

TECHNICAL SPECIFICATION

Process management for avionics – Aerospace and defence electronic systems
containing lead-free solder –
Part 4: Ball grid array (BGA) re-balling

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PROCESS MANAGEMENT FOR AVIONICS –
AEROSPACE AND DEFENCE ELECTRONIC
SYSTEMS CONTAINING LEAD-FREE SOLDER –****Part 4: Ball grid array (BGA) re-balling**

FOREWORD

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- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62647-4, which is a Technical Specification, has been prepared by IEC technical committee 107: Process management for avionics.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
107/314/DTS	107/331/RVDTS

Full information on the voting for the approval of this technical specification 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 the parts in the IEC 62647 series, published under the general title *Process management for avionics – Aerospace and defence electronic systems containing lead-free solder*, can be found on the IEC website.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

As the result of RoHS directives, soldering assembly processes have migrated predominantly from tin-lead to Pb-free, and a majority of BGA components manufacturers have converted from tin-lead solder balls to Pb-free solder balls. This has introduced well documented reliability concerns. In the case of a leaded soldering process, a solution can be to replace the Pb-free solder balls on the BGA components with tin-lead solder balls. This will prevent mixing solder alloys.

This document was prepared to standardize the requirements and guidelines for replacing the solder balls on applicable BGA components. The requirements within this document are derived from existing industry standards and a collaboration of service providers and customers, typically avionics original equipment manufacturers (OEMs).

This document is intended to be used by de-balling/re-balling providers and customers to incorporate these requirements into their operations to provide a consistent and well-controlled process, or to create a de-balling/re-balling plan that augments their existing processes.

There are two major reasons to de-ball/re-ball BGA components: alloy compatibility and replacement of damaged balls.

The customer should understand the potential risks of the BGA de-balling/re-balling process for a specific package.

To avoid reliability problems, the BGA de-balling/re-balling process should be qualified and carefully controlled to prevent the possibility of BGA failure after re-balling. Generally, automated processes contribute positively to this objective and are encouraged in the electronic industry.

This document does not guarantee a particular yield or reliability of BGA components going through the de-balling/re-balling process. BGA component construction and materials used should be evaluated for compatibility with the solder re-balling process to ensure that BGA component reliability and integrity are maintained.

Because of the dynamic nature of the transition to lead-free (Pb-free) electronics, this and other similar documents are based on the best information and expertise available; its update will be considered as future knowledge and data are obtained.

PROCESS MANAGEMENT FOR AVIONICS – AEROSPACE AND DEFENCE ELECTRONIC SYSTEMS CONTAINING LEAD-FREE SOLDER –

Part 4: Ball grid array (BGA) re-balling

1 Scope

This part of IEC 62647, which is a Technical Specification, defines the requirements for replacing solder balls on ball grid array (BGA) component packages in the context of an electronic components management plan (ECMP) for aerospace, defence and high reliability products.

NOTE 1 IEC TS 62239-1 and EIA-STD-4899 describe the electronic components management program (ECMP).

It does not apply to column grid array (CGA) components or chip scale components.

This re-balling document addresses two types of configurations. For other configuration types, see Annex A for tailoring.

- Configuration 1: A BGA package that will be de-balled and then re-balled with tin-lead balls compatible with a tin-lead soldering assembly process.
- Configuration 2: A BGA package that will be de-balled and then re-balled with Pb-free balls compatible with a Pb-free soldering assembly process.

The intent of this document is to provide re-balling companies (hereinafter referred to as the re-balling provider) with the administrative and technical requirements to be incorporated within existing processes or for establishing, implementing and maintaining a new set of processes or the creation of a stand-alone re-balling process.

This document is intended to be used by de-balling/re-balling providers and customers, typically avionics original equipment manufacturers (OEM); it defines the requirements for re-balling providers who are providing services to the aerospace, defence, high performance and high reliability electronics industry.

Requirements for new BGA component part number qualification are also included. This document identifies the need for the creation of new part numbers for re-balled BGA components, covers process and testing requirements for the de-balling/re-balling process and encourages the automated processes due to the ability to control the process.

Companies engaged in re-balling are supposed to have the necessary knowledge, experience and tools, and to customize if needed their own methods for defining a de-balling/re-balling process that meets the requirements in this document.

Each customer determines the applicability of this document and the need for full replacement of the existing solder balls. Some applications can have unique requirements that exceed the scope of this document and are therefore specified separately.

This document is not intended to address all procedures and processes associated with a de-balling/re-balling facility; it is assumed there are management, quality, manufacturing, safety, calibration and training processes/procedures in place as well as all the necessary tools and equipment to accomplish the work.

NOTE 2 For the purposes of this document, if the term “BGA” is used alone, it is stated as “BGA component”.

NOTE 3 The replacement, for example, of damaged tin-lead balls by new tin-lead balls or damaged Pb-free balls by new Pb-free balls is not specifically addressed in this document but some parts of the document and the table for tailoring the requirements (see Annex A) can be used for supporting the operations.

Although developed for the avionics industry, this process can be applied by other industrial sectors at their discretion.

