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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

October 2021

ICS 49.140

Will supersede EN 16602-60:2015

English version

Space product assurance - Electrical, electronic and electromechanical (EEE) components

Assurance produit des projets spatiaux - Composants électriques, électroniques et électromécaniques (EEE)

Raumfahrtproduktsicherung - Elektrische, elektronische und elektromechanische (EEE) Bauteile

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/CLC/JTC 5.

If this draft becomes a European Standard, CEN and CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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Table of contents

European Foreword.....	7
Introduction.....	8
1 Scope.....	9
2 Normative references	10
3 Terms, definitions and abbreviated terms.....	12
3.1 Terms from other standards.....	12
3.2 Terms specific to the present standard	12
3.3 Abbreviated terms.....	13
3.4 Conventions.....	15
3.5 Nomenclature	16
4 Requirements for Class 1 components	17
4.1 Component programme management	17
4.1.1 General	17
4.1.2 Components control programme	17
4.1.3 Parts control board.....	18
4.1.4 Declared components list	19
4.1.5 Electrical and mechanical GSE	19
4.1.6 EQM components	20
4.2 Component selection, evaluation and approval.....	20
4.2.1 General	20
4.2.2 Manufacturer and component selection.....	21
4.2.3 Component evaluation	26
4.2.4 Parts approval.....	29
4.3 Component procurement	30
4.3.1 General	30
4.3.2 Procurement specification	31
4.3.3 Screening requirements	32
4.3.4 Initial customer source inspection (precap)	32
4.3.5 Lot acceptance.....	33

4.3.6	Final customer source inspection (buy-off).....	34
4.3.7	Incoming inspections.....	35
4.3.8	Radiation verification testing	35
4.3.9	Destructive physical analysis	36
4.3.10	Relifing.....	38
4.3.11	Manufacturer's data documentation deliveries	38
4.4	Handling and storage.....	39
4.5	Component quality assurance	39
4.5.1	General	39
4.5.2	Nonconformances or failures	40
4.5.3	Alerts.....	40
4.5.4	Traceability	41
4.5.5	Lot homogeneity for sampling test.....	41
4.6	Specific components.....	41
4.6.1	General	41
4.6.2	ASICs.....	42
4.6.3	Hybrids.....	42
4.6.4	One time programmable devices.....	42
4.6.5	Microwave monolithic integrated circuits	43
4.6.6	Connectors	43
4.7	Documentation	44
5	Requirements for Class 2 components	46
5.1	Component programme management	46
5.1.1	General	46
5.1.2	Components control programme	46
5.1.3	Parts Control Board.....	46
5.1.4	Declared Components List.....	47
5.1.5	Electrical and mechanical GSE	48
5.1.6	EQM components	49
5.2	Component selection, evaluation and approval.....	49
5.2.1	General	49
5.2.2	Manufacturer and component selection.....	50
5.2.3	Component evaluation	54
5.2.4	Parts approval.....	56
5.3	Component procurement	57
5.3.1	General	57
5.3.2	Procurement specification	58

5.3.3	Screening requirements	59
5.3.4	Initial Customer Source Inspection (precap).....	60
5.3.5	Lot acceptance.....	60
5.3.6	Final customer source inspection (buy-off).....	61
5.3.7	Incoming inspections.....	61
5.3.8	Radiation verification testing	62
5.3.9	Destructive physical analysis	63
5.3.10	Relifing.....	64
5.3.11	Manufacturer's data documentation deliveries	64
5.4	Handling and storage.....	65
5.5	Component quality assurance	66
5.5.1	General	66
5.5.2	Nonconformances or failures	66
5.5.3	Alerts.....	66
5.5.4	Traceability	67
5.5.5	Lot homogeneity for sampling test.....	67
5.6	Specific components.....	68
5.6.1	General	68
5.6.2	ASICs.....	68
5.6.3	Hybrids.....	68
5.6.4	One time programmable devices.....	68
5.6.5	Microwave monolithic integrated circuits	69
5.6.6	Connectors	70
5.7	Documentation	70
6	Requirements for Class 3 components	72
6.1	Component programme management	72
6.1.1	General	72
6.1.2	Components control programme	72
6.1.3	Parts control board.....	72
6.1.4	Declared components list.....	73
6.1.5	Electrical and mechanical GSE	73
6.1.6	EQM components	74
6.2	Component selection, evaluation and approval.....	74
6.2.1	General	74
6.2.2	Manufacturer and component selection.....	75
6.2.3	Component evaluation	79
6.2.4	Parts approval.....	82

