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FOR SPACE STANDARDIZATION

Space product assurance

Electrical, electronic and electromechanical (EEE) components

ECSS Secretariat
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Requirements & Standards Section
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Foreword

This Standard is one of the series of ECSS Standards intended to be applied together for the management, engineering, product assurance and sustainability in space projects and applications. ECSS is a cooperative effort of the European Space Agency, national space agencies and European industry associations for the purpose of developing and maintaining common standards. Requirements in this Standard are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

This Standard has been prepared by the ECSS-Q-ST-60 Working Group, under the auspice of the ESCC Space Components Steering Board, reviewed by the ECSS Executive Secretariat and jointly approved by the ESCC SCSB and the ECSS Technical Authority.

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Change log

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ECSS-Q-ST-60C Rev. 3 12 May 2022	Third issue, Revision 3 Changes with respect to ECSS-Q-ST-60C Rev.2 (21 October 2013) are the following and identified in the document with revision tracking: **Main changes:** • Implementation of Change Requests • Topic "EQM components" added for all three classes • Topic "Pure tin lead finish – risk analysis" moved from ECSS-Q-ST-60-13 to ECSS-Q-ST-60 as clause 9. **Detailed changes:** Added requirements: 4.1.4i; 4.1.6a and b; 4.2.2.2i-l; 4.2.2.3d-g (moved from 4.2.2.1); 4.2.4f; 4.6.6a; 5.1.4i; 5.1.6a and b; 5.2.2.2i-l; 5.2.2.5a and b (moved from 5.2.2.1); 5.2.4f; 5.6.6a; Table 5-1; 6.1.4h; 6.1.6a and b; 6.2.2.2i-l; 6.2.2.3a-b (moved from 6.2.2.1); 6.2.4f; 6.6.6a; 9.2a. Modified requirements: 4.1.4d; 4.2.2.2c-e and h; 4.2.2.3e; 4.2.3.1e and i; 4.2.4a and d; 4.3.1e; 4.3.3h; 4.3.5a; 4.3.7b; 4.3.8b; 4.3.9e; 4.3.10b; 4.3.11c; 4.4.a (Note added); 4.5.3a; 4.5.4b; 4.6.4e and f; 5.1.4d; 5.2.2.2c-e and h; 5.2.3.1e and i; 5.2.4a and d; 5.3.1e; 5.3.3h; 5.3.5a; 5.3.7b; 5.3.8b; 5.3.9d; 5.3.10b; 5.3.11c; 5.4a (Note added); 5.5.3a; 5.5.4b; 5.6.4e and f; 6.1.4d; 6.2.2.2c-e and h; 6.2.3.1e and i; 6.2.4a and d; 6.3.2c; 6.3.3h; 6.3.5a; 6.3.7b; 6.3.8b; 6.3.9d; 6.3.10b; 6.3.11c; 6.4a (Note added); 6.5.3a; 6.5.4b; 6.6.4e and f.

	Deleted requirements: 4.1.1a; 4.1.2.1b; 4.2.2.1c-f (moved to 4.2.2.3); 4.2.2.5b; 4.2.3.1b; 4.2.4b; 4.3.3e and g; 4.3.9g; 4.5.4a; 5.1.1a; 5.2.2.1c and d (moved to 5.2.2.5); 5.2.2.4b; 5.2.3.1b; 5.2.4b; 5.3.3e; 5.3.9f; 5.5.4a; 6.1.1a; 6.2.2.1c and d (moved to 6.2.2.3); 6.2.2.5b; 6.2.3.1b; 6.2.4b; 6.3.3e; 6.3.9f and j; 6.5.4a.

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Introduction

The objective of the EEE component selection, control, procurement and use requirements is to ensure that EEE components used in a space project enables the project to meet its mission requirements.

Important elements of EEE component requirements include:

a. component programme management,

b. component selection, evaluation and approval,

c. procurement,

d. handling and storage,

e. component quality assurance,

f. specific components, and

g. documentation.

The main tools which can be used to reach the objective are:

a. concurrent engineering,

b. standardization of component types,

c. characterization of components,

d. assessment of component manufacturers including declared competencies and processes,

e. testing, screening, lot acceptance and periodic testing,

f. procurement specifications,

g. control and inspection,

h. control of nonconforming materials,

i. assessment and use of existing component data,

j. application of specific control to mitigate risk for components with limited data or confidence, and

k. information management.

The basic approach is as follows:

- The customer of a given space project defines the EEE component requirements within the boundaries of this standard. They appear in the appropriate clauses of the project requirements as defined in ECSS-M-ST-10.
- The supplier defines a component control plan to implement those requirements into a system which enables, for instance, to control the selection, approval, procurement, handling in a schedule compatible with his requirements, and in a cost-efficient way.
- The supplier ensures that the applicable parts requirements are passed down to lower level suppliers and ensure that they are compliant to these parts requirements.

1
Scope

This standard defines the requirements for selection, control, procurement and usage of EEE components for space projects.

This standard differentiates between three classes of components through three different sets of standardization requirements (clauses) to be met.

The three classes provide for three levels of trade-off between assurance and risk. The highest assurance and lowest risk is provided by class 1 and the lowest assurance and highest risk by class 3. Procurement costs are typically highest for class 1 and lowest for class 3. Mitigation and other engineering measures may decrease the total cost of ownership differences between the three classes. The project objectives, definition and constraints determine which class or classes of components are appropriate to be utilised within the system and subsystems.

a. Class 1 components are described in Clause 4.

b. Class 2 components are described in Clause 5

c. Class 3 components are described in Clause 6.

The requirements of this document apply to all parties involved at all levels in the integration of EEE components into space segment hardware and launchers.

This standard may be tailored for the specific characteristics and constraints of a space project in conformance with ECSS-S-ST-00.

2
Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revision of any of these publications do not apply, However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the more recent editions of the normative documents indicated below. For undated references, the latest edition of the publication referred to applies.

ECSS-S-ST-00-01	ECSS system — Glossary of terms
ECSS-M-ST-10	Space project management — Project planning and implementation
ECSS-Q-ST-10-09	Space product assurance — Nonconformance control system
ECSS-Q-ST-20	Space product assurance — Quality assurance
ECSS-Q-ST-30-11	Space product assurance — Derating — EEE components
ECSS-Q-ST-60-02	Space product assurance — ASIC and FPGA development
ECSS-Q-ST-60-05	Space product assurance — Generic procurement requirements for hybrid
ECSS-Q-ST-60-12	Space product assurance — Design, selection, procurement and use of die form monolithic microwave integrated circuits (MMICs)
ECSS-Q-ST-60-13	Commercial electrical, electronic and electromechanical (EEE) components
ECSS-Q-ST-60-14	Space product assurance – Relifing procedure – EEE components
ECSS-Q-ST-60-15	Radiation hardness assurance – EEE components
ECSS-Q-ST-70	Space product assurance — Materials, mechanical parts and processes
ESCC 20200	ESCC Basic Specification: Component Manufacturer Evaluation
ESCC 21004	ESCC Basic Specification: Guidelines for incoming inspection of EEE components
ESCC 22500	ESCC Basic Specification: Guidelines for displacement damage irradiation testing
ESCC 22800	ESCC Basic Specification: ESA/SCC Non conformance Control System

ESCC 22900	ESCC Basic Specification: Total Dose Steady-State Irradiation Test Method
ESCC 24900	ESCC Basic Specification: Minimum requirements for controlling environmental contamination of components
ESCC 25500	ESCC Basic Specification: Methodology for the detection of pure tin in the external surface finish of case and leads of EEE components
ESCC QPL	ESCC qualified part list (https://escies.org)
ESCC EPPL	ESCC European preferred parts list (https://escies.org)
ESCC QML	ESCC qualified manufacturers list (https://escies.org)
GEIA-STD-0005-2 (1 May 2012)	Standard for mitigating the effects of tin whiskers in aerospace and high performance electronic systems
MIL QPLs	MIL qualified parts lists
MIL QMLs	MIL qualified manufacturers lists
NPSL	NASA Parts Selection List
JAXA QPL	JAXA qualified parts list
JESD-201A (September 2008)	Environmental acceptance requirements for tin whisker susceptibility of tin and tin alloy surface finishes
JESD-22-A121A (July 2008)	Measuring whisker growth on tin and tin alloy surface finishes

ESCC, MIL & JAXA specifications and standards called in the document

3
Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 apply.

3.2 Terms specific to the present standard

3.2.1 agent

organization contracted to perform the procurement of EEE components including related engineering and quality assurance tasks

3.2.2 characterization

determination of the attributes of an EEE component, in sufficient detail to allow assessment of its suitability for a particular use or application

3.2.3 commercial component

part neither designed, nor manufactured with reference to military or space standards

3.2.4 concurrent engineering

engineering activity taking place in the context of simultaneous design of the product, the production process and all associated product usages, in an integrated, multifunctional team, with external organizational constraints minimized

3.2.5 destructive physical analysis

series of inspections, tests and analyses performed on a sample of components to verify that the material, design and workmanship used for its construction, as well as the construction itself, meet the requirements of the relevant specification and are suitable for the intended application

3.2.6 franchised distributor

distributor officially and contractually authorised by the manufacturer

3.2.7 parts engineer

professional engineer with demonstratable specialisation in EEE components

3.2.8 parts procurer

supplier who procures components by himself or a parts procurement agent who procures parts for the supplier

3.2.9 qualified parts

parts belonging to QPLs or QMLs from the following normative systems: ESCC, MIL, JAXA, CECC

3.2.10 screening

tests, inspections or combination thereof, imposed on 100% of parts, to remove unsatisfactory items or those likely to exhibit early failures

3.2.11 space qualified parts

parts belonging to QPLs or QMLs from the following normative systems (ESCC, MIL) according to quality levels listed in Table 7-1

NOTE 1 Space qualified parts are a subset of the qualified parts defined in clause 3.2.9.

NOTE 2 Parts belonging to JAXA QPL are considered as space qualified provided the equivalence of the generic JAXA specification with the ESCC or MIL generic specifications has been established.

3.3 Abbreviated terms

For the purpose of this Standard, the abbreviated terms from ECSS-S-ST-00-01 and the following apply:

Abbreviation	Meaning
ASIC	Application specific integrated circuit
CCD	charge coupled device
CCP	Component control plan
CDR	critical design review
CECC	CENELEC electronic components committee
CENELEC	Comité Européen de Normalisation Electrotechnique
CI	conformance inspection
CN	change notice
CoC	certificate of conformance
CPPA	centralized parts procurement agent
CR	change request
CSI	customer source inspection
CSV	comma-separated values
DCL	declared components list
DPA	destructive physical analysis
DRD	document requirement definition
EEE	electrical, electronic, electromechanical
EFR	established failure rate
EPPL	European preferred parts list
ESCC	European space components coordination

ESR	equivalent serial resistance
FPGA	field programmable gate arrays
GSE	ground support equipment
GSFC	Goddard space flight center
JAXA	Japanese aerospace exploration agency
JD	justification document
LAT	lot acceptance test
LED	light emitting diode
LVT	lot validation testing
MMIC	microwave monolithic integrated circuit
NASA	national aeronautics and space administration
NCR	nonconformance report
NPSL	NASA parts selection list
PA	product assurance
PAD	part approval document
PCB	Parts Control Board
PCN	process change notice
PDR	preliminary design review
PIND	particle impact noise detection
QCI	quality conformance inspection
QML	qualified manufacturers list
QPL	qualified parts list
RFD	request for deviation
RFW	request for waiver
RVT	radiation verification testing
SCSB	Space Components Steering Board
SEB	single event burn-out
SEE	single event effect
SEFI	single event functional interrupt
SEGR	single event gate rupture
SEL	single event latch-up
SET	single event transient
SEU	single event upset
TCI	technology conformance inspection
TRR	test readiness review
WFR	Weibull failure rate

3.4 Conventions

a. The term “EEE component“ is synonymous with the terms "EEE Part", "Component" or just "Part".

a. The term “for approval” means that a decision of the approval authority is necessary for continuing the process.

b. The term “for review” means that raised reviewers comments are considered and dispositioned.

c. The term “for information” means that no comments are expected about the delivered item.

d. For the purpose of clear understanding of this document, hereunder is a listing of component categories which are covered by the term EEE component, encapsulated or non-encapsulated, irrespective of the quality level:

1. Capacitors
2. Connectors
3. Crystals
4. Discrete semiconductors (including diodes, transistors)
5. Filters
6. Fuses
7. Magnetic components (e.g. inductors, transformers, including in-house products)
8. Monolithic Microcircuits (including MMICs)
9. Hybrid circuits
10. Relays
11. Resistors, heaters
12. Surface acoustic wave devices
13. Switches (including mechanical, thermal)
14. Thermistors
15. Wires and Cables
16. Optoelectronic Devices (including opto-couplers, LED, CCDs, displays, sensors)
17. Passive Microwave Devices (including, for instance, mixers, couplers, isolators and switches)

    NOTE Microwave switches consisting of multiple EEE components are considered as equipment. The requirements of this standard are applicable to the EEE parts they incorporate and to microwave switches having a simple design (single EEE part).

3.5 Nomenclature

The following nomenclature applies throughout this document:

a. The word “shall” is used in this Standard to express requirements. All the requirements are expressed with the word “shall”.

b. The word “should” is used in this Standard to express recommendations. All the recommendations are expressed with the word “should”.

NOTE It is expected that, during tailoring, recommendations in this document are either converted into requirements or tailored out.

c. The words “may” and “need not” are used in this Standard to express positive and negative permissions, respectively. All the positive permissions are expressed with the word “may”. All the negative permissions are expressed with the words “need not”.

d. The word “can” is used in this Standard to express capabilities or possibilities, and therefore, if not accompanied by one of the previous words, it implies descriptive text.

NOTE In ECSS “may” and “can” have completely different meanings: “may” is normative (permission), and “can” is descriptive.

e. The present and past tenses are used in this Standard to express statements of fact, and therefore they imply descriptive text.

4
Requirements for Class 1 components

4.1 Component programme management

4.1.1 General

ECSS-Q-ST-60_0480001

a. <<deleted>>

4.1.2 Components control programme

4.1.2.1 Organization

ECSS-Q-ST-60_0480002

a. The supplier shall identify the organization responsible for the management of the component programme, and describe the organization's approaches (including the procurement system and its rationale) and capability to efficiently implement, manage, and control the component requirements.

ECSS-Q-ST-60_0480003

b. <<deleted>>

4.1.2.2 Component control plan

ECSS-Q-ST-60_0480004

a. The supplier shall prepare a Component Control Plan (CCP) in conformance with its DRD in Annex A.

ECSS-Q-ST-60_0480492

b. The CCP may be part of the overall project PA plan.

ECSS-Q-ST-60_0480006

c. The supplier shall submit the CCP to the customer for approval.

4.1.3 Parts control board

ECSS-Q-ST-60_0480007

a. The approval of the selection and usage of EEE parts shall be implemented through Parts Control Boards (PCBs) held between the customer and the supplier (or lower tier subcontractor).

ECSS-Q-ST-60_0480008

b. At supplier's level, the Parts Control Board (PCB) shall be composed as follows:

   1. chaired by a member of the supplier’s PA team with designated responsibility for components management,
   2. include, as a minimum, in addition the suppliers’ parts engineer, the customer’s representative and the lower tier subcontractor parts engineers.

ECSS-Q-ST-60_0480493

c. Other pertinent experts from the customer or suppliers may also participate, on request.

ECSS-Q-ST-60_0480010

d. Depending on the progress of the program, the main PCB activities shall be:

   1. Review and approval of the supplier's EEE component control plan and any associated documents,
   2. Parts type reduction and standardization,
   3. Parts approval including evaluation activities,
   4. Problem assessment (e.g. alerts, nonconformances, RFD, RFW and delivery delays).
   5. Assessment activities (by sampling) including:
      (a) conformity of procurement conditions,
      (b) conformity of procurement data,
      (c) post-procurement data, and
      (d) application of alerts recommendations.

      NOTE For (a) to (c), assessment is made by comparison of procurement documentation versus approval document.

4.1.4 Declared components list

ECSS-Q-ST-60_0480011

a. For each equipment, its supplier shall issue a DCL in an editable and sortable electronic format, as a minimum compatible with CSV, identifying all component types needed.

NOTE CSV is a common file format that can be used to transfer data between database or spreadsheet tables (a spreadsheet program is for example Excel®).

ECSS-Q-ST-60_0480012

b. The list specified in 4.1.4a shall be kept under configuration control (issue and identification of changes).

ECSS-Q-ST-60_0480013

c. The DCL shall be issued as a minimum at PDR and CDR (as designed) and before TRR (as built).

ECSS-Q-ST-60_0480014

d. After equipment CDR, all modifications affecting the PAD and JD information shall be implemented, in the "as design" DCL and submitted to the customer for approval, before assembly.

ECSS-Q-ST-60_0480015

e. The “as design” DCL shall be sent to the customer for approval.

ECSS-Q-ST-60_0480016

f. Any change of parts during equipment manufacturing (e.g. type and manufacturer) shall be handled through RFWs submitted to the customer for approval before mounting.

ECSS-Q-ST-60_0480017

g. The “as built” DCL reflecting the actual EEE parts assembled into the flight hardware and their date code, shall be provided before TRR to the customer for review.

ECSS-Q-ST-60_0480018

h. The content of the DCL shall be in conformance with its DRD in Annex B.

ECSS-Q-ST-60_0480522

i. The supplier shall establish and update a consolidated “as design" DCL at its level and deliver it to the customer.

4.1.5 Electrical and mechanical GSE

ECSS-Q-ST-60_0480019

a. EEE components used in GSE, which are physically and directly interfacing to flight hardware, shall be:

1. Fit Form and Function compatible,
2. manufactured from materials identical to the flight opposite part, and
3. ensured to be visibly clean before each connection to flight hardware.

ECSS-Q-ST-60_0480020

b. Flight hardware connector interfaces to GSE shall interface to a flight compatible connector, as per 4.1.5a.

NOTE This connector can be installed on the test harness or can be a saver.

4.1.6 EQM components

ECSS-Q-ST-60_0480523

a. EEE components used in Engineering Qualification Model (EQM) shall be fit, form and function representative of the flight components and be from the same manufacturers.

ECSS-Q-ST-60_0480524

b. If thermal vacuum tests are performed on the EQM, the EEE parts shall be material representative of the FM parts.

4.2 Component selection, evaluation and approval

4.2.1 General

ECSS-Q-ST-60_0480021

a. The supplier shall ensure that the following requirements are met during his selection process:

   1. Project requirements (e.g. quality levels, component policy, manufacturing and delivery schedules and budgets, quantities),
   2. Design requirements (e.g. component type, case, dimensions, materials),
   3. Production requirements (e.g. packaging, thermal and storage constraints, component mounting process),
   4. Operational requirements (e.g. electrical, mechanical, radiation, reliability, assembly, and lifetime).

      NOTE The supplier of each product is responsible for the selection of components, which enable the performance, lifetime, environmental, material, safety, quality and reliability requirements of the product of which they form a part, to be satisfied in all respects.

ECSS-Q-ST-60_0480491

b. The selection, evaluation and approval of commercial EEE components for class 1 programmes shall be performed in conformance with clause 4.2 from ECSS-Q-ST-60-13.

4.2.2 Manufacturer and component selection

4.2.2.1 General rules

ECSS-Q-ST-60_0480022

a. The supplier shall establish and maintain in his own facility, and ensure that his suppliers also establish and maintain, procedures for selecting and controlling all components intended for use in deliverable products.

ECSS-Q-ST-60_0480023

b. Components shall be selected on the basis of proven qualification, characterization, and previous space experience and data, relevant with regard to the requirements for the programme, from manufacturers or sources (preferably European) employing effective Product Assurance Programmes in manufacturing and test.

c. <<deleted and moved to 4.2.2.3d>>

d. <<deleted, modified and moved to 4.2.2.3e>>

e. <<deleted and moved to 4.2.2.3f>>

f. <<deleted and moved to 4.2.2.3g>>

4.2.2.2 Parts and material restriction

ECSS-Q-ST-60_0480028

a. The supplier shall ensure that non-hermetically sealed materials of components meet the requirements of ECSS-Q-ST-70 regarding off-gassing, out-gassing, flammability, toxicity and any other criteria specified for the intended use.

ECSS-Q-ST-60_0480029

b. The supplier shall evaluate the robustness of selected EEE components against the stresses induced by the assembly techniques to be employed.

ECSS-Q-ST-60_0480030

c. With respect to health and safety, beryllium oxide and lithium (except for the one which is identified in the procurement specification), cadmium, magnesium, mercury, zinc, radioactive material and all material which can cause safety hazards shall not be used.

ECSS-Q-ST-60_0480031

d. For limited life duration, known instability, safety hazards or reliability risk reasons, the EEE components listed below shall not be used:

  1. <<deleted>>
  2. Hollow core resistors,
  3. Potentiometers (except for mechanism position monitoring),
  4. Non-metallurgically bonded diodes,
  5. Semiconductor dice with unglassivated active area,
  6. Wet slug tantalum capacitors other than capacitor construction using double seals and a tantalum case,
  7. Any component whose internal construction uses metallurgic bonding with a melting temperature not compatible with the end-application mounting conditions,
  8. <<deleted>>
  9. TO5 relays without double welding of the mechanism to the header or with any type of integrated diodes inside,
  10. Aluminium liquid electrolytic capacitors,
  11. Tin coated wires and cables,
  12. PVC insulated wires and cables,
  13. Electromechanical parts in commercial grade,
  14. Feedthrough filter in commercial grade,
  15. Connectors without gold plating contact in commercial grade.

ECSS-Q-ST-60_0480032

e. For limited life duration, known instability, safety hazards or reliability risk reasons, EEE components listed below shall not be used for new designs:

1. RNC90 > 100 kOhm,
2. TO3 and DO4/DO5 packages,
3. Wire link fuses.

ECSS-Q-ST-60_0480494

f. The use of pure tin in internal cavities may be authorized, on a case-by-case basis, based on the demonstration that there is no alternative product and there is no risk (supported by a technical justification).

ECSS-Q-ST-60_0480034

g. As per 4.2.2.2f., the justification of the use of pure tin shall be presented during a PCB for customer's approval.

ECSS-Q-ST-60_0480035

h. The use of pure tin (inside or outside the part) shall be declared in the PAD or in the JD.

ECSS-Q-ST-60_0480525

i. The customer shall specify either requirement 4.2.2.2j, or requirements 4.2.2.2k and 4.2.2.2l to handle risks linked with pure-tin terminations.

ECSS-Q-ST-60_0480526

j. The following actions shall be performed by the supplier to control the pure-tin risk:

1. Collect and synthesize all information participating to the risk analysis in conformance with Clause 9.
2. Based on the risk analysis, elaborate a mitigation plan.
3. Include in the JD the risk analysis and mitigation plan for customer approval.
4. Before retinning of flight parts, document the hot solder dip process by a procedure to be submitted to customer for approval.
5. Perform evaluation tests, lot acceptance tests and screening tests of retinned components after the retinning process.

NOTE 1 The mitigation plan can include one or a combination of the following solutions:

- Tin whisker sensitivity evaluation
- Retinning of terminations with complementary evaluation,
- Conformal coating,
- Design modification.

NOTE 2 Solder dip for tin whisker mitigation differs from solder dip for solderability in that for tin whisker mitigation, the termination is coated over its entire length, right up to the package surface (no stand off). As this process is critical it is good practice to evaluate it and control it well.

ECSS-Q-ST-60_0480527

k. All the following conditions shall be fulfilled to use Parts with matte pure tin finish, >97% tin:

1. They pass the JESD-201A class 2 requirements or meet the GEIA-STD-0005-2/Level 2B requirements,
2. They are not used in power function, where both Voltage >15 V and Current >2 A conditions are applied at the same time,
3. They are not mechanically torqued on board or equipment.

ECSS-Q-ST-60_0480528

l. If one of the three conditions specified in requirement 4.2.2.2k is not met, a mitigation plan shall be submitted to the customer for approval, through the JD approval process.

NOTE This mitigation plan can include, as an example, one of the following solutions:

- Conformal coating,
- Design analysis and risk assessment versus a possible short circuit.

4.2.2.3 Preferred sources

ECSS-Q-ST-60_0480036

a. Parts shall be chosen from the EPPL part I.

ECSS-Q-ST-60_0480037

b. For parts not selected from the EPPL part I, the following sources shall be considered in the following order of precedence:

1. EPPL part II (when compatible with the project requirements)
2. <<deleted>>
3. NPSL level 1 and level 2 or 3 (when compatible with the project requirements),
4. MIL QPL's and QML's.

ECSS-Q-ST-60_0480038

c. Parts subject to export restrictions or regulations shall not be preferred.

ECSS-Q-ST-60_0480024

d. Preference shall be given to components which necessitate the least evaluation or qualification effort.

ECSS-Q-ST-60_0480025

e. Starting with the design phase of the project the supplier shall ensure maximum use of preferred and qualified components to achieve component reduction and standardization.

ECSS-Q-ST-60_0480026

f. When selecting items, the supplier shall check the current data, applicability of the basis of qualification, problem notifications and alerts, and adequacy of specifications.

ECSS-Q-ST-60_0480027

g. The supplier shall implement a type reduction activity.

4.2.2.4 Radiation hardness

ECSS-Q-ST-60_0480039

a. The radiation requirements for EEE components are project specific.

ECSS-Q-ST-60_0480040

b. The supplier who is responsible for the design of the piece of hardware shall demonstrate the compliance of its components selection with the radiation constraints of the project.

ECSS-Q-ST-60_0480041

c. For this demonstration, the supplier shall consider all types of radiation including cosmic (Heavy Ions), electromagnetic, trapped (charged particles – electrons, protons – in radiation belts) and solar (flares).

ECSS-Q-ST-60_0480042

d. Due consideration shall be given to the mission orbit and trajectory, the duration, the associated spatial and temporal variations of the radiation environment as well as all protective factors such as shielding.

ECSS-Q-ST-60_0480043

e. The supplier shall assess the actual radiation tolerance of the selected components for compliance with the radiation requirements in term of total dose, displacement damage and Single Events Effects (SEE).

ECSS-Q-ST-60_0480044

f. The supplier shall identify components which are not compliant with the radiation requirements as critical radiation sensitive components.

ECSS-Q-ST-60_0480045

g. The supplier shall implement a Radiation Hardness Assurance Programme, in conformance with the requirements of ECSS-Q-ST-60-15, documented by a plan to be approved by the customer, for radiation sensitive components, covering the collection of all relevant information and specifying the necessary actions in terms of evaluation and procurement testing, planning and control.

ECSS-Q-ST-60_0480046

h. The supplier shall issue an Equipment Radiation Analysis document identifying all sensitive components w.r.t. the relevant radiation effects, possibly their impact and giving an adequate engineering solution (e.g. local shielding, design solution, specific test, and RVT) for the relevant equipment.

ECSS-Q-ST-60_0480047

i. The Equipment Radiation Analysis document shall be submitted to the customer for approval.

NOTE More detailed information about the above requirements is given in ECSS-E-ST-10-12 and ECSS-Q-ST-60-15.

4.2.2.5 Derating

ECSS-Q-ST-60_0480048

a. The supplier shall implement derating rules for components used in his designs in accordance with the requirements of ECSS-Q-ST-30-11.

ECSS-Q-ST-60_0480049

b. <<deleted>>

4.2.3 Component evaluation

4.2.3.1 General

ECSS-Q-ST-60_0480050

a. The supplier shall perform a component evaluation in absence of an approved demonstration that a component has the ability to conform to the requirements for functional performance, quality, dependability, and environmental resistance as required for the project.

ECSS-Q-ST-60_0480051

b. <<deleted>>

ECSS-Q-ST-60_0480052

c. The scope and planning of the component evaluation shall be derived from the results of an assessment of the design and intended application of the component.

ECSS-Q-ST-60_0480053

d. An evaluation plan shall be sent to the customer for approval, and include the following elements:

1. Component Manufacturer Assessment (as per clause 4.2.3.2),
2. Constructional Analysis (as per clause 4.2.3.3),
3. Evaluation Testing (as per clause 4.2.3.4),
4. Radiation Hardness (as per clause 4.2.3.4b.5).

ECSS-Q-ST-60_0480054

e. In the definition of the evaluation programme any information including pertinent reliability, analysis and test data from the manufacturer of the component and previous use in comparable applications shall be considered and their relevance justified.

ECSS-Q-ST-60_0480055

f. Omission of any of these elements, or the introduction of alternative activities, shall be justified.

ECSS-Q-ST-60_0480056

g. All tests and inspections shall be carried out on representative samples of the component type from the current production of the manufacturer selected for the component procurement for the flight hardware.

ECSS-Q-ST-60_0480057

h. For programmable devices, the representativeness shall include the programming hardware tools and the compatibility of the software.

ECSS-Q-ST-60_0480058

i. The supplier shall review the evaluation results to determine their impact on the content of the procurement specification and amend it as necessary.

ECSS-Q-ST-60_0480059

j. The supplier shall summarize the evaluation results in the evaluation report and send it to the customer for approval.

NOTE For guidance for the assessment of the space environmental aspects refer to ECSS-E-ST-10-04 and ECSS-E-ST-10-12.

4.2.3.2 Component manufacturer assessment

4.2.3.2.1 Purpose

The purpose of the manufacturer assessment is to determine its capability, to ensure the adequacy of its organization, plant and facilities, and to ascertain its fitness to supply components to the appropriate specifications for space application.

4.2.3.2.2 Requirements

ECSS-Q-ST-60_0480060

a. The supplier shall perform an evaluation against the ESCC basic specification no. 20200 and the ancillary specifications for dedicated component families and shall include, but not necessarily be limited to, a survey of:
   1. The overall manufacturing facility and its organization and management,
   2. The manufacturer’s system for inspection and manufacturing control including all relevant specifications, procedures, and internal documents,
   3. The production line used for the component.

ECSS-Q-ST-60_0480061

b. The complete manufacturer assessment, including the survey report and the associated corrective actions, shall be part of the evaluation report.

4.2.3.3 Constructional analysis

ECSS-Q-ST-60_0480062

a. Constructional analysis shall be carried out on representative components.

NOTE The primary aim is to provide an early indication of a component's constructional suitability for meeting the specified performances of the space project application.

ECSS-Q-ST-60_0480063

b. The Constructional Analysis shall comprise destructive and non-destructive inspections, analyses, and testing, to identify:

1. Design and construction technology,
2. Materials used,
3. Inherent reliability aspects,
4. Quality of workmanship,
5. Potential hazards.

ECSS-Q-ST-60_0480064

c. The findings of the analysis shall be contained within a Constructional Analysis Report and shall be included in the Evaluation Report.

4.2.3.4 Evaluation testing

ECSS-Q-ST-60_0480065

a. The evaluation shall determine which inspections or tests are required to provide the confidence that the component type under evaluation, when assembled and tested in accordance with the procurement specification, successfully meets the project requirements.

ECSS-Q-ST-60_0480066

b. The supplier shall review the already existing data in order to adapt and minimize the content of the evaluation testing while ensuring that there are inputs and pertinent results covering the following topics:

1. Endurance test (operating at elevated temperature and electrical stress),
2. Mechanical stress (shock, vibration, constant acceleration),
3. Environmental stress (thermal shock, temperature cycling, high and low temperature storage, humidity),
4. Assembly capability testing,
5. Radiation testing, for total dose and single event effects sensitivity.

NOTE For guidance refer to ESCC basic specification no. 22600 and the ancillary specifications for dedicated component families.

4.2.4 Parts approval

ECSS-Q-ST-60_0480067

a. All components shall be reviewed and approved by the customer through the Parts Control Board (PCB).

ECSS-Q-ST-60_0480068

b. <<deleted>>

ECSS-Q-ST-60_0480069

c. The supplier shall maintain a system of traceability of the acceptance and approval of each component used in flight products.

ECSS-Q-ST-60_0480070

d. The approval process by the customer depends on the part qualification status and shall be organized as follows:
    1. Space qualified parts: Space qualified parts listed in the DCL are approved through the DCL review except in the following cases where a PAD in conformance with ECSS-Q-ST-60 Annex D is delivered for customer's approval:
        (a) additional controls are required (e.g. precap, buy-off, LAT or LVT, RVT, DPA),
        (b) used outside the specified limits,
        (c) specific tests are required during procurement as per Table 7-1,
    2. Other HiRel parts: A PAD in accordance with ECSS Q-ST-60 Annex D is delivered to customer for approval
    3. Commercial parts: A Justification Document in accordance with ECSS-Q-ST-60-13 Annex F is delivered to customer for approval.
    4. <<deleted>>

ECSS-Q-ST-60_0480071

e. In case the evaluation results are changing the procurement conditions documented in the PAD or the JD (as per clause 4.2.3.1), a new revision of PAD or the JD shall be submitted to the customer for approval.

ECSS-Q-ST-60_0480529

f. The parts approval process, including PAD and JD approval, shall be completed prior to CDR, or MRR for recurring units if there is no CDR.

4.3 Component procurement

4.3.1 General

ECSS-Q-ST-60_0480072

a. The supplier shall ensure that all procured components meet the programme requirements with respect to inspection, screening and tests.

ECSS-Q-ST-60_0480073

b. Class 1 components shall meet the quality levels ands supplementary conditions specified in Table 7-1.

ECSS-Q-ST-60_0480074

c. The supplier shall be responsible for manufacturer surveillance and control throughout the procurement programme.

ECSS-Q-ST-60_0480075

d. For non qualified parts, the supplier shall put in place a configuration control system to ensure that any change of the product (e.g. mask, manufacturing and assembly process) affecting evaluation, performance, quality, reliability and interchangeability is communicated to him by the manufacturer (e.g. PCN).

ECSS-Q-ST-60_0480076

e. The supplier shall ensure the compatibility of the change with its application and update all the related documentation.

NOTE For example: RFD, PAD, JD evaluation.

ECSS-Q-ST-60_0480077

f. The change shall be submitted to the customer for approval.

ECSS-Q-ST-60_0480078

g. To reduce the risk of procuring counterfeit components, when parts are not directly procured from the manufacturer, the supplier shall procure parts only from distributors duly franchised by the parts manufacturer.

ECSS-Q-ST-60_0480447

h. The procurements of the commercial EEE components for class 1 programs shall be performed in conformance with the requirements of clause 4.3 of ECSS-Q-ST-60-13.

4.3.2 Procurement specification

ECSS-Q-ST-60_0480079

a. The supplier shall procure EEE components according to controlled specifications.

ECSS-Q-ST-60_0480080

b. International specifications systems, recognized as suitable for space applications (e.g. ESCC, MIL), shall be used by the supplier.

ECSS-Q-ST-60_0480081

c. Any new specification shall be prepared and designed by the supplier as per existing international specification systems (ESCC, MIL). Preference shall be given to ESCC format when agreed by the manufacturer.

ECSS-Q-ST-60_0480082

d. The content of any new specification shall be in conformance with Annex C.

ECSS-Q-ST-60_0480083

e. The use of any new specification shall be submitted to the customer for approval through the PAD process (see clause 4.2.4)

ECSS-Q-ST-60_0480084

f. Upon request, any new procurement specification prepared in the frame of the project, shall be delivered to the customer.

ECSS-Q-ST-60_0480085

g. The supplier shall keep each procurement specification under configuration control.

4.3.3 Screening requirements

ECSS-Q-ST-60_0480086

a. All components to be incorporated into flight standard hardware shall be subjected to screening.

ECSS-Q-ST-60_0480087

b. The screening test requirements shall be defined such that accumulated stress does not jeopardize component reliability.

ECSS-Q-ST-60_0480088

c. All screening tests shall be performed at the component manufacturer’s premises or at a facility approved either by the qualification approval authority, where applicable (e.g. ESCC), or otherwise by the supplier.

ECSS-Q-ST-60_0480089

d. The quality levels defined in Table 7-1 shall apply.

ECSS-Q-ST-60_0480090

e. <<deleted>>

ECSS-Q-ST-60_0480448

f. When a component is available in a qualified version according to quality level specified in Table 7-1 it shall be selected.

ECSS-Q-ST-60_0480449

g. <<deleted>>

ECSS-Q-ST-60_0480450

h. In case of X-rays or CT scan inspection, the total dose deposited and exposure time shall not deteriorate part performance or reliability.

4.3.4 Initial customer source inspection (precap)

ECSS-Q-ST-60_0480091

a. The procurement entity shall carry out, at the manufacturer's premises, a customer precap inspection for non-space qualified parts listed below:
    1. Capacitors (ceramic, mica and plastic film)
    2. Crystals
    3. Oscillators
    4. Discrete semiconductors (including diodes and transistors)
    5. Filters
    6. Fuses (cermet)
    7. Inductors, coils and transformers (not applicable to in-house products)
    8. Monolithic microcircuits (including MMICs)
    9. Hybrid circuits
    10. Relays
    11. Resistors (high precision, fixed, metal foil – RNC90)
    12. Switches (including mechanical and thermal)
    13. Optoelectronic devices (e.g. opto-couplers, LEDs, CCDs and sensors).

ECSS-Q-ST-60_0480092

b. The procurement entity shall carry out, at the manufacturer's premises, a customer precap inspection on critical space qualified parts , including as a minimum relays, crystals, oscillators and hybrids.

ECSS-Q-ST-60_0480093

c. When not covered by MIL or ESCC specifications, methods and accept/reject criteria for customer's precap inspection shall be documented by a procedure to be presented to the customer, on request, for review.

4.3.5 Lot acceptance

ECSS-Q-ST-60_0480094

a. The supplier shall ensure that any lot/date code of EEE parts is submitted to a lot acceptance procedure, in line with applied normative systems, according to the following rules:

   1. Space qualified parts:

      (a) ESCC: user's lot acceptance on the procured lot/date code is not required due to periodic lot validation testing performed by the manufacturer.

      (b) MIL: QCI or TCI performed by the manufacturer is in accordance with the quality level of the MIL specification.

   2. Other HiRel qualified parts:

      (a) The content of the lot acceptance is ESCC level LAT1 or level LAT2 or LVT (subgroups 1, 2 and 3) or comparable QCI.

      (b) The lot acceptance may be replaced by the review of available data less than 2 years old and provided there have been no changes to the manufacturing process and no changes to the part design and construction.

      (c) In case of partial available data, any complementary lot acceptance content is defined by the supplier subject to PCB agreement.

      (d) The PCB documents and justifies any reduced lot acceptance based on available data for customer approval.

   3. Commercial parts:

      (a) The content of the lot acceptance is defined according to information provided by the justification document according to ECSS-Q-ST-60-13.

      (b) The proposed lot acceptance is approved through the approval process in accordance with clause 4.2.4.

   NOTE LAT1 is required unless reliability data are available on the same package from the same manufacturer.

ECSS-Q-ST-60_0480095

b. The sample size for lot acceptance which may be reduced in some cases, shall be submitted to the customer for approval through the PAD process (see clause 4.2.4).

4.3.6 Final customer source inspection (buy-off)

ECSS-Q-ST-60_0480096

a. The procurement entity shall carry out, at the manufacturer's premises, a final customer source inspection for non-space qualified parts, based on inspections, tests and review activities to verify that the requirements of the purchase order are met prior to shipment of the flight parts.

ECSS-Q-ST-60_0480097

b. The buy-off shall include:
   1. External visual inspection,
   2. Witnessing electrical measurements,
   3. Verifying mechanical dimensions,
   4. Review and verification of the data-package.

ECSS-Q-ST-60_0480495

c. The buy-off may be replaced by an incoming inspection at the procurement entity's facilities.

ECSS-Q-ST-60_0480099

d. If the buy-off is replaced by an incoming inspection at the procurement entity's facilities, it shall be declared in the PAD submitted to the customer for approval.

4.3.7 Incoming inspections

ECSS-Q-ST-60_0480100

a. The procurement entity shall perform incoming inspection at his premises on all components to verify conformance with the purchase order requirements.

ECSS-Q-ST-60_0480101

b. The incoming inspection shall include the following items:
   1. For any part: the minimum inspections required in ESCC 21004.
   2. For the non-space qualified parts, when the final customer source inspection has not been performed, the following additional items:
      (a) External visual inspection by sampling (AQL 0,65% level II or 20 parts min)
      (b) Electrical measurements at room temperature on 20 parts or 100% (if lot size < 20 parts), or a datapackage review.

ECSS-Q-ST-60_0480102

c. The incoming inspection shall be documented by a procedure to be presented, on request, to the customer for review.

ECSS-Q-ST-60_0480496

d. If the parts have passed successfully a final CSI (or buy-off), the incoming inspection may be reduced to the following minimum:

1. Verification of the manufacturer's CoC
2. Packing checking,
3. Quantity verification.

ECSS-Q-ST-60_0480497

e. In case the incoming inspection has been performed by a procurement agent, the incoming inspection performed by the end-user, may be reduced to the following minimum:

1. Packing checking,
2. Quantity verification.

4.3.8 Radiation verification testing

ECSS-Q-ST-60_0480105

a. Radiation sensitive components, as defined in clause 4.2.2.4, and for which applicable existing test data is insufficient shall be subjected to RVT.

ECSS-Q-ST-60_0480106

b. RVT shall be performed in accordance with internationally recognized standards, such as ESCC Basic Specifications No. 22900 and 22500.

NOTE Additional information on test methods is given in MIL-STD-750 Test Method 1019, MIL-STD-883 Test Method 1019.

ECSS-Q-ST-60_0480107

c. In such a case, a PAD in conformance with Annex D shall be issued and processed as per clause 4.2.4.

ECSS-Q-ST-60_0480108

d. The results of RVT shall be documented by a report.

ECSS-Q-ST-60_0480109

e. When RVT is performed in the frame of the project, the supplier shall send the related report to the customer for information.

4.3.9 Destructive physical analysis

ECSS-Q-ST-60_0480110

a. The DPA shall be performed on 3 samples per lot/date code for non-space qualified parts belonging to the following categories:

   1. Capacitors (glass, ceramic, tantalum and variable)
   2. Crystals
   3. Oscillators
   4. Discrete semiconductors (including diodes and transistors)
   5. Filters
   6. Monolithic microcircuits (including MMICs)
   7. Hybrid circuits
   8. Relays
   9. Switches (including mechanical and thermal)
   10. Optoelectronic devices (e.g. opto-couplers, LED's, CCD's and sensors)
   11. Passive microwave devices (e.g. mixers, couplers, isolators and switches)

ECSS-Q-ST-60_0480111

b. The DPA shall be performed on 3 samples per lot/date code on critical space qualified parts, including as a minimum relays and oscillators. For other space qualified parts families, DPA is not required.

ECSS-Q-ST-60_0480498

c. DPA may be carried out on representative samples of the components families when the following three conditions are met:

   1. procured from the same manufacturer and same package without major change in the process,
   2. with a limited datecode range of 13 weeks,
   3. approved by the customer through the PAD process.

NOTE In complement of above conditions, for series of integrated circuits, series of thermal switches, series of active discrete and series of passive components (e.g. 54xxxx, 1N63xx, …), representative samples can be from the same family considering technology limit and their complexity.

ECSS-Q-ST-60_0480113

d. The DPA sample size may be reduced in some cases which shall be submitted to the customer for approval through the PAD process.

ECSS-Q-ST-60_0480114

e. The DPA process shall be documented by a procedure to be submitted , on request, to the customer for information.

NOTE For guidance refer to the basic specificaton ESCC 20600.

ECSS-Q-ST-60_0480115

f. The supplier shall verify that the outcome of the DPA is satisfactory prior to the installation of the components into flight hardware.

ECSS-Q-ST-60_0480499

g. <<deleted>>

ECSS-Q-ST-60_0480500

h. DPA may be performed by the manufacturer if witnessed by the supplier (or approved representative).

ECSS-Q-ST-60_0480118

i. For health and safety reasons, any test producing beryllium oxide dust shall be omitted.

ECSS-Q-ST-60_0480119

j. The results of DPA shall be documented by a report sent to the customer, on request, for information.

4.3.10 Relifing

ECSS-Q-ST-60_0480451

a. When components from a supplier's or parts procurement agent's stock are used, the following criteria shall be met:
    1. The parts are stored according to the minimum conditions given in clause 4.4,
    2. The minimum overall requirements (including screening) are in accordance with the project requirements,
    3. The lot/date code homogeneity and traceability can be demonstrated,
    4. The EEE parts documentation is available and the content is acceptable in accordance with the project requirements (including radiation data, if necessary),
    5. There are no open NCR's and no unresolved alerts with respect to their date code.

ECSS-Q-ST-60_0480121

b. For components meeting the criteria specified in requirement 4.3.10a, and which have a lot / date code exceeding the period defined in ECSS-Q-ST-60-14 clause 5, the relifing procedure ECSS-Q-ST-60-14 shall apply to the lot.

4.3.11 Manufacturer's data documentation deliveries

ECSS-Q-ST-60_0480122

a. The manufacturer's CoC shall be delivered to the parts procurer.

ECSS-Q-ST-60_0480123

b. Any other data (i.e. LAT or LVT, QCI orTCI), defined in the applicable procurement documents, shall be available at the manufacturer's facilities or delivered to the parts' procurer in line with the purchase order, as a minimum compatible with CSV.

NOTE CSV is a common file format that can be used to transfer data between database or spreadsheet tables (a spreadsheet program is for example Excel®).

ECSS-Q-ST-60_0480124

c. For non qualified parts, the parts procurer shall store the documentation for a minimum of 15 years after receiption of the components.

NOTE For qualified parts, the documentation storage period is under the responsibility of the manufacturer and the qualifying authority.

4.4 Handling and storage

ECSS-Q-ST-60_0480125

a. The supplier shall establish and implement procedures for handling and storage of components in order to prevent possible degradation.

NOTE For guidance, refer to the basic specification ESCC 20600.

ECSS-Q-ST-60_0480126

b. The procedures shall be applicable at any facility dealing with components for flight application.

ECSS-Q-ST-60_0480127

c. On request, handling and storage procedures shall be sent to the customer for review.

ECSS-Q-ST-60_0480128

d. As a minimum, the following areas shall be covered:

1. Control of the environment in accordance with ESCC Basic Specification No. 24900.
2. Measures and facilities to segregate and protect components during receiving inspection, storage, and delivery to manufacturing.
3. Control measures to ensure that electrostatic discharge susceptible components are identified and handled only by trained personnel using anti static packaging and tools.

4.5 Component quality assurance

4.5.1 General

ECSS-Q-ST-60_0480129

a. The supplier shall establish and implement the requirements of this document including methods, organizations and documents used to control the selection and procurement of components in accordance with the requirements of ECSS-Q-ST-20.

4.5.2 Nonconformances or failures

ECSS-Q-ST-60_0480130

a. The supplier shall establish and maintain a nonconformance control system in accordance with the general requirements in ECSS-Q-ST-10-09.

ECSS-Q-ST-60_0480131

b. Any observed deviation of EEE components from requirements as laid down in applicable specifications, procedures and drawings shall be controlled by the nonconformance control system.

NOTE This includes failures, malfunctions, deficiencies and defects.

ECSS-Q-ST-60_0480132

c. The nonconformance control system shall handle all nonconformances occurring on EEE components during:

1. Manufacture (if available), screening and acceptance tests,
2. Incoming inspection,
3. Integration and test of equipment,
4. Storage and handling.

ECSS-Q-ST-60_0480133

d. For ESCC qualified components the supplier shall apply the ESCC basic specification no 22800.

4.5.3 Alerts

ECSS-Q-ST-60_0480134

a. The supplier shall take into account all received alerts, errata sheets from international alert systems, from manufacturers or sent by the customer and shall validate that there are no alerts related to the intended applications and the recommendations of alerts were taken into account.

ECSS-Q-ST-60_0480135

b. If alerts become available at a later stage, the supplier shall analyse the alerts, analyse the project risk and propose an action plan for customer approval.

ECSS-Q-ST-60_0480136

c. The supplier shall initiate and distribute within the project notifications for all major problems arising on EEE parts during procurement, incoming inspection or during all levels of equipment manufacturing or testing, which are of general concern.

4.5.4 Traceability

ECSS-Q-ST-60_0480137

a. <<deleted>>

ECSS-Q-ST-60_0480138

b. The traceability shall be maintained through incoming, storage, and installation at the procurer and user of the component.

ECSS-Q-ST-60_0480139

c. In any case, the traceability requirements imposed by the supplier on the EEE parts manufacturer or distributor shall allow managing the adequacy of the tests performed by the supplier (i.e. evaluation, lot validation, any additional test or inspection).

ECSS-Q-ST-60_0480140

d. The traceability of EEE parts during installation in equipment, shall be ensured by the supplier through maintaining the traceability to the manufacturer’s lot/date code number of the EEE parts actually mounted.

ECSS-Q-ST-60_0480141

e. If the as built DCL has not yet been delivered, the supplier shall be able to provide this information (part type actually installed with its relevant lot/date code number) within one week.

4.5.5 Lot homogeneity for sampling test

ECSS-Q-ST-60_0480142

a. If tests are performed by sampling, the sampled parts shall be selected so that they are representative of the lot/date code distribution.

ECSS-Q-ST-60_0480143

b. For radiation tests, the set of test samples shall be in accordance with ECSS-Q-ST-60-15.

4.6 Specific components

4.6.1 General

ECSS-Q-ST-60_0480144

a. << deleted >>

4.6.2 ASICs

ECSS-Q-ST-60_0480145

a. ECSS-Q-ST-60-02 shall apply.

4.6.3 Hybrids

ECSS-Q-ST-60_0480146

a. Selection and validation of the hybrids manufacturers shall conform to clauses 5 and 6 of ECSS-Q-ST-60-05.

ECSS-Q-ST-60_0480452

b. Design of hybrids shall conform to clause 7 of ECSS-Q-ST-60-05.

ECSS-Q-ST-60_0480453

c. The hybrids shall be procured in conformance with the specifications listed in Table 7-1.

4.6.4 One time programmable devices

ECSS-Q-ST-60_0480147

a. For FPGA, ECSS-Q-ST-60-02 shall apply.

ECSS-Q-ST-60_0480148

b. The PAD shall allow traceability to the information related to the procurement of blank parts, the programming process and the acceptance of the programmed parts.

NOTE The programming process and the acceptance of the programmed parts are under the authority of the PCB if not otherwise determined in the PAD.

ECSS-Q-ST-60_0480501

c. <deleted>

ECSS-Q-ST-60_0480150

d. One time programmable components shall be submitted to a post-programming sequence.

ECSS-Q-ST-60_0480151

e. For one time programmable FPGA and PROM without a clear and defined heritage, a post-programming burn-in shall be applied, in conformance with ESCC9000 subclause 8.16, for a minimum duration of 160 h.

NOTE FPGA and PROM with defined heritage are documented in these reports: ESCC REP 010 and ESCC REP011, available on https://escies.org.

ECSS-Q-ST-60_0480152

f. The supplier shall prepare a post-programming procedure for customer's approval, depending on part types.

NOTE This includes, if applicable:

- electrical test conditions,
- programming conditions and equipment,
- programming software version qualified by the supplier,
- burn-in conditions,
- additional screening tests, and
- specific marking after programming.

ECSS-Q-ST-60_0480153

g. The lot acceptance procedure, as defined in clause 4.3.5, shall be performed on devices coming from the flight lot/date code and programmed on the same kind of hardware tools and compatible software.

ECSS-Q-ST-60_0480502

h. In case of several designs based on the same lot of blank parts, the lot acceptance procedure, as defined in clause, 4.3.5, may be limited to one representative flight programmed design.

4.6.5 Microwave monolithic integrated circuits

ECSS-Q-ST-60_0480155

a. Design, selection, procurement and use of the microwave monolithic integrated circuits shall be performed in conformance with the requirements from ECSS-Q-ST-60-12.

4.6.6 Connectors

ECSS-Q-ST-60_0480530

a. For connectors with removable contacts, contacts shall be procured from the same manufacturer as the connector in which they are mounted.

4.7 Documentation

ECSS-Q-ST-60_0480156

a. Any result from inspection or control shall be documented (including, precap, lot acceptance, buy-off, incoming, relifing and complementary tests).

Table 4-1: Document requirements list for Class 1 components

Document	Clause	Customer	Comments
Component control plan	4.1.2.2	Approval	
"as design" DCL	4.1.3d.5	Approval	
RFW during equipment manufacturing *(after "as design" DCL and before "as built" DCL)*	4.1.3d.5	Approval	
"as built" DCL	4.1.3d.5	Review	
Technical note for parts having pure tin in internal cavities	4.2.2.2	Approval	
Radiation hardness assurance plan	4.2.2.4	Approval	to document the radiation hardness assurance programme
Equipment radiation analysis document	4.2.2.4	Approval	
Evaluation plans	4.2.3.1	Approval	
Evaluation reports	4.2.3.1	Approval	
PAD's	4.2.4	Approval	
Justification Documents	4.2.4	Approval	applicable for commercial parts
Change on EEE parts	4.3.1	Approval	
Procurement specifications prepared in the frame of the project	4.3.2	Approval	
PIND test method for DO4, DO5 & TO3 packages	4.3.3	Approval	
Procedure for customer precap	4.3.4	Review (on request)	when not covered by ESCC or MIL specifications
Procedure for incoming	4.3.7	Review (on request)	
RVT reports when RVT is performed in the frame of the project	4.3.8	Information	
Procedure for DPA	4.3.9	Information (on request)	
DPA reports	4.3.9	Information	

Document	Clause	Customer	Comments
		(on request)	
Procedure for handling and storage of EEE parts	4.4	Review (on request)	
Action plan for alerts	4.5.3	Approval	
Procedure for post-programming sequence	4.6.3c	Approval	

5
Requirements for Class 2 components

5.1 Component programme management

5.1.1 General

ECSS-Q-ST-60_0480157

a. <<deleted>>

5.1.2 Components control programme

5.1.2.1 Organization

ECSS-Q-ST-60_0480158

a. The supplier shall identify the organization responsible for the management of the component programme, and describe the organization's approaches (including the procurement system and its rationale) and capability to efficiently implement, manage, and control the component requirements.

5.1.2.2 Component control plan

ECSS-Q-ST-60_0480159

a. The supplier shall prepare a compliance matrix to the clauses of this standard.

ECSS-Q-ST-60_0480160

b. The supplier shall submit his compliance matrix to the customer for approval.

5.1.3 Parts Control Board

ECSS-Q-ST-60_0480161

a. The approval of the selection and usage of EEE parts shall be implemented through Parts Control Boards (PCBs) held between the customer and the supplier (or lower tier subcontractor).

ECSS-Q-ST-60_0480162

b. At supplier's level, the Parts Control Board (PCB) shall be composed as follows:

   1. chaired by a member of the supplier's PA team with designated responsibility for components management,
   2. include, as a minimum, in addition the suppliers' parts engineer, the customer's representative and the lower tier subcontractor parts engineers.

ECSS-Q-ST-60_0480503

c. Other pertinent experts from the customer or suppliers may also participate, on request.

ECSS-Q-ST-60_0480164

d. Depending on the progress of the program, the main PCB activities shall be:

1. Review and approval of the supplier's compliance matrix to the clause of section 5 of this standard and any associated documents
2. Parts approval including evaluation activities,
3. Problem assessment (e.g. alerts, nonconformances, RFD, RFW and delivery delays).
4. Upon customer’s request, assessment activities (by sampling) including:
    (a) conformity of procurement conditions,
    (b) conformity of procurement data,
    (c) post-procurement data, and
    (d) application of alerts recommendations

NOTE 1 Customer request depends on from the criticality of the equipment or supplier.

NOTE 2 For (a) to (c), assessment of the procurement conditions, conformity of procurement and post-procurement data is performed versus approval document.

5.1.4 Declared Components List

ECSS-Q-ST-60_0480165

a. For each equipment, its supplier shall issue a DCL in an editable and sortable electronic format, as a minimum compatible with CSV, identifying all component types needed.

NOTE CSV is a common file format that can be used to transfer data between database or spreadsheet tables (a spreadsheet program is for example Excel®).

ECSS-Q-ST-60_0480166

b. The list specified in 5.1.4a shall be kept under configuration control (issue and identification of changes).

ECSS-Q-ST-60_0480167

c. The DCL shall be issued as a minimum at PDR and CDR (as designed) and before TRR (as built).

ECSS-Q-ST-60_0480168

d. After equipment CDR, all modifications affecting the PAD and JD information shall be implemented in the "as design" DCL and submitted to the customer for approval, before assembly.

ECSS-Q-ST-60_0480169

e. The “as design” DCL shall be sent to the customer for approval.

ECSS-Q-ST-60_0480170

f. Any change of parts during equipment manufacturing (e.g. type and manufacturer) shall be handled through RFWs submitted to the customer for approval before mounting.

ECSS-Q-ST-60_0480171

g. The “as built” DCL reflecting the actual EEE parts assembled into the flight hardware and their date code, shall be provided before TRR to the customer for review .

ECSS-Q-ST-60_0480172

h. The content of the DCL shall be in conformance with its DRD in Annex B.

ECSS-Q-ST-60_0480531

i. The supplier shall establish and update a consolidated “as design" DCL at his level and deliver it to the customer.

5.1.5 Electrical and mechanical GSE

ECSS-Q-ST-60_0480173

a. EEE components used in GSE, which are physically and directly interfacing to flight hardware, shall be:
   1. Fit Form and Function compatible,
   2. manufactured from materials identical to the flight opposite part, and
   3. ensured to be visibly clean before each connection to flight hardware.

ECSS-Q-ST-60_0480174

b. Flight hardware connector interfaces to GSE shall interface to a flight compatible connector, as per 5.1.5a.2.

NOTE This connector can be installed on the test harness or can be a saver.

5.1.6 EQM components

ECSS-Q-ST-60_0480532

a. EEE components used in Engineering Qualification Model (EQM) shall be fit, form and function representative of the flight components and be from the same manufacturers.

ECSS-Q-ST-60_0480533

b. If thermal vacuum tests are performed on the EQM, the EEE parts shall be material representative of the FM parts.

5.2 Component selection, evaluation and approval

5.2.1 General

ECSS-Q-ST-60_0480175

a. The supplier shall ensure that the following requirements are met during his selection process:

   1. Project requirements (e.g. quality levels, component policy, manufacturing and delivery schedules and budgets, and quantities),
   2. Design requirements (e.g. component type, case, dimensions, and materials),
   3. Production requirements (e.g. packaging, thermal and storage constraints, component mounting and process),
   4. Operational requirements (e.g. electrical, mechanical, radiation, reliability, assembly, and lifetime).

      NOTE The supplier of each product is responsible for the selection of components, which enable the performance, lifetime, environmental, material, safety, quality and reliability requirements of the product of which they form a part, to be satisfied in all respects.

ECSS-Q-ST-60_0480454

b. The selection, evaluation and approval of commercial EEE components for class 2 programmes shall be performed in conformance with clause 5.2 from ECSS-Q-ST-60-13.

5.2.2 Manufacturer and component selection

5.2.2.1 General rules

ECSS-Q-ST-60_0480176

a. The supplier shall establish and maintain in his own facility, and ensure that his suppliers also establish and maintain, procedures for selecting and controlling all components intended for use in deliverable products.

ECSS-Q-ST-60_0480177

b. Components shall be selected on the basis of proven qualification, characterization, and previous space experience and data, relevant with regard to the requirements for the programme, from manufacturers or sources (preferably European) employing effective Product Assurance Programmes in manufacturing and test.

c. <<deleted and moved to 5.2.2.5a>>

d. <<deleted and moved to 5.2.2.5b>>

5.2.2.2 Parts and material restriction

ECSS-Q-ST-60_0480180

a. The supplier shall ensure that non-hermetically sealed materials of components meet the requirements of ECSS-Q-ST-70 regarding off-gassing, out-gassing, flammability, toxicity and any other criteria specified for the intended use.

ECSS-Q-ST-60_0480181

b. The supplier shall evaluate the robustness of selected EEE components against the stresses induced by the assembly techniques to be employed.

ECSS-Q-ST-60_0480182

c. With respect to health and safety, beryllium oxide and lithium (except for the one which is identified in the procurement specification), cadmium, magnesium, mercury, zinc, radioactive material and all material which can cause safety hazard shall not be used.

ECSS-Q-ST-60_0480183

d. For limited life duration, known instability, safety hazard or reliability risk reasons, the EEE components listed below shall not be used:
   1. <<deleted>>
   2. Hollow core resistors,
   3. Potentiometers (except for mechanism position monitoring),
   4. Non-metallurgically bonded diodes,
   5. Semiconductor dice with unglassivated on active area,
   6. Wet slug tantalum capacitors other than capacitor construction using double seals and a tantalum case,
   7. Any component whose internal construction uses metallurgic bonding with a melting temperature not compatible with the end-application mounting conditions,
   8. <<deleted>>,
   9. TO5 relays without double welding of the mechanism to the header or with any type of integrated diodes inside.
   10. Aluminium liquid electrolytic capacitors,
   11. Tin coated wires and cables,
   12. PVC insulated wires and cables,
   13. Electromechanical parts in commercial grade,
   14. Feedthrough filter in commercial grade,
   15. Connectors without gold plating contact in commercial grade.

ECSS-Q-ST-60_0480184

e. For limited life duration, known instability, safety hazards or reliability risk reasons, EEE components listed below shall not be used for new designs:
   1. RNC90 > 100 kOhm,
   2. TO3 and DO4/DO5 packages,
   3. Wire link fuses.

ECSS-Q-ST-60_0480504

f. The use of pure tin in internal cavities may be authorized, on a case-by-case basis, based on the demonstration that there is no alternative product and there is no risk (supported by a technical justification).

ECSS-Q-ST-60_0480186

g. As per 5.2.2.2f., the justification of the use of pure tin shall be presented during a PCB for customer's approval,

ECSS-Q-ST-60_0480187

h. The use of pure tin (inside or outside the part) shall be declared in the PAD or in the JD.

ECSS-Q-ST-60_0480534

i. The customer shall specify either requirement 5.2.2.2j, or requirements 5.2.2.2k and 5.2.2.2l to handle risks linked with pure-tin terminations.

ECSS-Q-ST-60_0480535

j. The following actions shall be performed by the supplier to control the pure-tin risk:

1. Collect and synthesize all information participating to the risk analysis in conformance with Clause 9.
2. Based on the risk analysis, elaborate a mitigation plan.
3. Include in the JD the risk analysis and mitigation plan for customer approval.
4. Before retinning of flight parts, document the hot solder dip process by a procedure to be submitted to customer for approval.
5. Perform evaluation tests, lot acceptance tests and screening tests of retinned components after the retinning process.

NOTE 1 The mitigation plan can include one or a combination of the following solutions:

- Tin whisker sensitivity evaluation
- Retinning of terminations with complementary evaluation,
- Conformal coating,
- Design modification.

NOTE 2 Solder dip for tin whisker mitigation differs from solder dip for solderability in that for tin whisker mitigation, the termination is coated over its entire length, right up to the package surface (no stand off). As this process is critical it is good practice to evaluate it and control it well.

ECSS-Q-ST-60_0480536

k. All the following conditions shall be fulfilled to use Parts with matte pure tin finish, >97% tin:

1. They pass the JESD-201A class 2 requirements or meet the GEIA-STD-0005-2/Level 2B requirements,
2. They are not used in power function, where both Voltage >15 V and Current >2 A conditions are applied at the same time,
3. They are not mechanically torqued on board or equipment.

ECSS-Q-ST-60_0480537

l. If one of the three conditions specified in requirement 5.2.2.2k is not met, a mitigation plan shall be submitted to the customer for approval, through the JD approval process.

NOTE This mitigation plan can include, as an example, one of the following solutions:

- Conformal coating,
- Design analysis and risk assessment versus a possible short circuit.

5.2.2.3 Radiation hardness

a. The radiation requirements for EEE components are project specific.

ECSS-Q-ST-60_0480189

b. The supplier who is responsible for the design of the piece of hardware shall demonstrate the compliance of its components selection with the radiation constraints of the project.

ECSS-Q-ST-60_0480190

c. For this demonstration, the supplier shall consider all types of radiation including cosmic (Heavy Ions), electromagnetic, trapped (charged particles – electrons, protons – in radiation belts) and solar (flares).

ECSS-Q-ST-60_0480191

d. Due consideration shall be given to the mission orbit and trajectory, the duration, the associated spatial and temporal variations of the radiation environment as well as all protective factors such as shielding.

ECSS-Q-ST-60_0480192

e. The supplier shall assess the actual radiation tolerance of the selected components for compliance with the radiation requirements in term of total dose, displacement damage and Single Events Effects (SEE).

ECSS-Q-ST-60_0480193

f. The supplier shall identify components which are not compliant with the radiation requirements as critical radiation sensitive components.

ECSS-Q-ST-60_0480194

g. The supplier shall implement a Radiation Hardness Assurance Programme, in conformance with the requirements of ECSS-Q-ST-60-15, documented by a plan to be approved by the customer, for radiation sensitive components, covering the collection of all relevant information and specifying the necessary actions in terms of evaluation and procurement testing, planning and control.

ECSS-Q-ST-60_0480195

h. The supplier shall issue an Equipment Radiation Analysis document identifying all sensitive components w.r.t. the relevant radiation effects, possibly their impact and giving an adequate engineering solution (e.g. local shielding, design solution, specific test, RVT) for the relevant equipment.

ECSS-Q-ST-60_0480196

i. The Equipment Radiation Analysis document shall be submitted to the customer for approval.

NOTE More detailed information about the above requirements is given in ECSS-E-ST-10-12 and ECSS-Q-ST-60-15.

5.2.2.4 Derating

ECSS-Q-ST-60_0480197

a. The supplier shall implement derating rules for components used in his designs in accordance with the requirements of ECSS-Q-ST-30-11.

ECSS-Q-ST-60_0480198

b. <<deleted>>

5.2.2.5 Preferred sources

ECSS-Q-ST-60_0480178

a. Preference shall be given to components which necessitate the least evaluation or qualification effort.

ECSS-Q-ST-60_0480179

b. When selecting items, the supplier shall check the current data, applicability of the basis of qualification, problem notifications and alerts, and adequacy of specifications.

5.2.3 Component evaluation

5.2.3.1 General

ECSS-Q-ST-60_0480199

a. The supplier shall perform a component evaluation in absence of an approved demonstration that a component has the ability to conform to the requirements for functional performance, quality, dependability, and environmental resistance as required for the project.

ECSS-Q-ST-60_0480200

b. <<deleted>>

ECSS-Q-ST-60_0480201

c. The scope and planning of the component evaluation actions shall be derived from the results of an assessment of the design and intended application of the component.

ECSS-Q-ST-60_0480202

d. An evaluation plan shall be sent to the customer for approval, and include the following elements:

    1. Constructional Analysis (as per clause 5.2.3.3),
    2. Evaluation Testing (as per clause 5.2.3.4),
    3. Radiation Hardness (as per clause 5.2.3.4b.5).

ECSS-Q-ST-60_0480203

e. In the definition of the evaluation programme any information including pertinent reliability, analysis and test data from the manufacturer of the component and previous use in comparable application shall be considered and their relevance justified.

ECSS-Q-ST-60_0480204

f. Omission of any of these elements, or the introduction of alternative activities, shall be justified.

ECSS-Q-ST-60_0480205

g. All tests and inspections shall be carried out on representative samples of the component type from the current production of the manufacturer selected for the component procurement for the flight hardware.

ECSS-Q-ST-60_0480206

h. For programmable devices, the representativeness shall include the programming hardware tools and the compatibility of the software.

ECSS-Q-ST-60_0480207

i. The supplier shall review the evaluation results to determine their impact on the content of the procurement specification and amend it as necessary.

ECSS-Q-ST-60_0480208

j. The supplier shall summarize the evaluation results in the evaluation report and send it to the customer for approval.

NOTE For guidance for the assessment of the space environmental aspects refer to ECSS-E-ST-10-04 and ECSS-E-ST-10-12.

5.2.3.2 Component manufacturer assessment

a. A component manufacturer assessment is not required.

5.2.3.3 Constructional analysis

ECSS-Q-ST-60_0480210

a. Constructional analysis shall be carried out on representative components.

NOTE The primary aim is to provide an early indication of a component’s constructional suitability for meeting the specified performances of the space project application.

ECSS-Q-ST-60_0480211

b. The Constructional Analysis shall comprise destructive and non-destructive inspections, analyses, and testing, to identify:

1. Design and construction technology,
2. Materials used,
3. Inherent reliability aspects,
4. Quality of workmanship,
5. Potential hazards.

ECSS-Q-ST-60_0480212

c. The findings of the analysis shall be contained within a Constructional Analysis Report and shall be included in the Evaluation Report.

5.2.3.4 Evaluation testing

ECSS-Q-ST-60_0480213

a. The evaluation shall determine which inspections or tests are required to provide the confidence that the component type under evaluation, when assembled and tested in accordance with the procurement specification, successfully meets the project requirements.

ECSS-Q-ST-60_0480214

b. The supplier shall review the already existing data in order to adapt and minimize the content of the evaluation testing while ensuring that there are inputs and pertinent results covering the following topics:

1. Endurance test (operating at elevated temperature and electrical stress),
2. Mechanical stress (shock, vibration, constant acceleration),

3. Environmental stress (thermal shock, temperature cycling, high and low temperature storage, humidity),
4. Assembly capability testing,
5. Radiation testing, for total dose and single event effects sensitivity.

NOTE For guidance refer to ESCC basic specification no. 22600 and the ancillary specifications for dedicated component families.

5.2.4 Parts approval

ECSS-Q-ST-60_0480215

a. All components shall be reviewed and approved by the customer through the Parts Control Board (PCB).

ECSS-Q-ST-60_0480216

b. <<deleted>>

ECSS-Q-ST-60_0480217

c. The supplier shall maintain a system of traceability of the acceptance and approval of each component used in flight products.

ECSS-Q-ST-60_0480218

d. The approval process by the customer depends on the part qualification status and shall be organized as follows:

1. Space qualified parts : Space qualified parts listed in the DCL are approved through the DCL review except in the following cases where a PAD in conformance with ECSS-Q-ST-60 Annex D is delivered for customer's approval:
    (a) additional controls are required (e.g. precap, buy-off, LAT or LVT, RVT, DPA),
    (b) used outside the specified limits,
    (c) specific tests are required during procurement as per Table 7-1,
2. Other HiRel parts: A PAD in accordance with ECSS-Q-ST-60 Annex D is delivered to customer for approval.
3. Commercial parts: A Justification Document in accordance with ECSS-Q-ST-60-13 Annex F is delivered to customer for approval.
4. <<deleted>>

ECSS-Q-ST-60_0480219

e. In case the evaluation results (as per clause 5.2.3.1) are changing the procurement conditions documented in the PAD or the JD, a new revision of PAD or the JD shall be submitted to the customer for approval.

ECSS-Q-ST-60_0480538

f. The parts approval process, including PAD and JD approval, shall be completed prior to CDR, or MRR for recurring units if there is no CDR.

5.3 Component procurement

5.3.1 General

ECSS-Q-ST-60_0480220

a. The supplier shall ensure that all procured components meet the programme requirements with respect to inspection, screening and tests.

ECSS-Q-ST-60_0480221

b. Class 2 components shall meet the quality levels and supplementary conditions specified in Table 7-2.

ECSS-Q-ST-60_0480222

c. The supplier shall be responsible for manufacturer surveillance and control throughout the procurement programme.

ECSS-Q-ST-60_0480223

d. For non qualified parts, the supplier shall put in place a configuration control system to ensure that any change of the product (e.g. mask, manufacturing and assembly process) affecting evaluation, performance, quality, reliability and interchangeability is communicated to him by the manufacturer (e.g. PCN).

ECSS-Q-ST-60_0480224

e. The supplier shall ensure the compatibility of the change with its application and update all the related documentation.

NOTE For example: RFD, PAD, JD evaluation.

ECSS-Q-ST-60_0480225

f. The change shall be submitted to the customer for approval.

ECSS-Q-ST-60_0480226

g. To reduce the risk of procuring counterfeit components, when parts are not directly procured from the manufacturer, the supplier shall procure parts only from distributors duly franchised by the parts manufacturer.

ECSS-Q-ST-60_0480455

h. The procurement of commercial EEE components for class 2 programmes shall be performed in conformance with the requirements of clause 5.3 of ECSS-Q-ST-60-13.

5.3.2 Procurement specification

ECSS-Q-ST-60_0480227

a. The supplier shall procure EEE components according to controlled specifications.

ECSS-Q-ST-60_0480228

b. International specifications systems, new specifications or manufacturer's datasheets under configuration shall be used by the supplier.

ECSS-Q-ST-60_0480229

c. Any new specification shall be prepared and designed by the supplier as per existing international specification systems (ESCC, MIL). Preference shall be given to ESCC format when agreed by the manufacturer.

ECSS-Q-ST-60_0480230

d. The content of any new specification shall be in conformance with Annex C.

ECSS-Q-ST-60_0480231

e. The use of any new specification or datasheet shall be submitted to the customer for approval through the PAD process (see clause 5.2.4).

ECSS-Q-ST-60_0480232

f. Upon request, any new procurement specification prepared in the frame of the project, shall be delivered to the customer.

ECSS-Q-ST-60_0480233

g. The supplier shall keep each procurement specification or manufacturer's datasheet under configuration control.

5.3.3 Screening requirements

ECSS-Q-ST-60_0480234

a. All components to be incorporated into flight standard hardware shall be subjected to screening.

ECSS-Q-ST-60_0480235

b. The screening test requirements shall be defined such that accumulated stress does not jeopardize component reliability.

ECSS-Q-ST-60_0480236

c. All screening tests shall be performed at the component manufacturer's premises or at facility approved either by the qualification approval authority, where applicable (e.g. ESCC), or otherwise by the supplier.

ECSS-Q-ST-60_0480237

d. The quality levels defined in Table 7-2 shall apply.

ECSS-Q-ST-60_0480238

e. <<deleted>>

ECSS-Q-ST-60_0480456

f. When a component is available in a qualified version according to quality level specified in Table 7-2 it shall be selected.

ECSS-Q-ST-60_0480457

g. In case a component is not available in a qualified version according to quality level specified in Table 7-2, the screening of the component shall meet the screening flow defined by the generic specifications listed in Table 7-2.

ECSS-Q-ST-60_0480458

h. In case of X-rays or CT scan inspection, the total dose deposited and exposure time shall not deteriorate part performance or reliability.

5.3.4 Initial Customer Source Inspection (precap)

ECSS-Q-ST-60_0480239

a. The procurement entity shall carry out, at the manufacturer's premises, a customer precap inspection for the following non-space qualified parts types: relays, crystals, oscillators and hybrids.

ECSS-Q-ST-60_0480240

b. When not covered by MIL or ESCC specifications, methods and accept/reject criteria for customer's precap inspection shall be documented by a procedure to be presented to the customer, on request, for review.

5.3.5 Lot acceptance

ECSS-Q-ST-60_0480241

a. The supplier shall ensure that any lot/date code of EEE parts is submitted to a lot acceptance procedure, in line with applied normative systems, according to the following rules:

    1. Space qualified parts:

        (a) ESCC: user's lot/date code acceptance on the procured lot is not required due to periodic lot validation testing performed by the manufacturer.

        (b) MIL: QCI or TCI performed by the manufacturer is in accordance with the quality level of the MIL specification.

    2. Other HiRel qualified parts:

        (a) The content of the lot acceptance is defined according to the available data.

        (b) The proposed lot acceptance is approved through the approval process (see clause 5.2.4).

3. Commercial parts:
    (a) The content of the lot acceptance is defined according to information provided by the justification document according to ECSS-Q-ST-60-13.
    (b) The proposed lot acceptance is approved through the approval process in accordance with clause 5.2.4.

ECSS-Q-ST-60_0480459

b. The sample size for lot acceptance which may be reduced in some cases, shall be submitted to the customer for approval through the PAD process (see clause 5.2.4).

5.3.6 Final customer source inspection (buy-off)

ECSS-Q-ST-60_0480243

a. The procurement entity shall carry out, at the manufacturer's premises, a final customer source inspection for non-space qualified parts based on inspections, tests and review activities to verify that the requirements of the purchase order are met prior to shipment of the flight parts.

ECSS-Q-ST-60_0480244

b. The buy-off shall include:
    1. External visual inspection,
    2. Witnessing electrical measurements,
    3. Verifying mechanical dimensions,
    4. Review and verification of the data-package.

ECSS-Q-ST-60_0480505

c. The buy-off may be replaced by an incoming inspection at the procurement entity's facilities;

ECSS-Q-ST-60_0480246

d. If the buy-off is replaced by an incoming inspection at the procurement entity's facilities; it shall be declared in the PAD submitted to the customer for approval.

5.3.7 Incoming inspections

ECSS-Q-ST-60_0480247

a. The procurement entity shall perform incoming inspection at his premises on all components to verify conformance with the purchase order requirements.

ECSS-Q-ST-60_0480248

b. The incoming inspection shall include the following items:
    1. For any part: the minimum inspections required in ESCC 21004.

2. For the non-space qualified parts, when the final customer source inspection has not been performed, the following additional items:
    (a) External visual inspection by sampling (AQL 0,65% level II or 20 parts min)
    (b) Electrical measurements at room temperature on 20 parts or 100% (if lot size < 20 parts), or a datapackage review.

ECSS-Q-ST-60_0480249

c. The incoming inspection shall be documented by a procedure to be presented, on request, to the customer for review.

ECSS-Q-ST-60_0480506

d. If the parts have passed successfully a final CSI (or buy-off), the incoming inspection may be reduced to the following minimum:
    1. Verification of the manufacturer’s CoC,
    2. Packing checking,
    3. Quantity verification.

ECSS-Q-ST-60_0480507

e. In case the incoming inspection has been performed by a procurement agent, the incoming inspection performed by the end-user, may be reduced to the following minimum:
    1. Packing checking,
    2. Quantity verification

5.3.8 Radiation verification testing

ECSS-Q-ST-60_0480252

a. Radiation sensitive components, as defined in clause 5.2.2.3 and for which applicable existing test data is insufficient shall be subjected to RVT.

ECSS-Q-ST-60_0480253

b. RVT shall be performed in accordance with internationally recognized standards, such as ESCC Basic Specifications No. 22900 and 22500.

NOTE Additional information on test methods is given in MIL-STD-750 Test Method 1019, MIL-STD-883 Test Method 1019.

ECSS-Q-ST-60_0480254

c. In such a case, a PAD in conformance with Annex D shall be issued and processed as per clause 5.2.4.

ECSS-Q-ST-60_0480255

d. The results of RVT shall be documented by a report.

ECSS-Q-ST-60_0480256

e. When RVT is performed in the frame of the project, the supplier shall send the related report to the customer for information.

5.3.9 Destructive physical analysis

ECSS-Q-ST-60_0480257

a. The DPA shall be performed on 3 samples per lot/date code for the following non-space qualified parts types: as a minimum relays, oscillators and commercial parts.

ECSS-Q-ST-60_0480508

b. DPA may be carried out on representative samples of the components families when the following three conditions are met:

1. procured from the same manufacturer and same package without major change in the process,
2. with a limited datecode range of 13 weeks,
3. approved by the customer through the PAD (or Justification document) process.

NOTE In complement of above conditions, for series of integrated circuits, series of thermal switches, series of active discrete and series of passive components (e.g. 54xxxx, 1N63xx, …), representative samples can be from the same family considering technology limit and their complexity.

ECSS-Q-ST-60_0480259

c. The DPA sample size may be reduced in some cases which shall be submitted to the customer for approval through the PAD process.

ECSS-Q-ST-60_0480260

d. The DPA process shall be documented by a procedure to be submitted, on request, to the customer for information.

NOTE For guidance, refer to the basic specification ESCC 20600.

ECSS-Q-ST-60_0480261

e. The supplier shall verify that the outcome of the DPA is satisfactory prior to the installation of the components into flight hardware.

ECSS-Q-ST-60_0480509

f. <<deleted>>

ECSS-Q-ST-60_0480510

g. DPA may be performed by the manufacturer if witnessed by the supplier (or approved representative).

ECSS-Q-ST-60_0480264

h. For health and safety reasons, any test producing beryllium oxide dust shall be omitted.

ECSS-Q-ST-60_0480265

i. The results of DPA shall be documented by a report sent to the customer, on request, for information.

5.3.10 Relifing

ECSS-Q-ST-60_0480460

a. When components from a supplier's or parts procurement agent's stock are used, the following criteria shall be met:
   1. The parts are stored according to the minimum conditions given in clause 5.4,
   2. The minimum overall requirements (including screening) are in accordance with the project requirements,
   3. The lot/date code homogeneity and traceability can be demonstrated,
   4. The EEE parts documentation is available and the content is acceptable in accordance with the project requirements (including radiation data, if necessary),
   5. There are no open NCR's and no unresolved alerts with respect to their date code.

ECSS-Q-ST-60_0480267

b. For components meeting the criteria specified in requirement 5.3.10a, and which have a lot / date code exceeding the period defined in ECSS-Q-ST-60-14 clause 5, the relifing procedure ECSS-Q-ST-60-14 shall apply to the lot.

5.3.11 Manufacturer's data documentation deliveries

ECSS-Q-ST-60_0480268

a. The manufacturer's CoC shall be delivered to the parts procurer.

ECSS-Q-ST-60_0480269

b. Any other data (i.e. LAT or LVT, QCI or TCI), defined in the applicable procurement documents, shall be available at the manufacturer's facilities or delivered to the parts' procurer in line with the purchase order, as a minimum compatible with CSV.

NOTE CSV is a common file format that can be used to transfer data between database or spreadsheet tables (a spreadsheet program is for example Excel®).

ECSS-Q-ST-60_0480270

c. For non qualified parts, the parts procurer shall store the documentation for a minimum of 15 years after receiption of the components.

NOTE For qualified parts, the documentation storage period is under the responsibility of the manufacturer and the qualifying authority.

5.4 Handling and storage

ECSS-Q-ST-60_0480271

a. The supplier shall establish and implement procedures for handling and storage of components in order to prevent possible degradation.

NOTE For guidance, refer to the basic specification ESCC 20600.

ECSS-Q-ST-60_0480272

b. The procedures shall be applicable at any facility dealing with components for flight application.

ECSS-Q-ST-60_0480273

c. On request, handling and storage procedures shall be sent to the customer for review.

ECSS-Q-ST-60_0480274

d. As a minimum, the following areas shall be covered:

1. Control of the environment in accordance with ESCC Basic Specification No. 24900.
2. Measures and facilities to segregate and protect components during receiving inspection, storage, and delivery to manufacturing.
3. Control measures to ensure that electrostatic discharge susceptible components are identified and handled only by trained personnel using anti static packaging and tools.

5.5 Component quality assurance

5.5.1 General

ECSS-Q-ST-60_0480275

a. The supplier shall establish and implement the requirements of this document including methods, organizations and documents used to control the selection and procurement of components in accordance with the requirements of ECSS-Q-ST-20.

5.5.2 Nonconformances or failures

ECSS-Q-ST-60_0480276

a. The supplier shall establish and maintain a nonconformance control system in accordance with the general requirements in ECSS-Q-ST-10-09.

ECSS-Q-ST-60_0480277

b. Any observed deviation of EEE components from requirements as laid down in applicable specifications, procedures and drawings shall be controlled by the nonconformance control system.

NOTE This includes failures, malfunctions, deficiencies and defects.

ECSS-Q-ST-60_0480278

c. The nonconformance control system shall handle all nonconformances occurring on EEE components during:

1. Manufacture (if available), screening and acceptance tests,
2. Incoming inspection,
3. Integration and test of equipment,
4. Storage and handling.

ECSS-Q-ST-60_0480279

d. For ESCC qualified components the supplier shall apply the ESCC basic specification no 22800.

5.5.3 Alerts

ECSS-Q-ST-60_0480280

a. The supplier shall take into account all received alerts, errata sheets from international alert systems, from manufacturers or sent by the customer and shall validate that there are no alerts related to the intended applications and the recommendations of alerts were taken into account.

ECSS-Q-ST-60_0480281

b. If alerts become available at a later stage, the supplier shall analyse the alerts, analyse the project risk and propose an action plan for customer approval.

5.5.4 Traceability

ECSS-Q-ST-60_0480282

a. <<deleted>>

ECSS-Q-ST-60_0480283

b. The traceability shall be maintained through incoming, storage, and installation at the procurer and user of the component.

ECSS-Q-ST-60_0480284

c. In any case, the traceability requirements imposed by the supplier on the EEE parts manufacturer or distributor shall allow managing the adequacy of the tests performed by the supplier (i.e. evaluation, lot validation, any additional test or inspection).

ECSS-Q-ST-60_0480285

d. The traceability of EEE parts during installation in equipment, shall be ensured by the supplier through maintaining the traceability to the manufacturer’s lot/date code number of the EEE parts actually mounted.

ECSS-Q-ST-60_0480286

e. If the as built DCL has not yet been delivered, the supplier shall be able to provide this information (part type actually installed with its relevant lot/date code number) within one week.

5.5.5 Lot homogeneity for sampling test

ECSS-Q-ST-60_0480287

a. For radiation tests, the set of test samples shall be in accordance with ECSS-Q-ST-60-15.

5.6 Specific components

5.6.1 General

ECSS-Q-ST-60_0480288

a. << deleted >>

5.6.2 ASICs

ECSS-Q-ST-60_0480289

a. ECSS-Q-ST-60-02 shall apply.

5.6.3 Hybrids

ECSS-Q-ST-60_0480290

a. Selection and validation of the hybrids manufacturers shall conform to clauses 5 and 6 of ECSS-Q-ST-60-05.

ECSS-Q-ST-60_0480462

b. Design of hybrids shall conform to clause 7 of the ECSS-Q-ST-60-05.

ECSS-Q-ST-60_0480463

c. The hybrids shall be procured in conformance with the specifications listed in Table 7-2.

5.6.4 One time programmable devices

ECSS-Q-ST-60_0480291

a. For FPGA, ECSS-Q-ST-60-02 shall apply.

ECSS-Q-ST-60_0480292

b. The PAD shall allow traceability to the information related to the procurement of blank parts, the programming process and the acceptance of the programmed parts.

NOTE The programming process and the acceptance of the programmed parts are under the authority of the PCB if not otherwise determined in the PAD.

ECSS-Q-ST-60_0480511

c. << deleted >>

ECSS-Q-ST-60_0480294

d. One time programmable components shall be submitted to a post-programming sequence.

ECSS-Q-ST-60_0480295

e. For one time programmable FPGA and PROM without a clear and defined heritage, a post-programming burn-in shall be applied, in conformance with ESCC9000 subclause 8.16, for a minimum duration of 160 h.

NOTE FPGA and PROM with defined heritage are documented in these reports: ESCC REP 010 and ESCC REP011, available on https://escies.org.

ECSS-Q-ST-60_0480296

f. The supplier shall prepare a post-programming procedure for customer's approval, depending on part types.

NOTE This includes, if applicable:

- electrical test conditions,
- programming conditions and equipment,
- programming software version qualified by the supplier,
- burn-in conditions,
- additional screening tests, and
- specific marking after programming.

ECSS-Q-ST-60_0480297

g. The lot acceptance procedure, as defined in clause 5.3.5, shall be performed on devices coming from the flight lot/date code and programmed on the same kind of hardware tools and compatible software.

ECSS-Q-ST-60_0480512

h. In case of several designs based on the same lot of blank parts, the lot acceptance procedure, as defined in clause 5.3.5, may be limited to one representative flight programmed design.

5.6.5 Microwave monolithic integrated circuits

ECSS-Q-ST-60_0480299

a. Design, selection, procurement and use of the microwave monolithic integrated circuits shall be performed in conformance with the requirements from ECSS-Q-ST-60-12.

5.6.6 Connectors

ECSS-Q-ST-60_0480539

a. For connectors with removable contacts, contacts shall be procured from the same manufacturer as the connector in which they are mounted.

5.7 Documentation

ECSS-Q-ST-60_0480300

a. Any result from inspection or control shall be documented (including, precap, lot acceptance, buy-off, incoming, relifing and complementary tests).

Table 5-1: Document requirements list for Class 2 components

Document	Clause	Customer	Comments
Compliance matrix	5.1.2.2	Approval	
“as design” DCL	5.1.4	Approval	
RFW during equipment manufacturing *(after “as design” DCL and before “as built” DCL)*	5.1.4	Approval	
“as built” DCL	5.1.4	Review	
Technical note for parts having pure tin in internal cavities	5.2.2.2	Approval	
Radiation hardness assurance plan	5.2.2.3	Approval	to document the radiation hardness assurance programme
Equipment radiation analysis document	5.2.2.3	Approval	
Evaluation plans	5.2.3.1	Approval	
Evaluation reports	5.2.3.1	Approval	
PAD’s	5.2.4	Approval	
Justification documents	5.2.4	Approval	applicable for commercial parts
Change on EEE parts	5.3.1	Approval	
Procurement specifications prepared in the frame of the project	5.3.1h	Approval	
PIND test method for DO4, DO5 & TO3 packages	5.3.3	Review	
Procedure for customer precap	5.3.4	Review (on request)	When not covered by ESCC or MIL specifications

Document	**Clause**	**Customer**	**Comments**
Procedure for incoming	5.3.7	Review (on request)	
RVT reports when RVT is performed in the frame of the project	5.3.8	Information	
Procedure for DPA	5.3.9	Information (on request)	
DPA reports	5.3.9	Information (on request)	
Procedure for handling and storage of EEE parts	5.4	Review (on request)	
Action plan for alerts	5.5.3	Approval	
Procedure for post-programming sequence	5.6.4	Approval	

6
Requirements for Class 3 components

6.1 Component programme management

6.1.1 General

ECSS-Q-ST-60_0480301

a. <<deleted>>

6.1.2 Components control programme

6.1.2.1 Organization

ECSS-Q-ST-60_0480302

a. The supplier shall identify the organization responsible for the management of the component programme, and describe the organization's approaches (including the procurement system and its rationale) and capability to efficiently implement, manage, and control the component requirements.

6.1.2.2 Component control plan

ECSS-Q-ST-60_0480303

a. The supplier shall prepare a compliance matrix to the clauses of this standard.

ECSS-Q-ST-60_0480304

b. The supplier shall submit his compliance matrix to the customer for approval.

6.1.3 Parts control board

a. A PCB is not required.

6.1.4 Declared components list

ECSS-Q-ST-60_0480306

a. For each equipment, its supplier shall issue a DCL in an editable and sortable electronic format, as a minimum compatible with CSV, identifying all component types needed.

NOTE CSV is a common file format that can be used to transfer data between database or spreadsheet tables (a spreadsheet program is for example Excel®).

ECSS-Q-ST-60_0480307

b. The list specified in 6.1.4a shall be kept under configuration control (issue and identification of changes).

ECSS-Q-ST-60_0480308

c. The DCL shall be issued as a minimum at PDR and CDR (as designed) .

ECSS-Q-ST-60_0480309

d. After equipment CDR, all modifications affecting the PAD and JD information shall be implemented, in the "as design" DCL and submitted to the customer for approval, before assembly.

ECSS-Q-ST-60_0480310

e. The “as design” DCL shall be sent to the customer for approval.

ECSS-Q-ST-60_0480311

f. Any change of parts during equipment manufacturing (e.g. type and manufacturer) shall be handled through RFWs submitted to the customer for approval before mounting.

ECSS-Q-ST-60_0480312

g. The content of the DCL shall be in conformance with the DRD in Annex B.

ECSS-Q-ST-60_0480540

h. The supplier shall establish and update a consolidated “as design" DCL at his level and deliver it to the customer.

6.1.5 Electrical and mechanical GSE

ECSS-Q-ST-60_0480313

a. EEE components used in GSE, which are physically and directly interfacing to flight hardware, shall be:
   1. Fit Form and Function compatible,
   2. manufactured from materials identical to the flight opposite part,
   3. ensured to be visibly clean before each connection to flight hardware.

ECSS-Q-ST-60_0480314

b. Flight hardware connectors interfaces to GSE shall interface to a flight compatible connector, as per 6.1.5a.

NOTE This connector can be installed on the test harness or can be a saver.

6.1.6 EQM components

ECSS-Q-ST-60_0480541

a. EEE components used in Engineering Qualification Model (EQM) shall be fit, form and function representative of the flight components and be from the same manufacturers.

ECSS-Q-ST-60_0480542

b. If thermal vacuum tests are performed on the EQM, the EEE parts shall be material representative of the FM parts.

6.2 Component selection, evaluation and approval

6.2.1 General

ECSS-Q-ST-60_0480315

a. The supplier shall ensure that the following requirements are met during his selection process:

1. Project requirements (e.g. quality levels, component policy, manufacturing and delivery schedules and budgets, quantities),
2. Design requirements (e.g. component type, case, dimensions, materials),
3. Production requirements (e.g. packaging, thermal and storage constraints, component mounting process),
4. Operational requirements (e.g. electrical, mechanical, radiation, reliability, assembly, lifetime).

NOTE The supplier of each product is responsible for the selection of components, which enable the performance, lifetime, environmental, material, safety, quality and reliability requirements of the product of which they form a part, to be satisfied in all respects.

ECSS-Q-ST-60_0480464

b. The selection, evaluation and approval of commercial EEE components for class 3 programmes shall be performed in conformance with clause 6.2 from ECSS-Q-ST-60-13 standard.

6.2.2 Manufacturer and component selection

6.2.2.1 General rules

ECSS-Q-ST-60_0480316

a. The supplier shall establish and maintain in his own facility, and ensure that his suppliers also establish and maintain, procedures for selecting and controlling all components intended for use in deliverable products.

ECSS-Q-ST-60_0480317

b. Components shall be selected on the basis of proven qualification, characterization, and previous space experience and data, relevant with regard to the requirements for the programme, from manufacturers or sources (preferably European) employing effective Product Assurance Programmes in manufacturing and test.

c. <<deleted and moved to 6.2.2.3a>>

d. <<deleted and moved to 6.2.2.3b>>

6.2.2.2 Parts and material restriction

ECSS-Q-ST-60_0480320

a. The supplier shall ensure that non-hermetically sealed materials of components meet the requirements of ECSS-Q-ST-70 regarding off-gassing, out-gassing, flammability, toxicity and any other criteria specified for the intended use.

ECSS-Q-ST-60_0480321

b. The supplier shall evaluate the robustness of selected EEE components against the stresses induced by the assembly techniques to be employed.

ECSS-Q-ST-60_0480322

c. With respect to health and safety, beryllium oxide and lithium (except for the one which is identified in the procurement specification), cadmium, magnesium, mercury, zinc, radioactive material and all material which can cause safety hazard shall not be used.

ECSS-Q-ST-60_0480323

d. For limited life duration , known instability, safety hazard or reliability risk reasons, the EEE components listed below shall not be used:

1. <<deleted>>
2. Hollow core resistors,
3. Potentiometers (except for mechanism position monitoring),
4. Non-metallurgically bonded diodes,
5. Semiconductor dice with unglassivated active area,
6. Wet slug tantalum capacitors other than capacitor construction using double seals and a tantalum case,
7. Any component whose internal construction uses metallurgic bonding with a melting temperature not compatible with the end-application mounting conditions,
8. <<deleted>>,
9. TO5 relays without double welding of the mechanism to the header or with any type of integrated diodes inside.
10. Aluminium liquid electrolytic capacitors,
11. Tin coated wires and cables,
12. PVC insulated wires and cables,

13. Electromechanical parts in commercial grade,
14. Feedthrough filter in commercial grade,
15. Connectors without gold plating contact in commercial grade.

ECSS-Q-ST-60_0480324

e. For limited life duration, known instability, safety hazard or reliability risk reasons, the use of EEE components listed below shall not be used for new designs:
    1. RNC90 > 100 kOhm,
    2. TO3 and DO4/DO5 packages,
    3. Wire link fuses.

ECSS-Q-ST-60_0480513

f. The use of pure tin in internal cavities may be authorized, on a case-by-case basis, based on the demonstration that there is no alternative product and there is no risk (supported by a technical justification).

ECSS-Q-ST-60_0480326

g. As per 6.2.2.2f, the justification of the use of pure tin shall be sent to the customer for approval.

ECSS-Q-ST-60_0480327

h. The use of pure tin (inside or outside the part) shall be declared in the PAD or in the JD.

ECSS-Q-ST-60_0480543

i. The customer shall specify either requirement 6.2.2.2j, or requirements 6.2.2.2k and 6.2.2.2l to handle risks linked with pure-tin terminations.

ECSS-Q-ST-60_0480544

j. The following actions shall be performed by the supplier to control the pure-tin risk:
    1. Collect and synthesize all information participating to the risk analysis in conformance with Clause 9.
    2. Based on the risk analysis, elaborate a mitigation plan.
    3. Include in the JD the risk analysis and mitigation plan for customer approval.
    4. Before retinning of flight parts, document the hot solder dip process by a procedure to be submitted to customer for approval.
    5. Perform evaluation tests, lot acceptance tests and screening tests of retinned components after the retinning process.

NOTE 1 The mitigation plan can include one or a combination of the following solutions:

- Tin whisker sensitivity evaluation
- Retinning of terminations with complementary evaluation,
- Conformal coating,
- Design modification.

NOTE 2 Solder dip for tin whisker mitigation differs from solder dip for solderability in that for tin whisker mitigation, the termination is coated over its entire length, right up to the package surface (no stand off). As this process is critical it is good practice to evaluate it and control it well.

ECSS-Q-ST-60_0480545

k. All the following conditions shall be fulfilled to use Parts with matte pure tin finish, >97% tin:

1. They pass the JESD-201A class 2 requirements or meet the GEIA-STD-0005-2/Level 2B requirements,
2. They are not used in power function, where both Voltage >15 V and Current >2 A conditions are applied at the same time,
3. They are not mechanically torqued on board or equipment.

ECSS-Q-ST-60_0480546

l. If one of the three conditions specified in requirement 6.2.2.2k is not met, a mitigation plan shall be submitted to the customer for approval, through the JD approval process.

NOTE This mitigation plan can include, as an example, one of the following solutions:

- Conformal coating,
- Design analysis and risk assessment versus a possible short circuit.

6.2.2.3 Preferred sources

ECSS-Q-ST-60_0480318

a. Preference shall be given to components which necessitate the least evaluation or qualification effort.

ECSS-Q-ST-60_0480319

b. When selecting items, the supplier shall check the current data, applicability of the basis of qualification, problem notifications and alerts, and adequacy of specifications.

6.2.2.4 Radiation hardness

a. The radiation requirements for EEE components are project specific.

ECSS-Q-ST-60_0480330

b. The supplier who is responsible for the design of the piece of hardware shall demonstrate the compliance of its components selection with the radiation constraints of the project.

ECSS-Q-ST-60_0480331

c. For this demonstration, the supplier shall consider all types of radiation including cosmic (Heavy Ions), electromagnetic, trapped (charged particles – electrons, protons – in radiation belts) and solar (flares).

ECSS-Q-ST-60_0480332

d. Due consideration shall be given to the mission orbit and trajectory, the duration, the associated spatial and temporal variations of the radiation environment as well as all protective factors such as shielding.

ECSS-Q-ST-60_0480333

e. The supplier shall assess the actual radiation tolerance of the selected components for compliance with the radiation requirements in term of total dose, displacement damage and Single Events Effects (SEE).

ECSS-Q-ST-60_0480334

f. The supplier shall identify components which are not compliant with the radiation requirements as critical radiation sensitive components.

ECSS-Q-ST-60_0480335

g. The supplier shall implement a Radiation Hardness Assurance Programme, in conformance with the requirements of the ECSS-Q-ST-60-15, documented by a plan to be approved by the customer, for radiation sensitive components, covering the collection of all relevant information and specifying the necessary actions in terms of evaluation and procurement testing, planning and control.

ECSS-Q-ST-60_0480336

h. The supplier shall issue an Equipment Radiation Analysis document identifying all sensitive components w.r.t. the relevant radiation effects, possibly their impact and giving an adequate engineering solution (e.g. shielding, design solution, specific test, and RVT) or the relevant equipment.

ECSS-Q-ST-60_0480337

i. The Equipment Radiation Analysis document shall be submitted to the customer for approval.

NOTE More detailed information about the above requirements is given in ECSS-E-ST-10-12 and ECSS-Q-ST-60-15.

6.2.2.5 Derating

ECSS-Q-ST-60_0480338

a. The supplier shall implement derating rules for components used in his designs in accordance with the requirements of ECSS-Q-ST-30-11.

ECSS-Q-ST-60_0480339

b. <<deleted>>

6.2.3 Component evaluation

6.2.3.1 General

ECSS-Q-ST-60_0480340

a. The supplier shall perform a component evaluation in absence of an approved demonstration that a component has the ability to conform to the requirements for functional performance, quality, dependability, and environmental resistance as required for the project.

ECSS-Q-ST-60_0480341

b. <<deleted>>

ECSS-Q-ST-60_0480342

c. The scope and planning of the component evaluation actions shall be derived from the results of an assessment of the design and intended application of the needed component.

ECSS-Q-ST-60_0480343

d. An evaluation plan shall be sent to the customer for approval, and include the following elements:

   1. Constructional Analysis (as per clause 6.2.3.3),
   2. Evaluation Testing (as per clause 6.2.3.4),
   3. Radiation Hardness (as per clause 6.2.3.4b.5).

ECSS-Q-ST-60_0480344

e. In the definition of the evaluation programme any information including pertinent reliability, analysis and test data from the manufacturer of the component and previous use in comparable application shall be considered and their relevance justified.

ECSS-Q-ST-60_0480345

f. Omission of any of these elements, or the introduction of alternative activities, shall be justified.

ECSS-Q-ST-60_0480346

g. All tests and inspections shall be carried out on representative samples of the component type from the current production of the manufacturer selected for the component procurement for the flight hardware.

ECSS-Q-ST-60_0480347

h. For programmable devices, the representativeness shall include the programming hardware tools and the compatibility of the software.

ECSS-Q-ST-60_0480348

i. The supplier shall review the evaluation results to determine their impact on the content of the procurement specification and amend it as necessary.

ECSS-Q-ST-60_0480349

j. The supplier shall summarize the evaluation results in the evaluation report and send it to the customer for approval.