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 61340-5-1, *Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements*

IEC TR 61340-5-2, *Electrostatics – Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide*

IEC 62090, *Product package labels for electronic components using bar code and two-dimensional symbologies*

IEC 62668 (all parts), *Process management for avionics – Counterfeit prevention*

AEC-Q100-010, *Solder ball shear test*

ANSI/ESD S20.20, *Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices)*

ECA/IPC/JEDEC J-STD-075, *Classification of Non-IC Electronic Components for Assembly Processes*

IPC J-STD-001, *Requirements for Soldered Electrical and Electronic Assemblies*

IPC J-STD-001xS1, *Space Applications Electronic Hardware Addendum to IPC J-STD-001x Requirements for Soldered Electrical and Electronic Assemblies*

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

IPC J-STD-004, *Requirements for Soldering Fluxes*

IPC J-STD-005, *Requirements for Soldering Pastes*

IPC/JEDEC J-STD-020, *Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface Mount Devices*

IPC/JEDEC J-STD-033, *Handling, Packing Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices*

IPC/JEDEC J-STD-035, *Acoustic Microscopy for Non-Hermetic. Encapsulated. Electronic. Components*

¹ In « IPC J-STD-001xS » the « x » refers to the issue of the IPC J-STD-001 document ; for exemple « IPC J-STD-001FS » refers to « IPC JST-001F » (issue F).

IPC-TM-650 number 2.3.25, *Test Methods Manual – Detection and Measurement of Ionizable Surface Contaminants by Resistivity of Solvent Extract (ROSE)*

JEDEC J-STD-046, *Customer Notification of Product/Process Changes by Electronic Product Suppliers*

JEDEC JESD625, *Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices*

JEDEC JESD22-A101, *Steady State Temperature Humidity Bias Life Test*

JEDEC JESD22-B101, *External visual*

JEDEC JESD22-B107, *Mark Permanency*

JEDEC JESD22-B117, *Solder Ball Shear*

JEDEC JESD213, *Standard Test Method Utilizing X-ray Fluorescence (XRF) for Analyzing Component Finishes and Solder Alloys to Determine Tin (Sn) – Lead (Pb) Content*

MIL-STD-883, *Test Method Standard: Microcircuits*

SAE AS5553, *Counterfeit Electronic Parts, Avoidance, Detection, Mitigation, and Disposition*

3 Terms and definitions **(standards.iteh.ai)**

For the purposes of this document, the following terms and definitions 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

AM

acoustic microscopy

microscopy that employs very high or ultra-high frequency ultrasound

Note 1 to entry: Acoustic microscopy is a technical field where the acoustic microscope operates non-destructively and penetrates most solid materials to make visible images of internal features, including defects such as cracks, delaminations and voids; the acoustic microscope is generally called “scanning acoustic microscope (SAM)”.

3.2

approved supplier

organization selling or supplying materiel, parts, products or provision of a service, which has been determined capable by a procuring organization to deliver throughout the lifetime of a contract

3.3

BGA

ball grid array

surface mount package wherein the balls for terminations are formed in a grid on the bottom of a package

Note 1 to entry: There are different varieties of BGA packages and solder ball technologies such as CBGA, PBGA, TBGA packages.

3.4**CBGA****ceramic ball grid array**

BGA package with a ceramic body

3.5**declaration of conformance**

document certified by a competent authority that the supplied good or service meets the required specifications

Note 1 to entry: Declaration of conformance can also be called certificate of conformance; the competent authority can be the original manufacturer of the supplied good or service.

3.6**CTE****coefficient of thermal expansion**

degree of expansion of a material divided by the change in temperature

Note 1 to entry: PCB/PWB CTE (x-y) is measured in the direction in the plane of the piece part mounting surface and is used to quantify the stresses in the solder joint arising from the differences in CTE between the piece parts and the PCB/PWB during thermal cycling. CTE (z axis) is measured in the "thickness" direction and is typically used to quantify plated through hole stress

Note 2 to entry: The term "piece part" can be used in lieu of "component".

[SOURCE: IEC TS 62647-22:2013, 3.1.8, modified – Note 2 has been added.]

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3.7**customer**

one who pays for the service or the services provided by another

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3.8**de-balling**

process operation that consists in removing the solder balls from a BGA

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3.9**HIC****humidity indicator card**

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

3.10**Pb-free****lead-free**

less than 0,1 % by weight of lead (Pb) in accordance with reduction of hazardous substances (RoHS) guidelines

[SOURCE: IEC TS 62647-1:2012, 3.8, modified – "lead-free" has been added as a second term.]

3.11**MSL****moisture sensitivity level**

alphanumeric rating indicating a plastic electronic device's susceptibility to damage due to absorbed moisture when subjected to reflow soldering as determined by IPC/JEDEC J-STD-020

3.12**OCM****original component manufacturer**

company specifying and manufacturing the electronic component

[SOURCE: IEC TS 62668-1:2016, 3.1.13]

3.13**part number**

unambiguous identifier

Note 1 to entry: A part number unambiguously identifies for example an electronic component, a design, or an equipment.

3.14**PCB****printed circuit board****PWB****printed wiring board**

substrate using conductive pathways, tracks or signal traces etched from copper sheets laminated, and allowing to connect electrically a set of electronic components to realize a circuit card

[SOURCE: IEC TS 62647-21:2013, 3.1.10]

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3.15**PBGA****plastic ball grid array**

BGA with a plastic body

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3.16**qualification by similarity**

act of qualifying a product part number based on already available testing results which have been used to deliver the qualification to another product part number whose technical characteristics are considered similar or practically similar

Note 1 to entry: Qualification by similarity may apply to a component part number when the component has package and die sizes, construction and materials which are considered to be insignificantly different from an already "qualified" component part number.

3.17**re-balling**

process operation that consists in putting back a solder ball in replacement of the previous one on a ball grid array (BGA) package

3.18**re-balling provider**

company offering de-balling and re-balling service

3.19**RoHS**

European directive dealing with the restriction of the use of certain hazardous substances

Note 1 to entry: The RoHS directive is a European Union directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment.