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Ersatz für
DIN EN 13291-2:2005-11**Raumfahrtproduktsicherung –
Qualitätssicherung;
Englische Fassung EN 16602-20:2014**

Space product assurance –
Quality assurance,
English version EN 16602-20:2014

Assurance produit des projets spatiaux –
Assurance qualité;
Version anglaise EN 16602-20:2014

Gesamtumfang 71 Seiten

DIN-Normenausschuss Luft- und Raumfahrt (NL)

Nationales Vorwort

Dieses Dokument (EN 16602-20:2014) wurde vom Technischen Komitee CEN/CLC/TC 5 „Raumfahrt“ erarbeitet, dessen Sekretariat vom DIN (Deutschland) gehalten wird.

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).

Dieses Dokument ersetzt DIN EN 13291-2:2005-11.

Dieses Dokument enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Originalfassung von EN 16602-20:2014.

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.

Änderungen

Gegenüber DIN EN 13291-2:2005-11 wurden folgende Änderungen vorgenommen:

- a) Norm-Nummer geändert;
- b) keinerlei Änderungen des Textes.

Frühere Ausgaben

DIN EN 13291-2: 2005-11

Nationaler Anhang NA (informativ)

Begriffe und Abkürzungen

3 Begriffe und Abkürzungen

3.1 Begriffe aus anderen Normen

Für die Anwendung dieses Dokuments gelten die Begriffe nach ECSS-ST-00-01 und besonders die folgenden Benennungen:

Nichtkonformität/Fehler

Prozess

Produktsicherung

Qualitätssicherung

Raumfahrtsystem

Raumsegmentelement

Raumsegment-Subsystem

Startsegmentelement

Startsegment-Subsystem

Bodensegmentelement

Bodensegment-Subsystem

Raumsegmenteinrichtung

Startsegmenteinrichtung

Bodensegmenteinrichtung

3.2 Für diese Norm spezifische Begriffe

3.2.1

Bodendienstgerät (GSE)

optisches, mechanisches, fluidisches, elektrisches und Software-Dienstgerät oder System, das z. B. für Kalibrierung, Messungen, Prüfung, Simulation, Transport und Handhabung von Raumsegmenten oder Raumsegmentelementen verwendet wird

3.2.2

Inspizierbarkeit; (Über-)Prüfbarkeit; Kontrollierbarkeit

Einheit, an der eine Inspektion durchgeführt werden kann

ANMERKUNG Die Inspizierbarkeit umfasst Vorschriften für folgende Aspekte:

- eindeutige und quantifizierte Definition für die Inspektion einschließlich der Kriterien für Abnahme oder Zurückweisung;
- Zugänglichkeit zu Teilen und Bauelementen zur Durchführung der Inspektion;
- Definition der Toleranzverfahren für die Durchführung der Maßprüfung (z. B. Funktionstoleranzen).

3.2.3

Herstellbarkeit; Erzeugbarkeit

Einheit, die produziert werden kann

ANMERKUNG Die Herstellbarkeit umfasst Vorschriften für folgende Aspekte:

- Vereinfachung und Normung des Designs, Verringerung der Arten und der Anzahl von Teilen;
- Richtlinien für die Auswahl vorzugsweise anzuwendender Teile, Materialien und Prozesse;
- eindeutige Definitionen für die anzuwendenden Anforderungen und Grenzen;
- Definition der Toleranzverfahren zwecks Vereinfachung von Herstellung, Montage und Inspektion;
- Normung der Schnittstellen;
- Zugänglichkeit zu Teilen für Montage und Inspektion;
- Definition der Designkriterien, die mit den Fähigkeiten der Herstellungsprozesse konsistent sind;
- Definition der Designverfahren zur Sicherstellung der Kompatibilität der Anforderungen an die Reinheit und der Fähigkeit der zum Reinigen verwendeten Verfahren und Geräte.