NOTE For guidance for the assessment of the space environmental aspects refer to ECSS-E-ST-10-04 and ECSS E-ST-10-12.

ECSS-Q-ST-60_0480350

k. <<deleted>>

6.2.3.2 Component manufacturer assessment

a. A component manufacturer assessment is not required.

6.2.3.3 Constructional analysis

ECSS-Q-ST-60_0480352

a. Constructional analysis shall be carried out on representative components.

NOTE The primary aim is to provide an early indication of a component's constructional suitability for meeting the specified performances of the space project application.

ECSS-Q-ST-60_0480353

b. The Constructional Analysis shall comprise destructive and non-destructive inspections, analyses, and testing, to identify:

1. Design and construction technology,
2. Materials used,
3. Inherent reliability aspects,
4. Quality of workmanship,
5. Potential hazards.

ECSS-Q-ST-60_0480354

c. The findings of the analysis shall be contained within a Constructional Analysis Report and shall be included in the Evaluation Report.

6.2.3.4 Evaluation testing

ECSS-Q-ST-60_0480355

a. The evaluation shall determine which inspections or tests are required to provide the confidence that the component type under evaluation, when assembled and tested in accordance with the procurement specification, successfully meets the project requirements.

ECSS-Q-ST-60_0480356

b. The supplier shall review the already existing data in order to adapt and minimize the content of the evaluation testing while ensuring that there are inputs and pertinent results covering the following topics:

1. Endurance test (operating at elevated temperature and electrical stress),
2. Mechanical stress (shock, vibration, constant acceleration),
3. Environmental stress (thermal shock, temperature cycling, high and low temperature storage, humidity),
4. Assembly capability testing,
5. Radiation testing, for total dose and single event effects sensitivity.

NOTE For guidance refer to ESCC basic specification no. 22600 and the ancillary specifications for dedicated component families.

6.2.4 Parts approval

ECSS-Q-ST-60_0480357

a. All components shall be reviewed and approved by the customer through the Parts Control Board (PCB).

ECSS-Q-ST-60_0480358

b. <<deleted>>

ECSS-Q-ST-60_0480359

c. The supplier shall maintain a system of traceability of the acceptance and approval of each component used in flight products.

ECSS-Q-ST-60_0480360

d. The approval process by the customer depends on the part qualification status and shall be organized as follows:

1. Space qualified parts: Space qualified parts listed in the DCL are approved through the DCL review except in the following cases where a PAD in conformance with ECSS-Q-ST-60 Annex D is delivered for customer's approval:
    (a) additional controls are required (e.g. precap, buy-off, LAT or LVT, RVT, DPA),
    (b) used outside the specified limits,
    (c) specific tests are required during procurement as per Table 7-1,
2. Other HiRel parts: A PAD in accordance with ECSS-Q-ST-60 Annex D is delivered to customer for approval.
3. Commercial parts: A Justification Document in accordance with ECSS-Q-ST-60-13 Annex F is delivered to customer for approval.

ECSS-Q-ST-60_0480361

e. In case the evaluation results (as per clause 6.2.3.1) are changing the procurement conditions documented in the PAD or the JD, a new revision of the PAD or the JD shall be submitted to the customer for approval.

ECSS-Q-ST-60_0480547

f. The parts approval process, including PAD and JD approval, shall be completed prior to CDR, or MRR for recurring units if there is no CDR.

6.3 Component procurement

6.3.1 General

ECSS-Q-ST-60_0480362

a. The supplier shall ensure that all procured components meet the programme requirements with respect to inspection, screening and tests.

ECSS-Q-ST-60_0480363

b. Class 3 components shall meet the quality levels and supplementary conditions specified in Table 7-3.

ECSS-Q-ST-60_0480364

c. The supplier shall be responsible for manufacturer surveillance and control throughout the procurement programme.

ECSS-Q-ST-60_0480365

d. To reduce the risk of procuring counterfeit components, when parts are not directly procured from the manufacturer, the supplier shall procure parts only from distributors duly franchised by the parts manufacturer.

ECSS-Q-ST-60_0480465

e. The procurement of commercial EEE components for class 3 programmes shall be in conformance with the requirements of clause 6.3 of ECSS-Q-ST-60-13.

6.3.2 Procurement specification

ECSS-Q-ST-60_0480366

a. The supplier shall procure EEE components according to controlled specifications.

ECSS-Q-ST-60_0480367

b. International specifications systems, new specifications or manufacturer’s datasheets under configuration shall be used by the supplier.

ECSS-Q-ST-60_0480368

c. Any new specification shall be prepared and designed by the supplier as per existing international specification systems (ESCC, MIL) and preference be given to ESCC format when agreed by the manufacturer.

ECSS-Q-ST-60_0480369

d. The content of any new specification shall be in conformance with the procurement specification DRD in Annex C.

ECSS-Q-ST-60_0480370

e. The use of any new specification or datasheet shall be submitted to the customer for review through the approval process (see clause 6.2.4).

ECSS-Q-ST-60_0480371

f. Upon request, any new procurement specification prepared in the frame of the project, shall be delivered to the customer.

ECSS-Q-ST-60_0480372

g. The supplier shall keep each procurement specification or manufacturer's datasheet under configuration control.

6.3.3 Screening requirements

ECSS-Q-ST-60_0480373

a. All components to be incorporated into flight standard hardware shall be subjected to screening.

ECSS-Q-ST-60_0480374

b. The screening test requirements shall defined such that accumulated stress does not jeopardize component reliability.

ECSS-Q-ST-60_0480375

c. All screening tests shall be performed at the component manufacturer's premises or at a facility approved either by the qualification approval authority, where applicable (e.g. ESCC), or otherwise by the supplier .

ECSS-Q-ST-60_0480376

d. The applicable quality levels defined in Table 7-3 shall apply.

ECSS-Q-ST-60_0480377

e. <<deleted>>

ECSS-Q-ST-60_0480466

f. When a component is available in a qualified version according to quality level specified in Table 7-3 it shall be selected.

ECSS-Q-ST-60_0480467

g. In case a component is not available in a qualified version according to quality level specified in Table 7-3, the screening of the component shall meet the screening flow defined by the generic specifications listed in Table 7-3.

ECSS-Q-ST-60_0480468

h. In case of X-rays or CT scan inspection, the total dose deposited and exposure time shall not deteriorate part performance or reliability.

6.3.4 Initial customer source inspection (precap)

a. A customer precap is not required.

6.3.5 Lot acceptance

ECSS-Q-ST-60_0480379

a. The supplier shall ensure that any lot/date code of EEE parts is submitted to a lot acceptance procedure, in line with applied normative systems, according to the following rules:

1. Space qualified parts:
    (a) ESCC: user's lot acceptance on the procured lot/date code is not required due to periodic lot validation testing performed by the manufacturer.
    (b) MIL: QCI or TCI performed by the manufacturer is in accordance with the quality level of the MIL specification.
2. Other HiRel qualified parts:
    (a) The content of the lot acceptance is defined according to the available data.
    (b) The proposed lot acceptance is approved through the approval process (see clause 6.2.4).
3. Commercial parts:
    (a) The content of the lot acceptance is defined according to information provided by the justification document according to ECSS-Q-ST-60-13.
    (b) The proposed lot acceptance is approved through the approval process in accordance with clause 6.2.4.

ECSS-Q-ST-60_0480380

b. The sample size for lot acceptance which may be reduced in some cases, shall be submitted to the customer approval through the PAD process (see clause 6.2.4).

6.3.6 Final customer source inspection (buy-off)

a. A buy-off is not required.

6.3.7 Incoming inspections

ECSS-Q-ST-60_0480382

a. The procurement entity shall perform incoming inspection at his premises on all components to verify conformance with the purchase order requirements.

ECSS-Q-ST-60_0480383

b. The incoming inspection shall include the following items:

1. For any part: the minimum inspections required in ESCC 21004.

ECSS-Q-ST-60_0480384

c. The incoming inspection shall be documented by a procedure to be presented, on request, to the customer for review.

ECSS-Q-ST-60_0480514

d. If the parts have passed successfully a final CSI (or buy-off), the incoming inspection may be reduced to the following minimum:

1. Verification of the manufacturer's CoC,
2. Packing checking,
3. Quantity verification.

ECSS-Q-ST-60_0480515

e. In case the incoming inspection has been performed by a procurement agent, the incoming inspection performed by the end-user, may be reduced to the following minimum:

1. Packing checking,
2. Quantity verification.

6.3.8 Radiation verification testing

ECSS-Q-ST-60_0480387

a. Radiation sensitive components, as defined in clause 6.2.2.4 and for which applicable existing test data is insufficient shall be subjected to RVT.

ECSS-Q-ST-60_0480388

b. RVT shall be performed in accordance with internationally recognized standards, such as ESCC Basic Specifications No. 22900 and 22500.

NOTE Additional information on test methods is given in MIL-STD-750 Test Method 1019, MIL-STD-883 Test Method 1019.

ECSS-Q-ST-60_0480389

c. In such a case, a PAD in conformance with Annex D shall be issued and processed as per clause 6.2.4.

ECSS-Q-ST-60_0480390

d. The results of RVT shall be documented by a report.

ECSS-Q-ST-60_0480391

e. When RVT is performed in the frame of the project, the supplier shall send the related report to the customer for information.

6.3.9 Destructive physical analysis

ECSS-Q-ST-60_0480392

a. The DPA shall be performed on 3 samples per lot/date code for the following non-space qualified part types, as a minimum relays and commercial parts.

ECSS-Q-ST-60_0480516

b. DPA may be carried out on representative samples of the components families when the following three conditions are met:

1. procured from the same manufacturer and same package without major change in the process,
2. with a limited datecode range of 13 weeks,
3. approved by the customer through the PAD (or Justification document) process.

NOTE In complement of above conditions, for series of integrated circuits, series of thermal switches, series of active discrete and series of passive components (e.g. 54xxxx, 1N63xx, …), representative samples can be from the same family considering technology limit and their complexity.

ECSS-Q-ST-60_0480394

c. The DPA sample size may be reduced in some cases which shall be submitted to the customer for approval through the PAD process.

ECSS-Q-ST-60_0480395

d. The DPA process shall be documented by a procedure to be submitted, on request, to the customer for information.

NOTE For guidance refer to the basic specificaton ESCC 20600.

ECSS-Q-ST-60_0480396

e. The supplier shall verify that the outcome of the DPA is satisfactory prior to the installation of the components into flight hardware.

ECSS-Q-ST-60_0480517

f. <<deleted>>

ECSS-Q-ST-60_0480518

g. DPA may be performed by the manufacturer if witnessed by the supplier (or approved representative).

ECSS-Q-ST-60_0480400

h. For health and safety reasons, any test producing beryllium oxide dust shall be omitted.

ECSS-Q-ST-60_0480401

i. The results of DPA shall be documented by a report sent to the customer, on request, for information.

6.3.10 Relifing

ECSS-Q-ST-60_0480490

a. When components from a supplier's or parts procurement agent's stock are used, the following criteria shall be met:

1. The parts are stored according to the minimum conditions given in clause 6.4,
2. The minimum overall requirements (including screening) are in accordance with the project requirements,
3. The lot homogeneity and traceability can be demonstrated,
4. The EEE parts documentation is available and the content is acceptable in accordance with the project requirements (including radiation data, if necessary),
5. There are no open NCR's and no unresolved alerts with respect to their date code.

ECSS-Q-ST-60_0480403

b. For components meeting the criteria specified in requirement 6.3.10a, and which have a lot / date code exceeding the period defined in ECSS-Q-ST-60-14 clause 5, the relifing procedure ECSS-Q-ST-60-14 shall apply to the lot.

6.3.11 Manufacturer's data documentation deliveries

ECSS-Q-ST-60_0480404

a. The manufacturer's CoC shall be delivered to the parts procurer.

ECSS-Q-ST-60_0480405

b. Any other data (i.e. LAT or LVT, QCI or TCI), defined in the applicable procurement documents, shall be available at the manufacturer's facilities or delivered to the parts' procurer in line with the purchase order, as a minimum compatible with CSV.

NOTE CSV is a common file format that can be used to transfer data between database or spreadsheet tables (a spreadsheet program is for example Excel®).

ECSS-Q-ST-60_0480406

c. For non qualified parts, the parts procurer shall store the documentation for a minimum of 15 years after receiption of the components.

NOTE For qualified parts, the documentation storage period is under the responsibility of the manufacturer and the qualifying authority.

6.4 Handling and storage

ECSS-Q-ST-60_0480407

a. The supplier shall establish and implement procedures for handling and storage of components in order to prevent possible degradation.

NOTE For guidance, refer to the basic specification ESCC 20600.

ECSS-Q-ST-60_0480408

b. The procedures shall be applicable at any facility dealing with components for flight application.

ECSS-Q-ST-60_0480409

c. On request, handling and storage procedures shall be sent to the customer for review.

ECSS-Q-ST-60_0480410

d. As a minimum, the following areas shall be covered:
    1. Control of the environment in accordance with ESCC Basic Specification No. 24900.
    2. Measures and facilities to segregate and protect components during receiving inspection, storage, and delivery to manufacturing.
    3. Control measures to ensure that electrostatic discharge susceptible components are identified and handled only by trained personnel using anti static packaging and tools.

6.5 Component quality assurance

6.5.1 General

ECSS-Q-ST-60_0480411

a. The supplier shall establish and implement the requirements of this document including methods, organizations and documents used to control the selection and procurement of components in accordance with the requirements of ECSS-Q-ST-20.

6.5.2 Nonconformances or failures

ECSS-Q-ST-60_0480412

a. The supplier shall establish and maintain a nonconformance control system in accordance with the general requirements in ECSS-Q-ST-10-09.

ECSS-Q-ST-60_0480413

b. Any observed deviation of EEE components from requirements as laid down in applicable specifications, procedures and drawings shall be controlled by the nonconformance control system.

NOTE This includes failures, malfunctions, deficiencies and defects.

ECSS-Q-ST-60_0480414

c. The nonconformance control system shall handle all nonconformances occurring on EEE components during:

1. Manufacture (if available), screening and acceptance tests,
2. Incoming inspection,
3. Integration and test of equipment,
4. Storage and handling.

ECSS-Q-ST-60_0480415

d. For ESCC qualified components the supplier shall apply the ESCC basic specification no 22800.

6.5.3 Alerts

ECSS-Q-ST-60_0480416

a. The supplier shall take into account all received alerts, errata sheets from international alert systems, from manufacturers or sent by the customer and shall validate that there are no alerts related to the intended applications and the recommendations of alerts were taken into account.

ECSS-Q-ST-60_0480417

b. If alerts become available at a later stage, the supplier shall analyse the alerts, analyse the project risk and propose an action plan for customer approval.

6.5.4 Traceability

ECSS-Q-ST-60_0480418

a. <<deleted>>

ECSS-Q-ST-60_0480419

b. The traceability shall be maintained through incoming, storage, and installation at the procurer and user of the component.

ECSS-Q-ST-60_0480420

c. In any case, the traceability requirements imposed by the supplier on the EEE parts manufacturer or distributor shall allow managing the adequacy of the tests performed by the supplier (i.e. evaluation, lot validation, any additional test or inspection).

ECSS-Q-ST-60_0480421

d. The traceability of EEE parts during installation in equipment, shall be ensured by the supplier through maintaining the traceability to the manufacturer’s lot/date code number of the EEE parts actually mounted.

ECSS-Q-ST-60_0480422

e. The supplier shall be able to provide these information (part type actually installed with its relevant lot/date code number) within one working day (when the flight system is on launch pad) or within one week (in the other cases).

6.5.5 Lot homogeneity for sampling test

ECSS-Q-ST-60_0480423

a. For radiation tests, the set of test samples shall be in accordance with ECSS-Q-ST-60-15.

6.6 Specific components

6.6.1 Overview

ECSS-Q-ST-60_0480424

a. << deleted >>

6.6.2 ASICs

ECSS-Q-ST-60_0480425

a. ECSS-Q-60-02 shall apply.

6.6.3 Hybrids

ECSS-Q-ST-60_0480426

a. Selection and validation of the hybrids manufacturers shall conform to clauses 5 and 6 of ECSS-Q-ST-60-05.

ECSS-Q-ST-60_0480470

b. Design of hybrids shall conform to clause 7 of ECSS-Q-ST-60-05.

ECSS-Q-ST-60_0480471

c. The hybrids shall be procured in accordance with the specifications listed in Table 7-3.

6.6.4 One time programmable devices

ECSS-Q-ST-60_0480427

a. For FPGA, ECSS-Q-ST-60-02 shall apply.

ECSS-Q-ST-60_0480428

b. The PAD shall allow traceability to the information related to the procurement of blank parts, the programming process and the acceptance of the programmed parts.

NOTE The programming process and the acceptance of the programmed parts can be addressed between the customer and the supplier if not otherwise determined in the PAD.

ECSS-Q-ST-60_0480519

c. << deleted >>

ECSS-Q-ST-60_0480430

d. One time programmable components shall be submitted to a post-programming sequence.

ECSS-Q-ST-60_0480431

e. For one time programmable FPGA and PROM without a clear and defined heritage, a post-programming burn-in shall be applied, in conformance with ESCC9000 subclause 8.16, for a minimum duration of 160 h.

NOTE FPGA and PROM with defined heritage are documented in these reports: ESCC REP 010 and ESCC REP011, available on https://escies.org.

ECSS-Q-ST-60_0480432

f. The supplier shall prepare a post-programming procedure for customer’s approval, depending on part types

NOTE This includes, if applicable:

- electrical test conditions,
- programming conditions and equipment,
- programming software version qualified by the supplier,
- burn-in conditions,
- additional screening tests, and
- specific marking after programming.

ECSS-Q-ST-60_0480433

g. The lot acceptance procedure, as defined in clause 6.3.5, shall be performed on devices coming from the flight lot/date code and programmed on the same kind of hardware tools and compatible software.

ECSS-Q-ST-60_0480520

h. In case of several designs based on the same lot of blank parts, the lot acceptance procedure, as defined in clause 6.3.5, may be limited to one representative flight programmed design.

6.6.5 Microwave monolithic integrated circuits

ECSS-Q-ST-60_0480435

a. Design, selection, procurement and use of the microwave monolithic integrated circuits shall be performed in conformance with the requirements from ECSS-Q-ST-60-12.

6.6.6 Connectors

ECSS-Q-ST-60_0480548

a. For connectors with removable contacts, contacts shall be procured from the same manufacturer as the connector in which they are mounted.

6.7 Documentation

ECSS-Q-ST-60_0480436

a. Any result from inspection or control shall be documented (including, precap, lot acceptance, buy-off, incoming, relifing and complementary tests).

