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Entwurf**Raumfahrtproduktsicherung –
Elektrische, elektronische und elektromechanische (EEE) Bauteile;
Englische Fassung FprEN 16602-60:2014**

Space product assurance –
Electrical, electronic and electromechanical (EEE) components;
English version FprEN 16602-60:2014

Assurance produit des projets spatiaux –
Composants électriques, électroniques et électromécaniques (EEE);
Version anglaise FprEN 16602-60:2014

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Gesamtumfang 104 Seiten

Normenausschuss Luft- und Raumfahrt (NL) im DIN

Nationales Vorwort

Dieses Dokument (FprEN 16602-60:2014) wurde vom Technischen Komitee CEN/CLC/TC 5 „Raumfahrt“ erarbeitet, dessen Sekretariat vom DIN (Deutschland) gehalten wird.

Dieses Dokument ist derzeit zum einstufigen Annahmeverfahren vorgelegt.

Dieses Dokument wurde speziell zur Behandlung von Raumfahrtsystemen erarbeitet und hat daher Vorrang vor jeglicher Europäischer Norm, da es denselben Anwendungsbereich hat, jedoch über einen größeren Geltungsbereich (z. B. Luft- und Raumfahrt) verfügt.

Das zuständige deutsche Normungsgremium ist der Arbeitsausschuss NA 131-10-01 AA „Interoperabilität von Informations-, Kommunikations- und Navigationssystemen“ im DIN-Normenausschuss Luft- und Raumfahrt (NL).

Nationaler Anhang NA (informativ)

3 Begriffe und Abkürzungen

3.1 Begriffe aus anderen Normen

Für die Anwendung dieser Norm gelten die Begriffe nach ECSS-S-ST-00-01.

3.2 Für diese Norm spezifische Begriffe

3.2.1

Agent

Organisation, die dazu unter Vertrag genommen wird, die Beschaffung der EEE-Komponenten durchzuführen, einschließlich damit in Verbindung stehender Entwicklungs- und Qualitätssicherungsaufgaben

3.2.2

Charakterisierung

Festlegung von Attributen einer EEE-Komponente, ausreichend detailliert, um eine Bewertung ihrer Eignung für eine spezielle Verwendung oder Anwendung vornehmen zu können

3.2.3

handelsübliche Komponente

Teil, das weder nach militärischen Normen noch nach Raumfahrtnormen konstruiert oder hergestellt wurde

3.2.4

gleichzeitige Entwicklung

Entwicklungstätigkeit, die im Kontext einer gleichzeitigen Konstruktion des Produkts, des Produktionsprozesses und aller damit in Verbindung stehenden Produktnutzungen stattfindet, in einem integrierten, multidisziplinären Teams, wobei die externen Organisationsbeschränkungen minimiert sind

3.2.5

zerstörende physikalische Analyse

Serie von Inspektionen, Prüfungen und Analysen, die an Mustern der Komponenten durchgeführt wird, um zu prüfen, ob zu ihrem Bau verwendete Materialien, Konstruktionen und Verarbeitungen sowie der Bau selbst die Anforderungen der relevanten Spezifikation erfüllen und ob sie für die vorgesehene Verwendung geeignet sind

3.2.6

Franchiseverteiler

vom Hersteller offiziell und vertraglich autorisierter Verteiler

3.2.7

Teileentwickler

professioneller Ingenieur mit nachweislicher Spezialisierung auf EEE-Komponenten

3.2.8

Teilebeschaffer

Lieferer, der Komponenten entweder selbst beschafft oder Teilebeschaffungsagent, der Teile für den Lieferer beschafft

3.2.9

qualifizierte Teile

Teile, die zu den QPLs oder QMLs der folgenden normativen Systeme gehören: ESCC, MIL, JAXA, CECC

3.2.10**Kontrolle**

Prüfungen, Inspektionen oder eine Kombination daraus, die auf 100 % der Teile angewendet werden, um ungeeignete Artikel oder solche, die wahrscheinlich frühe Fehler aufweisen werden, auszusondern

3.2.11**für die Raumfahrt qualifizierte Teile**

Teile, die zu den QPLs oder QMLs der folgenden normativen Systeme (ESCC, MIL) gehören, nach den in Tabelle 7-1 aufgelisteten Qualitätsniveaus

Anmerkung 1 zum Begriff: Für die Raumfahrt qualifizierte Teile sind eine Untergruppe der qualifizierten Teile, die in 3.2.9 definiert sind.

Anmerkung 2 zum Begriff: Teile, die zu JAXA-QPL gehören, gelten als für die Raumfahrt qualifiziert, unter der Voraussetzung, dass sich die Gleichwertigkeit der generischen JAXA-Spezifikation mit den generischen ESCC- oder MIL-Spezifikationen bestätigt wurde.

3.3 Abkürzungen

Für die Anwendung dieser Norm gelten die Abkürzungen in ECSS-S-ST-00-01 und die folgenden Abkürzungen:

Abkürzung	Bedeutung
ASIC	anwendungsspezifischer integrierter Schaltkreis (en: application specific integrated circuit)
CCD	ladungsgekoppeltes Bauelement (en: charge coupled device)
CCP	Bauteilkontrollplan (en: component control plan)
CDR	kritische Konstruktionsprüfung (en: critical design review)
CECC	CENELEC Ausschuss für elektronische Komponenten (en: CENELEC electronic components committee)
CENELEC	Europäisches Komitee für elektrotechnische Normung (fr: Comité Européen de Normalisation Electrotechnique)
CI	Konformitätsinspektion (en: conformance inspection)
CN	Änderungsbenachrichtigung (en: change notice)
CoC	Konformitätszertifikat (en: certificate of conformance)
CPPA	zentralisierter Teilebeschaffungsagent (en: centralized parts procurement agent)
CR	Änderungsanforderung (en: change request)
CSI	Kundenquellinspektion (en: customer source inspection)
CSV	durch Komma geteilte Werte (en: comma-separated values)
DCL	deklarierte Komponentenliste (en: declared components list)
DPA	destruktive physische Analyse (en: destructive physical analysis)
DRD	Dokumenten Anforderungsdefinition (en: document requirement definition)

Abkürzung	Bedeutung
EEE	elektrisch, elektronisch, elektromechanisch (en: electrical, electronic, electromechanical)
EFR	ermittelte Misserfolgsrate (en: established failure rate)
EPPL	für Europa bevorzugte Teileliste (en: European preferred parts list)
ESCC	Europäische Raumfahrtkomponentenkoordination (en: European space components coordination)
ESR	Äquivalent des Serienwiderstands (en: equivalent serial resistance)
FPGA	feldprogrammierbare Gate Arrays (en: field programmable gate arrays)
GSE	Bodenunterstützungsausrüstung (en: ground support equipment)
GSFC	Goddard Weltraumflugcenter (en: Goddard space flight center)
JAXA	japanische Organisation für Luftfahrt- und Weltraumforschung und -entwicklung (en: Japanese aerospace exploration agency)
JD	Rechtfertigungsdokument (en: justification document)
LAT	Losannahmeprüfung (en: lot acceptance test)
LED	Leuchtdiode (en: light emitting diode)
LVT	Losvalidierungsprüfung (en: lot validation testing)
MMIC	monolithisch integrierte Mikrowellenschaltung (en: microwave monolithic integrated circuit)
NASA	Nationale Luft- und Raumfahrtbehörde (en: national aeronautics and space administration)
NCR	Abweichungsbericht (en: nonconformance report)
NPSL	NASA Teileauswahlliste (en: NASA parts selection list)
PA	Produktsicherung (en: product assurance)
PAD	Teilezulassungsdokument (en: parts approval document)
PCB	Teileschalttafel (en: parts control board)
PCN	Prozessänderungsbenachrichtigung (en: process change notice)
PDR	Vorentwurfsprüfung (en: preliminary design review)
PIND	Partikel-Auswirkungs-Geräusch-Abfragung (en: particle impact noise detection)
QCI	Qualitätsentsprechungsinspektion (en: quality conformance inspection)
QML	Liste qualifizierter Hersteller (en: qualified manufacturers list)
QPL	Liste qualifizierter Teile (en: qualified parts list)