3.2.4

Wiederholbarkeit; Wiederholpräzision

Fähigkeit zum Reproduzieren von Leistungen und Merkmalen einer Einheit

ANMERKUNG Die Wiederholbarkeit umfasst Vorschriften für folgende Aspekte:

- Definition der allgemeingültigen genormten Toleranzen;
- empfohlene Konzepte und Lösungen für das Design zur Sicherstellung der Wiederholbarkeit;
- empfohlene Herstellungsprozesse mit nachgewiesener Wiederholbarkeit;
- Designkriterien zur Optimierung der Umsetzung automatisierter Herstellungsverfahren oder einer computergestützten Herstellung.

3.2.5

Testbarkeit; Prüfbarkeit

Einheit, an der eine Prüfung durchgeführt werden kann

ANMERKUNG Die Testbarkeit umfasst Vorschriften für folgende Aspekte:

- eindeutige und quantifizierte Definition für die Prüfanforderungen einschließlich der Kriterien für Abnahme oder Zurückweisung;
- Zugänglichkeit zu Teilen und Bauelementen zur Durchführung der Prüfung;
- Definition der empfohlenen Design-Techniken zur Erleichterung von Nachweis, Identifikation und Lagezuordnung von Fehlern (z. B. Testpunkte, Modularität, integrierte Test-Software und Feedbackschleifen).

3.3 Abkürzungen

Für die Anwendung dieses Dokuments gelten die Abkürzungen in ECSS-S-ST-00-01 und die folgenden Abkürzungen:

Abkürzung	Bedeutung
AIV	Baugruppe, Integration und Verifizierung (en: assembly, integration, verification)
BB	Lochraster(leiter)platte (en: breadboard)
CI	Konfigurationseinheit (en: configuration item)
CoC	Konformitätszertifikat (en: certificate of conformity)

Abkürzung	Bedeutung
DRB	Lieferungs-Untersuchungsausschuss (en: delivery review board) ANMERKUNG DRB ist synonym zu „Abnahme-Review-Ausschuss“ (en: acceptance review board) (ARB) in ECSS-M-ST-10.
DRD	Dokumenten-Anforderungsdefinition (en: document requirements definition)
EEE	elektrisch, elektronisch und elektromechanisch (en: electrical, electronic, electromechanical)
EGSE	elektrisches Bodendienstgerät (en: electrical ground support equipment)
EIDP	Endeinheit-Datenpaket (en: end item data package)
FGSE	fluidisches Bodendienstgerät (en: fluidic ground support equipment)
FM	Flugmodell (en: flight model)
GSE	Bodendienstgerät (en: ground support equipment)
MGSE	mechanisches Bodendienstgerät (en: mechanical ground support equipment)
MIP	verbindlich vorgeschriebener Prüfpunkt (en: mandatory inspection point)
NCR	Nichtkonformitäten-/Fehler-Bericht (en: nonconformance report)
NRB	Nichtkonformitäts-Untersuchungsausschuss (en: nonconformance review board)
OGSE	optisches Bodendienstgerät (en: optical ground support equipment)
PA	Produktsicherung (en: product assurance)
PM	Projektmanager (en: project manager)
QA	Qualitätssicherung (en: quality assurance)
QM	Qualifizierungsmodell (en: qualification model)
RFD	Abweichungsantrag (en: request for deviation)
RFW	Antrag auf Sonderfreigabe (nach Realisierung) (en: request for waiver)
TRB	Test-Untersuchungsausschuss (en: test review board)
TRR	Testbereitschafts-Review (en: test readiness review)
VCB	Verifikationskontroll-Ausschuss (en: verification control board)
VCD	Verifikationskontroll-Dokument (en: verification control document)

3.4 Nomenklatur

Für dieses Dokument gilt folgende Nomenklatur:

- c) Das Wort „muss“ (en: shall) wird in dieser Norm zur Kennzeichnung von Anforderungen verwendet. Für alle Anforderungen wird das Wort „muss“ (oder „ist zu ...“) verwendet.
- d) Das Wort „sollte“ (en: should) wird in dieser Norm zur Kennzeichnung von Empfehlungen verwendet. Für alle Empfehlungen wird das Wort „sollte“ verwendet.