Table 6-1:Document requirements list for Class 3 components

Document	Clause	Customer	Comments
Compliance matrix	6.1.2.2	Approval	
"as design" DCL	6.1.4	Approval	
RFW during equipment manufacturing *(after "as design" DCL)*	6.1.4	Approval	
Technical note for parts having pure in internal cavities	6.2.2.2	Approval	
Radiation hardness assurance plan	6.2.2.4	Approval	to document the radiation hardness assurance programme
Equipment radiation analysis document	6.2.2.4	Approval	
Evaluation plans	6.2.3.1	Approval	
Evaluation reports	6.2.3.1	Approval	
PAD's	6.2.4	Approval	
Justification documents	6.2.4	Approval	applicable for commercial parts
Procurement specifications prepared in the frame of the project	6.3.2	Review	

Document	Clause	Customer	Comments
PIND test method for DO4, DO5 & TO3 packages	6.3.3.	Review	
Procedure for incoming	6.3.7	Review (on request)	
RVT reports when RVT is performed in the frame of the project	6.3.8	Information	
Procedure for DPA	6.3.9	Information (on request)	
DPA reports	6.3.9	Information (on request)	
Procedure for handling and storage of EEE parts	6.4	Review (on request)	
Action plan for alerts	6.5.3	Approval	
Procedure for post-programming sequence	6.6.3c	Approval	

7
Quality levels

ECSS-Q-ST-60_0480442

Table 7-1: Quality levels for Class 1 components

EEE part family	Quality level			Supplementary Conditions
	ESCC	MIL	Other	
Capacitors, chip, ceramic	ESCC 3009 level C	MIL-PRF-55681 EFR level R min MIL-PRF-123		For ceramic capacitors procured through ESCC or MIL specifications but in an extended, non qualified, range of values or not belonging to ESCC QPL or MIL QML/QPL, the humidity, steady state, low voltage test (cf ESCC 3009, § 5.2.2) is mandatory if U rated < 50V and C > 1µF.
Capacitors, molded, ceramic	ESCC 3001 level C	MIL-PRF-39014 EFR level R min MIL-PRF-20 EFR level R min MIL-PRF-123 MIL-PRF-49470 EFR level T		For ceramic capacitors procured through ESCC or MIL specifications but in an extended, non qualified, range of values or not belonging to ESCC QPL or MIL QML/QPL, the humidity, steady state, low voltage test (cf ESCC 3009, § 5.2.2) is mandatory if U rated < 50V and C > 1µF.
Capacitors, glass (CYR type)	-	MIL-PRF-23269 EFR level R min		Lifetest 1000 h / 125 °C/ 1,5 Ur on each lot/date code. Not recommended for new designs
Capacitors, mica	ESCC 3007 level C	MIL-PRF-39001 EFR level R min		
Capacitors, chip, solid tantalum (e.g. TAJ, T495, CWR11)	ESCC 3011 level C ESCC 3012 level C	MIL-PRF-55365 WFR level C min		All capacitors shall be surge current tested.
Capacitors, non-solid tantalum, electrolytic (CLR79)	ESCC 3003 level C	MIL-PRF-39006 EFR level R min		39006 / 22, 25, 30, 31 and "H“ dash number designated devices are recommended
Capacitors, solid tantalum, electrolytic (CSR type)	ESCC 3002 level C	MIL-PRF-39003 WFR level C min		Surge current test mandatory on low ESR capacitors (CSR21 and CSR33).
Capacitors, super metallized plastic film, (CRH type)	ESCC 3006 level C	MIL-PRF-83421 EFR level R min		

EEE part family	Quality level			Supplementary Conditions
	ESCC	MIL	Other	
Capacitors, metallized film, (HTP86, KM94S, PM94S, PM90SR2, MKT, …)	ESCC 3006 level C	-		
Capacitors, variable	ESCC 3010 level C	-		
Connectors, non filtered, D-sub rectangular	ESCC 3401 level B	-		
Connectors, filtered, D-sub rectangular	ESCC 3405 level B	-		Lifetest 1000h / 125°C / 1,5Ur on each tubular ceramic lot. By default, assured for ESCC products.
Connectors, printed circuit board	ESCC 3401 level B	-		
Connectors, RF coaxial	ESCC 3402 level B	-		
Connectors, microminiature rectangular	ESCC 3401 level B	-		
Connectors, non filtered, circular	ESCC 3401 level B	-		
Connectors, filtered, circular	ESCC 3405 level B	-		Lifetest 1000h / 125°C / 1,5Ur on each tubular ceramic lot. By default, assured for ESCC products.
Crystals	ESCC 3501 level B	-		
Diodes	ESCC 5000	MIL-PRF-19500 JANS		PIND test (see note).
Diodes microwave	ESCC 5010 level B	MIL-PRF-19500 JANS		PIND test (see note).
Filters	ESCC 3008 level B	MIL-PRF-28861 acc. to class S		MIL-PRF-28861/6 filters not recommended For M28861 filters not “class S” qualified, group B is required on every lot/date code
Fuses (wire link ≥ 5A)	ESCC 4008	MIL-PRF-23419		Burn-in (168h – 85°C – 50% rated current) is mandatory on each lot/date code
Fuses (CERMET)	ESCC 4008	MIL-PRF-23419		
Heaters flexible	ESCC 4009	-		
Inductors, coils, (molded)	ESCC 3201 level C	MIL-STD-981 class S		
Inductors, coils (non molded)	ESCC 3201 level C	MIL-STD-981 class S		
Integrated circuits	ESCC 9000	MIL-PRF-38535 class V		PIND test (see note).

EEE part family	**Quality level**			**Supplementary Conditions**
	ESCC	**MIL**	**Other**	
Integrated circuits microwave (MMIC)	ESCC 9010 level B	MIL-PRF-38535 class V		PIND test (see note).
Microwave passive parts (circulators, isolators)	ESCC 3202 level B	MIL-DTL-28791 (isolators)		
Microwave passive parts (coupler, power dividers)	ESCC 3404 level B	MIL-DTL-15370 (couplers) MIL-DTL-23971 (dividers) “space flight”		
Microwave passive parts (attenuators, loads)	ESCC 3403 level C	MIL-DTL-39030 (loads) S letter (screened parts) MIL-DTL-3933 (attenuators) S letter (screened parts)		
Microwave switches	-	MIL-DTL-3928		
Oscillators (hybrids)	ECSS Q-ST-60-05 level 1	MIL-PRF-55310 (class 2) level S		
Relays, electromagnetic, latching and non-latching	ESCC 3601 level B ESCC 3602 level B	-		
Resistors, fixed, film, (RNC, MB x xxxx type, except RNC90)	ESCC 4001	MIL-PRF-55182 EFR level R min MIL-PRF-39017 EFR level R min		
Resistors, high precision, fixed, metal foil (RNC90)	ESCC 4001	MIL-PRF-55182/9 EFR level R min		100 kΩ max allowed.
Resistors, network, thick film	ESCC 4005 level C	-		
Resistors, current sensing (RLV type)	-	MIL-PRF-49465		
Resistors, power, fixed, wirewound (RWR type)	ESCC 4002 level C	MIL-PRF-39007 EFR level R min		
Resistors, power, fixed, wirewound, chassis mounted (RER type)	ESCC 4003 level C	MIL-PRF-39009 EFR level R min		
Resistors, precision, fixed, wirewound (RBR type)	-	MIL-PRF-39005 EFR level R min		Diameter of wire shall be greater than 0,03 mm.
Resistors, fixed, film, high voltage (RHV type)	ESCC 4001	-		
Resistors, fixed, thick and thin film chip	ESCC 4001 ESCC 4001 EFR level R min	MIL-PRF-55342 EFR level R min		
Resistor, chip, fixed film, zero ohm	-	MIL-PRF-32159 level T		
Switches, electromechanical	ESCC 3701 level B	MIL-PRF-8805		

EEE part family	Quality level			Supplementary Conditions
	ESCC	MIL	Other	
Switches, thermostatic	ESCC 3702 level B	MIL-PRF-24236 (b)		(b) Products based on MIL-PRF-24236 are allowed with ESCC screening: Run-in (500 cycles 60/100mA) Elect. test per ESCC table 2 External visual insp. 100 %
Thermistors	ESCC 4006 level C	-		
Transformers	ESCC 3201 level C	MIL-STD-981 class S		
Transistors	ESCC 5000	MIL-PRF-19500 JANS		PIND test (see note).
Transistors microwave	ESCC 5010 level B	MIL-PRF-19500 JANS		PIND test (see note).
Cables & wires, low frequency	ESCC 3901 level B	MIL-DTL-16878		
Cables, coaxial, radio frequency	ESCC 3902 level B	MIL-DTL-17		
Hybrids	ECSS-Q-ST-60-05 level 1	MIL-PRF-38534 class K		
Surface Acoustic Waves (SAW)	ESCC 3502 level B	MIL-PRF-38534 class K		
Charge coupled devices (CCD)	ESCC 9020	-		
Opto discrete devices Photodiodes, LED Phototransistors Opto-couplers	ESCC 5000	MIL-PRF-19500 JANS		PIND test (see note).

NOTE 1 Particle Inducted Noise Detection (PIND) test is applicable to all cavity packages of active components.

NOTE 2 For semiconductor devices the JANS criteria is applicable per MIL-PRF-19500.
The lot/date code is submitted to 100 % PIND testing according to test condition A (per test method 2052 of MIL-STD-750).

NOTE 3 For integrated circuits the Class V criteria is applicable per MIL-PRF-38535.
The lot /date code is submitted to 100 % PIND testing according to test condition A (per test method 2020 of MIL-STD-883).

NOTE 4 By default, PIND test is assured for ESCC products.

NOTE 5 << deleted >>

NOTE 6 << deleted >>

ECSS-Q-ST-60_0480443

Table 7-2: Quality levels for Class 2 components

EEE part family	Quality level			Supplementary Conditions
	ESCC	MIL	Other	
Capacitors, chip, ceramic	ESCC 3009 level C	MIL-PRF-55681 EFR level R min MIL-PRF-123	CECC 32101 (qualified parts) + burn-in	For ceramic capacitors procured through ESCC or MIL specifications but in an extended, non qualified, range of values or not belonging to ESCC QPL or MIL QML/QPL, the humidity, steady state, low voltage test (cf ESCC 3009, § 5.2.2) is mandatory if U rated < 50V and C > 1µF.
Capacitors, molded, ceramic	ESCC 3001 level C	MIL-PRF-39014 EFR level R min MIL-PRF-20 EFR level R min MIL-PRF-123 MIL-PRF-49470 EFR level T	CECC 30601 (type 1) CECC 30602 (type 2) (qualified parts) + burn-in	For ceramic capacitors procured through ESCC or MIL specifications but in an extended, non qualified, range of values or not belonging to ESCC QPL or MIL QML/QPL, the humidity, steady state, low voltage test (cf ESCC 3009, § 5.2.2) is mandatory if U rated < 50V and C > 1µF.
Capacitors, glass (CYR type)	-	MIL-PRF-23269 EFR level R min		Not recommended for new designs
Capacitors, mica	ESCC 3007 level C	MIL-PRF-39001 EFR level R min		
Capacitors, chip, solid tantalum (e.g. TAJ, T495, CWR11)	ESCC 3011 level C ESCC 3012 level C	MIL-PRF-55365 WFR level C min		All capacitors shall be surge current tested.
Capacitors, non-solid tantalum, electrolytic (CLR79)	ESCC 3003 level C	MIL-PRF-39006 EFR level R min		39006 / 22, 25, 30, 31 and "H" designated devices are recommended
Capacitors, solid tantalum, electrolytic (CSR type)	ESCC 3002 level C	MIL-PRF-39003 WFR level C min		Surge current test mandatory on low ESR capacitors (CSR21 and CSR33).
Capacitors, super metallized plastic film, (CRH type)	ESCC 3006 level C	MIL-PRF-83421 EFR level R min		

EEE part family	**Quality level**			**Supplementary Conditions**
	ESCC	**MIL**	**Other**	
Capacitors, metallized film, (HTP86, KM94S, PM94S, PM90SR2, MKT, …)	ESCC 3006 level C	-		
Capacitors, variable	ESCC 3010 level C	-		
Connectors, non filtered, D-sub rectangular	ESCC 3401 level B	-		
Connectors, filtered, D-sub rectangular	ESCC 3405 level B	-		Lifetest 1000h / 125°C / 1,5Ur on each tubular ceramic lot. By default, assured for ESCC products.
Connectors, printed circuit board	ESCC 3401 level B	-		
Connectors, RF coaxial	ESCC 3402 level B	-		
Connectors, microminiature rectangular	ESCC 3401 level B	-		
Connectors, non filtered, circular	ESCC 3401 level B	-		
Connectors, filtered, circular	ESCC 3405 level B	-		Lifetest 1000h / 125°C / 1,5Ur on each tubular ceramic lot. By default, assured for ESCC products.
Crystals	ESCC 3501 level B	-		
Diodes	ESCC 5000	MIL-PRF-19500 JANTXV + PIND test		PIND test (see note).
Diodes microwave	ESCC 5010 level C + PIND test	MIL-PRF-19500 JANTXV + PIND test	-	PIND test (see note).
Filters	ESCC 3008 level C	MIL-PRF-28861 acc. to class S		MIL-PRF-28861/6 filters not recommended
Fuses (wire link ≥ 5A)	ESCC 4008	MIL-PRF-23419		Burn-in (168h – 85°C – 50% rated current) is mandatory on each lot/date code
Fuses (CERMET)	ESCC 4008	MIL-PRF-23419		

EEE part family	Quality level			Supplementary Conditions
	ESCC	MIL	Other	
Heaters flexible	ESCC 4009	-	GSFC S-311-P-079	
Inductors, coils, (molded)	ESCC 3201 level C	MIL-STD-981 class S		
Inductors, coils (non molded)	ESCC 3201 level C	MIL-STD-981 class S		
Integrated circuits	ESCC 9000	MIL-PRF-38535 class Q or M + PIND test		PIND test (see note).
Integrated circuits microwave (MMIC)	ESCC 9010 level C + PIND test	MIL-PRF-38535 class Q or M + PIND test	-	PIND test (see note).
Microwave passive parts (circulators, isolators)	ESCC 3202 level B	MIL-DTL-28791 (isolators)		
Microwave passive parts (coupler, power dividers)	ESCC 3404 level B	MIL-DTL-15370 (couplers) MIL-DTL-23971 (dividers) “space flight”		
Microwave passive parts (attenuators, loads)	ESCC 3403 level C	MIL-DTL-39030 (loads) S letter (screened parts) MIL-DTL-3933 (attenuators) S letter (screened parts)		
Microwave microswitches	-	MIL-DTL-3928		
Oscillators (hybrids)	ECSS Q-ST-60-05 level 1	MIL-PRF-55310 (class 2) level S		
Relays, electromagnetic, latching and non-latching	ESCC 3601 level B ESCC 3602 level B	MIL-PRF-39016 EFR level R min + ESCC screening according to chart 3		
Resistors, fixed, film, (RNC, MB x xxxx type, except RNC90)	ESCC 4001	MIL-PRF-55182 EFR level R min MIL-PRF-39017 EFR level R min	CECC 40401 + burn-in (qualified parts)	

EEE part family	**Quality level**			**Supplementary Conditions**
	ESCC	**MIL**	**Other**	
Resistors, high precision, fixed, metal foil (RNC90)	ESCC 4001	MIL-PRF-55182/9 EFR level R min		100 kΩ max allowed.
Resistors, network, thick film	ESCC 4005 level C	MIL-PRF-83401 level M		
Resistors, current sensing (RLV type)	-	MIL-PRF-49465		
Resistors, power, fixed, wirewound (RWR type)	ESCC 4002 level C	MIL-PRF-39007 EFR level R min	CECC 40201 + burn-in (qualified parts)	
Resistors, power, fixed, wirewound, chassis mounted (RER type)	ESCC 4003 level C	MIL-PRF-39009 EFR level R min	CECC 40201 + burn-in (qualified parts)	
Resistors, precision, fixed, wire wound (RBR type)	-	MIL-PRF-39005 EFR level R min		Diameter of wire shall be greater than 0,03 mm.
Resistors, fixed, film, high voltage (RHV type)	ESCC 4001	-		
Resistors, fixed, thick and thin film chip	ESCC 4001 ESCC 4001 EFR level R min	MIL-PRF-55342 EFR level R min	CECC 40401 + burn-in (qualified parts)	
Resistors, chip, fixed film, zero ohm	-	MIL-PRF-32159 level T		
Switches, electromechanical	ESCC 3701 level B	MIL-PRF-8805		
Switches, thermostatic	ESCC 3702 level C	MIL-PRF-24236 (b)		(b) Products based on MIL-PRF-24236 are allowed with ESCC screening : Run-in (500 cycles 60/100mA) Elect. test per ESCC table 2 External visual insp. 100 %
Thermistors	ESCC 4006 level C	MIL-PRF-23648	GSFC S-311-P-018	
Transformers	ESCC 3201 level C	MIL-STD-981 class S		
Transistors	ESCC 5000	MIL-PRF-19500, JANTXV + PIND test		PIND test (see note).
Transistors microwave	ESCC 5010 level C + PIND test	MIL-PRF-19500, JANTXV + PIND test		PIND test (see note).

EEE part family	**Quality level**			**Supplementary Conditions**
	ESCC	**MIL**	**Other**	
Cables & wires, low frequency	ESCC 3901 level B	MIL-DTL-16878		
Cables, coaxial, radio frequency	ESCC 3902 level B	MIL-DTL-17		
Hybrids	ECSS-Q-ST-60-05 level 2	MIL-PRF-38534 class K		
Surface Acoustic Waves (SAW)	ESCC 3502 level C	MIL-PRF-38534 class K		
Charge coupled devices (CCD)	ESCC 9020	-		
Opto discrete devices Photodiodes, LED Phototransistors Opto-couplers	ESCC 5000	MIL-PRF-19500 JANTXV + PIND test		PIND test (see note).

NOTE 1 Particle Inducted Noise Detection (PIND) test is applicable to all cavity packages of active components.

NOTE 2 By default, PIND test is assured for ESCC products.

NOTE 3 For semiconductor devices the JANS criteria is applicable per MIL-PRF-19500.
The lot/date code is submitted to 100 % PIND testing according to test condition A (per test method 2052 of MIL-STD-750).

NOTE 4 For integrated circuits the Class V criteria is applicable per MIL-PRF-38535.
The lot/date code is submitted to 100 % PIND testing according to test condition A (per test method 2020 of MIL-STD-883)

NOTE 5 <<deleted>>

ECSS-Q-ST-60_0480444

Table 7-3: Quality levels for Class 3 components

EEE part family	**Quality level**			**Supplementary Conditions**
	ESCC	**MIL**	**Other**	
Capacitors, chip, ceramic	ESCC 3009 level C	MIL-PRF-55681 EFR level R min MIL-PRF-123	CECC 32101 (qualified parts) + burn-in	For ceramic capacitors procured through ESCC or MIL specifications but in an extended, non qualified, range of values or not belonging to ESCC QPL or MIL QML/QPL, the humidity, steady state, low voltage test (cf ESCC 3009, § 5.2.2) is mandatory if U rated < 50V and C > 1µF.
Capacitors, molded, ceramic	ESCC 3001 level C	MIL-PRF-39014 EFR level R min MIL-PRF-20 EFR level R min MIL-PRF-123 MIL-PRF-49470 EFR level T	CECC 30601 (type 1) CECC 30602 (type 2) (qualified parts) + burn-in	For ceramic capacitors procured through ESCC or MIL specifications but in an extended, non qualified, range of values or not belonging to ESCC QPL or MIL QML/QPL, the humidity, steady state, low voltage test (cf ESCC 3009, § 5.2.2) is mandatory if U rated < 50V and C > 1µF.
Capacitors, glass (CYR type)	-	MIL-PRF-23269 EFR level R min		Not recommended for new designs
Capacitors, mica	ESCC 3007 level C	MIL-PRF-39001 EFR level R min		
Capacitors, chip, solid tantalum (e.g. TAJ, T495, CWR11)	ESCC 3011 level C ESCC 3012 level C	MIL-PRF-55365 WFR level C min		All capacitors shall be surge current tested.
Capacitors, non-solid tantalum, electrolytic (CLR79)	ESCC 3003 level C	MIL-PRF-39006 EFR level R min		39006 / 22, 25, 30, 31 and "H“ designated devices are recommended
Capacitors, solid tantalum, electrolytic (CSR type)	ESCC 3002 level C	MIL-PRF-39003 WFR level C min		Surge current test mandatory on low ESR capacitors (CSR21 and CSR33).
Capacitors, super metallized plastic film, (CRH type)	ESCC 3006 level C	MIL-PRF-83421 EFR level R min		

EEE part family	**Quality level**			**Supplementary Conditions**
	ESCC	**MIL**	**Other**	
Capacitors, metallized film, (HTP86, KM94S, PM94S, PM90SR2, MKT, …)	ESCC 3006 level C	-		
Capacitors, variable	ESCC 3010 level C	-		
Connectors, non filtered, D-sub rectangular	ESCC 3401 level B	-		
Connectors, filtered, D-sub rectangular	ESCC 3405 level B	-		
Connectors, printed circuit board	ESCC 3401 level B	-		
Connectors, RF coaxial	ESCC 3402 level B	-		
Connectors, microminiature rectangular	ESCC 3401 level B	-		
Connectors, non filtered, circular	ESCC 3401 level B	-		
Connectors, filtered, circular	ESCC 3405 level B	-		
Crystals	ESCC 3501 level B	-		
Diodes	ESCC 5000	MIL-PRF-19500 JANTXV + PIND test		PIND test (see note).
Diodes microwave	ESCC 5010 level C + PIND test	MIL-PRF-19500 JANTXV+ PIND test	-	PIND test (see note).
Filters	ESCC 3008 level C	MIL-PRF-28861 acc. to class B min		MIL-PRF-28861/6 filters not recommended
Fuses (wire link ≥ 5A)	ESCC 4008	MIL-PRF-23419		Burn-in (168h – 85°C – 50% rated current) is mandatory on each lot/date code
Fuses (CERMET)	ESCC 4008	MIL-PRF-23419		
Heaters flexible	ESCC 4009	-	GSFC S-311-P-079	
Inductors, coils, (molded)	ESCC 3201 level C	MIL-STD-981 class S		
Inductors, coils (non molded)	ESCC 3201 level C	MIL-STD-981 class S		
Integrated circuits	ESCC 9000	MIL-PRF-38535 TM 5004 class level B + PIND test		PIND test (see note).

