BS EN 62435-5:2017

BSI Standards Publication

Electronic components — Long-term storage of electronic semiconductor devices

Part 5: Die and wafer devices

bsi.

National foreword

This British Standard is the UK implementation of EN 62435-5:2017. It is identical to IEC 62435-5:2017.

The UK participation in its preparation was entrusted to Technical Committee EPL/47, Semiconductors.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Electronic components - Long-term storage of electronic semiconductor devices - Part 5: Die and wafer devices (IEC 62435-5:2017)

Composants électroniques - Stockage de longue durée des dispositifs électroniques à semiconducteurs - Partie 5: Dispositifs de puces et plaquettes (IEC 62435-5:2017)

Elektronische Bauteile - Langzeitlagerung elektronischer Halbleiterbauelemente - Teil 5: Chip- und Wafererzeugnisse (IEC 62435-5:2017)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

The text of document 47/2328/FDIS, future edition 1 of IEC 62435-5, prepared by IEC/TC 47 "Semiconductor devices" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62435-5:2017.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2017-11-24
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2020-02-24

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62435-5:2017 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60068-2-17	NOTE	Harmonized as EN 60068-2-17.
IEC 60068-2-20	NOTE	Harmonized as EN 60068-2-20.
IEC 60749-3	NOTE	Harmonized as EN 60749-3.
IEC 60749-20-1	NOTE	Harmonized as EN 60749-20-1.
IEC 60749-21	NOTE	Harmonized as EN 60749-21.
IEC 60749-22	NOTE	Harmonized as EN 60749-22.
IEC 61340-5-1	NOTE	Harmonized as EN 61340-5-1.
IEC 61340-2-1	NOTE	Harmonized as EN 61340-2-1.
IEC/TR 62258-3	NOTE	Harmonized as CLC/TR 62258-3.
IEC 62435-1	NOTE	Harmonized as EN 62435-1.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

Publication	Year	Title	EN/HD	Year
IEC 62435-2	-	Electronic components - Long-term storage of electronic semiconductor devices - Part 2: Deterioration mechanisms	EN 62435-2	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRONIC COMPONENTS – LONG-TERM STORAGE OF ELECTRONIC SEMICONDUCTOR DEVICES –

Part 5: Die and wafer devices

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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International Standard IEC 62435-5 has been prepared by IEC technical committee 47: Semiconductor devices.

The text of this standard is based on the following documents:

FDIS	Report on voting
47/2328/FDIS	47/2351/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62435 series, published under the general title *Electronic components – Long-term storage of electronic semiconductor devices*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This document applies to the long-duration storage of electronic components.

This is a document for long-term storage (LTS) of electronic devices drawing on the best long-term storage practices currently known. For the purposes of this document, LTS is defined as any device storage whose duration may be more than 12 months for product scheduled for long duration storage. While intended to address the storage of unpackaged semiconductors and packaged electronic devices, nothing in this document precludes the storage of other items under the storage levels defined herein.

Although it has always existed to some extent, obsolescence of electronic components and particularly of integrated circuits, has become increasingly intense over the last few years.

Indeed, with the existing technological boom, the commercial life of a component has become very short compared with the life of industrial equipment such as that encountered in the aeronautical field, the railway industry or the energy sector.

The many solutions enabling obsolescence to be resolved are now identified. However, selecting one of these solutions should be preceded by a case-by-case technical and economic feasibility study, depending on whether storage is envisaged for field service or production, for example:

- remedial storage as soon as components are no longer marketed;
- preventive storage anticipating declaration of obsolescence.

Taking into account the expected life of some installations, sometimes covering several decades, the qualification times, and the unavailability costs, which can also be very high, the solution to be adopted to resolve obsolescence should often be rapidly implemented. This is why the solution retained in most cases consists in systematically storing components which are in the process of becoming obsolescent.

The technical risks of this solution are, a priori, fairly low. However, it requires perfect mastery of the implemented process and especially of the storage environment, although this mastery becomes critical when it comes to long-term storage.

