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BSI Standards Publication

Process management for avionics — Management plan

Part 1: Preparation and maintenance of an electronic components management plan

National foreword

This Published Document is the UK implementation of IEC/TS 62239-1:2015. It supersedes PD IEC/TS 62239-1:2012 which is now withdrawn.

The UK participation in its preparation was entrusted to Technical Committee GEL/107, Process management for avionics.

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

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Process management for avionics – Management plan – Part 1: Preparation and maintenance of an electronic components management plan

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 03.100.50; 31.020; 49.060

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PROCESS MANAGEMENT FOR AVIONICS – MANAGEMENT PLAN –

Part 1: Preparation and maintenance of an electronic components management plan

FOREWORD

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- 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 62239-1, which is a technical specification, has been prepared by IEC Technical Committee 107: Process management for avionics.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the number of “shall” requirements has been rationalized;
b) the terms “supplier”, “equipment manufacturer”, and “OEM” have been replaced by “plan owner”;
c) the term “device” has been replaced by “component”;
d) a requirement matrix has been included in Annex A, Table A.1;
e) various specifications and standards have been updated;
f) a new subclause (4.3.5.2) on mechanical stresses generated by temperature variation has been added;
g) a new subclause (4.3.10) on moisture and corrosion has been added.

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

Enquiry draft	Report on voting
107/245/DTS	107/258/RVC

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

A list of all the parts in the IEC TS 62239 series under the general title *Process management for avionics – Management plan,* 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
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This technical specification provides the structure for avionics equipment manufacturers, subcontractors, maintenance facilities, and other aerospace component users to develop their own Electronic Component Management Plans (ECMPs), hereinafter also referred to as ‘plan’. This technical specification states objectives to be accomplished. The plan is not prescriptive and those who prepare plans in compliance with this technical specification will document processes that are the most effective and efficient for them in accomplishing the objectives of this technical specification. In order to allow flexibility in implementing and updating the documented processes, plan owners are encouraged to refer to their own internal process documents instead of including detailed process documentation within their plans.

NOTE The equipment manufacturer, often called in the industry the original equipment manufacturer (OEM) is in general considered as the plan owner.

This component management technical specification is intended for aerospace users of electronic components. This technical specification is not intended for use by the manufacturers of electronic components. Components selected and managed according to the requirements of a plan compliant with this technical specification may be approved by the concerned parties for the proposed application, and for other applications with equal or less severe requirements.

Organizations that prepare such plans may prepare a single plan, and use it for all relevant products supplied by the organization, or may prepare a separate plan for each relevant product or customer.

PROCESS MANAGEMENT FOR AVIONICS – MANAGEMENT PLAN –

Part 1: Preparation and maintenance of an electronic components management plan

1 Scope

This part of IEC 62239, which is a technical specification, defines the requirements for developing an Electronic Components Management Plan (ECMP) to assure customers that all of the electronic components in the equipment of the plan owner are selected and applied in controlled processes compatible with the end application and that the technical requirements detailed in Clause 4 are accomplished.

In general, the plan owner of a complete Electronic Components Management Plan is the avionics original equipment manufacturer (OEM).

This document provides an aid in the aerospace certification process.

Although developed for the avionics industry, this process may be applied by other industrial sectors.

2 Normative references

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.

IEC 62396-1:2012, *Process management for avionics – Atmospheric radiation effects – Part 1: Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment*[1]

IEC TS 62647-1, *Process management for avionics – Aerospace and defence electronic systems containing lead-free solder – Part 1: Preparation for a lead-free control plan*

IPC/JEDEC J-STD-20*, Moisture/Reflow Sensitivity Classifications for Nonhermetic Solid State Surface Mount Devices*

3 Terms, definitions and abbreviations

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

NOTE In their plan, plan owners can use alternative definitions consistent with convention in their company.

[1] A new edition is under development. It will be published soon.

3.1 Terms and definitions

3.1.1
environment
applicable environmental conditions (as described per the equipment specification) that the equipment is able to withstand without loss or degradation in equipment performance throughout its manufacturing cycle and maintenance life (the length of which is defined by the plan owner in conjunction with customers)

3.1.2
purchased
bought outside the plan owner organization, from an independent supplier

Note 1 to entry: This indicates that the plan owner does not manufacture this in-house.

3.1.3
capable
capacity of a component to be used successfully in the intended application

3.1.4
certified
assessed to and compliant with an applicable certification body

3.1.5
characterization
process of testing a sample of components to determine the key electrical parameter values that can be expected of all produced components of the type tested

3.1.6
component application
domain of use where the component meets the design requirements

3.1.7
component manufacturer
organization responsible for the component specification and its production

3.1.8
component obsolescence
absence of availability of a component which is not procurable due to the manufacturer(s) ceasing production

Note 1 to entry: Component obsolescence management is considered as an element of component dependability.

3.1.9
component qualification
process used to demonstrate that the component is capable of meeting its specification for all the required conditions and environments

3.1.10
component quality assurance
activities and processes to provide adequate confidence that each individual component meets the performance and environmental requirements

3.1.11
component selection
process of choosing a specific component for a specific application

3.1.12
component standardization
process of developing and agreeing by consensus on uniform engineering criteria for products and methods for achieving compatibility, interoperability, interchangeability, or commonality of material

Note 1 to entry: Standardization is used to reduce proliferation of components into inventory.

3.1.13
counterfeit, verb
action of simulating, reproducing or modifying a material good or its packaging without authorization

Note 1 to entry: It is the practice of producing products which are imitations or are fake goods or services. This activity infringes the intellectual property rights of the original manufacturer and is an illegal act. Counterfeiting generally relates to wilful trade mark infringement.

[SOURCE: IEC TS 62668-1:2014, 3.1.4]

3.1.14
counterfeited component
material good imitating or copying an authentic material good which may be covered by the protection of one or more registered or confidential intellectual property rights

Note 1 to entry: A counterfeited component is one whose identity or pedigree has been altered or misrepresented by its supplier.

Identity = original manufacturer, part number, date code, lot number, testing, inspection, documentation or warranty etc.

Pedigree = origin, ownership history, storage, handling, physical condition, previous use etc.

[SOURCE: IEC TS 62668-1:2014, 3.1.5]

3.1.15
fraudulent component
electronic component produced or distributed either in violation of regional or local law or regulation, or with the intent to deceive the customer

Note 1 to entry: This includes, but is not limited to the following which are examples of components which are fraudulently sold as new ones to a customer:

(1) a stolen component;

(2) a component scrapped by the original component manufacturer (OCM) or by any user;

(3) a recycled component, that becomes a fraudulent recycled component when it is a disassembled component resold as new component (see Figure 1), where typically there is evidence of prior use and rework (e.g. solder, re-plating or lead re-attachment activity) on the package terminations;

(4) a counterfeit component, copy, imitation, full or partial substitute of brands;

(5) fraudulent designs, models, patents, software or copyright sold as being new and authentic. For example: a component whose production and distribution are not controlled by the original manufacturer;

(6) unlicensed copies of a design;

(7) a disguised component (remarking of original manufacturer name, reference date/code or other identifiers etc.), which may be a counterfeit component; see Figure 1;

(8) component without internal silicon die or with substituted silicon die which is not the original manufacturer's silicon die.

[SOURCE: IEC TS 62668-1:2014, 3.1.10]

3.1.16
dependability
capability of a product enabling it to achieve the specified functional performance at the appropriate time and for the planned duration, without damage to itself or its environment

Note 1 to entry: Dependability is generally characterised by the following four parameters: reliability, maintainability, availability, safety.

3.1.17
franchised distributor or agent
individual or corporate organization that is legally independent from the franchiser (in this case the electronic component manufacturer or OCM) and who agrees under contract to distribute products using the franchiser's name and sales network

Note 1 to entry: Distribution activities are carried out in accordance with standards set and controlled by the franchiser. Shipments against orders placed can be dispatched either direct from the OCM or the franchised distributor or agent. In other words, the franchised distributor enters into contractual agreements with one or more electronic component manufacturers to distribute and sell said components. Distribution agreements may be stipulated according to the following criteria: geographical area, type of clientele (avionics for example), maximum manufacturing lot size. Components sourced through this route are protected by the OCM's warranty and supplied with full traceability.

[SOURCE: IEC TS 62668-1:2014, 3.1.9]

3.1.18
Electronic Components Management Plan
ECMP
plan owner's document that defines the processes and practices for applying components to an equipment or range of equipment and which generally addresses all relevant aspects of controlling components during system design, development, production, and post-production support

3.1.19
electronic components
electronic parts
piece parts
electrical or electronic devices that are not subject to disassembly without destruction or impairment of design use

Note 1 to entry: Resistors, capacitors, diodes, integrated circuits, hybrids, application specific integrated circuits, wound components and relays are examples of electronic component.

3.1.20
electronic equipment
functioning electronic device produced by the plan owner, which incorporates electronic components

Note 1 to entry: End items, sub-assemblies, line-replaceable units and shop-replaceable units are examples of electronic equipment.

3.1.21
flight equipment
equipment used for the active flying of the aircraft (UAV, etc.) and associated with active flying of the aircraft such as flight recorders, etc.

Note 1 to entry: This excludes equipment fitted to the aircraft not actively involved with the flying of the aircraft, such as in-flight entertainment, galley equipment, etc.

3.1.22
NAND
Negative-AND
logic gate which produces, in digital electronics, an output that is false (0) only if all its inputs are true (1) and an output true (1) if one or both inputs are false (0)

3.1.23
NOR
Negative-OR
logic gate which produces, in digital electronics, an output that is true (1) if both the inputs are false (0) and an output false (0) if one or both inputs are true (1)

3.1.24
obsolete component
component which is no longer manufactured, and may or may not still be available

3.1.25
package type
generic package family describing the physical outline and lead style

Note 1 to entry: Plastic quad flat-package, ball grid array, chip scale package, SOIC package, SOT23, etc., are examples of package type.

3.1.26
plan owner
original design authority responsible for all aspects of the design, functionality and reliability of the delivered equipment in the intended application and responsible for writing and maintaining their specific ECMP

3.1.27
recycled component
electrical component removed from its original product or assembly and available for reuse

Note 1 to entry: The component has authentic logos, trademarks and markings. However, it typically has no output to measure the useful life remaining for its reuse. A recycled component can fail earlier than a new one when re-assembled into another product or assembly. A recycled component may also be physically or ESD damaged during the removal process.

[SOURCE: IEC TS 62668-1:2014, 3.1.17]

3.1.28
risk
measure of the potential inability to achieve overall program objectives within defined cost, schedule, and technical constraints

3.1.29
risk management
act or practice of dealing with risk that includes planning for risk, assessing (identifying and analysing) risk areas, developing risk handling options, monitoring risks to determine how risks have changed, and documenting the overall risk management program

3.1.30
single event effect
SEE
response of a component caused by the impact of a single particle (for example galactic cosmic rays, solar energetic particles, energetic neutrons and protons)

Note 1 to entry: The range of responses can include both non-destructive (for example upset) and destructive (for example latch-up or gate rupture) phenomena.

[SOURCE: IEC 62396-1:2012, 3.48]

3.1.31
subcontractor assembly facilities
location where the subcontractor conducts assembly processes and uses approved test equipment to the plan owners drawings and bills of material and test specifications without owning the intellectual property rights to the equipment

3.1.32
subcontractor
person or entity to whom the holder of obligations under a contract has delegated part or all of such obligations

3.1.33
substitute component
component used as a replacement in equipment after the equipment design has been approved

Note 1 to entry: In some contexts, the term “alternate component” is used to describe a substitute component that is equal to or better than the original component.

3.1.34
suspect component
electronic component which has lost supply chain traceability back to the original manufacturer and which may have been misrepresented by the supplier or manufacturer and may meet the definition of fraudulent or counterfeit component

Note 1 to entry: Suspect components may include but are not limited to:

(1) counterfeit components;

(2) recycled components coming from uncontrolled recycling operations carried outside of the OEM. Franchised network and OEM business where typically it has been fraudulently sold to the OEM as being in a new unused condition.