Abkürzung	Bedeutung
RFD	Abweichungsantrag (en: request for deviation)
RFW	Antrag auf Verzichtserklärung (en: request for waiver)
RVT	Strahlungsverifikationsprüfung (en: radiation verification testing)
SCSB	Raumfahrtkomponenten-Lenkungsausschuss (en: Space Components Steering Board)
SEB	Einzelereignis-Ausbrennen (en: single event burn out)
SEE	Einzelereignis-Effekt (en: single event effect)
SEFI	Einzelereignis-Funktionsunterbrechung (en: single event functional interrupt)
SEGR	Einzelereignis-Gate-Bruch (en: single event gate rupture)
SEL	Einzelereignis-Latch-Up (en: single event latch up)
SET	Einzelereignis-Transiente (en: single event transient)
SEU	Einzelereignis-Upset (en: single event upset)
TCI	Technikkonformitätsinspektion (en: technology conformance inspection)
TRR	Prüfungsbereitschaftsbericht (en: test readiness review)
WFR	Weibull-Ausfallrate (en: Weibull failure rate)

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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 unique acceptance procedure. It has been drawn up by the Technical Committee CEN/CLC/TC 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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Foreword

This document (FprEN 16602-60:2014) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN (Germany).

This document (FprEN 16602-60:2014) originates from ECSS-Q-ST-60C Rev.2.

This document is currently submitted to the Unique Acceptance Procedure.

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 domain 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.

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.

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 16602-60-05	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

EN reference	Reference in text	Title
		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
	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.

4

Requirements for Class 1 components

4.1 Component programme management

4.1.1 General

- a. The supplier shall establish and implement throughout the duration of the business agreement a component programme which ensures that the requirements of the project as defined by the customer and the supplier in the related business agreement are in compliance with this standard.

4.1.2 Components control programme

4.1.2.1 Organization

- 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.
- b. The supplier's organization shall comply with all the requirements of ECSS-M-ST-10.

4.1.2.2 Component control plan

- a. The supplier shall prepare a Component Control Plan (CCP) in conformance with its DRD in Annex A.
- b. The CCP may be part of the overall project PA plan.
- c. The supplier shall submit the CCP to the customer for approval.

4.1.3 Parts control board

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

- 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®).

- b. The list specified in 4.1.4a shall be kept under configuration control (issue and identification of changes).
- c. The DCL shall be issued as a minimum at PDR and CDR (as designed) and before TRR (as built).
- d. After equipment CDR, all modifications affecting the PAD information shall be implemented, in the "as design" DCL, through the CN / CR process and submitted to the customer for approval.

NOTE For PAD generation, see 4.2.4d.

- e. The "as design" DCL shall be sent to the customer for approval.

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

4.1.5 Electrical and mechanical GSE

- 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.
- 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.

4.2 Component selection, evaluation and approval

4.2.1 General

- 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.

- 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

- 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.
- 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. Preference shall be given to components which necessitate the least evaluation or qualification effort.
- d. Starting with the design phase of the project the supplier shall ensure maximum use of preferred (see 4.2.2.3) and qualified components to achieve an effective component reduction and standardization.
- e. When selecting items, the supplier shall check the current data, applicability of the basis of qualification, problem notifications and alerts, and adequacy of specifications.
- f. The supplier shall implement a type reduction activity.