All handling, protection, storage and test operations are recommended to be performed according to the state of the art.

The application of the approach proposed in this standard in no way guarantees that the stored components are in perfect operating condition at the end of this storage. It only comprises a means of minimizing potential and probable degradation factors.

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 careful and adequate storage of such parts to maintain the as-received solderability and minimize any 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 outgassing.

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.

For storage of devices that are moisture sensitive but that do not need to be stored for long periods of time, refer to IEC TR 62258-3.

Long-term storage assumes that the device is going to be placed in uninterrupted storage for a number of years. It is essential that it is useable after storage. Particular attention should be paid to storage media surrounding the devices together with the local environment.

These guidelines do not imply any warranty of product or guarantee of operation beyond the storage time given by the original device manufacturer.

The IEC 62435 series is intended to ensure that adequate reliability is achieved for devices in user applications after long-term storage. Users are encouraged to request data from suppliers to these specifications to demonstrate a successful storage life as requested by the user. These standards are not intended to address built-in failure mechanisms that would take place regardless of storage conditions.

These standards are intended to give practical guide to methods of long-term storage of electronic components where this is intentional or planned storage of product for a number of years. Storage regimes for work-in-progress production are managed according to company internal process requirements and are not detailed in this series of standards.

The IEC 62345 series includes a number of parts. Parts 1 to 4 apply to any long-term storage and contain general requirements and guidance, whereas Parts 5 to 9[1] are specific to the type of product being stored. It is intended that the product specific part should be read alongside the general requirements of Parts 1 to 4.

Electronic components requiring different storage conditions are covered separately starting with Part 5.

The structure of the IEC 62435 series as currently conceived is as follows:

Part 1 – General
Part 2 – Deterioration mechanisms
Part 3 – Data
Part 4 – Storage
Part 5 – Die and wafer devices
Part 6 – Packaged or finished devices
Part 7 – MEMS
Part 8 – Passive electronic devices
Part 9 – Special cases

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[1] Under preparation.

ELECTRONIC COMPONENTS – LONG-TERM STORAGE OF ELECTRONIC SEMICONDUCTOR DEVICES –

Part 5: Die and wafer devices

1 Scope

This part of IEC 62435, is applicable to long-term storage of die and wafer devices and establishes specific storage regimen and conditions for singulated bare die and partial or complete wafers of die including die with added structures such as redistribution layers and solder balls or bumps or other metallisation. This part also provides guidelines for special requirements and primary packaging that contain the die or wafers for handling purposes. Typically, this part is used in conjunction with IEC 62435-1 for long-term storage of devices whose duration can be more than 12 months for products scheduled for long duration storage.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62435-2, *Electronic components – long-term storage of electronic semiconductor devices – Part 2: Deterioration mechanisms*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Terms and definitions

3.1.1
storage environment
specially controlled storage area, with particular control of temperature, humidity, atmosphere and any other conditions depending on the product requirements

3.1.2
long-term storage
LTS
planned storage of components to extend the life-cycle for a duration with the intention of supporting future use

3.1.3
desiccant
hygroscopic substance used to remove moisture from an atmosphere

3.2 Abbreviations

MEMS	microelectromechanical systems
rH	relative humidity
ESD	electro-static discharge
EMR	electromagnetic radiation
RF	radio frequency
MBB	moisture barrier bag
HIC	humidity indicator card
V_T	voltage threshold
QSS	surface state charge
I_OFF	current off
V_OFF	voltage off
VCI	volatile corrosion inhibitors
ILD	inter-layer dielectric

4 Storage requirements

4.1 General

This clause details requirements for storage of dies and wafers including specific environmental options. The required environment and control for any product shall be determined according to the exposure concern detailed in Tables 1 and 2.

For example, if oxygen is determined to be a possible concern for degradation of product over the expected length of storage, then a storage environment should be selected that best reduces the risk of long-term exposure to oxygen during storage.