[SOURCE: IEC TS 62668-1:2014, 3.1.21]

3.1.35
validation
method of qualifying components at the plan owner, when no in-service data from prior use is available and there is no manufacturer’s qualification data to analyse

3.2 Abbreviations

AQEC	Aerospace qualified electronic component (see IEC TS 62564-1)
BGA	Ball grid array (related to an electronic component package)
COTS	Commercial off the shelf
DDR	Double data rate
DMSMS	Diminishing manufacturing sources and materials shortages
DPMO	Defects per million opportunities
DRAM	Dynamic random access memory
DLA	Defence Logistics Agency
DSCC	Defence Supply Centre Columbus (now known as the DLA)
ECMP	Electronic Components Management Plan
EM	Electro-migration
EMC	Electromagnetic compatibility
ESS	Environmental stress screening
FPGA	Field-programmable gate array
H3TRB	High humidity, high temperature reverse bias
HAST	Highly accelerate stress testing
HCI	Hot carrier injection
HTOL	High temperature operating life
HTRB	High temperature reverse bias

IATF	International Automotive Task Force
IECQ	International electrotechnical system quality
ILD	Inter-level dielectric
IMD	Intra-metal dielectric
JEDEC	Joint Electron Device Engineering Council
LCC	Leadless chip carrier (related to an electronic component package)
MRAM	Magnetic random access memory
OEM	Original equipment manufacturer
OCM	Original component manufacturer
PCB	Printed circuit board
PCN	Product/process change notice (in this abbreviation “Product” stands for “electronic component”)
RH	Relative humidity
SDRAM	Synchronous dynamic random access memory
SEE	Single event effects
SMT	Surface-mount technology
SRAM	Static random access memory
STACK	STACK International, a non-profit consortium
TDDB	Time dependent dielectric breakdown
THB	Temperature humidity bias
UAV	Unmanned avionic vehicle

4 Technical requirements

4.1 General

The plan shall document the processes used by the plan owner to accomplish the following requirements which apply to all electronic components, including off-the-shelf components, which are defined by the component manufacturer's data sheet, and custom components, which are defined by the plan owner:

a) component selection;
b) component application;
c) component qualification;
d) component quality assurance;
e) component dependability;
f) component compatibility with the equipment manufacturing process;
g) component data;
h) configuration control.

Table A.1 provides a requirements matrix that may be used to document the accomplishments of the technical requirements for this part of IEC TS 62239-1.

Table D.1 provides guidelines for environmental protection techniques to be considered during the avionics design process.

4.2 Component selection

4.2.1 General

All components shall be selected according to documented processes and satisfy the requirements of 4.2 regardless of additional criteria such as standardisation, order of preference, etc.

Because of the highly individual nature of most plan owners' administrative processes, no detail is included here. Component selection can include the use of a preferred COTS component list, provided the requirements of 4.2 are met when the components are placed onto the standard list. Components should then be selected from the standard list for use in specific applications. The selection process may include levels of preference. This may refer to another process document describing how components are selected. A preference list can be included in a contract document.

It is recommended that component selection utilize the following criteria:

– minimal number of component types;
– selection of components from those readily available and produced in large volume;
– selection of components from those in a preferred stage of their lifecycle.

4.2.2 Application conditions for use

The conditions for use of the component shall be adequately identified from the component specification based on the component manufacturer's data sheet and any additional requirements to ensure suitability in the end application.

4.2.3 Availability and durability

From the selection level, availability and durability shall be considered as major component selection criteria.

4.2.4 Additional performance

Components shall be selected within temperature ranges in excess of or matching the temperature range required in the application, see 4.3.4.

Components which meet the requirements of IEC TS 62686-1 need to be applied in avionics applications with caution as they may not necessarily meet the full requirements of 4.3 (component application) and 4.6 (component dependability). In some applications an AQEC component in conformity with IEC TS 62564-1 or a custom component with special design characteristics or special screening may be required instead. Users need to demonstrate why IEC TS 62686-1 components can be successfully used in avionics applications. Such demonstrations may include (1) the analysis of component field history of similar equipment in similar avionics applications, (2) unit qualification testing of similar equipment, (3) component qualification testing, (4) other analysis etc.

The use of AQEC components to IEC TS 62564-1 (see 4.4.5.3.2.3) may be considered where there are no off-the-shelf components available which will operate within the temperature limits required.

If additional performance is required (for example upscreening, uprating, additional parameters defined), then the component shall be considered as a specific one and be uniquely identified. (See thermal analysis, 4.3.4.)

4.2.5 Component identification

Each selected component shall be comprehensively identified within the selection process.

NOTE Associated component data and information are addressed in 4.8.2.

4.3 Component application

4.3.1 General

4.3.1.1 Application processes

Listed here are some categories of component application processes that may be documented in a plan. Not all of the categories listed below are relevant to every component application; therefore, the requirements listed below are applicable only if relevant to the given application. The plan shall:

1) Document the processes that are expected to be applicable to the majority of the plan owner's products, with the understanding that some of the documented processes may not be used for specific programs or specific functionality of products.
2) Verify if the equipment containing the component is capable of continuing to meet its performance requirements and specifications throughout the manufacturing, full service storage, and operating lifetime.

Table D.1 provides more information on environmental protection techniques which may be relevant.

4.3.1.2 Design reviews

In order to determine the design suitability of equipment, there shall be a formal design review where the application technical design aspects given below in 4.3.2 to 4.3.11 are documented for each component.

The following application processes are not specific to an individual component, but are typically encountered when the component is placed into a circuit assembly.

4.3.2 Electromagnetic compatibility (EMC)

EMC is demonstrated by analysis, testing and simulation to customer requirements. The component performance shall be capable of EMC compliance at equipment level.

Certain components, for example high power switching components, may produce more electromagnetic signal than other types and additionally certain components can be more susceptible to electromagnetic interference than others. EMC aspects at electronic component level have been addressed in the IEC 61967 series and IEC 62132 series. Testing is typically carried out at electronic equipment level.

4.3.3 Derating and stress analysis

4.3.3.1 Verification of derating criteria

The documented processes shall verify that the component is used within the operating limits specified by the original component manufacturer according to a documented set of derating criteria, based wherever possible on the component manufacturer's derating criteria and methods and thereafter using the plan owner's appropriate derating criteria and methods.

4.3.3.2 Failure to meet derating criteria

All instances in which a component fails to meet the derating criteria above (see 4.3.3.1) shall be documented in the design records, with the corrective action, or the justification for not satisfying the criteria shall be documented.

Derating methods that can be used in avionics applications can be found in JEP149. Components handled in the manner described in JEP149 are considered to be used within the specification limits provided by the manufacturer, if internal parameters and technical data

used for component thermal modelling (which encompasses the application) are documented with the component manufacturer data. JEP149 outlines two important analyses related to thermal considerations of the application: reliability and functional performance, both of which employ a process utilizing junction temperature analysis. These analyses may require information from the component manufacturer not provided in published data sheets. In these cases, the manufacturer shall be contacted to determine the data needed to support appropriate application of the component with regard to these issues.

NOTE Derating the device stressors can mitigate semiconductor wear out mechanisms (see 4.6.7) and could enable improvement of both the device reliability and the device operating life capability. The derating can take several forms which include voltage derating, operating frequency reduction, component held in standby till the required reduction of power is dissipated and environment improvement. Methods of thermal derating of semiconductor devices are detailed in JEP149 and methods for determining acceleration factors form testing in JESD91.

4.3.3.3 Components operation

4.3.3.3.1 Component used inside the original component manufacturers' specifications

The use of components within their specifications as defined and guaranteed by the original component manufacturer shall be implemented before considering alternative high risk solutions such as uprating (see 4.3.3.3.2).

4.3.3.3.2 Component used outside the original component manufacturers' specifications (uprating process)

The use of components outside the original component manufacturers' operating specifications (thermal, voltage, frequency, etc) is strongly discouraged.

Where no components are available that are functionally appropriate and operate with the limits specified, the use of AQEC components (see 4.4.5.3.2.3) to IEC TS 62564-1, within a wider range may be considered. Where such components are not available then the plan owner is to contact the original component manufacturer to determine if they are willing to produce a suitable AQEC component or to perform the uprating process (custom part number or creation of a new COTS component). The above processes are to be followed before the plan owner considers using his own uprating process.

If components are used outside the original component manufacturers' operating specifications and uprated by the plan owner, the plan owner shall implement a capability assessment process including risks assessment and risks mitigation in the application. The plan owner shall demonstrate how the uprating process is controlled.

NOTE Temperature uprating is addressed in 4.3.4.2.

4.3.3.3.3 Identification of uprated component

A list of these components used outside the operating limits specified by the original component manufacturer shall be clearly identified by the plan owner with specific component references and custom drawings. The customer shall be notified of this list upon request.

4.3.4 Thermal analysis

4.3.4.1 Thermal suitability verification

The documented processes shall verify that the component is used within the temperature limits specified by the original component manufacturer, or by the plan owner.

Where no components are available that are functionally appropriate and operate within the limits specified, the use of AQEC components (see 4.4.5.3.2.3) to IEC TS 62564-1, within a wider range may be considered. Where such components are not available then the plan owner can contact the original component manufacturer to determine if they are willing to

produce a suitable AQEC component or to perform the uprating process (custom part number or creation of a new COTS component). The above processes are preferred before the plan owner considers using its own uprating process (see 4.3.4.2).

4.3.4.2 Temperature uprating

4.3.4.2.1 General

The use of components outside the temperature ranges specified by the original component manufacturer is strongly discouraged.

4.3.4.2.2 Component temperature uprating process

If components are used outside the temperature ranges specified by the original component manufacturer and uprated by the plan owner, then the plan owner shall implement a capability assessment process including risks assessment and risks mitigation in the application. The plan owner shall demonstrate how the temperature uprating process is controlled. Recommendations and guidelines on how to do this are contained in IEC TR 62240-1 and may be used in addition to the plan prepared according to this technical specification (refer to 4.3.3.3). Note that use of IEC TR 62240-1 is a non-preferred technique. Equivalent procedures from other documents may also be permissible if justified.

NOTE 1 A common maximum temperature for semiconductor devices is the junction temperature. In some instances, other limiting temperatures can be specified for semiconductor devices driven by physical properties of materials used in packaging, bond pad and lead frame, etc., and other types of components. When the application thermal analysis has successfully implemented the thermal and stress analysis process outlined in 4.3.3, in accordance with the component manufacturer, the component is considered to be used within the manufacturer's rating.

NOTE 2 In some instances, the manufacturer does not specify the maximum temperature. However, the maximum temperature can be calculated from other information supplied by the component manufacturer.

NOTE 3 Verification processes can include analysis, modelling, thermal survey, simulation, or testing. Testing is typically carried out at electronic equipment level.

4.3.5 Mechanical analysis

4.3.5.1 Mechanical stresses

The documented processes shall verify that the component is mechanically compatible with the application, including mechanical fit, and has the ability to withstand vibration, and mechanical shock.

NOTE Verification processes can include analysis, modelling, simulation, or testing.

4.3.5.2 Mechanical stresses generated by temperature variation (cycling)

The documented processes shall verify that the component is compatible with the mechanical stresses generated by mismatches of coefficients of thermal expansion of the different materials throughout the application lifetime.

NOTE Verification processes can include analysis, modelling, simulation, or testing.

4.3.6 Testing, testability, and maintainability

The documented processes shall assure testability and maintainability of the equipment by the plan owner.

The focus here is on testing and testability with regard to component verification, not on software or system verification. Examples include board level or sub-assembly level testing, provision for test pins, and ensuring that other equipment level tests will be available to verify component function at the appropriate level. Exhaustive testing of complex components is not always realistic, but documented processes should assure some level of evaluation of all components at appropriate points in the production flow.

This requirement also includes design for maintainability, for example, placement for ease of component replacement, mounting that minimises the risk of damage during maintenance and assures equipment quality following maintenance or repair by the plan owner.

4.3.7 Avionics radiation environment

4.3.7.1 General

The documented processes shall verify that the components will operate successfully in the application with regard to the effects of atmospheric radiation on them in accordance with Clause 9 (SEE compliance) of IEC 62396-1:2012 and with reference to the other parts of the IEC 62396 series.

These effects include various types of single event effects (SEE), such as single event upset (SEU), single event latch-up (SEL), single event burn-out (SEB) and single event functional interrupt (SEFI). If radiation effects are accommodated by the equipment design, then the method of accommodation needs to be documented in the equipment design records. Guidance on the effects of atmospheric radiation may be found in the IEC 62396 series. The effects of atmospheric radiation and their accommodation shall be assessed and documented.

The SEE assessment is achieved through quantifying the SEE rates in avionics systems in accordance with IEC 62396-1, based on:

a) the atmospheric neutron environment;

b) the components in a given system;

c) the SEE response of those components to energetic neutrons.

NOTE The SEE response of devices is complicated and has been shown to increase significantly with advancing integrated circuit technologies, for example, reduced feature size. Thus for feature sizes of < 35 nm in SRAMs, all neutron interactions are expected to result in two or more upsets within the memory array compared to technologies of >150 nm where approximately 3 % to 5 % of the interactions resulted in multi-cell upsets. In a similar manner different revisions of the same component (identical part number) incorporating modifications in their die fabrication process, can dramatically change from no sensitivity to a pronounced SEE sensitivity.

4.3.7.2 Induced radiation

When avionics electronics is subject to large amounts of total dose radiation, for example as a result of structural X-rays analysis or of X-ray inspection in the electronic board assembly process where this is significant (above 50 rad), consideration shall be given with regard to the impact on the electronics or on the limitation or removal of the electronic equipment from exposure to X-rays.