6.3	Component procurement	83
6.3.1	General	83
6.3.2	Procurement specification	83
6.3.3	Screening requirements	84
6.3.4	Initial customer source inspection (precap)	85
6.3.5	Lot acceptance.....	85
6.3.6	Final customer source inspection (buy-off).....	86
6.3.7	Incoming inspections.....	86
6.3.8	Radiation verification testing	86
6.3.9	Destructive physical analysis	87
6.3.10	Relifing.....	88
6.3.11	Manufacturer's data documentation deliveries	89
6.4	Handling and storage.....	89
6.5	Component quality assurance	90
6.5.1	General	90
6.5.2	Nonconformances or failures	90
6.5.3	Alerts.....	91
6.5.4	Traceability	91
6.5.5	Lot homogeneity for sampling test.....	92
6.6	Specific components.....	92
6.6.1	Overview	92
6.6.2	ASICs.....	92
6.6.3	Hybrids.....	92
6.6.4	One time programmable devices.....	92
6.6.5	Microwave monolithic integrated circuits	94
6.6.6	Connectors	94
6.7	Documentation	94
7	Quality levels	96
8	Evaluation and lot acceptance for retinned parts.....	111
9	Pure tin lead finish –risk analysis	112
9.1	Overview	112
9.2	Requirements	112
Annex A (normative)	Component control plan (CCP) - DRD	114
Annex B (normative)	Declared component list (DCL) - DRD	116
Annex C (normative)	Procurement specification - DRD.....	118

Annex D (normative) Part approval document (PAD) - DRD	120
Annex E (informative) EEE documents delivery per review	123
Bibliography.....	126

Tables

Table 4-1: Document requirements list for Class 1 components	45
Table 5-1: Document requirements list for Class 2 components	70
Table 6-1: Document requirements list for Class 3 components	95
Table 7-1: Quality levels for Class 1 components	96
Table 7-2: Quality levels for Class 2 components	100
Table 7-3: Quality levels for Class 3 components	106
 Table D-1 : PAD sheet.....	 121
Table E-1 : EEE delivery documents	124

European Foreword

This document (prEN 16602-60:2021) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN (Germany).

This document (prEN 16602-60:2021) originates from ECSS-Q-ST-60C Rev.3 DIR1.

This document is currently submitted to the ENQUIRY.

This document will supersede EN 16602-60:2015.

The main changes with respect to EN 16602-60:2015 are listed below:

- to be completed (currently the changes are identified with revision tracking).

This document has been developed to cover specifically space systems and will therefore have precedence over any EN covering the same scope but with a wider do-main of applicability (e.g. : aerospace).

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.