ANMERKUNG Es ist davon auszugehen, dass bei der Anpassung alle in diesem Dokument angegebenen Empfehlungen entweder in Anforderungen umgewandelt oder dass sie aus dem Text entfernt werden.

- e) Die Wörter „darf“ (en: may) und „braucht nicht“ (en: need not) werden in dieser Norm zur Kennzeichnung einer positiven bzw. negativen Erlaubnis verwendet. Für jede positive Erlaubnis (Genehmigung) wird das Wort „darf“ verwendet. Für jede negative Erlaubnis (Freistellen der Unterlassung) wird das Wort „braucht nicht“ verwendet.
- f) Das Wort „kann“ wird in dieser Norm zur Kennzeichnung von Fähigkeiten oder Möglichkeiten verwendet; daher impliziert die Anwendung von „kann“, sofern nicht mit einem der oben genannten Wörter kombiniert, stillschweigend beschreibende Texte.

ANMERKUNG In ECSS haben „darf“ (en: may) und „kann“ (en: can) vollständig andere Bedeutungen: „darf“ ist normativ (Erlaubnis), „kann“ wird für Beschreibungen verwendet.

- g) Präsens und Präteritum werden in dieser Norm verwendet, um Tatbestände auszudrücken; daher implizieren sie beschreibende Texte.

English version

Space product assurance - Quality assurance

Assurance produit des projets spatiaux - Assurance qualité

Raumfahrtproduktsicherung - Qualitätssicherung

This European Standard was approved by CEN on 6 March 2014.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN and CENELEC member.

This European Standard exists 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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CEN-CENELEC Management Centre:
Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 16602-20:2014) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN.

This standard (EN 16602-20:2014) originates from ECSS-Q-ST-20C Rev.1.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2015, and conflicting national standards shall be withdrawn at the latest by March 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13291-2:2003.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

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

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1

Scope

This Standard defines the quality assurance (QA) requirements for the establishment and implementation of a Quality Assurance programme for products of space projects.

Discipline related qualification activities are complemented in standards specific to those disciplines (e.g. ECSS-E-ST-32-01 for fracture control).

For software quality assurance, the software product assurance standard, ECSS-Q-ST-80 is applicable.

This Standard is applicable to all space projects.

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

For the tailoring of this standard the following information is provided:

- A table providing the pre-tailoring per “Product types” in clause 6
- A table providing the pre-tailoring per “Project phase” in Annex J

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 16602-10	ECSS-Q-ST-10	Space product assurance - Product assurance management
EN 16602-10-04	ECSS-Q-ST-10-04	Space product assurance - Critical-item control
EN 16602-10-09	ECSS-Q-ST-10-09	Space product assurance - Nonconformance control system
	EN 61340-5-1 (2007)	Electrostatics - Part 5-1: Protection of electronic devices from electrostatic phenomena - General requirements
	ANSI-ESD S20.20-2007	Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment

Terms and definitions

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-ST-00-01 apply, in particular for the following terms:

- nonconformance
- process
- product assurance
- quality assurance
- space system
- space segment element
- space segment sub-system
- launch segment element
- launch segment sub-system
- ground segment element
- ground segment sub-system
- space segment equipment
- launch segment equipment
- ground segment equipment

3.2 Terms specific to the present standard

3.2.1 ground support equipment (GSE)

optical, mechanical, fluidic, electrical and software support equipment or systems used for example for calibration, measurements, testing, simulation, transportation, and handling of space segment or of space segment elements

3.2.2 inspectability

ability of an item of being inspected

NOTE Inspectability includes provisions for the followings aspects:

- Definition of inspection including acceptance or rejection criteria, expressed in an unambiguous and quantified manner.
- Part and component accessibility for inspection
- Definition of tolerance methods for dimensional inspection performance (e.g. functional tolerances).

