5% relative humidity (RH) or less.

2.2.7 CONTAINER

Portable or fixed enclosure for electronic devices depending on type specified.

2.2.8 HUMIDITY INDICATOR CARD

A card on which a moisture-barrier chemical is printed such that it will undergo a significant, perceptible change in color (hue), typically from blue (dry) to pink (wet) when the indicated relative humidity is exceeded.

2.2.9 FRESHNESS DETERMINATION

Freshness determination is the suitability of items to the original qualities after having been placed in long term storage. This determination of suitability and verification will need to be coordinated between the storage facility and the intended customer and can either be geared for use in its intended application or specific to the capability of the device.

2.2.10 FUNCTIONAL FAILURE

Failure of a device to deliver correct output data or signals during operation (e.g., stuck-high or stuck-low output, open input or output, logic error, etc.).

2.2.11 PARAMETRIC FAILURE

An out-of-tolerance current or voltage level at an input, output, or power supply terminal of a component. Parametric failures are usually detected during input-leakage, output-voltage, power-supply-current, timing/switching, and capacitance tests.

2.3 Acronyms and Abbreviations

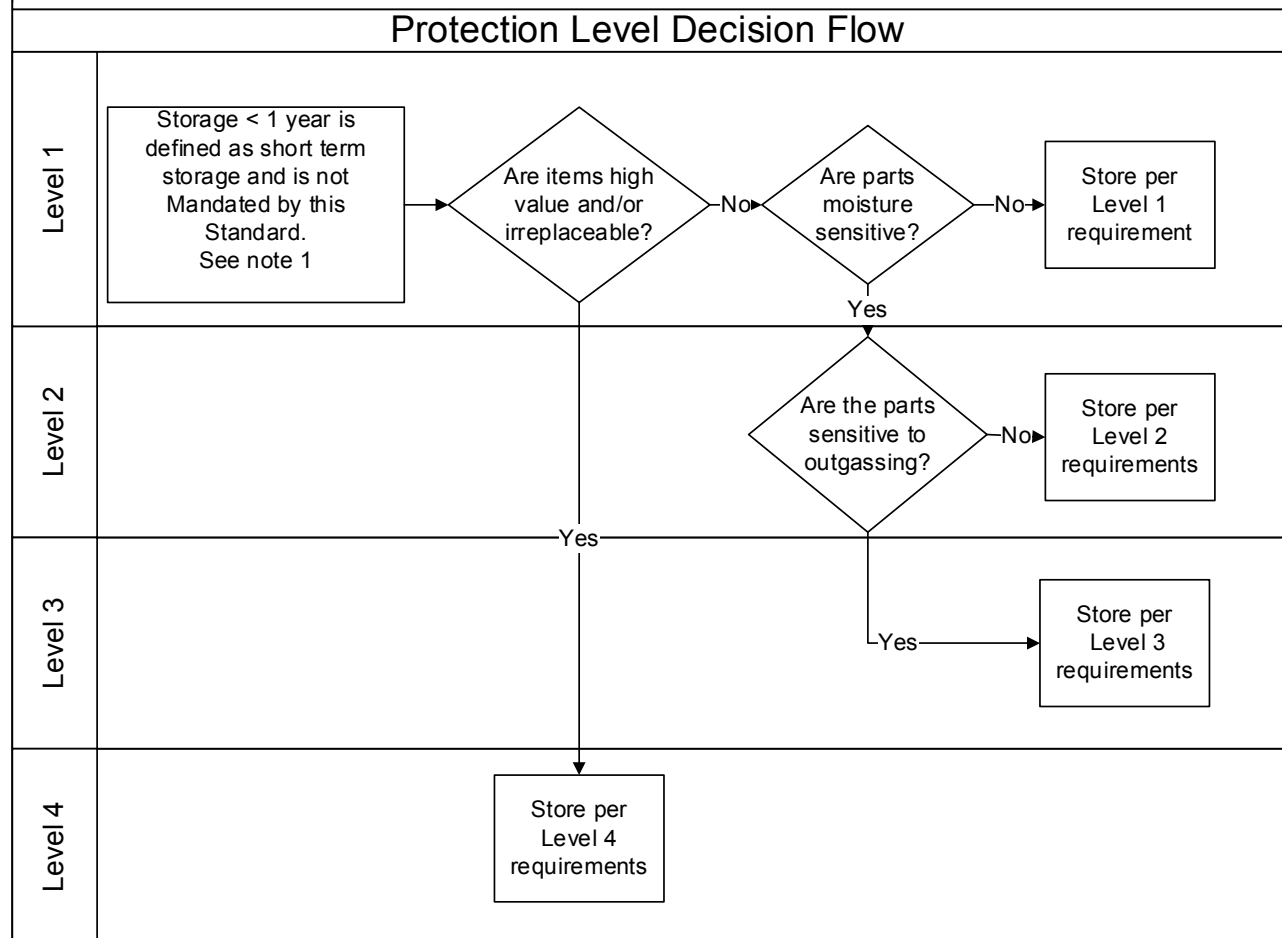
C	Celsius
CCA	Circuit Card Assembly
C of C	Certificate of Conformance
CCA	Circuit Cart Assembly
Dry N ₂	Dry Nitrogen
EEE	Electrical, Electronic, Electro-mechanical
ESD	Electrostatic Discharge
ESDS	Electrostatic Discharge Sensitive
g	grams
HIC	Humidity Indicator Card
LTS	Long Term Storage
MBB	Moisture Barrier Bag
MVTR	Moisture Vapor Transmission Rate
PEM	Plastic Encapsulated Microcircuit
QMS	Quality Management System
RH	Relative Humidity
SMD	Surface Mount Devices