4.2.2.2 Parts and material restriction

- 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.
- b. The supplier shall evaluate the robustness of selected EEE components against the stresses induced by the assembly techniques to be employed.
- c. With respect to health and safety, beryllium oxide (except if identified in the procurement specification), cadmium, lithium, magnesium, mercury, zinc, radioactive material and all material which can cause safety hazards shall not be used.
- d. For limited life duration, known instability, safety hazards or reliability risk reasons, the EEE components listed below shall not be used:
 - 1. EEE components with pure tin (less than 3% Pb in case of SnPb alloy) used as a finish on the leads, terminations and external surfaces of components and packages.
 - 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. Wire link fuses < 5A,
9. TO5 relays without double welding of the mechanism to the header or with any type of integrated diodes inside,
- 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 k Ω ,
 2. TO3 and DO4/DO5 packages.
- 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).
- 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.
- h. The use of pure tin (inside or outside the part) shall be declared in the PAD.

4.2.2.3 Preferred sources

- a. Parts shall be chosen from the EPPL part I.
- 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.
- c. Parts subject to export restrictions or regulations shall not be preferred.

4.2.2.4 Radiation hardness

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

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

- a. The supplier shall implement derating rules for components used in his designs in accordance with the requirements of ECSS-Q-ST-30-11.
- b. For wire link fuses, the current derating factor shall be 50 % with an additional derating of 0,2 %/°C for an increase in the temperature of fuse body above 25 °C.

4.2.3 Component evaluation

4.2.3.1 General

- 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.
- b. The supplier shall plan and carry out the evaluation.

- 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.
- 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).
- 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.
- f. Omission of any of these elements, or the introduction of alternative activities, shall be justified.
- 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.
- h. For programmable devices, the representativeness shall include the programming hardware tools and the compatibility of the software.
- 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.
- 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

- 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.
- 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

- 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.

- 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.
- 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

- 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.
- 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

- a. The supplier shall document the procedure for approval of each component type intended for use in flight products.
- b. The approval of components shall be based on consideration of all pertinent data including both the electrical and environmental performance as well as the established quality and the dependability assurance requirements.
- c. The supplier shall maintain a system of traceability of the acceptance and approval of each component used in flight products.
- d. Prior to procurement of components (or before equipment CDR, at the latest), the approval process by the customer shall be organized as follows:
 1. A PAD in conformance with Annex D (or information included in the DCL) is required for space qualified parts when:
 - (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,
 - (d) pure tin is used inside or outside the part.
 2. All other space qualified parts listed in the DCL are approved through the DCL review,
 3. For any other part a PAD, in conformance with Annex D is required,
 4. For any commercial part, a Justification Document, as per ECSS-Q-ST-60-13 (clause 4.2.4), is required, instead of a PAD.
- 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.

4.3 Component procurement

4.3.1 General

- a. The supplier shall ensure that all procured components meet the programme requirements with respect to inspection, screening and tests.
- b. Class 1 components shall meet the quality levels and supplementary conditions specified in Table 7-1.
- c. The supplier shall be responsible for manufacturer surveillance and control throughout the procurement programme.
- 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).

- e. The supplier shall ensure the compatibility of the change with its application.
- f. The change shall be submitted to the customer for approval.
- 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.
- 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

- a. The supplier shall procure EEE components according to controlled specifications.
- b. International specifications systems, recognized as suitable for space applications (e.g. ESCC, MIL), shall be used by the supplier.
- 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.
- d. The content of any new specification shall be in conformance with Annex C.
- e. The use of any new specification shall be submitted to the customer for approval through the PAD process (see clause 4.2.4)
- f. Upon request, any new procurement specification prepared in the frame of the project, shall be delivered to the customer.
- g. The supplier shall keep each procurement specification under configuration control.

4.3.3 Screening requirements

- a. All components to be incorporated into flight standard hardware shall be subjected to screening.
- b. The screening test requirements shall be defined such that accumulated stress does not jeopardize component reliability.
- 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.
- d. The quality levels defined in Table 7-1 shall apply.
- e. For active parts (transistors, diodes) packaged in TO3, DO4 or DO5, the PIND test method shall be submitted to the customer's approval.

NOTE See also clause 4.2.2.2e.2.