This section details the different storage options commonly available.

4.2 Assembly data

Care should be taken that data or information required for subsequent processing of the product, such as wafer maps, is useable after storage.

4.3 Prerequisite for storage

Only a product with a known status, including quality and functionality, shall be stored. If in wafer form, the wafer should be inked or a wafer map should be stored in a way that can be used at the end of LTS. Be aware that wafer maps on electronic media may not be retrievable at the end of the storage period and backup methods should be periodically reviewed. It should be noted that ink may also be a potential source of contamination and may require evaluation for LTS.

Where initial 100 % test of the wafer cannot be performed, an alternative method shall be used to determine the overall quality and functionality of the product to be stored. This may include sample testing or qualification of an assembled sample of product representative of the wafers being stored.

4.4 Damage to die products during long-term storage

Defects caused by mechanical damage may affect different regions of the die or wafer and should be considered when designing long-term storage schemes.

4.5 Mechanical storage conditions

In order to ensure adequate mechanical protection for die and wafers, care shall be taken in the initial placement of products in storage containers and removal from these containers after storage. Damage can easily occur during loading and unloading.

During storage, sufficient protection shall be given to the product to guard against movement or vibration. Die or wafer orientation can be important, especially for MEMS or sensor products, to minimize damage due to shock or vibration. Containers and shelving may require anti-vibration or anti-resonance mounting. Packing material should be designed to offer some degree of protection against shock or vibration.

Die and wafers shall not be inspected unless required under a specific sample programme in order to minimize the amount of handling to which the die or wafers are subjected.

Material in contact with the wafer or die surface shall ensure that there is minimal abrasion and adhesion of foreign matter to surfaces.

4.6 Long-term storage environment

These conditions are more stringent than those for short-term storage since the storage environment is critical to successful long-term storage. Packing methods suggested here may not be suitable for shipping, especially by air transportation.

This storage atmosphere is designed to exclude oxygen and limit humidity which are known deterioration sources for unencapsulated semiconductor devices. Actual failure mechanisms shall be determined according to the device being stored with reference to IEC 62435-2.

Cabinets or containers for long-term storage of die or wafers shall use the following conditions:

a) purge gas: 99 % nitrogen or inert gas (see 4.7);
b) temperature: 17 °C to 25 °C;
c) cabinet humidity: rH minimum of 7 %, maximum of 25 %;
d) pressure: slightly above ambient atmospheric pressure.

The gas pressure should be sufficiently high to prevent the ingress of external contaminants.

To control the relative humidity, it is normal for die and wafer storage environments to use high-purity nitrogen, for example, derived from a liquid source.

Relative humidity should not fall below 7 % in order to prevent build-up of electrostatic fields and should not exceed 25 % in order to prevent condensation and moisture ingress. This is important after a storage cabinet has been opened; it is normal to fit a timed purge regulator to rapidly bring the relative humidity back down after a cabinet has been opened.

Packing materials incorporating static shielding, such as metal foils, may also be used. Static dissipative coatings shall not be used since these coatings may degrade during storage and contaminate the die or wafers.

Temperature or humidity during the storage period shall be recorded and logged.

Out-of-limit temperature and humidity conditions shall be dealt with by appropriate corrective action. It is unlikely that a few minor out-of-limit excursions will permanently degrade stored products. However, these out-of-limit conditions shall be taken into account when the product is taken out of storage for use.

4.7 Recommended inert atmosphere purity

When inert gas supply for the storage environment is selected, it shall satisfy the following:

- Better than 99,5 % purity containing
  - less than 0,5 % oxygen,
  - less than 0,01 % other gases,
  - less than 10^{-6} halides, and
  - less than 10^{-6} sulphurated gases.

4.8 Chemical contamination

Die and wafers shall be protected from ionic contamination of the active area or contamination by other chemicals, bearing in mind the mobility of contaminants through semiconductor materials and the possibility of induced intermetallic growths.