3. REQUIREMENTS

3.1 Storage Conditions

- a. This standard identifies the required storage environment for specified items to be stored. This standard establishes minimum requirements for the storage of items.
- b. At a minimum, the storage environment shall be ESDS controlled (per 3.5.3b), temperature controlled (per 3.5.5a), free from high ionizing and non-ionizing radiation environments (per 3.5.3e), free from extraneous chemical contamination (per 3.5.3d and 3.5.6), humidity controlled (per 3.5.5b), and free from mechanical environments (e.g., shock and vibration) which could introduce damage. All items shall be stored in a heat-sealed Moisture Barrier Bag (MBB) or container.
- c. Protection from both ionizing and non-ionizing radiation shall be accomplished by isolating the storage environment from conditions that would produce elevated levels of each. Thus, the storage environment shall be placed/shielded away from X-ray facilities and other ionizing radiation producing areas. The storage environment shall not be placed in areas with high non-ionizing radiation (transmitters, high power lines, etc.) and sufficient shielded enclosures (e.g., Faraday cage) shall be used when measurements of the ambient environment show elevated levels.
- d. Dry Nitrogen Storage: For items that require storage in dry nitrogen (N₂), the dry N₂ atmosphere requirement is identified in 3.4.4. The dry N₂ atmosphere can be applied in one of two methods. The first method will be the backfilling of an evacuated MBB with the dry N₂. The MBB would then be placed in the specified container. The second method will have a sealed container which is sealed with positive overpressure of dry N₂ per 3.4.4. This container can be either a constant-flow container (the positive overpressure will constantly push out a small amount of dry N₂ which is replaced by fresh dry N₂) or the container can also be a constant-pressure container. With this type of container, the ambient atmosphere is evacuated and then replaced with the dry N₂.

- e. Alternate to Dry Nitrogen: Other gases may be considered besides dry nitrogen, but the user(s) would have to verify that any other gases considered would still provide the protection from corrosives (e.g., oxygen, water vapor, etc.) that dry nitrogen provides.
- f. Due to the large variety of items that could be stored, guidelines on selecting the level of protection required or desired are shown in Figure 1.
- g. There are many known and unknown degradation factors with long term storage of electronic product. Some of these can be mitigated by the requirements of this standard. The guidelines of Appendix B shall be updated when any of these factors are further identified and clarified in regard to their effect on the requirements of this standard. Those factors which cannot be controlled by the requirements of this standard will be separated and information provided to users of items in long term storage.
- h. The dynamic nature of the technology of electronic product could result in new approaches to long term protection. ~~Both the guidelines of Appendix B and the requirements of this document shall be updated when new technology dictates that updates are necessary.~~



NOTE 1: If a customer opts for Short Term Storage (e.g., < 1 year), they can use any method described in this Long Term Storage document or can also use other documentation specific to the item to be stored such as the device manufacturer's instructions, distributor handling guidelines or IPC/JEDEC J-STD-033 (Standard for Moisture Sensitive Surface Mount Devices (SMDs)).

Figure 1 – Protection level decision flow