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.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system — Glossary of terms
EN 16601-10	ECSS-M-ST-10	Space project management — Project planning and implementation
EN 16602-10-09	ECSS-Q-ST-10-09	Space product assurance — Nonconformance control system
EN 16602-20	ECSS-Q-ST-20	Space product assurance — Quality assurance
EN 16602-30-11	ECSS-Q-ST-30-11	Space product assurance — Derating — EEE components
EN 16602-60-02	ECSS-Q-ST-60-02	Space product assurance — ASIC and FPGA development
EN 16602-05	ECSS-Q-ST-60-05	Space product assurance — Generic procurement requirements for hybrid microcircuits
EN 16602-60-12	ECSS-Q-ST-60-12	Space product assurance — Design, selection, procurement and use of die form monolithic microwave integrated circuits (MMICs)
EN 16602-60-13	ECSS-Q-ST-60-13	Commercial electrical, electronic and electromechanical (EEE) components
EN 16602-60-14	ECSS-Q-ST-60-14	Space product assurance — Relifing procedure — EEE components
EN 16602-60-15	ECSS-Q-ST-60-15	Radiation hardness assurance — EEE components
EN 16602-70	ECSS-Q-ST-70	Space product assurance — Materials, mechanical parts and processes
	ESCC 20200	ESCC: Component Manufacturer Evaluation
	ESCC 22800	ESCC: ESA/SCC Non conformance Control System
	ESCC 22900	ESCC Basic Specification: Total Dose Steady-State Irradiation Test Method
	ESCC 24900	Minimum requirements for controlling environmental contamination of components
	ESCC 25500	Methodology for the detection of pure tin in the external surface finish of case and leads of EEE components

	GEIA-STD-005-2	Standard for Mitigating the Effects of Tin Whiskers in Aerospace and High Performance Electronic Systems.
	ESCC 21004	GUIDELINES FOR INCOMING INSPECTION OF EEE COMPONENTS (ESCC Basic Specification No. 21004)
	ESCC25100	Single Event Effects Test Method and Guidelines
	ESCC22500	GUIDELINES FOR DISPLACEMENT DAMAGE IRRADIATION TESTING
	ESCC20600	Preservation Packaging and Despatch of SCC 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)
	MIL QPLs	MIL qualified parts lists
	MIL QMLs	MIL qualified manufacturers lists
	NPSL	NASA Parts Selection List
	JAXA QPL	JAXA qualified parts list
	ESCC, MIL & JAXA specifications and standards called in the document	

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”.
- b. The term “for approval” means that a decision of the approval authority is necessary for continuing the process.
- c. The term “for review” means that raised reviewers comments are considered and dispositioned.
- d. The term “for information” means that no comments are expected about the delivered item.
- e. 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.

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, such as .xls or .xlsx or .csv..

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 mounting.

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.
- 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

- 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.
- 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.

~~ECSS-Q-ST-60_0480024~~

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

~~ECSS-Q-ST-60_0480025~~

- d. <<deleted and moved to 4.2.2.3e>>

~~ECSS-Q-ST-60_0480026~~

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

~~ECSS-Q-ST-60_0480027~~

- 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, lithium (except if 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

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 kΩ 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.
- 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.
- 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 reflowing 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 reflowed components after the reflowing process
- NOTE 1 The mitigation plan can include one or a combination of the following solutions:
- Tin whisker sensitivity evaluation
 - Reflowing of terminations with complementary evaluation.
- 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). This process is critical and needs to be evaluated and well controlled.
- Conformal coating.
 - Design modification.
- k. All the following conditions shall be fulfilled to use Parts with matte pure tin finish, >97% tin:
1. They pass the JESD-201 class 2 requirements or meet the GEIA-STD-0005-2/Class 2B requirements,
 2. They are not used in power function, Voltage > 15V and Current > 2A,
 3. They are not mechanically torqued on board or equipment.
- 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 which shall be amended 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 Q-ST-60 Annex D delivered to customer for customer's approval

3. Commercial parts: A Justification Document in accordance with Q-ST-60-13 Annex F is delivered to customer for customer's approval.

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.
- 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 and 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 e.g. 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>>

NOTE .

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/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. Non-space 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 components:

- (a) The content of the lot acceptance is defined according to information provided by the justification document according to ECSS-Q-ST-60-13 Annex F.
- (b) The proposed lot acceptance is approved through the approval process in accordance with the 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 ESCC21004.
 - 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, 25100 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. 54xxx, 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 review.

NOTE For guidance refer to the basic specification ESCC20600.

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.