Special attention shall be given to the protection of contact areas, active areas and back side contacts. Wafers such as those that use III-V materials are particularly sensitive and may need special consideration.

Any degradable packing material used for die or wafer shipping shall be removed before placing the bare die or wafers in a suitable container for long-term storage. In particular, any packing items that could give rise to chemical or particulate contamination by long-term degradation shall be removed, for example all paper, cardboard, foam or pink film. This shall include any material that has been coated with a film to reduce static (ESD coated) since the film will outgas during storage.

4.9 Vacuum packing

4.9.1 General

Vacuum packing is commonly used for shipping bare die and wafers. However, this method may not be suitable for long-term storage due to the fact that a vacuum encourages ingress of contaminants through packing materials and will degrade over time. Addition of desiccants within the primary packing may cause minor particles to be present that could damage the product.

In general, foam should not be used inside the vacuum pack since foam may release absorbed contaminants when compressed. Nitrogen-filled, closed-cell foam does not have this problem and may be used.

4.9.2 Vacuum dry pack

An industry recognised form of vacuum packing is a vacuum dry pack where a moisture barrier bag is used to contain the primary packing unit of die and wafers, complete with desiccant and HIC card. Light evacuation of the bag is preferred over full evacuation.

Refer to IEC 60749-20-1 for more information.

4.10 Positive pressure systems for packing

Packing methods that use positive pressure are inherently better than vacuum-sealed bags. However, this requires good inlet filtering and is commonly implemented by initial vacuum followed by back-fill with nitrogen to help keep major contaminants out.

4.11 Use of packing material having sacrificial properties

Packing materials are sometimes used that have sacrificial properties, for example the packing material may contain reactive copper which is designed to corrode in preference to the die device. Other sacrificial materials, such as volatile corrosion inhibitors (VCI), may also be used but often have issues related to high toxicity and environmental controls.

4.12 Use of bio-degradable material

Some packing material is deliberately bio-degradable, such as the foam commonly used in wafer jars or tubs. Packing materials that are known to deteriorate over time shall not be used since emission of chemicals during deterioration can contaminate the product.

Examples here include:

- sulphur from rubber bands;
- chlorine from cardboard and paper;
- fluorine from antistatic foam.

Some foams are designed specifically for long-term use and are not biodegradable, e.g. closed-cell foams with nitrogen filling. If using a carbon-filled variant of this type of foam, take care to ensure that the carbon is fixed in the material and cannot shed particles when compressed or disturbed.

4.13 Plasma cleaning

Plasma cleaning may be used to remove any possible contamination of the surface of wafers before they are stored, or may be used after storage to clean bond pads prior to assembly. Surface cleanliness and adhesion may be monitored using a water droplet test. Plasma process and gas shall be qualified for use on the wafers to be cleaned.

4.14 Electrical effects

Conductive or electro-static dissipative materials shall be used for packing materials and storage cabinet construction as determined from susceptibility and mitigation analysis.

Possible damage due to ESD can be caused by using inappropriate packing materials, too low RH or proximity to electro-static field sources. This can lead to p-n junction damage, oxide breakdown/puncturing, sensitive parameter shifting, changed voltage threshold (V_T) from trapped surface state charge (QSS) charge or changed current-off/voltage-off I_{off}/V_{off} parameters.

4.15 Protection from radiation

Die exposure to illumination or radiation of any kind should be limited. Care should be taken to ensure protection from nuclear radiation (high background), EMR (RF and microwave sources), ultraviolet, X-ray radiation and ambient illumination. Some die types, such as analogue devices, may be particularly sensitive.

Die storage areas are normally protected from sunlight and care should be taken to minimise common sources of radiation from items such as mobile phones, wireless communication and microwave ovens in the vicinity of the storage area.

4.16 Periodic qualification of stored die products

For long-term storage of individual dies, it is possible to qualify the condition of the stored product by sample qualification. However, this may only be appropriate where large quantities of individual die are stored since sample testing necessarily involves using up some of the stored product. Where periodic qualification is required, additional die should be stored to allow for this.

In this case, representative samples of the product should be removed from storage at predetermined time intervals. The sample die shall be checked for any signs of damage or deterioration and assembled into suitable packages for subsequent electrical tests and reliability checks. The bondability of the die shall be assessed during assembly.

Care should be taken to avoid unnecessary disturbance of stored products. A balance should be sought between the desire for periodic qualification and the need to maintain an undisturbed storage environment.

Where it is undesirable to examine the condition of the stored product, qualification of the packing may provide the required level of assurance.

To avoid opening and re-handling the stored material (which may be more damaging than storage itself), periodic qualification tests should be performed on a dedicated batch that is not intended to be used/sold at the end of the storage.

5 Long-term storage failure mechanisms

Failure mechanisms that may occur during long-term storage include:

- outgassing of packing materials causing ionic contamination;
- humidity infiltration of packing material causing metal corrosion;
- interactions between incompatible packing and/or IC materials causing hazardous reactions;
- temperature cycling causing metal fatigue, solder creep or glassification crazing;
- improper handling causing cracking, scratches or contamination to die surfaces;
- non-specific electrical or radiation events in the atmosphere causing gate oxide and metallization failures;
- piezo-electric effect – changing electrical parameters through in-built stress;
- photovoltaic effect – changing electrical parameters through imposed charge;
- electrical overstress caused by ESD or other sources of radiation.

6 LTS concerns, method, verification and limitations

6.1 General

This clause details the exposure concerns for wafers and dies and lists recommended packaging methods, verification, suitable environment and storage time limitations according to the particular exposure concern.

The exposure concern shall be determined in consultation with the original device manufacturer and/or physical analysis of the product according to the expected duration of LTS. It is recommended that IEC 62435-2 should be used to help determine which mechanisms apply to the parts being stored and hence the particular exposure concern that applies.

Refer to Clause 4 for details of the various packaging methods available.

6.2 Wafers

Table 1 lists the environmental factors that wafers are likely to be exposed to and the actions to be taken to mitigate them.

Table 1 – LTS exposure concerns for wafers

Exposure Concern	LTS Packaging Method	LTS Verification	Environment / Specifications (see Key)	Storage Time Limitation	Preconditions	Contents Verification Testing
Moisture	MBB, HIC when acceptable	HIC (when acceptable); MBB seal integrity	B and C	Based on HIC results where applicable; verification testing results	NA	Inspection [1]; Bondability (Wire) [2]; Solderability (C4 Solder) [3]
Moisture	Dry cabinet	Atmosphere flow meter	A	verification testing results	NA	
Oxygen	N_2 or inert gas backfill	Gas flow meter; ppm O_2 detection; O_2 sensors;	A	verification testing results	NA	
Oxygen	MBB without air	O_2 sensors; MBB seal integrity	B and C	verification testing results	NA	
Outgassing	N_2, inert gas, or air dry cabinet	Gas flow meter	A	verification testing results	NA	
Outgassing	MBB	MBB seal integrity	B	NA	NA	

The use of desiccant may be required for polymer based ILD or passivation layers; this should be evaluated for the product and defined by the product requirements.

Key

A: Dry cabinet storage, typically oil-free air.

B: MBB storage,

C: Nitrogen (N_2) backfill or positive-pressure MBB storage.

See IEC 62435-4: Storage (proposed)

[1] Such as IEC 60749-3 for backside inspection or other applicable inspections.

[2] Such as IEC 60749-22 for wirebond shear or related applicable testing.

[3] Such as IEC 60749-20-1 or other applicable testing.

6.3 Bare dice

Table 2 lists the environmental factors that bare dice are likely to be exposed to and the actions to be taken to mitigate them.