4.3.8 Management of lead-free termination finish and soldering

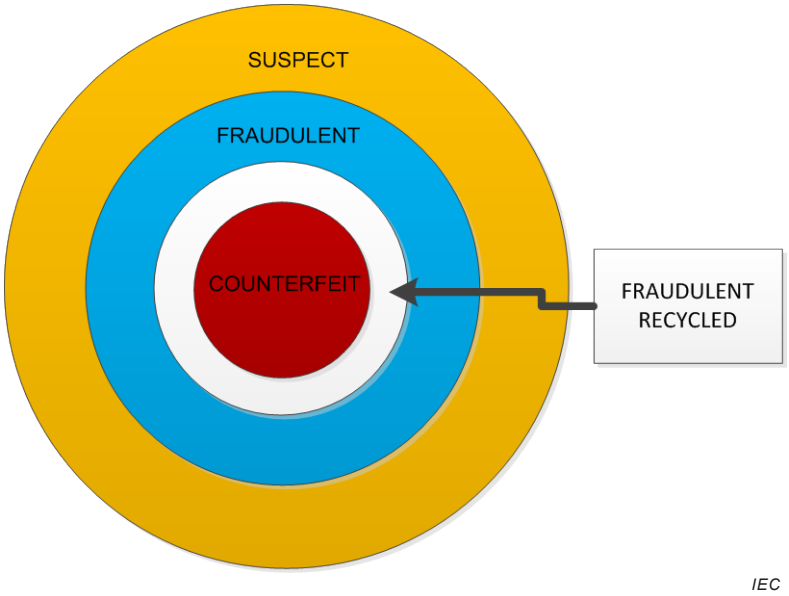
The plan owner shall document a lead-free control plan in accordance with IEC TS 62647-1.

NOTE 1 IEC TS 62647-1 takes into consideration the potential deleterious effects of tin whiskers as part of the lead-free control plan; this concern is addressed by IEC TS 62647-2.

NOTE 2 Guidelines for planning performance testing for systems containing lead-free solder and finishes are included in IEC TS 62647-3.

4.3.9 Counterfeited, fraudulent and recycled component avoidance

IEC TS 62668-1 gives requirements and guidelines to assist with avoiding counterfeited, fraudulent and recycled components and with managing suspect components (see Figure 1).



NOTE: The figure is taken from IEC TS 62668-1:2014, 4.4.3.

Figure 1 – Suspect components perimeter

The plan owner shall have a risk mitigation plan describing how to avoid and prevent the use of counterfeited, fraudulent and recycled components using international standards, for example IEC TS 62668-1 or SAE AS5553 or an equivalent method.

NOTE 1 The risk associated with non-franchised distributors is considered in IEC TS 62668-2.

NOTE 2 The definitions for counterfeited, fraudulent and recycled components are found in IEC TS 62668-1 or SAE AS5553.

4.3.10 Moisture and corrosion

The documented processes shall verify that the component is compatible with the system application environment for moisture and corrosion.

4.3.11 Additional customer related application requirements

When the mission profile (see 4.6.8) contains additional customer requirements which are outside the scope of this plan, then the plan owner shall demonstrate how these requirements are accomplished.

4.4 Component qualification

4.4.1 General

The documented processes shall verify that the installed component is qualified for the application requirements for performance and reliability through the processes listed in this technical specification.

Table B.1 provides guidance for typical component minimum qualification requirements which may be applicable.

Table D.1 provides guidelines for environmental protection techniques to be considered during the avionics design process.

Table D.2 provides guidelines for the comparison of internationally available component specifications for microcircuits.

The tables in Annex D need to be used with caution. The plan owner is responsible for ensuring that components selected using Annex D meet the application requirements. The plan owner may need to carry out additional testing, analysis, further verification, etc., as needed to ensure all application requirements are accommodated (see 4.3).

4.4.2 Minimum component qualification requirements

Components shall be obtained from manufacturers who meet the requirements of 4.4.3, 4.4.4, and 4.4.5; where these requirements are not met then 4.4.6 applies.

4.4.3 Original component manufacturer quality management

4.4.3.1 Quality system

The original component manufacturer shall have a quality system assessed to an internationally recognised quality management system. The documented quality management system is a major part of the plan owner verification.

NOTE An internationally recognised quality management system can be relevant parts of the ISO 9000 series or equivalent.

4.4.3.2 Quality system assessment

Where the original component manufacturer is not assessed in accordance with 4.4.3.1 above or an approved existing scheme, then the plan owner shall demonstrate how the quality management system of the original component manufacturer is maintained, including enabling an audit on the component manufacturing facility conducted by suitably trained auditors in accordance with an internationally recognised quality management system.

NOTE An internationally recognised quality management system can be relevant parts of the ISO 9000 series or equivalent.

4.4.4 Original component manufacturer process management approval

The plan owner shall verify that the original component manufacturer has a manufacturing process capability utilising manufacturing technologies with demonstrable repeatability which may be satisfied by one of the following:

a) Approval of the component manufacturing process by a relevant authority or body, with specific verification that the manufacturing process results in demonstrated product repeatability and reproducibility.

   NOTE A relevant body can be IECQ, DLA, IATF, STACK, etc.

b) Where the original component manufacturer is not assessed as in a) above, then the plan owner demonstrates how the process management capability of the original component manufacturer is ensured. When the plan owner conducts or enables an audit on the component manufacturing facility, then the audit is conducted by suitably trained auditors (as in 4.4.3.2 above).

4.4.5 Demonstration of component qualification

4.4.5.1 General

The plan owner shall document and justify the approach for obtaining the required quality and reliability including the component qualification process for each component verifying that the installed component is qualified for the circuit application requirements. These requirements include performance and reliability through the processes listed in this technical specification and including test procedures, sampling and criteria of acceptance (with the defined margins). This can be demonstrated by any of the following (see 4.4.5.2 to 4.4.5.3), but the choice shall be justified.

4.4.5.2 Component qualification

Components can be qualified by a relevant authority or body (as in 4.4.4a)), with documented evidence that the qualification is appropriate for the application.

4.4.5.3 Component qualification by the plan owner

4.4.5.3.1 General

Component qualification by the plan owner is demonstrated by one or more of the following subclauses 4.4.5.3.2 to 4.4.5.3.4.

NOTE Additional validation can be considered (see 4.4.3.5).

4.4.5.3.2 Component manufacturer technology qualification data

4.4.5.3.2.1 Suitable component manufacturer data

Original component manufacturers perform and record data from initial and regular on-going qualification testing on significant numbers of components. The plan owner shall review such defined qualification testing with acceptance criteria and resulting data for suitability in the end application and validate that each component type utilized is adequately qualified for the customer performance requirements. Component manufacturers produce components across a wide range of market sectors, and qualification testing will reflect these. Stress levels in the component qualification should equate or exceed those of the end application or additional testing will be necessary. This data is not guaranteed performance data.

The component manufacturer may choose to qualify specific components in accordance with JESD94, JESD47, AEC-Q100, AEC-Q101, AEC-Q200 and/or IEC TS 62686-1 or STACK S/0001.

4.4.5.3.2.2 Use of JESD94

If the use of JESD94 is determined to be applicable to any components to be used on an avionics application, it shall be specifically demonstrated that the manufacturer’s qualification data was applicable to the avionics application.

The integrated circuit manufacturers are increasingly limiting their products to commercial or industrial temperature range products. This trend is most pronounced in the functional areas that are critical to avionics products, microprocessors, FPGAs and memories.

4.4.5.3.2.3 Use of AQEC

The use of data obtained from an avionics qualified electronic component manufacturer (as per IEC TS 62564-1) is permitted and encouraged. This data is not guaranteed performance data and it will be necessary for the avionics manufacturer to validate that each device utilized meets the customer performance requirements in 4.3, 4.4 and 4.6.

NOTE Components compliant with AQEC are typically sole source products. Further, each AQEC device type can be tested to different levels, therefore there is no standardization guaranteed from one AQEC manufacturer to another for the same nominal component.

The AQEC program is basically a mechanism to obtain data from the device manufacturer which is not formally available. The availability of this data does not substitute for guaranteed performance data and device characteristic changes are not necessarily going to be covered by PCNs or other change notification.

4.4.5.3.3 In-service experience

Satisfactory performance including reliability of the component in a similar or harsher environment shall be documented.

4.4.5.3.4 Similarity

The plan shall address the ground rules for assessment by similarity to other components including documentary evidence from test data or in-service experience of a previously qualified associated component. For further details on similarity rules, refer to relevant standards.

NOTE For example AEC-Q100, AEC-Q101 and AEC-Q200.

4.4.5.3.5 Plan owner additional validation

The plan owner can complete the components qualification at component level, with additional validation at equipment level. For example new components technologies or package types not used before may be validation tested within the equipment assembly.

NOTE This validation operation at equipment level does not allow the determination of results at individual component level as it applies to the set of components that make up the circuit application.

For equipment which contains software, component validation can demonstrate or verify that the components and the operational software are compatible over the entire operating range of the equipment.

The plan owner can define suitable, defined and justified functional margins of the application to validate that component variation will not cause equipment failure during operation.

If plan owner validation is utilized because the component qualification information available does not support use of the component in the application, this shall be justified by demonstrating that no other satisfactory alternative exists and a suitable final acceptance test for each end product is carried out with defined and justified margins.

4.4.6 Qualification of components from a supplier that is not qualified

If the component supplier is not qualified, then the plan shall document how the components are qualified.

4.4.7 Distributor process management approval

4.4.7.1 General

The supply of components from an original component manufacturer or original component manufacturer franchise is considered the lower risk of being counterfeited or fraudulent. The plan owner shall verify that the distributors have a documented quality management system in a similar way to 4.4.3.1 or 4.4.3.2, related to the original component manufacturer, based on, as a minimum requirement, an internationally recognised quality management system for all its activities including storage, component handling, traceability, testing, shipment, information and technical data handling.

NOTE An internationally recognised quality management system can be relevant parts of the ISO 9000 or AS/EN/JISQ9100 series or equivalent.

The plan owner shall verify that the distributors have a counterfeited electronic components avoidance process.

When the distributor accepts returned stock from customers, these components will have to be considered in the counterfeit or fraudulent risk management plan.

4.4.7.2 Franchised distributors

Wherever possible the supply of components from an original component manufacturer or original component manufacturer franchise shall be selected over non franchised distributors.

NOTE Franchised distributors can soon implement anti-counterfeit mitigations based on the forthcoming SAE AS 6496.

4.4.7.3 Non-franchised or non-authorised distributors

If the plan owner or its distributor supplies components other than from an original component manufacturer or original component manufacturer franchise then these components are considered at higher risk of being counterfeited or fraudulent than those from franchised distributors. The plan owner shall implement in the frame of its counterfeit electronic components avoidance process measures for preventing and avoiding procurement and supply of counterfeited or fraudulent components.

NOTE 1 IEC TS 62668-2 offers considerations, requirements and guidelines for avoiding the use of counterfeited, recycled and fraudulent components when these components are purchased outside of franchised distributor networks.

NOTE 2 Usually this practice corresponds to exceptional circumstances and after having exhausted all options within the original component manufacturer and the franchised system. Purchasing through non-franchised channels is considered as a derogation process with high risk for which the plan owner is fully responsible.

4.4.8 Subcontractor assembly facility quality and process management approval

The plan owner shall verify that all subcontract assembly facilities have a documented quality management system in accordance with an internationally recognised quality management system or equivalent, where specific attention is made to the following requirements for avionics plan owners:

a) component traceability is maintained to the original manufacturer;

b) component substitutions are approved by the plan owner;

c) the requirements of 4.7 are met.

NOTE An internationally recognised quality management system can be relevant parts of the AS/EN/JISQ 9100 series or ISO 9000 or equivalent.

4.5 Continuous component quality assurance

4.5.1 General quality assurance requirements

The documented processes shall assure the continuous quality and performance of all components used throughout the production cycle, prior to delivery. This is to assure that the impact of component manufacturer lot-to-lot variations, lot-to-lot assembly handling variations, etc., are minimized and controlled. This will assure the delivered components conform to the delivered equipment requirements.

4.5.2 On-going component quality assurance

4.5.2.1 Component manufacturer quality assurance

Components shall be purchased from sources that have been successfully assessed by an accredited component assessment system, which includes a means to assess continuous quality assurance. Such assessment systems include applicable international and industry consensus standards, or the plan owner's approved process for evaluation of the original component manufacturer’s internal quality assurance processes.

NOTE Examples of government or industry standards are the DOD qualified manufacturers lists, DSCC(JAN), AEC-Q100, AEC-Q200, AEC-Q101, IEC TS 62686-1 or STACK S/0001 and CECC/IECQ approved electronic components suitable for the application.

4.5.2.2 Component quality assurance data

Where the requirement of 4.5.2.1 is not met, the plan owner shall have a documented process to assure that compliance to the component specification is maintained, either by original component manufacturer test or plan owner test where:

a) an original component manufacturer assessment includes component test processes, ongoing component qualification test plans and acceptance criteria;

b) the plan owner performs quality assurance tests and has documented quality acceptance criteria. Quality assurance tests can also be at either the equipment level or subassembly level.

NOTE Typical quality assurance processes include statistical process control, periodic qualification testing, component testing and screening, etc.