EEE part family	**Quality level**			**Supplementary Conditions**
	ESCC	**MIL**	**Other**	
Integrated circuits microwave (MMIC)	ESCC 9010 level C+ PIND test	MIL-PRF-38535 TM 5004 class level B + PIND test		PIND test (see note).
Microwave passive parts (circulators, isolators)	ESCC 3202 level B	MIL-DTL-28791 (isolators)		
Microwave passive parts (coupler, power dividers)	ESCC 3404 level B	MIL-DTL-15370 (couplers) MIL-DTL-23971 (dividers) "space flight"		
Microwave passive parts (attenuators, loads)	ESCC 3403 level C	MIL-DTL-39030 (loads) S letter (screened parts) MIL-DTL-3933 (attenuators) S letter (screened parts)		
Microwave switches	-	MIL-DTL-3928		
Oscillators (hybrids)	ECSS Q-ST-60-05 level 1	MIL-PRF-55310 (class 2) level S		
Relays, electromagnetic, latching and non-latching	ESCC 3601 level B ESCC 3602 level B	MIL-PRF-39016 EFR level R min + ESCC screening according to chart 3		
Resistors, fixed, film, (RNC, MB x xxxx type, except RNC90)	ESCC 4001	MIL-PRF-55182 EFR level R min MIL-PRF-39017 EFR level R min	CECC 40401 + burn-in (qualified parts)	
Resistors, high precision, fixed, metal foil (RNC90)	ESCC 4001	MIL-PRF-55182/9 EFR level R min		100 kΩ max allowed.

EEE part family	Quality level			Supplementary Conditions
	ESCC	MIL	Other	
Resistors, network, thick film	ESCC 4005 level C	MIL-PRF-83401 level M		
Resistors, current sensing (RLV type)	-	MIL-PRF-49465		
Resistors, power, fixed, wirewound (RWR type)	ESCC 4002 level C	MIL-PRF-39007 EFR level R min	CECC 40201 + burn-in (qualified parts)	
Resistors, power, fixed, wirewound, chassis mounted (RER type)	ESCC 4003 level C	MIL-PRF-39009 EFR level R min	CECC 40201 + burn-in (qualified parts)	
Resistors, precision, fixed, wire wound (RBR type)	-	MIL-PRF-39005 EFR level R min		Diameter of wire shall be greater than 0,03 mm.
Resistors, fixed, film, high voltage (RHV type)	ESCC 4001	-		
Resistors, fixed, thick and thin film chip	ESCC 4001 ESCC 4001 EFR level R min	MIL-PRF-55342 EFR level R min	CECC 40401 + burn-in (qualified parts)	
Resistors, chip, fixed film, zero ohm	-	MIL-PRF-32159 level T		
Switches, electromechanical	ESCC 3701 level B	MIL-PRF-8805		
Switches, thermostatic	ESCC 3702 level C	MIL-PRF-24236		
Thermistors	ESCC 4006 level C	MIL-PRF-23648	GSFC S-311-P-018	
Transformers	ESCC 3201 level C	MIL-STD-981 class S		
Transistors	ESCC 5000	MIL-PRF-19500 JANTXV + PIND test		PIND test (see note).
Transistors microwave	ESCC 5010 level C + PIND test	MIL-PRF-19500 JANTXV+ PIND test		PIND test (see note).
Cables & wires, low frequency	ESCC 3901 level B	MIL-DTL-16878		
Cables, coaxial, radio frequency	ESCC 3902 level B	MIL-DTL-17		
Hybrids	ECSS-Q-ST-60-05 level 2	MIL-PRF-38534 class H + PIND test		
Surface Acoustic Waves (SAW)	ESCC 3502 level C	MIL-PRF-38534 class H + PIND test		
Charge coupled devices (CCD)	ESCC 9020 + PIND test	-		

EEE part family	Quality level			Supplementary Conditions
	ESCC	MIL	Other	
Opto discrete devices Photodiodes, LED Phototransistors Opto-couplers	ESCC 5000	MIL-PRF-19500 JANTXV + PIND test	-	PIND test (see note).

NOTE 1 Particle Inducted Noise Detection (PIND) test is applicable to all cavity packages of active components.

NOTE 2 By default, PIND test is assured for ESCC products.

NOTE 3 For semiconductor devices the JANS criteria is applicable per MIL-PRF-19500.
The lot/date code is submitted to 100 % PIND testing according to test condition A (per test method 2052 of MIL-STD-750).

NOTE 4 For integrated circuits the Class V criteria is applicable per MIL-PRF-38535.
The lot/date code is submitted to 100 % PIND testing according to test condition A (per test method 2020 of MIL-STD-883).

NOTE 5 << deleted >>

8
Evaluation and lot acceptance for retinned parts

This topic is covered in ECSS-Q-ST-60-13 only.

9
Pure tin lead finish – risk analysis

9.1 Overview

Pure tin finish has a propensity to generate whiskers. Tin whiskers are highly conductive ''hair-like'' protrusions of tin that can grow from the surface of pure tin plated parts due in part to compressive stress from the tin plating process or from other sources of compressive stress (e.g., tightening of a fastener) and can induce failures as:

- Electrical instantaneous or permanent short circuit
- Metal vapour arc in reduced atmospheric pressure conditions and for application with high levels of current and voltage (more than 12V)
- Contamination: a free floating whisker can interfere with the movement of mechanical parts or induce contamination of optical surfaces

Many parameters can have an impact on whisker growth. The purpose of the risk analysis is to evaluate those parameters.

9.2 Requirements

ECSS-Q-ST-60_0480549

a. A pure tin lead finish risk analysis facing whiskers shall include, as a minimum, the following:

 1. Lead material
 2. Underlayer material and thickness
 3. Plating chemistry and thickness.
 4. Heat treatment by manufacturer
 5. Procedure for SnPb dipping of the parts
 6. Conformal coating presence and characteristics: material and thickness
 7. Design criticality, shorter distances between 2 connections or between a connection and an area at another potential
 8. Supply voltage and current
 9. Tin whisker sensitivity results as per JESD-201A and JESD22-A121A
 10. Mission profile: storage, mission duration, thermal cycling
 11. Previous experiences
 12. Impact of failure at unit/system level

NOTE 1 For requirement 9.2a.1 examples of lead material are alloy 42 and copper

NOTE 2 For requirement 9.2a.2 examples of underlayer material and thickness are Ni underlayer, silver underlayer.

NOTE 3 For requirement 9.2a.3 examples of plating chemistry and thickness are matte or bright tin, tin thickness

NOTE 4 For requirement 9.2a.4 examples of heat treatment by manufacturer are 1hour at 150 °C for Cu based lead frame

NOTE 5 For requirement 9.2a.5: The risk to degrade the reliability of components during the retinning can be higher than the risk to generate an anomaly with tin whiskers. This risk has to be assessed.

NOTE 6 The Annex A of GEIA STD-0005-02 can be used as guideline

Annex A (normative) Component control plan (CCP) - DRD

A.1 DRD identification

A.1.1 Requirement identification and source document

This DRD is called up from ECSS-Q-ST-60 requirement 4.1.2.2a.

A.1.2 Purpose and objective

The purpose of the component control plan (CCP) is to define and structure the activities to be implemented to ensure that the management of a CLASS 1 component programme meets the project objectives. This includes achieving the specified project cost, appropriate quality (including function and performance) and minimising schedule and overall risk.

A.2 Expected response

A.2.1 Scope and content

ECSS-Q-ST-60_0480437

a. The CCP shall include or refer to the following information:
    1. A description of the purpose, content and the reason prompting its preparation,
    2. A list of the applicable and reference documents,
    3. Any additional terms, definitions and abbreviations,
    4. The organizational breakdown structure, responsibility descriptions, management approach and concurrent engineering,
    5. Control of lower level suppliers, procurement agents (if any) and manufacturers,
    6. Procurement system,
    7. Radiation control programme,
    8. Component selection and standardization,
    9. Component data acquisition and assessment,
    10. Component evaluation and related testing approach,
    11. Component approval,
    12. Component testing, inspection and storage,
    13. Component quality assurance activities,
    14. Assessment of problem notifications and alerts,

15. Programme planning with schedule of tasks linked to programme milestones,
16. Specific components control and back-up plans whenever there is evidence of possible schedule, quality or technical problems,
17. Reporting and deliverables,
18. Compliance matrix to the clauses of this standard.

A.2.2 Special remarks

ECSS-Q-ST-60_0480521

a. The CCP may be part of the overall project PA plan (see clause 4.1.2.2b).

Annex B (normative) Declared component list (DCL) - DRD

B.1 DRD identification

B.1.1 Requirement identification and source document

This DRD is called up from ECSS-Q-ST-60 requirements 4.1.4h, 5.1.4h and 6.1.4g.

B.1.2 Purpose and objective

The purpose of the Declared Components List (DCL) is to provide a status list of all the EEE components intended to be used or actually used as dictated by the phases of the project.

B.2 Expected response

B.2.1 Scope and content

ECSS-Q-ST-60_0480439

a. The DCL shall include or refer to the following information:
   1. A description of the purpose, content and the reason prompting its preparation,
   2. A list of the applicable and reference documents,
   3. Any additional terms, definitions or abbreviations,
   4. Component number (commercial equivalent designation),
   5. Family (ESCC group code),
   6. Package,
   7. Value or range of values with tolerance for non qualified parts,
   8. Component manufacturer (name, country),
   9. Generic procurement specification,
   10. Detail procurement specification (with issue and revision for non qualified parts),
   11. Specification amendment (including issue and revision),
   12. Name of the procurement agents (CPPA, supplier, distributor),
   13. Quality level and lot test (ESCC LAT or LVT, MIL TCI or QCI or CI),
   14. Space qualified status (yes or no),
   15. RVT (yes or no),

16. Reference of the PAD or Justification Document, where required,
17. Approval status of the part,
18. Change identification between each DCL issue,
19. Date-code (only for “as built” DCL).

B.2.2 Special remarks

None.

Annex C (normative)
Procurement specification - DRD

C.1 DRD identification

C.1.1 Requirement identification and source document

This DRD is called up from ECSS-Q-ST-60 requirements 4.3.2d, 5.3.2d and 6.3.2d.

C.1.2 Purpose and objective

The purpose of the Procurement Specification is to establish the component technical specification baseline.

C.2 Expected response

C.2.1 Scope and content

ECSS-Q-ST-60_0480440

a. The procurement specification shall include or refer to the following information:
   1. A description of the purpose, content and the reason prompting its preparation,
   2. A list of the applicable and reference documents,
   3. Any additional terms, definitions or abbreviations,
   4. Absolute maximum ratings,
   5. Electrical and mechanical parameters and limits,
   6. Screening, burn-in, and acceptance requirements,
   7. Package material and lead finish,
   8. Documentation/data requirements,
   9. Delta limits when applicable,
   10. Criteria for percent defective allowable,
   11. LAT or LVT, QCI or TCI,
   12. Marking,
   13. Storage requirements,
   14. Requirements for lot homogeneity,
   15. Serialization (when applicable),
   16. Protective packaging and handling requirements,
   17. Radiation Verification Testing requirements, when applicable.

C.2.2 Special remarks

None.

Annex D (normative) Part approval document (PAD) - DRD

D.1 DRD identification

D.1.1 Requirement identification and source document

This DRD is called up from ECSS-Q-ST-60 requirements 4.2.4d, 4.3.8c, 5.2.4d, 5.3.8c, 6.2.4d and 6.3.8c.

D.1.2 Purpose and objective

The PAD is a control document the objective of which is to identify the component and to provide information about its evaluation and its acceptability w.r.t.:

- approval status,
- evaluation tests,
- procurement inspections and tests,
- lot acceptance or lot verification tests,
- radiation hardness data and RVT

D.2 Expected response

ECSS-Q-ST-60_0480441

a. The information given in Table D-1 shall be provided.

ECSS-Q-ST-60_0480445

Table D-1: PAD sheet

PROJECT:……………. Doc n°:………………. Prepared by: …………….
Issue:………………….. Date:………………..

Approval requested by:…………………………
Family:……………….. Fcode [ ] Group:……………… Gcode [ ]
Component Number:…………………………………..
Commercial Equivalent Designation:………………….
Manufacturer/ Country:……………………………
Technology/Characteristics (value or range of values with tolerance, voltage, package etc):
……………………………..
Pure tin free (Y/N) [ ]
Generic specification:………………...
Detail specification:…………….……. Issue:….. Rev.:….. variant:…….
Specification amendment: …………. Issue:….. Rev.:….. variant:…….
Quality level:…………………….. Procurement by:………………………..

APPROVAL STATUS

EPPL Part 1/2 listed (1/2/N) [ ]
ESCC QPL or EQML listed. (Y/N) [ ]
MIL QPL or QML listed (Y/N) [ ] If yes: QPL/QML Reference:…………………………
Other approvals/former usage ………………………………………
Evaluation programme required (Y/N) [ ]
If yes reference of the Evaluation Programme:…………………………

PROCUREMENT INSPECTIONS and TESTS

Precap (Y/N) [ ]
Lot acceptance:
ESCC LAT/LVT level or subgroup [ ]
MIL QCI/TCI group [ ]
Buy-off (Y/N) [ ]
DPA (Y/N) [ ] if yes: sample size …………………………

Complementary tests …………………………………………

RADIATION HARDNESS DATA

Radiation Hardness Assurance Plan applicable (Y/N)[ ]
Doc. Ref.: ....

Total Dose Effects:
Evaluation Test Data (report) reference: ..…………….…

Single Event Effects: SEL/SEU/SET/SEFI/SEB/SEGR/others: *(cross out when non applicable)*
Evaluation Test Data (report) reference: ..…………….…

RVT required (Y/N)[ ]

REMARKS

Approval customer .... Date ....

Approval first-level supplier .... Date ....

GUIDANCE NOTE FOR COMPLETION OF PART APPROVAL DOCUMENT

with justification a single PAD may be generic to cover different ranges of parts

Doc No:	Unique sequential number
Issue:	Issue of document
Date:	Date of issue
Project:	Name of project using the component
Prepared by	Name of the person submitting the PAD
Approval requested by:	Name of the company submitting the PAD
Family:	Capacitor, resistor, etc. (Refer ECSS Family Code)
Group:	Ceramic, tantalum, etc. (Refer ECSS Group Code)
Component Number:	In accordance with the procurement specification May be generic to cover different range of parts (with justification): e.g. range of resistors or capacitors or variants for connectors & accessories
Commercial Equivalent Designation	Self explanatory
Technology/Characteristics:	Additional details of the components covered by the PAD
Pure tin free (Y/N)	When tin ≥ 97% (inside the component and terminations)
Generic specification:	Relevant specification
Detail specification:	Relevant specification with issue and revisions only required for non qualified parts
Specification Amendment	Relevant specification with issue and revisions
Quality level:	As defined in 7
Procurement by:	Identify the name of the company procuring the part. E.g. This can be self, CPPA, distributor, manufacturer or a combination thereof.
Manufacturer/Country:	Self-explanatory.
Approval status:	Information about known approvals (EPPL, ESCC, ESCC/QML, MIL, MIL/QML or other approvals/former usage.)
Evaluation programme required:	Y/N as applicable
Procurement inspections and test:	Y/N as applicable
DPA sample size:	Number
Complementary tests	Testing/Inspection in addition to that defined in the procurement specification shall be identified, e.g. PIND, upscreening, …
Lot Acceptance:	Identify level and subgroups
Radiation Hardness Data	Self-explanatory.
SEL/SEU/SET/SEFI/SEB/SEGR/others: Evaluation Test Data (report) reference	Reference of the test report for SingleEvent Latchup/ SingleEvent Upset/ Single Event Transient/Single Event Functional Interrupt/Single Event Burn out/Single Event Gate Rupture
RVT	Radiation Verification Test Y/N as applicable
REMARKS	Any additional information
Approval customer:	Signature signifies acceptance
Approval first-level supplier:	Signature signifies acceptance

Annex E (informative) EEE documents delivery per review

Scope of the Table E-1 is to present relation of documents associated to EEE components activities to support project review objectives as specified in ECSS-M-ST-10.

NOTE This table constitutes a first indication for the data package content at various reviews. The full content of such data package is established as part of the business agreement, which also defines the delivery of the document between reviews.

The table lists the documents necessary for the project reviews (identified by "+").

The various crosses in a row indicate the increased levels of maturity progressively expected versus reviews. The last cross in a row indicates that at that review the document is expected to be completed and finalized.

NOTE All documents, even when not marked as deliverables in Table E-1, are expected to be available and maintained under configuration management as per ECSS-M-ST-40 (e.g. to allow for backtracking in case of changes).

Documents listed in Table E-1 are either ECSS-Q-ST-60 DRDs, or DRDs to other ECSS-Q-ST-60-XX, or defined within the referenced DRDs.

For better understanding of the Phase Review during which the relevant document has to be provided, the following assumptions are given:

- Phase Reviews relevant to Documents recalled in Q-ST-60, Q-ST-60-05, Q-ST-60-12 and Q-ST-60-14 have to be considered as "Equipment Level Reviews".
- Phase Reviews relevant to Documents recalled in Q-ST-60-02 have to be considered as "ASIC or FPGA Level Reviews".
- All document deliveries are given for equipment under development, while for other types of equipment the table content could be different and tailored consequently.

Table E-1: EEE delivery documents

Document or DRD title	Reviews													DRD ref.
	MDR	PRR	SRR	PDR	CDR	QR	AR	ORR	FRR	LRR	CRR	ELR	MCR	
Component control plan (CCP)			+	+										ECSS-Q-ST-60
Declared component list (DCL)				+	+	+	+							ECSS-Q-ST-60
Procurement specification				+	+									ECSS-Q-ST-60
Part approval document (PAD)				+	+									ECSS-Q-ST-60
Radiation hardness assurance plan				+										ECSS-Q-ST-60
Evaluation plans				+										ECSS-Q-ST-60
Evaluation reports					+									ECSS-Q-ST-60
ASIC and FPGA control plan (ACP)			+	+										ECSS-Q-ST-60-02
ASIC and FPGA development plan (ADP)			+	+	+									ECSS-Q-ST-60-02
ASIC and FPGA requirements specification (ARS)			+	+	+									ECSS-Q-ST-60-02
Feasibility and risk assessment report (FRA)			+	+										ECSS-Q-ST-60-02
Verification Plan (VP)				+	+	+								ECSS-Q-ST-60-02
Design validation plan (DVP)					+	+								ECSS-Q-ST-60-02
Data sheet				+	+	+								ECSS-Q-ST-60-02
Detailed specification (DS)					+	+								ECSS-Q-ST-60-02
Experience summary report						+								ECSS-Q-ST-60-02
Hybrid circuit technology identification (HTIF)				+	+									ECSS-Q-ST-60-05

Document or DRD title	Reviews													DRD ref.
	MDR	PRR	SRR	PDR	CDR	QR	AR	ORR	FRR	LRR	CRR	ELR	MCR	
Format of the detail specification of a hybrid circuit				+	+									ECSS-Q-ST-60-05
Similarity form				+	+									ECSS-Q-ST-60-05
MMIC electrical design specification			+	+	+									ECSS-Q-ST-60-12
Compliance matrix for custom MMIC design			+	+	+									ECSS-Q-ST-60-12
Design package document				+	+									ECSS-Q-ST-60-12
MMIC summary design data sheet				+	+									ECSS-Q-ST-60-12
MMIC procurement specification				+	+									ECSS-Q-ST-60-12
MMIC lot acceptance specification for user LAT				+	+									ECSS-Q-ST-60-12
MMIC visual inspection summary sheet					+									ECSS-Q-ST-60-12
Internal supplier’s specification				+	+									ECSS-Q-ST-60-13
Justification document				+	+									ECSS-Q-ST-60-13
Relifing report					+									ECSS-Q-ST-60-14
Mission radiation environment specification				+										ECSS-Q-ST-60-15
Radiation analysis report				+	+									ECSS-Q-ST-60-15

Bibliography

ECSS-S-ST-00	ECSS system – Description, implementation and general requirements
ECSS-E-ST-10-04	Space engineering — Space environment
ECSS-E-ST-10-12	Space engineering — Methods for calculation of radiation received and its effects, and a policy for design margins
ECSS-M-ST-40	Space project management - Configuration and information management
ESCC 20600	ESCC Basic Specification: Preservation Packaging and Despatch of SCC Components
MIL-STD-750 Test Method 1019	Steady-state total dose irradiation procedure
MIL-STD-883 Test Method 1019	Ionizing Radiation (Total dose) test Procedure
ESCC REP 010	SCSB Decisions Regarding OTP FPGA PPBI
ESCC REP 011	SCSB Decisions Regarding OTP PROM PPBI