Table 2 – LTS exposure concerns for bare dice

Exposure concern	LTS packaging method	LTS verification	Environment / specifications (see Key)	Storage time limitation	Preconditions	Contents verification testing
Moisture	MBB; HIC when acceptable; NOTE 2	HIC (when acceptable); MBB seal integrity	B and C	Based on HIC results where applicable; verification testing results	NA	Inspection [1]; bondability (wire) [2]; Solderability (C4 solder) [3]; underfill / adhesive integrity [4]
Moisture	Dry cabinet	Atmosphere flow meter	A	verification testing results	NA	
Oxygen	N_2 or inert gas dry cabinet	Gas flow meter; ppm O_2 detection; O_2 sensors;	A	verification testing results	NA	Inspection [1]; bondability (wire) [2]; Solderability (C4 Solder) [3]
Oxygen	MBB without air	O_2 sensors; MBB seal integrity	B and C	verification testing results	NA	
Outgassing	N_2 , Inert gas, or air dry cabinet	Gas flow meter	A	verification testing results	NA	Inspection[1]; bondability (wire)[2]; Solderability (C4 solder) [3]; underfill / adhesive integrity [4]
Outgassing	MBB	MBB seal integrity	B and C	verification testing results	NA	

The use of desiccant may be required for polymer based ILD or passivation layers; this should be evaluated for the product and defined by the product requirements.

Key

A: Dry cabinet storage, typically oil-free air.

B: MBB storage,

C: Nitrogen (N_2) backfill or positive-pressure MBB storage.

See IEC 62435-4: Storage (proposed)

[1] Such as IEC 60749-3 for backside inspection or other applicable inspections.

[2] Such as IEC 60749-22 for wirebond shear or related applicable testing.

[3] Such as IEC 60749-20-1 or other applicable testing.

[4] Verification of underfill encapsulant or die attach adhesive integrity includes examination for delamination, voiding, poor fillets, etc.

7 Deterioration mechanisms specific to bare die and wafers

7.1 Wire bondability

Wire bondability can be impacted by oxides and/or contamination. Proper storage procedures are required to prevent moisture contamination from occurring.

7.2 Staining

Moisture-induced stains can be created during LTS on surfaces where the dry conditions have been compromised. Contaminants including fluorine and chlorine have been shown to enhance the creation of such stains. Stains can lead to aesthetic concerns as well as affect visual marking legibility.

7.3 Topside delamination

Moisture or chemical contamination of the surface of die may cause penetration of organic-based passivation leading to swelling or delamination of the passivation layers. This effect can normally be checked for by visual inspection.

8 Specific handling concerns

8.1 Die on wafer film frames

Die on wafer film frames can be subject to problems of removal from adhesives, which tend to change adhesive strength over time. In cases of long storage, a residue of the adhesive can remain on the rear of the die. This could be a reliability concern for dies in which the rear is used for a thermal and/or electrical connection. An adhesive residue on the rear of the die can prevent the formation of a complete solder joint or contaminate some thermal interface materials, which in turn could degrade part or all of the thermal function and/or electrical connection.

8.2 Devices and dice embossed or punched tape storage

Devices and die stored in embossed or punched tape may be subject to problems in removing the cover tape due to changes in adhesive strength over time. Industry tape adhesion testing (ASTM D 3330 or similar) can be used to evaluate changes in adhesive strength. Any LTS methodology should take into account length of storage and temperature ranges to avoid inducing issues.

8.3 Handling damage

Defects caused by handling, transportation, vibration, mechanical impact, or other mechanical influences may affect susceptible regions of the wafer, die, or device and should be considered when designing long-term storage solutions. Damage to bagged desiccant shall be avoided to eliminate loose desiccant concerns that can result in particle dispersion. Tears in the MBB can allow the external environment to compromise the LTS integrity. Shifting of trays or product can cause scuffs and debris contamination.

Annex A
(informative)

Audit checklist

Table A.1 contains questions that may be used in a planning an audit checklist.