The following recommendations apply if component level screening is done.

– The components are subjected to screening conditions of sufficient rigor and duration to detect defects.

– A process for screening sampling rates can be proposed by the plan owner, provided that sufficient data is available, and the reject rate is low enough. A process for screening sampling rates may be proposed by the plan owner to reduce from 100 %, provided that sufficient data is available, and the reject rate is low enough.

4.5.3 Plan owner in-house continuous monitoring

The plan owner shall have:

a) a documented process including the various levels of processing, assembly and test of the equipment to assure the required performance of components prior to delivery of the equipment, and including: identification, recovery and recording of component removals or replacements during in-house processing;

b) an investigation of significant component replacement trends, equipment repair actions or pattern of component replacements (that are indicative of a potential component problem) to determine the root cause;

c) an appropriate root cause analysis and corrective actions approach.

4.5.4 Component design and manufacturing process change monitoring

The process for tracking (or detecting), and monitoring component design and manufacturing process change data, with analysis and appropriate corrective actions, shall be documented including the effects of these changes on equipment performance and using design change procedures in accordance with 4.9. This process could include: direct information from component manufacturers or distributors, sharing technical information sources, other users' information, functional or physical analysis during in-house processing.

NOTE 1 Most of the components used in aerospace applications are designed, manufactured and targeted for other industries, and are beyond the control of the plan owner. Frequent design and manufacturing changes are made to improve yield, reduce cost, and enhance performance. Although these changes are documented by the component manufacturer and evaluated for their effects on high-volume applications, their effects on the unique applications of the plan owner may not be evaluated or documented by the component manufacturer. The purpose of 4.5.4 is to describe a process to monitor the components to detect any changes that may affect their performance in the applications of the plan owner.

Typically, the processes include:

a) an awareness process, such as access to notices of change from the component manufacturer or distributor;

b) an evaluation process, such as periodic functional testing and/or destructive physical analysis or construction analysis (assuming an initial physical analysis) of a sample of each component;

c) a review of the component manufacturer's reliability monitoring data or quality data to look for failures and other reports of change.

NOTE 2 Alternatively, a process of periodic lot re-qualification of the component can be documented. If used, the periodic lot re-qualification process can be described here and include test frequency, sample size, etc.

4.6 Component dependability

4.6.1 General

The documented processes shall assure the reliability, availability, obsolescence management and maintainability of the components used throughout the customer agreed warranty period or maintenance period and/or agreed lifetime of the equipment provided the end user uses the equipment within the agreed environmental limits.

4.6.2 Component availability and associated risk assessment

The documented processes shall identify the risks associated with the availability of the component, and the methods to mitigate those risks including:

a) rating at risk components using appropriate metrics that reflect their susceptibility to technology change and obsolescence;
b) tracking and reporting the status of risk mitigation efforts when required by customer or business needs;
c) addressing logistics supportability and life management issues when required by customer or business needs.

The following risk areas may be addressed as part of the above risk assessment with regard to design, production, procurement or marketing processes or practices:

1) new technology availability or maturity for meeting the specified requirements;
2) component delivery and production rate schedules;
3) component obsolescence during design, production, or support;
4) lack of qualification or quality assurance data;
5) qualification test schedule (especially risk of failure);
6) cost drivers (especially with custom components);
7) component changes (design or process changes, known and unknown);
8) quality and reliability of product from a component manufacturer (especially from a new manufacturer);
9) quantification of single event effects rates in components;
10) uprated components;
11) lack of proactive measures for component obsolescence.

NOTE 1 These risk areas can include low volume manufacturers, allocation risks, financial stability of manufacturers, single source manufacturers, etc.

NOTE 2 Input for consideration of metrics can include: technology risk and maturity, life cycle, level of confidence in the manufacturer, predicted obsolescence, mono-source component, manufacturer supply file information, imprecise manufacturer specification of component performance (specified as “typical”, not specified, etc.), components other than those readily available in large volumes and identified on avionics technology roadmaps. Use of components outside the manufacturer’s specifications and component obsolescence are specific risk issues that that can be addressed outside of or included in 4.6.

NOTE 3 The processes can include the actions to react to component obsolescence occurrences. They can include bridge stock or life-time buy, identification of alternative sources, equipment re-design, etc.

4.6.3 Component obsolescence

The plan owner shall prepare an obsolescence management plan addressing obsolescence issues from design through support including:

- pro-active measures for component obsolescence;
- component obsolescence awareness;
- reaction to component obsolescence,

and define documented processes to resolve obsolete component occurrences to assure continued production and support as required.

IEC TS 62402 and SAE STD-0016 provide guidelines regarding component obsolescence.

NOTE This includes processes used to react to component obsolescence occurrences. They can include bridge stock or lifetime buys, identification of alternative sources, equipment re-design, etc.

4.6.4 Proactive measures

Proactive measures for component obsolescence include documented processes that minimize the impact of component obsolescence. These are typically equipment design processes including such activities as inclusion of a component obsolescence forecast, disposable electronic modules, or design processes/architectures to accommodate future components.

They may also include a component technology roadmap identifying components with substantial risk of obsolescence.

4.6.5 Component obsolescence awareness

Component obsolescence awareness includes processes that identify existing and impending component discontinuance changes in component design or manufacturing processes. The plan owner can use one or more external services and specific applications or databases for this purpose.

4.6.6 Reporting

During the contract period of performance, the plan owner shall maintain a periodic report addressing:

a) all existing and impending obsolescence issues, even if the obsolescence issue only has impact beyond the contract obligation. This includes cases in which the plan owner possesses adequate component inventory to meet contractual delivery obligations, but there is a known issue with future procurement of components. Additionally, it includes all instances in which an original component manufacturer (OCM) has announced an end of life (EOL) or last time buy (LTB) opportunity. This report will be delivered to the customer for review/approval as required in the purchase contract;

b) the potential issues described in 4.6.

4.6.7 Semiconductor reliability and wear out

Semiconductor wear out considerations using available suitable models for the application shall be required for highly complex integrated semiconductors manufactured in 90 nm process node and below including SRAMs, DRAMs (SDRAMs, DDR series), flash memories (NOR logic gate, NAND logic gate), MRAMs, microprocessors, FPGAs; when available, analysis of data from the original component manufacturer can lead to identify reliability and wear out risks according to given application stress levels. Refer to Annex C for additional information.

JESD 47 provides guidance to determine the component lifetime based on the qualification reports written by the original component manufacturer. In the event test data is not available from the manufacturers, or analysis based on up to date models, then the plan owner should demonstrate their own process for achieving satisfactory service life for the application (by analysis, testing, field return survey, etc.).

4.6.8 Reliability assessment

The documented processes shall:

- Define the mission profile of the component as well as the application reliability requirements including the expected lifetime of the mission.
- Identify the component stress conditions that could potentially shorten component lifetime in the application and the failure mechanisms involved.
- Verify that the component utilized is compatible with the application mission profile and the reliability requirements through the processes listed in this technical specification, including semiconductor wear out characteristics which would not be compatible with the required application lifetime, and identify and list the component that is susceptible to wear out prior to the end of the application lifetime.
- Justify the lifetime of the installed component in the application and demonstrate mitigation actions in case the component is susceptible to wear out prior to the end of the application lifetime and would not be satisfactory towards the application reliability requirements.
- These processes include component qualification (including a life test requirement), assurance of quality (consistency), equipment reliability assessments, qualification of the equipment (environmental), and equipment reliability monitors and maintenance plans. Refer to Annex C for additional information on semiconductor wear out.

NOTE 1 This can be produced either by using a standard method, original component manufacturer reliability tests, equipment field return data, similarity with any other similar applications, etc.

NOTE 2 The description of mission profile at component level includes the following features: altitude factors, temperature profile a day, number of operating hours a day, number of day mission a year and the design life of the application in years.

This is part of a design for a reliability approach.

4.7 Component compatibility with the equipment manufacturing process

The documented processes shall:

a) identify the key manufacturing, assembly, shipping, handling, storage, test, repair and rework processes by the plan owner and associated subcontractors; and

b) describe how their impact on components is identified, documented and controlled.

Hereafter are some examples of actions or phenomena that can create damage to components:

1) component shipping, handling, and storage (short and long term): mechanical damage, corrosion, etc.
2) electrostatic discharge (ESD) damage during component storage and handling, during each step of the equipment assembly process. Use of the relevant sections of MIL-HDBK-263, IEC 61340-5-1, and/or IEC TR 61340-5-2 will aid in the prevention of ESD damage;
3) use of lead-free terminated components and lead-free solder assembly if that process is used by the plan owner or his sub-contractors (see IEC TS 62647-1 and IEC TS 62647-2);
4) moisture sensitivity damage (MSL) during each step of the equipment assembly process (see IPC/JEDEC J-STD-20).

4.8 Component data

4.8.1 General

The plan owner shall have a system for collection, storage, retrieval, analysis and reporting of all relevant data from the component manufacturer, equipment design, equipment manufacturing and equipment use in service, and for keeping the data as per customer or regulatory requirements.

The data cannot necessarily reside in one database and may be retrieved from several databases or data retrieval systems across the plan owner's business. A relational approach

can be used wherein the data system provides access to the data. For example, if the component qualification data is collected and stored by the component manufacturer, the plan owner's data system could consist of a process, software, and hardware to access that data through the component manufacturer's web page or other source, provided the access is available when needed. As another example, any data that is specific to a program, such as functional simulation results or thermal analysis data, could be accessible via a path through the program data. The plan owner may wish to identify processes that were developed and documented for other initiatives, such as ISO 9000, ISO/TS 16949, AS/EN/JISQ 9000, or AS/EN/JISQ 9100 to satisfy the system for component data.

NOTE 1 Typical data includes:

- Component data sheet or specification data, for example, input and output parameters, voltage rating, packaging dimensions, availability data, etc.
- Component application data, for example, functional simulation data, breadboard test data, thermal analysis data, structural analysis data, and electromagnetic emission and susceptibility data.
- Component qualification data, for example, component manufacturer qualification test data, component qualification data, similarity analysis results, and component in-service data used for qualification.
- Component quality assurance data, for example, component manufacturer statistical process control data, component manufacturer component screening data, component screening data, and ESS data from higher-level assembly screening used to reduce or eliminate screening.
- Manufacturing and assembly data, for example, plan owner statistical process control data, ESS data from manufacturing and assembly, and in-process and final functional test.
- Customer's reject data.
- In-service data.

NOTE 2 It is anticipated that this information will be available to the customer upon request.

4.8.2 Minimum component data requirements

The documented processes shall ensure that the component data and any additional information are available to ensure suitability in the application:

- For off-the-shelf components: data sheet, technical and application notes, conditions of use, qualification and quality monitoring data, packaging data, reliability data, availability information, storage conditions, assembly data (for example, soldering conditions), productibility data (including storage, soldering conditions, etc.), lead-free status and lead-free termination finish.
- For components specified by the plan owner: the specific documentation (including specification, manufacturer data and process, reliability, specific tests and screening, and associated in-house continuous monitoring).

NOTE Most of the above information can be available from the component manufacturer.

If the information is modified, or additional information is required to satisfy the suitability in the application, then that information falls within this requirement. Examples include results of additional tests or screens conducted by the plan owner or coming from other sources but verified by the plan owner, programming data, or modifications to the data sheet

4.9 Configuration control

4.9.1 General

The documented processes shall verify that the equipment configuration control is maintained relative to the component usage in the application, including the following as minimum requirements:

a) each assembly has a controlled components list;

b) a documented path to the original component manufacturer is required;

c) each time the documented path is missing, particular qualification or/and additional documentation is required to ensure compatibility with the application.

NOTE It is anticipated that this information will be available to the customer upon request.

4.9.2 Alternative components

An alternative component shall have an approved process to establish that it is acceptable in the application with the same quality and reliability level.

4.9.3 Alternative sources

Alternative sources of component may be qualified and identified in the plan owner component database to reduce potential risks to component procurement or to solve an obsolescence or unavailability problem of the previous sources.

In this case, the alternative source component performance (fit, form, function and productibility) shall be:

a) fully compliant with the component drawing (or the data sheet and technical performance notes) of the previous component, as described within its selection process;

b) selected to ensure that the reliability, functionality, performance, interchangeability, etc., of the equipment or assembly are not compromised.

NOTE Attention can be paid to detect “false” alternative sources (the same die or component type could be packaged, tested and distributed by two or more component manufacturers).

4.9.4 Equipment change documentation

All component substitutions shall be documented and include the following information as per agreement between the involved parties (typically between the customer and the plan owner):

a) PCN number;

b) change date;

c) other related PCNs;

d) name of the substitute component manufacturer;

e) reason for change;

f) type of customer notification required (see 4.9.5, it is also anticipated that this information will be available to the customer upon request);

g) applications or equipment in which the new component is used;

h) existing component part number;

i) new component type identification;

j) statement that the new component is compliant to this plan;

k) impact of the change on reliability, safety, and other critical equipment requirements;

l) required signatures (program manager, component engineer, quality assurance representative, etc.);

m) whether or not the new component is uprated.

NOTE Usually, PCNs are stored in a controlled, retrievable data system. A copy of the PCN form can be included as an annex to the plan.

4.9.5 Customer notifications and approvals

Customer notifications and approvals shall be defined between plan owner and customer, if required. Since the customer notification and approval process is likely to be unique to each customer-supplier relationship, related requirements are beyond the scope of the baseline component management process described in this technical specification, and should be documented in the contractual agreements between the plan owner and the customer.

4.9.6 Focal organization

A focal organization (internal to the plan owner) for configuration control shall be identified in the plan.

5 Plan administration requirements

5.1 Plan organization

The plan shall be organized in such a manner that each of the requirements of Clause 4 is addressed clearly, concisely and unambiguously.

5.2 Plan terms and definitions

The terms and definitions used in the plan shall be those of Clause 3, unless they are clearly defined otherwise in the plan.

5.3 Plan focal point

5.3.1 Primary interface

The plan shall identify an authority or an organization to serve as the primary interface between the plan owner and outside parties in matters pertaining to the plan.

5.3.2 Plan focal point responsibilities

The plan's focal point shall:

- assure that the plan is reviewed and updated as necessary;
- ensure that any engineering issues are comprehensively resolved in a timely manner.

NOTE The use of a dedicated functional group, such as a component engineering group, greatly increases the efficiency and effectiveness of implementing and maintaining a plan owner's ECMP.

5.4 Plan references

The plan shall include a list of references to all the documents referenced in the plan, including this technical specification, other industry and government documents, and the plan owner's internal documents.

5.5 Plan applicability

The plan shall document:

a) all the electronic component types or technologies, and

b) the range of equipment manufactured by the plan owner to which the plan applies.

NOTE 1 The range of equipment is not intended to be a list of part numbers. It can include, for example, the applicable market segment such as: "this plan applies to all equipment manufactured for aerospace applications." It also can include an effectivity date, for example, "this plan applies to all new equipment, and to components substituted into existing equipment." The range of equipment also can be limited or required by certain contractual agreements.

NOTE 2 Ground support test equipment, flight demonstrator assemblies, and prototypes are typically exempt from the ECMP requirements, unless the plan owner states otherwise in the plan.

5.6 Plan implementation

5.6.1 ECMP compliance

The plan owner shall implement and follow the processes documented in the plan, within its range of applicability. Components selected and managed according to the plan requirements are called ECMP-compliant or plan-compliant components.

5.6.2 Plan objectives

The plan shall state clearly, concisely, and unambiguously:

a) what the plan owner does to accomplish each of the requirements;

b) how compliance to the plan is demonstrated;

c) the evidence that is available to show that the requirements have been accomplished;

d) the documented processes used to address each of the requirements listed above and described in 4.1 to 4.9 depending on program or product line requirements. The plan owner may, with appropriate justification, amend the above list of requirements by adding or deleting requirements. If this is done, then the plan is assessed according to the amended list of requirements stated in the plan.

The only type of amendment permitted is to add or delete entire requirements (those designated and described in 4.1 to 4.9). Modification of any of the requirements listed above and described in 5.6.2 is not permitted.

5.6.3 Plan owner subcontracted activities

The plan owner shall flow down to its potential subcontractors the IEC TS 62239-1 applicable requirements or endorse as responsible of the subcontracted activities the implementation of the appropriate actions to fulfill 4.1 to 4.9.

In either case, the plan owner shall satisfy and demonstrate, with objective evidence, compliance to all requirements by documenting how the subcontractor is managed, and maintaining compliance with the applicable clauses of this technical specification regardless of the source from which the components are obtained and supplied.

5.7 Plan acceptance

The plan shall be accepted when the plan owner and customer agree that the plan is acceptable to both parties, if the customer chooses to exercise the right of plan acceptance. Certification by an assessment body may be used as evidence that the plan satisfies the requirements of this technical specification.

NOTE

– An ECMP plan can be certified by an international certification body.

– A plan owner ECMP plan can be audited by the customer. A lower level tier's ECMP plan can be audited by the plan owner and/or the customer. Information regarding skills of the auditor and his training can be found, for example, in applicable sections of IECQ documents: IECQ 03-4, IECQ OD 702 and IECQ OD 703.

– The plan owner can get objective evidence that the subcontractor's product satisfies the requirements of this technical specification, according to:

  1) certification and/or audit of the subcontractor's ECMP;

  2) appropriate tests or analyses.

5.8 Plan maintenance

The plan shall have a 12-month transition time allowed before compliance with the next revision is required.

Annex A
(informative)

Requirement matrix for IEC TS 62239-1

Table A.1 provides the requirements matrix for this technical specification.

Table A.1 – Requirements matrix

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
	4	**Technical requirements**			
1	4.1	General	The plan shall document the processes used by the plan owner to accomplish the requirements a) to h).		
	4.2	**Component selection**			
2	4.2.1	General	All components shall be selected according to documented processes and satisfy the requirements of 4.2.		
3	4.2.2	Application conditions for use	The conditions for use of the component shall be adequately identified.		
4	4.2.3	Availability and durability	From the selection level, availability and durability shall be considered as major component selection criteria.		
5	4.2.4	Additional performance (1)	Components shall be selected within temperature ranges in excess of or matching the temperature range required in the application, see 4.3.4.		
6	4.2.4	Additional performance (2)	If additional performance is required then the component shall be considered as a specific one and be uniquely identified.		
7	4.2.5	Component identification	Each selected component shall be comprehensively identified within the selection process.		
	4.3	**Component application**			

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
8	4.3.1.1	Application processes	Listed in 4.3.2 to 4.3.11 are some categories of component application processes that may be documented in a plan. Not all of the categories listed below are relevant to every component application; therefore, the requirements listed below are applicable only if relevant to the given application. The plan shall: 1) document the processes that are expected to be applicable to the majority of the plan owner's products, with the understanding that some of the documented processes may not be used for specific programs or specific functionality of products; 2) verify if the equipment containing the component is capable of continuing to meet its performance requirements and specifications throughout the manufacturing, full service storage, and operating lifetime.		
9	4.3.1.2	Design reviews	In order to determine the design suitability of equipment, there shall be a formal design review where the application technical design aspects given below in 4.3.2 to 4.3.11 are documented for each component. The following application processes are not specific to an individual component, but are typically encountered when the component is placed into a circuit assembly.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
10	4.3.2	Electromagnetic capability	The component performance shall be capable of EMC compliance at equipment level.		
11	4.3.3.1	Verification of derating criteria	The documented processes shall verify that the component is used within the operating limits specified by the component manufacturer.		
12	4.3.3.2	Failure to meet derating criteria (1)	All instances in which a component fails to meet the derating criteria above (see 4.3.3.1); these shall be documented in the design records.		
13	4.3.3.2	Failure to meet derating criteria (2)	Either corrective action or justification for not satisfying the criteria shall be documented.		
14	4.3.3.2	Failure to meet derating criteria (3)	These analyses (JEP149) may require information from the component manufacturer not provided in the published data sheets; in these cases, the manufacturer shall be contacted to determine the data needed to support appropriate application of the component with regard to these issues.		
15	4.3.3.3.1	Component used inside the original component manufacturers' specifications	The use of components within their specifications as defined and guaranteed by the original component manufacturer shall be implemented before considering alternative high risk solutions such as uprating (see 4.3.3.3.2).		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
16	4.3.3.3.2	Component used outside the original component manufacturers' specifications (uprating process) (1)	If components are used outside the original component manufacturers' operating specifications, the plan owner shall implement a capability assessment process including risk assessment and risk mitigation in the application.		
17	4.3.3.3.2	Component used outside the original component manufacturers specifications' (uprating process) (2)	The plan owner shall demonstrate how the uprating process is controlled.		
18	4.3.3.3.3	Identification of uprated component (1)	A list of these components used outside the operating limits specified by the original component manufacturer shall be clearly identified by the plan owner with specific component references and custom drawings.		
19	4.3.3.3.3	Identification of uprated component (2)	The customer shall be notified of this uprated component list upon request.		
20	4.3.4.1	Thermal suitability verification	The documented processes shall verify that the component is used within the temperature limits specified by the original component manufacturer, or by the plan owner.		
21	4.3.4.2.2	Component temperature uprating process (1)	If components are used outside the temperature ranges specified by the original component manufacturer, the plan owner shall implement a capability assessment process including risks assessment and risks mitigation in the application.		
22	4.3.4.2.2	Component temperature uprating process (2)	The plan owner shall demonstrate how the temperature uprating process is controlled.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
23	4.3.5.1	Mechanical stresses	The documented processes shall verify that the component is mechanically compatible with the application including mechanical fit, and has the ability to withstand vibration and mechanical shock.		
24	4.3.5.2	Mechanical stresses generated by temperature variation (cycling)	The documented processes shall verify that the component is compatible with the mechanical stresses generated by mismatches of the coefficients of thermal expansion of the different materials throughout the application lifetime.		
25	4.3.6	Testing, testability, and maintainability	The documented processes shall assure testability and maintainability of the equipment by the plan owner.		
26	4.3.7.1	Avionics radiation environment (1)	The documented processes shall verify that the components will operate successfully in the application with regard to the effects of atmospheric radiation on them in accordance with Clause 9 (SEE compliance) of IEC 62396-1:2012 and with reference to the other parts of the IEC 62396 series.		
27	4.3.7.1	Avionics radiation environment (2)	The effects of atmospheric radiation and their accommodation shall be assessed and documented.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
28	4.3.7.2	Induced radiation	When avionics electronics is subject to large amounts of total dose radiation, for example as a result of structural X-rays analysis or of X-ray inspection in the electronic board assembly process where this is significant (above 50 rad), the consideration shall be given with regard to the impact on the electronics or on the limitation or removal of the electronic equipment from exposure to X-rays.		
29	4.3.8	Management of lead-free termination finish and soldering	The plan owner shall document a lead-free control plan in accordance with IEC TS 62647-1 and IEC TS 62647-2.		
30	4.3.9	Counterfeited, fraudulent, and recycled component avoidance	The plan owner shall have a risk mitigation plan describing how to avoid and prevent the use of counterfeited, fraudulent and recycled components using international standards, for example IEC TS 62668-1 or SAE AS5553 or an equivalent method.		
31	4.3.10	Moisture and corrosion	The documented processes shall verify that the component is compatible with the system application environment for moisture and corrosion.		
32	4.3.11	Additional customer related application requirements	When the mission profile (see 4.6.8) contains additional customer requirements which are outside the scope of this plan, then the plan owner shall demonstrate how these requirements are accomplished.		
	4.4	**Component qualification**			