Table A.1 – Planning checklist *(1 of 3)*

Good practice item	**Question**	**IEC 62425-5, Clause/Subclause**	**Answer**
Storage requirements		**Clause 4**	
Exposure concern	How have the exposure concerns been determined with reference to Clause 6?	**4.1**	
Exposure concern list	How have each of the applicable items in Tables 1 and 2 been checked for the method of storage? What verification testing has been done?	**4.1 and Clause 6**	
Assembly data	What data is stored that can be required for subsequent processing of the product, and how?	**4.2**	
Known status	What is the known status of the product prior to storage? Where 100% testing has not been performed, how has the functionality of the product been determined?	**4.3**	
Handling damage	How is product protected from mechanical damage during handling?	**4.5**	
Storage mechanical damage	How is product protected from mechanical damage during storage?	**4.5**	
Minimising handling	What controls are in place to ensure that product is handled as infrequently as possible during storage?	**4.5**	
Storage environment (for parts sensitive to oxygen and moisture – for other sensitivities, refer to IEC 62435-2)		**4.6 and 4.7**	
Cabinet environment	What is the purge gas purity? What temperature range is allowed? What humidity range is allowed? What is the relative pressure?	**4.6**	
Cabinet controls	After opening and closing the cabinet, how quickly does the internal atmosphere return to control conditions? What controls are in place to ensure the door is not left open for an extended period of time?	**4.6**	

Table A.1 *(2 of 3)*

Good practice item	**Question**	**IEC 62425-5, clause/subclause**	**Answer**
Control of static dissipative coatings	What products containing static dissipative coatings are allowed in the storage cabinet?	**4.6**	
Temperature and humidity logging	How is temperature and humidity measured and logged?	**4.6**	
Temperature and humidity control and alarm	When an out-of-control condition is measured how is this brought to the attention of store personnel and how is corrective action dealt with and recorded?	**4.6**	
Out-of-control events	What assessment of out-of-control events is done when product is removed from storage for use?	**4.6**	
Inert gas purity	What analysis of the inert gas is performed and how often? Does the analysis confirm the purity is within the required limits?	**4.7**	
Chemical contamination protection		**4.8**	
Ionic contamination protection	How are die and wafers protected from possible sources of ionic contamination?	**4.8**	
Packing material	What items of packing material have been identified as possible sources of ionic contamination? How have these been removed during packing for storage?	**4.8**	
Vacuum packing for storage		**4.9**	
Vacuum packing	How has vacuum packing been assessed to provide an adequate storage environment for the product?	**4.9**	
Desiccants	Have desiccants been included in the moisture barrier bag with low-air vacuum pack?	**4.9**	
Packing method	Which vacuum pack system has been used and how has this been assessed for suitability?	**4.9**	
Protection from electrical or radiation effects		**4.14 and 4.15**	
Electrical effects	What packaging material is used to minimise damage caused by electrical effects – i.e. ESD? How has the cabinet been designed in order to minimise damage caused by electrical effects – i.e. ESD?	**4.14**	
Radiation effects	How is the product protected from the effects of EMR radiation? Sunlight? RF? X-ray?	**4.15**	
Radiation effects	What sources of RF are allowed in the storage area – WiFi, mobile phones etc.?	**4.15**	

Table A.1 *(3 of 3)*

Good practice item	Question	IEC 62425-5, clause/subclause	Answer
Periodic qualification		**4.16**	
Qualification samples	Is additional product stored for qualification use and how is it controlled?	**4.16**	
Qualification periods	What time interval is used for checking stored qualification samples?	**4.16**	
Qualification tests	What qualification tests are performed?	**4.16**	
Removal of qualification samples for testing	How is the removal of qualification samples controlled so that minimal disturbance is caused to the main stored product?	**4.16**	
Packing qualification	Is the integrity of the packing method for the main product checked periodically and how is this done?	**4.16**	
Specific handling concerns		**Clause 8**	
Film frames	Is product on film frames stored?	**8.1**	
Tape and reel	Is product stored in tape and reel form? What controls are in place to ensure the cover tape does not cause problems?	**8.2**	

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[2] Under preparation.

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