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
33	4.4.1	General	The documented processes shall verify that the installed component is qualified for the application requirements for performance and reliability through the processes listed in this technical specification.		
34	4.4.2	Minimum component qualification requirements	Components shall be obtained from manufacturers who meet the requirements of 4.4.3, 4.4.4, and 4.4.5; where these requirements are not met then 4.4.6 applies.		
35	4.4.3.1	Quality system	The original component manufacturer shall have a quality system assessed to an internationally recognised quality management system.		
36	4.4.3.2	Quality system assessment	The plan owner shall demonstrate how the quality management system of the original component manufacturer is maintained.		
37	4.4.4	Original component manufacturer process management approval	The plan owner shall verify that the original component manufacturer has a manufacturing process capability utilizing manufacturing technologies with demonstrable repeatability which may be satisfied by a) or b).		
38	4.4.5.1	Demonstration of component qualification – General (1)	The plan owner shall document and justify the approach for obtaining the required quality and reliability including the component qualification process for each component verifying that the installed component is qualified for the circuit application requirements.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
39	4.4.5.1	Demonstration of component qualification – General (2)	Component qualification can be demonstrated by any of 4.4.5.2 to 4.4.5.3, but the choice shall be justified.		
40	4.4.5.3.2.1	Suitable component manufacturer data	The plan owner shall review such defined qualification testing with acceptance criteria and resulting data for suitability in the end application and validate that each component type utilized is adequately qualified for the customer performance requirements.		
41	4.4.5.3.2.2	Use of JESD94	If the use of JESD94 is determined to be applicable to any components to be used on an avionics application, it shall be specifically demonstrated that the manufacturer's qualification data was applicable to the avionics application.		
42	4.4.5.3.3	In-service experience	Satisfactory performance including reliability of the component in a similar or harsher environment shall be documented.		
43	4.4.5.3.4	Similarity	The plan shall address the ground rules for assessment by similarity to other components including documentary evidence from test data or in-service experience of a previously qualified associated component.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
44	4.4.5.3.5	Plan owner additional validation	If plan owner validation is utilized because the component qualification information available does not support use of the component in the application, this shall be justified demonstrating that no other satisfactory alternative exists and a suitable final acceptance test for each end product done with defined and justified margins.		
45	4.4.6	Qualification of components from a supplier that is not qualified	If the component supplier is not qualified, then the plan shall document how the components are qualified.		
46	4.4.7.1	Distributor process management approval – General (1)	The plan owner shall verify that the distributors have a documented quality management system in a similar way to 4.4.3.1 or 4.4.3.2, related to the original component manufacturer, based on as a minimum an internationally recognised quality management system for all its activities including storage, component handling, traceability, testing, shipment, information and technical data handling.		
47	4.4.7.1	Distributor process management approval – General (2)	The plan owner shall verify that the distributors have a counterfeited electronic components avoidance process.		
48	4.4.7.2	Franchised distributors	Wherever possible the supply of components from an original component manufacturer or original component manufacturer franchise shall be selected over non-franchised distributors.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
49	4.4.7.3	Non-franchised or non-authorised distributors	The plan owner shall implement in the frame of its counterfeited electronic components avoidance process measures for preventing and avoiding procurement and supply of counterfeited or fraudulent components.		
50	4.4.8	Subcontractor assembly facility quality and process management approval	The plan owner shall verify that all subcontract assembly facilities have a documented quality management system in accordance with an internationally recognised quality management system or equivalent, where specific attention is made to the following requirements for avionics plan owners: 1) Component traceability is maintained to the original manufacturer. 2) Component substitutions are approved by the plan owner. 3) The requirements of 4.7 are met.		
	4.5	**Continuous component quality assurance**			
51	4.5.1	General quality assurance requirements	The documented processes shall assure the continuous quality and performance of all components used throughout the production cycle, prior to delivery.		
52	4.5.2.1	Component manufacturer quality assurance	Components shall be purchased from sources that have been successfully assessed by an accredited component assessment system, which includes a means to assess continuous quality assurance.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
53	4.5.2.2	Component quality assurance data	Where the requirement of 4.5.2.1 is not met, the plan owner shall have a process to assure that compliance to the component specification is maintained, either by the original component manufacturer test or plan owner test.		
54	4.5.3	Plan owner in-house continuous monitoring	The plan owner shall have: a) a documented process including the various levels of processing, assembly and test of the equipment to assure the required performance of components prior to delivery of the equipment, and including: identification, recovery and recording of component removals or replacements during in-house processing; b) an investigation of significant component replacement trends, equipment repair actions or pattern of component replacements (that are indicative of a potential component problem) to determine root cause; c) an appropriate root cause analysis and corrective actions approach.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
55	4.5.4	Component design and manufacturing process change monitoring	The process for tracking (or detecting), and monitoring component design and manufacturing process change data, with analysis and appropriate corrective actions, shall be documented including the effects of these changes on equipment performance and using design change procedures in accordance with 4.9.		
	4.6	**Component dependability**			
56	4.6.1	General	The documented processes shall assure the reliability, availability, obsolescence management and maintainability of the components used throughout the customer agreed warranty period or maintenance period and/or agreed lifetime of the equipment provided the end user uses the equipment within the agreed environmental limits.		
57	4.6.2	Component availability and associated risk assessment	The documented processes shall identify risks associated with the availability of the component, and the methods to mitigate those risks.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
58	4.6.3	Component obsolescence	The plan owner shall prepare an obsolescence management plan addressing obsolescence issues from design through support including: • pro-active measures for component obsolescence • component obsolescence awareness • reaction to component obsolescence and define documented processes to resolve obsolete component occurrences to assure continued production and support as required.		
59	4.6.6	Reporting	During the contract period of performance, the plan owner shall maintain a periodic report.		
60	4.6.7	Semiconductor reliability and wear out	Semiconductor wear out considerations using available suitable models for the application shall be required for highly complex integrated semiconductors manufactured in 90 nm process node and below including SRAMs, DRAMs (SDRAMs, DDR series), flash memories (NOR logic gate, NAND logic gate), MRAMs, microprocessors, and FPGAs; when available, analysis of data from the original component manufacturer can lead to identify reliability and wear out risks according to given application stress levels. Refer to Annex C for additional information.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
61	4.6.8	Reliability assessment	The documented processes shall: • Define the mission profile of the component as well as the application reliability requirements including the expected lifetime of the mission. • Identify the component stress conditions that could potentially shorten component lifetime in the application and the failure mechanisms involved. • Verify that the component utilized is compatible with the application mission profile and the reliability requirements through the processes listed in this technical specification, including semiconductor wear out characteristics which would not be compatible with the required application lifetime, and identify and list the component that is susceptible to wear out prior to the end of the application lifetime. • Justify the lifetime of the installed component in the application and demonstrate mitigation actions in case the component is susceptible to wear out prior to the end of the application lifetime and would not be satisfactory towards the application reliability requirements.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
62	**4.7**	**Component compatibility with the equipment manufacturing process**	The documented processes shall: a) identify the key manufacturing, assembly, shipping, handling, storage, test, repair and rework processes by the plan owner and associated subcontractors; and b) describe how their impact on components is identified, documented and controlled.		
	4.8	**Component data**			
63	4.8.1	General	The plan owner shall have a system for collection, storage, retrieval, analysis and reporting of all relevant data from the component manufacturer, equipment design, equipment manufacturing and equipment use in service, and for keeping the data as per customer or regulatory requirements.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
64	4.8.2	Minimum component data requirements	The documented processes shall ensure that the component data and any additional information are available to ensure suitability in the application: • For off-the-shelf components: data sheet, technical and application notes, conditions of use, qualification and quality monitoring data, packaging data, reliability data, availability information, storage conditions, assembly data (for example, soldering conditions), productibility data (including storage, soldering conditions, etc.), lead-free status and lead-free termination finish. • For components specified by the plan owner: the specific documentation (including specification, manufacturer data and process, reliability, specific tests and screening, and associated in-house continuous monitoring).		
	4.9	**Configuration control**			

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
65	4.9.1	General	The documented processes shall verify that the equipment configuration control is maintained relative to the component usage in the application, including the following as minimum requirements: a) Each assembly has a controlled components list. b) A documented path to the original component manufacturer is required. c) Each time the documented path is missing, particular qualification or/and additional documentation is required to ensure compatibility with the application.		
66	4.9.2	Alternative components	Alternative components shall have an approved process to establish that they are acceptable in the application with the same quality and reliability level.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
67	4.9.3	Alternative sources	the alternative source component performance (fit, form, function and productibility) shall be: a) Fully compliant with the component drawing (or the data sheet and technical performance notes) of the previous component, as described within its selection process. b) Selected to ensure that the reliability, functionality, performance, interchangeability, etc., of the equipment or assembly are not compromised.		
68	4.9.4	Equipment change documentation	All component substitutions shall be documented and include the information in 4.9.4 as per agreement between the involved parties (typically between the aircraft manufacturer and avionics plan owner).		
69	4.9.5	Customer notifications and approvals	Customer notifications and approvals shall be defined between plan owner and customer, if required.		
70	4.9.6	Focal organization	A focal organization (internal to the plan owner) for configuration control shall be identified in the plan.		
	5	**Plan administration requirements**			
71	5.1	Plan organization	The plan shall be organized in such a manner that each of the requirements of Clause 4 is addressed clearly, concisely and unambiguously.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
72	5.2	Plan terms and definitions	The terms and definitions used in the plan shall be those of Clause 3 of this technical specification, unless they are clearly defined otherwise in the plan.		
73	5.3.1	Plan focal point – Primary interface	The plan shall identify an authority or an organization to serve as the primary interface between the plan owner and outside parties in matters pertaining to the plan.		
74	5.3.2	Plan focal point responsibilities	The plan's focal point shall: • assure that the plan is reviewed and updated as necessary, • ensure that any engineering issues are comprehensively resolved in a timely manner.		
75	5.4	Plan references	The plan shall include a list of references to all the documents referenced in the plan, including this technical specification, other industry and government documents, and the plan owner's internal documents.		
76	5.5	Plan applicability	The plan shall document: a) all the electronic component types or technologies, and b) the range of equipment manufactured by the plan owner to which the plan applies.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
77	5.6.1	ECMP compliance	The plan owner shall implement and follow the processes documented in the plan, within its range of applicability. Components selected and managed according to the plan requirements are called ECMP-compliant or plan-compliant components.		
78	5.6.2	Plan objectives	The plan shall state clearly, concisely, and unambiguously: a) what the plan owner does to accomplish each of the requirements; b) how compliance to the plan is demonstrated; c) the evidence that is available to show that the requirements have been accomplished; d) the documented processes used to address each of the requirements listed above and described in 4.1 to 4.9 depending on program or product line requirements. The plan owner may, with appropriate justification, amend the above list of requirements by adding or deleting requirements. If this is done, then the plan is assessed according to the amended list of requirements stated in the plan.		

Requirement no.	IEC TS 62239-1 (edition 2.0) clause or subclause	IEC TS 62239-1 (edition 2.0) clause or subclause title	Abbreviated requirement	EIA-STD-4899 clause or subclause	Plan owner internal reference to meet clause/subclause or statement of what plan owner does to satisfy requirements
79	5.6.3	Plan owner subcontracted activities (1)	The plan owner shall flow down to its potential subcontractors this technical specification's applicable requirements or endorse as responsible of the subcontracted activities the implementation of the appropriate actions to fulfil 4.1 to 4.9.		
80	5.6.3	Plan owner subcontracted activities (2)	In either case, the plan owner shall satisfy and demonstrate, with objective evidence, compliance to all requirements by documenting how the subcontractor is managed and maintaining compliance with the applicable clauses of this technical specification regardless of the source from which the components are obtained and supplied.		
81	5.7	Plan acceptance	The plan shall be accepted when the plan owner and the customer agree that the plan is acceptable to both parties, if the customer chooses to exercise the right of plan acceptance. Certification by an assessment body may be used as evidence that the plan satisfies the requirements of this technical specification.		
82	5.8	Plan maintenance	The plan shall have a 12-month transition time allowed before compliance to the next revision is required.		
NOTE The SAE has produced EIA-STD-4899 which is an ECMP, Electronic Component Management Plan similar to this technical specification.					

Annex B
(informative)

Typical qualification requirements and typical component minimum qualification requirements

Annex B is designed to provide guidance on qualification tests for various component types as shown in Table B.1. These tests are suitable for the plan owner to demonstrate by testing on a representative sample of components that the component type is suitable for the avionics application.

Table B.1 – Typical qualification requirements and typical component minimum qualification requirements *(1 of 3)*

Component type	Typical test method	Suggested minimum qualification requirements	Comments
Hermetic, microcircuits and discrete diodes or transistors	AEC-Q100 IEC TS 62686-1 JESD 47 JESD 94 [a] MIL-PRF-38535 MIL-STD-883 or for example DLA SMD-5962-87517 MIL-PRF-19500	Die: 1) High temperature operating life (HTOL) test 1 000 h steady state life test at +125 °C, 2) Write/erase endurance life testing for memories 3) Data retention bake for memories, 1 000 h at +125 °C 4) High temperature reverse bias (HTRB) testing for semiconductors for 1 000 h at 150 °C 5) Intermittent operating life where applicable for semiconductors for 1 000 h Hermetic package: 1) Precondition SMT packages 2) Temperature cycling for 100 cycles to MIL-STD-883 method 1010 post electrical testing followed by seal test	Components are divided into generic families for testing, see MIL-PRF-38535 for guidelines. Specification DLA SMD-5962-87517 is an example of a component level detail drawing specification produced by the US Department of Defense.
Non hermetic COTS, encapsulated microcircuits and discrete diodes or transistors	AEC-Q100 AEC-Q101 IEC TS 62686-1 JESD 47 JESD94 [a] MIL-STD-883	Die: 1) High temperature operating life (HTOL) test 1 000 h steady state life test at +125 °C, sample 2) Write/erase endurance life testing for memories 3) Data retention bake for memories, 1 000 h at +125 °C 4) High temperature reverse bias (HTRB) testing for semiconductors for 1 000 h 5) Intermittent operating life where applicable for semiconductors for 1 000 h Plastic encapsulated package: 1) Precondition SMT packages 2) Temperature cycling for 1 000 cycles –55 °C to +125 °C or 500 cycles for –65 °C to +150 °C, 3) Humidity testing: THB 1 000 h at 85 °C and 85 % RH HAST at 130 °C for 96 h Autoclave 121 °C and 100 % RH for 96 h, 15 psig (pound/square inch [gauge]) unbiased H3TRB for semiconductors for 1000 h at 85 °C and 85 % RH with reverse bias followed by electrical testing	Components are divided into generic families for testing, see MIL-PRF-38535 or AEC-Q100 or AEC-Q101 for guidelines. Samples sizes for the HTOL testing are statistically significant to enable calculation of FIT rates for long term Arrhenius high temperature operating life failure rates.

Table B.1 *(2 of 3)*

Component type	Typical test method	Suggested minimum qualification requirements	Comments
Crystal oscillators	MIL-PRF-55310 AEC-Q200	Crystal: 1) Frequency aging Packaging: 2) Vibration 3) Shock 4) For plastic encapsulated: Humidity testing: THB 1 000 h at 85 °C/85 % RH HAST at 130 °C for 96 h Autoclave 121 °C/100 % RH for 96 h, 15 psig (pound/square inch [gauge]) unbiased	Components are divided into generic families for testing, see MIL-PRF-55310 or AEC-Q100 for guidelines.
Resistors	AEC-Q200 MIL-PRF-55182 MIL-PRF-55342	Resistor element: 1) Load life testing; 1 000 h or more at max operating temperature Packaging: 2) Ceramic un-encapsulated SMT packages: Temperature cycling 3) Plastic encapsulated packages: Moisture resistance or humidity steady state and temperature cycling	Components are divided into generic families for testing, see MIL-PRF-55182 or AEC-Q100 for guidelines. Samples sizes for the load life testing are statistically significant to enable calculation of FIT rates for long term Arrhenius high temperature operating life failure rates.
Capacitors	AEC-Q200 MIL-PRF-55342	Capacitor element: 1) Load life testing; 1 000 h or more at max operating temperature Packaging: 2) Ceramic un-encapsulated SMT packages: Temperature cycling 3) Plastic encapsulated packages: Moisture resistance or humidity steady state and temperature cycling	Components are divided into generic families for testing, see MIL-PRF-55 or AEC-Q200 for guidelines. Samples sizes for the load life testing are statistically significant to enable calculation of FIT rates for long term Arrhenius high temperature operating life failure rates.

Table B.1 *(3 of 3)*

Component type	Typical test method	Suggested minimum qualification requirements	Comments
Magnetics	AEC-Q200 MIL-PRF-21028 MIL-PRF-27	Life testing Temperature cycling Humidity Vibration Dielectric withstand voltage Insulation resistance	
Connectors	MIL-DTL-38999 series MIL-DTL-5015 MIL-STD-1344 EIA364.09	Life testing Temperature cycling Humidity Durability Vibration Dielectric withstand voltage Insulation resistance	MIL specified external connectors are recommended.
[a] JESD94 is used for characterising specific environments. Therefore review how the component manufacturer has applied JESD 94 for the specific part and analyse each environment to check suitability for the end application.			

Annex C
(informative)

Semiconductor reliability and wear out

Semiconductor wear out considerations may be required for high density, highly complex silicon based technology components of feature size 90 nm and below including SRAMs, DRAMs (SDRAMs, DDR series), flash memories (NOR logic gate, NAND logic gate), MRAMs, microprocessors, and FPGAs. Components that have feature sizes above 0,1 μm have been used in avionics applications and in order to perform reliability predictions a constant failure rate with time has been successfully used with no consideration of wear out of the semiconductor components (increasing rate of failure with time). However, by reducing technology feature sizes below 0,1 μm, current leakage, density and the internal stresses (power per unit volume, electric field) within these components have greatly been increased because the bias voltage and currents on one side, and the geometric features on the other side, have not been shrunk in a homothetic way with the same factor. As a consequence for these kinds of components, internal electrical stresses have enhanced degradation mechanisms and may impact both the reliability and operating life in the application environment.

Some degradation mechanisms have been identified and these include:

- hot carrier injection (HCI);
- time dependent dielectric breakdown (TDDB);
- positive bias temperature instability (PBTI) and negative bias temperature instability (NBTI);
- electro-migration (EM);
- time dependent dielectric breakdown (TDDB) for intra-metal dielectric (IMD) and inter-level dielectric (ILD).

As a population within equipment during operational usage the components will degrade away from their initial characteristics and the time at which the components fail intrinsically in the application is dependent on a complex function of a large number of factors including technological features (size and material), deployment, environmental and application electrical stresses. Investigation of these effects in components with geometric feature sizes below 0,2 μm has been carried out by the Aerospace Vehicle Systems Institute as part of projects AFE17 and 71. Guidance on failure mechanisms and modelling are given in JEP122 and DSIAC (formerly RIAC) publication “Physics of Failure Based Handbook of Microelectronics Systems”.

Derating the component stressors can mitigate such mechanisms and may enable the improvement of both the component reliability and the component operating life capability. The derating may take several forms which include voltage derating, operating frequency reduction, part held in standby till the required reduction of power dissipated and environment improvement. Methods of thermal derating of semiconductor components are detailed in JEP149 and methods for determining the acceleration factors form testing are detailed in JESD91.

Standards and reference information which can be useful when addressing the wear out requirement are: JESD47, JESD91, JEP122 and DSIAC (formerly RIAC) publication “Physics of Failure Based Handbook of Microelectronic Systems”.

NOTE Contract data services are available to facilitate analysis of component dependability.

Annex D
(informative)

Guidelines for environmental protection techniques and for comparison of components specifications

Table D.1 shows the environmental protection techniques to be considered during the avionics design process.

Table D.1 – Environmental protection techniques to be considered during the avionics design process

Environmental factor	Component, for example microcircuit, diode, transistor, connector, etc.	Module or PCB	Plan owner delivered unit	Aircraft, UAV or satellite bay	Aircraft, UAV, satellite or space unit	Aircraft, UAV, satellite or space unit external
Temperature	Thermal coefficient of expansion trade studies for materials used in modules, MCMs, hybrids, etc. Select lowest thermal resistance package for power components Use largest footprint for power components Heat sinks Peltier cooling Heat pipes Local fan Select components which operate within the manufacturer specified maximum operating and storage temperature ranges Derating Uprate only when no other option available	Match the coefficient of thermal expansion (CTE) of assembly materials Minimize thermal resistance of power components in assembly PCB heat ladders Plenum cooled Heat planes Heat pipes Heat sink Heaters Thermally micromanaged local component environment to avoid uprating Allow components to self-heat prior to operating to specification limits at cold extremes	Position , for example against a cold plate to maximise thermal conduction Provision of forced air Spray cooling Internal cooling Liquid cooling Phase change material (exothermic) cooling Reduce specification requirements	Position electronics in benign environments, for example within cargo bay or cockpit Keep away from thermal hotspots, for example engines, engine hot air vents, etc., and cold spots, for example external areas such as windscreen or tail Supply cooling (filtered)	Cooling on ground Load sharing Thermal shielding and/or cooling Worldwide geographical use from artic to tropical regions	Solar shielding, for example cockpit and windows of aircraft Solar shielding of satellite

Environmental factor	Component, for example microcircuit, diode, transistor, connector, etc.	Module or PCB	Plan owner delivered unit	Aircraft, UAV or satellite bay	Aircraft, UAV, satellite or space unit	Aircraft, UAV, satellite or space unit external
Humidity	Conformal coating Select plastic encapsulated microcircuits which have passed a HAST humidity test to JESD22-A110 Select components with finishes which will not corrode in humid environments Manage moisture sensitivity of plastic encapsulated SMT components to J-STD-033	Dry PCBs and conformal coating Selection of best conformal coating for humidity environment	Desiccants Hermetic enclosures Dry air Enclosure drainage for rain water or liquid runoff	Dry air supply dehumidifiers Anti-condensation heaters	Dehumidifiers/ desiccants Worldwide geographical use from artic to tropical regions	Space external environment is a vacuum but launch sites are typically in tropical areas of the world

Environmental factor	Component, for example microcircuit, diode, transistor, connector, etc.	Module or PCB	Plan owner delivered unit	Aircraft, UAV or satellite bay	Aircraft, UAV, satellite or space unit	Aircraft, UAV, satellite or space unit external
Vibration	Complaint leading Select physically small components with low mass with lead-frame terminations, i.e. minimize LCCs and BGAs Position away from vibration nodes Room temperature vulcanisation (RTV) material (such as silicone) Lacing Local potting Select vibration ruggedized components for very high vibration levels: 1) Use hard gold plated connector contacts to prevent 'fretting' 2) Use high vibration crystals and oscillators 3) Use semiconductor timing microcircuits instead of crystals if operating temperature permits 4) Select high vibration circuit breakers, relays and contactors 5) Vibration test large components e.g. displays, power suppliers, as part of component qualification testing to minimize unit qualification risk	Stiffeners (reduce flexing) of PCB Local anti-vibration mounting Potting or room temperature vulcanisation (RTV) material (such as silicone) Lacing of cables or wires Keep length of cables and interconnect relatively short, evaluate cable chaffing, ensure sufficient strain relief in cables Use strain-relief connector back-shells to protect wires	Anti-vibration mounts Position (benign) Vibration analysis of nodes and redesign as required to minimize PCB deflections and stress on components	Position Active cancellation Anti-vibration mounts Position (benign) – keep electronics away from engines, gun fire positions, doors, wheel-wells, etc.	Determined by aircraft operation, i.e. military, civil or space Military aircraft may have several additional vibration requirements, for example gunfire, acoustic noise, etc.	Design

Environmental factor	Component, for example microcircuit, diode, transistor, connector, etc.	Module or PCB	Plan owner delivered unit	Aircraft, UAV or satellite bay	Aircraft, UAV, satellite or space unit	Aircraft, UAV, satellite or space unit external
EMC	Local shield Local supply filtering/ regulation Review COTS transient voltage suppressor (TVS) requirements	System architecture – Circuit function partitioning Local shielding Local module Supply/filtering Improved grounding – check ground loops	Position Additional shielding Reduced electrical connectivity	Reduced electrical connectivity Shielded bay Maximize optical signalling	Maximize optical signalling	Composite structures may increase EMC requirements
Altitude	Void free component encapsulation e.g. transformers, encapsulated modules	Void free PCBs and conformal coatings. Review minimum spacings / gaps to avoid flashover during DWV and IR testing at altitude	Hermetic enclosure / pressurized enclosure / venting valves	Pressurized bay	Determined by aircraft operational profile i.e. military, civil or space	
Shock/ acceleration	As vibration					
Power supply	Local supply filtering	Local module power supply	Local conditioning		Load sharing/filtering	
Long term dormant storage	Select plastic encapsulated components which have passed a HAST humidity test to JESD22-A110 Store under dry nitrogen Store wafers under dry nitrogen instead of assembled components	Conformal coat Desiccants Dry bag/desiccants Store in dry nitrogen cabinets	Desiccants Hermetic enclosures Dry air storage for long term storage of units	Dry atmospheric storage	Dry atmospheric storage	

Environmental factor	Component, for example microcircuit, diode, transistor, connector, etc.	Module or PCB	Plan owner delivered unit	Aircraft, UAV or satellite bay	Aircraft, UAV, satellite or space unit	Aircraft, UAV, satellite or space unit external
Atmospheric SEU radiation	Select components, for example memories not subject to SEU effects Select components, for example memories not subject to SEL Test components of a certain die revision or lot date code for atmospheric SEU susceptibility to IEC 62396-2 and consider one time buys Select components which do not use Boron 10 Derate SEU susceptible high voltage components	System architecture design mitigation techniques to IEC 62396-3 Design PCB assemblies with no single point failures	System architecture design mitigation techniques to IEC 62396-3	Select location and materials to minimize thermal neutron magnification effects Select components which do not use Boron materials	Maximum attitude of operation, as the effects are harder to manage the higher the altitude is	
Total dose radiation effects for space use	Select components immune to total dose radiation effects Select components, for example memories not subject to SEL or SEU Test components of a certain die revision or lot date code and carry out one time buys	System architecture design mitigation techniques Design PCB assemblies with no single point failures	System architecture design mitigation			
Semiconductor wear out	Derate Select older design geometry (> 90 nm) components which are less susceptible to these effects	Design PCB assemblies with no single point failures Use dual redundancy circuit techniques to minimize effects Design PCB upgrades for maintainability programs	Maintainability plans for components susceptible to early wear out			

Table D.2 gives guidelines for the comparison of internationally available component specifications – microcircuits.

Table D.2 – Guidelines for the comparison of internationally available component specifications – Microcircuits[a]

Environmental or audit test conditions	Consideration with document: STACK S/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
Audit capability	The STACK consortium arranges audits as part of "STACK Certification" program, where any reduced testing for marketing reasons is defined as "limitations"	JEDEC has no audit capability	JEDEC has no audit capability. JESD94 can be used with JESD47 where testing is customised for known failure mechanisms, e.g. temperature cycling, humidity, life testing	The IATF manages ISO/TS 16949 third party quality systems and audit activity. In addition, automotive components are qualified to AEC-Q100, AEC-Q101 and AEC-Q200	Audit activity may be based on automotive ISO/TS 16949 or "STACK Certification" program	The DLA manages audits to the Military specifications	The DLA manages audits to the Military specifications
Is the scheme a standard 'stress test' style qualification method?	Yes	Yes	No. Testing is customised for the end application for known failure mechanisms where the test duration and conditions vary on application variables. Does not cover characterisation tests or 'go/no-go' type tests	Yes	Yes plus additional AQEC test data	Yes	Yes

Environmental or audit test conditions	Consideration with document: STACK S/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
Is this a customised qualification program where JESD47 or similar stress testing is inappropriate?	No	No	Yes for known failure mechanisms where the test duration and conditions vary on application variables	No	No	No	No
Oxide integrity of wafer	Yes – JP001	Yes – JP001	Customised for application	Yes	Typically included to JP001	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013
Electromigration of wafer	Yes – JEP119 or JP001	Yes – JEP119	Customised for application	Yes	Typically included to JP001	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013
Hot carrier injection testing on wafer	Yes – JP001	Yes – JP001	Customised for application	Yes	Typically included to JP001	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013
Negative bias instability testing on wafer	To be added at next revision	Yes – JP001	Customised for application	Yes	Typically included to JP001	Considered part of wafer acceptance	Considered part of wafer acceptance
Time dependent dielectric breakdown	Yes – JP001	Yes – JP001	Customised for application	Yes	Typically included to JP001	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013

Environmental or audit test conditions	Consideration with document: STACKS/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
Stress migration	Yes – JEP001.01	Yes – JP001	Customised for application	Yes	Typically included	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013	Yes as part of wafer acceptance criteria per Appendix H of MIL-PRF-38535:2013
Internal visual	Yes – MIL-STD-883 method 2010	Not mentioned	No	Not mentioned	Yes if requested	Yes – MIL-STD-883 method 2010	Yes – MIL-STD-883 method 2010
Material restrictions	Allows RoHS compliant components, including tin termination finishes	Allows RoHS compliant components, including tin termination finishes	No	Allows RoHS compliant components, including tin termination finishes	Typically allows RoHS compliance but can be tailored for tin/lead if requested	Yes – not RoHS compliant, tin platings not allowed, some internal material restrictions	Yes – not RoHS compliant, tin platings not allowed, some internal material restrictions
Electrical testing over –55 °C to +125 °C range	Yes for hermetic components. No for plastic encapsulated components. Some are tested: –40 °C to +125 °C or –40 °C to +105 °C or –40 °C to +85 °C	Yes for hermetic components. No for plastic encapsulated components. Some are tested: –40 °C to +125 °C or –40 °C to +105 °C or –40 °C to +85 °C	No	No but either: –40 °C to +125 °C or –40 °C to +105 °C or –40 °C to +85 °C	Yes if this temperature range is requested. Other options include: –40 °C to +125 °C or –40 °C to +105 °C or –40 °C to +85 °C	Yes	Yes

Environmental or audit test conditions	Consideration with document: STACKS/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
Electrical distributions	Yes – JESD86	Yes – JESD86	No	AEC-Q100-009, fault grading AEC-Q100-009, characterisation AEC-Q003, short circuit characterisation for smart power devices AEC-Q100-012	Typically included	Not addressed	Not addressed
ESD	Yes – ANSI/ESDA/JEDEC JS-001	Yes – ANSI/ESDA/JEDEC JS-001, JESD22-C101	No	AEC Q100-002 AEC Q100-003 AEC Q100-011	Typically included	MIL-STD-883 method 3015 or ANSI/ESDA/JEDEC JS-001	MIL-STD-883 method 3015 or ANSI/ESDA/JEDEC JS-001
100 % screening	No	No	No	No	No – only if specially requested	Yes – MIL-STD-883 method 5004,	Yes- MIL-STD-883 method 5004
100 % electrical testing and rejects removed from deliverable batch	Sometimes – depends on manufacturer, see audit report, otherwise guaranteed outgoing electrical testing quality level to max of 150 DPMO (defects per million opportunities) for > 1 M gates	No	No	Yes – zero defects program per AEC-Q004	Sometimes – depends on manufacturer-can request this	Yes	Yes

Environmental or audit test conditions	Consideration with document: STACK S/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
100 % visual/ mechanical inspection	Yes – visual to JESD22-B101, dimensions to JESD22-B100. Guarantee of 200 DPMO (defects per million opportunities)	No	No	Yes – visual to JESD22-B101 and dimensions to JESD22-B100 and B108B	Only if specially requested	Yes – visual to MIL-STD-883 method 1004 and 1010,dimensions to MIL-STD-883 method 2016	Yes – visual to MIL-STD-883 method 1004 and 1010, dimensions to MIL-STD-883 method 2016
1 000 h static operating life test at +125 °C (HTOL)	Yes whatever the electrical operating temperature range – JESD22-A108	Yes whatever the electrical operating temperature range – JESD22-A108	Customised for application	Yes JESD22-A108 for: 1) grade 0, –40 °C to +150 °C electrically rated components, 2) grade 1, –40 °C to +125 °C 3) grade 2, –40 °C to +105 °C electrically rated components	Yes included	Yes – MIL-STD-883 method 1005	Yes – MIL-STD-883 method 1005
Arrhenius short and long term failure rate guarantees in PPM at 0,7 eV and 55 °C and 60 % CL	Yes –long term PPM limits guaranteed: Discrete transistors 5 FITS, < 5 k transistors 25 FITS, < 1 M transistors 100 FITS, < 100 M transistors 200 FITS	Sample size table given to calculate various ELFRs but no ELFR targets listed. No guarantee of long term FIT rates	Customised for application	Yes – AEC Q100-008 for ELFR	Typically included	No PPM limits guaranteed. Sample sizes often too small to calculate PPM limits	No PPM limits guaranteed. Sample sizes often too small to calculate PPM limits

Environmental or audit test conditions	Consideration with document: STACK S/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
Extended longer term semiconductor wear out curves	No	No	Customised for application	No	Yes – wear out graphs available if requested	No	No
Thermal characterisation and derating curves	See data sheets – thermal resistance characterised	See data sheets – thermal resistance characterised	No	See data sheets – thermal resistance characterised	Yes, see data sheets – extended thermal detail available if requested	Yes – MIL-STD-883 method 1012 – see DSC specification	Yes – MIL-STD-883 method 1012 – see MIL slash sheet
Mechanical shock	Not for plastic encapsulated components. Yes for hermetic – JEDEC JESD22-B110	Not for plastic encapsulated components. Yes for hermetic – JEDEC JESD22-B110 or MIL-STD-883 method 2002	No			MIL-STD-883 method 2002 for cavity hermetic packages	MIL-STD-883 method 2002 for cavity hermetic packages
EMC characterisation	Not specifically addressed	Not specifically addressed	No	SAE-J1752/3 radiated emissions for smart power devices as agreed on case by case basis	Yes if requested	Not typically addressed	Not typically addressed
Vibration testing	Not for plastic encapsulated components. Only as part of mechanical sequence for hermetic components to JEDEC JESD22-B110 or MIL-STD-883 method 2007 condition a, peak acceleration of 20 g	Not for plastic encapsulated components. Yes for hermetic – MIL-STD-883 method 2007	No		Yes if requested to customer requirements	Yes – MIL-STD-883 method 2007	Yes – MIL-STD-883 method 2007

Environmental or audit test conditions	Consideration with document: STACK S/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
Salt atmosphere	No	No	No	No	Not typically carried out for COTS enhanced plastic	MIL-STD-883 method 1009	MIL-STD-883 method 1009
Temperature cycling –55 °C to +125 °C for 1 000 cycles	Yes – JESD 22-A104	JESD22-A104, 700 cycles for 1) B, –55 °C to +125 °C, 700 cycles 2) G, –40 °C to +125 °C, 850 cycles 3) C, –65 °C to +150 °C, 500 cycles	Customised for application	Yes – JESD 22-A104	Yes – included	Hermetic components have 100 cycles to MIL-STD-883 method 1010	Hermetic components have 100 cycles to MIL-STD-883 method 1010
Internal water vapour	Not applicable for plastic encapsulated components. Yes for hermetic packages – Mil-STD-883 method 1018	Not applicable for plastic encapsulated components. Yes for hermetic – Mil-STD-883 method 1018	No	Not applicable for plastic encapsulated components	Not applicable for plastic encapsulated components		Yes – Mil-STD-883 method 1018
Thermal shock			No		Yes if requested	Yes – Mil-STD-883 method 1011, 15 cycles	Yes – Mil-STD-883 method 1011, 15 cycles

Environmental or audit test conditions	Consideration with document: STACK S/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
Humidity testing	Yes – THB (85 °C/85 % RH) to JESD22-A101 and HAST to JESD22-A110 and autoclave to JESD22-A102 or THRB for semiconductors	THB (85 °C/85 % RH) to JESD322-A101 and HAST to JESD22-A110 and autoclave to JESD22-A102	Customised for application	THB (85 °C/85 % RH) to JESD22-A101 and HAST to JESD22-A110 and autoclave to JESD22-A102	Yes – included	Hermetic – not applicable	Hermetic – not applicable
Moisture resistance	See humidity testing	See humidity testing	Customised for application	See humidity testing	See humidity testing	MIL-STD-883 method 1004	MIL-STD-883 method 1004
Soft error testing or latch up	Yes – JESD89	Yes – JESD78, JESD89-1 or JESD89-2 , JESD89-3	No	Memory > 1 Mbit SRAM or DRAM Unaccelerated to JESD89-1 or accelerated to JESD89-2 and -3 AEC-Q100-004, latch up to AEC-Q100-004	Typically included	JESD78	JESD78
Atmospheric SEU radiation testing	No	No	No	No	Yes if requested – detailed SEU testing may be available	No – testing available for total dose and SEU for Space environment	No – testing available for total dose and SEU for Space environment
Bond strength	Yes – JESD22-B116	Yes – pull to MIL-STD-883 method 2011, shear to JESD22-B116	No	Yes – Pull to MIL-STD-883 method 2011, shear to AEC-Q100-001	Yes included	Yes	Yes – pull to MIL-STD-883 method 2011
Die strength	Yes – MIL-STD-883 method 2019		No		Yes included	Yes	Yes – MIL-STD-883 method 2019

Environmental or audit test conditions	Consideration with document: STACKS/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
Solderability	Yes – JESD22-B102	Yes – JESD22-B102	No	Yes – JESD22-B102	Yes included	Yes	Yes – MIL-STD-883 method 2003
Marking permenancy	Yes – JESD22-B107		No		Yes included	Yes	Yes
Flammability	Yes – UL94 or IEC 60695-11-5	Yes – UL94 material declaration	No	Yes – UL94 material declaration	Yes included	Hermetic – not applicable	Hermetic – not applicable
Lead integrity	JESD22-B105		No	Yes JESD22-B105	Yes included	Yes – MIL-STD-883 method 2004	Yes – MIL-STD-883 method 2004
Terminal strength	MIL-TSD-750 method 2036		No		Yes included	Yes	Yes
Hermeticity, i.e. seal test	Yes for hermetic only – JESD22-A109	Yes for hermetic only – JESD22-A109	No		Typically included if hermetic packaged	Yes	Yes – MIL-STD-883 method 1014
Moisture sensitivity level	Yes – J-STD020	Yes – J-STD020	No	Yes – J-STD020	Typically included if plastic encapsulated	Hermetic – not applicable	Hermetic – not applicable
BGA package ball shear	Yes – JESD22-B117	JESD22-B117	No	Yes – AEC-Q100-010	Typically included		
X-ray	Yes – MIL-STD-883 method 2012		No		Yes if requested		
Tin whisker testing	No – may be added at next revision	JESD22-A121 and JESD201	No		Yes if requested	Not applicable	Not applicable

Environmental or audit test conditions	Consideration with document: STACKS/0001 or IEC TS 62686-1– typically COTS, packaging is plastic encapsulated but can be hermetic	Consideration with document: JESD47 –typically COTS, packaging is plastic encapsulated but can be hermetic[b]	Consideration with document: JESD94 typically COTS, packaging is typically plastic encapsulated[b]	Consideration with document: AEC-Q100, Rev G, automotive,[b] typically COTS plastic encapsulated	Consideration with document: IEC TS 62564-1, typically COTS 'enhanced' plastic encapsulated	Consideration with document: Hermetically packaged to MIL-STD-883, see for example DLA SMD-5962-87517	Consideration with document: MIL-PRF-38535 typically hermetically packaged using MIL-STD-883 method 5004 and method 5005
Product monitor program	Yes – SPC control of wafer production, assembly process and final testing. Also: HTOL, early life and long term life, non-volatile memory operating life, temperature cycling and humidity testing	No	No	Yes SPC control	Only if requested	Periodic Group B, C, D and E testing	Yes SPC for SEM, wire bond, die attach, lid seal, PIND, lead trimming and lead finish thickness. Periodic Group B, C, D and E testing
Product change notice notification	YES – JESD46		No		Typically included	Yes	Yes
Last time buy notification	Yes		No		Typically included	Yes	Yes
Obsolescence protection	No	No	No	No but typically 8+ years for automotive market	Target is 8 years. Extended lifetime is available if specially negotiated	No guarantees but typically > 10-year lifetime	No guarantees but typically > 10-year lifetime

[a] The plan owner can ensure that components from these schemes are qualified in accordance with the application requirements and manage any additional verification or testing accordingly.

[b] When using JESD47, it is desirable to note that the testing specified therein may not be appropriate for all applications. The scope paragraph of JESD47 states that JESD91 and JESD94 may be used to tailor qualification testing for known failure mechanisms to meet specific requirements.

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NOTE 1 Bibliographic references may need to be reviewed to ensure they are current with technology.

NOTE 2 Bibliographic references may need to be reviewed to ensure those listed are the current version.

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