3.2.3 producibility

ability of an item of being producible

NOTE Producibility includes provisions for the following aspects:

- Design simplification and standardization, reduction in part types and part number.
- Guidelines for selection of preferred parts, materials and processes.
- Unambiguous definitions of the requirements and limits to be used.
- Definition of tolerance build-up methods, in order to simplify manufacturing, assembly, inspection.
- Standardization of interfaces.
- Part accessibility for assembly and inspection.
- Definition of design criteria consistent with the capability of manufacturing processes.
- Definition of design methods to ensure that the cleanliness requirements are compatible with the capability of related cleanliness procedures and facilities.

3.2.4 repeatability

ability to reproduce the performance and characteristics of an item

NOTE Repeatability includes provisions for the following aspects:

- Definition of standard tolerances generally applicable.
- Recommended design concepts and solutions to ensure repeatability.
- Recommended manufacturing processes having proven repeatability.
- Design criteria that optimize implementation of automated manufacturing methods, or computer-aided manufacturing

3.2.5 testability

ability of an item of being tested

NOTE Testability includes provisions for the followings aspects:

- Definition of test requirements, including acceptance or rejection criteria, expressed in an unambiguous and quantified manner.
- Part and component accessibility for test.
- Definition of recommended design techniques to facilitate fault detection, identification and location (e.g. test points, modularity, built-in test software, and feedback loops).

3.3 Abbreviated terms and symbols

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

Abbreviation	Meaning
AIV	assembly, integration, verification
BB	breadboard
CI	configuration item
CoC	certificate of conformity
DRB	delivery review board
NOTE: DRB is synonymous to "Acceptance Review Board" (ARB) in ECSS-M-ST-10	
DRD	document requirements definition
EEE	electrical, electronic, electromechanical
EGSE	electrical ground support equipment
EIDP	end item data package
FGSE	fluidic ground support equipment
FM	flight model
GSE	ground support equipment
MGSE	mechanical ground support equipment
MIP	mandatory inspection point
NCR	nonconformance report
NRB	nonconformance review board
OGSE	optical ground support equipment
PA	product assurance
PM	project manager
QA	quality assurance
QM	qualification model

RFD	request for deviation
RFW	request for waiver
TRB	test review board
TRR	test readiness review
VCB	verification control board
VCD	verification control document

3.4 Nomenclature

The following nomenclature apply 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, all the 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 a complete different meaning: “may” is normative (permission) and “can” is descriptive.

- e. The present and past tense are used in this standard to express statement of fact, and therefore they imply descriptive text.

Quality assurance principles

4.1 QA management principles

The prime objective of Quality Assurance (QA) management is to ensure that a QA programme for projects covering mission definition, design, development and production of space systems is established, maintained and implemented.

All QA requirements are specified through definition and implementation of adequate methods and procedures.

Personnel whose performance determines or affects product quality are trained and certified in accordance with project needs.

4.2 General principles

The implementation of the following phase-independent activities is ensured by the QA function throughout the lead-time of projects:

- critical-items control
- nonconformance control
- alert management
- stamp control
- traceability
- metrology and calibration
- handling, storage and preservation
- statistical quality control (if required by the business agreement).

4.3 Design and verification principles

The objective of the QA function is to ensure that:

- a. a set of design rules and methods has been set up and is consistent with the project techniques and technologies;
- b. methods, procedures and tools have been defined and are implemented in order to prove that each applicable requirement is verified through one or more of the following methods: analysis, inspection, test, review of design, audits;
- c. the design is producible and repeatable and that the resulting product can be verified and operated within the required operating limits;

- d. design and verification activities are planned in a consistent and logical way;
- e. the verification process is complete and includes clear test, test model and verification logic;
- f. a defined qualification approach is implemented to demonstrate that the item performs satisfactorily in the intended environment.

4.4 Procurement principles

All procurement activities including selection of procurement sources, procurement documents, procurement source surveillance and receiving inspection are controlled to ensure that all procured items and services conform to requirements.

4.5 Manufacturing, assembly and integration principles

All manufacturing, assembly and integration operations are planned and performed in coordination with inspections and tests to ensure that the deliverables are built, assembled and integrated to the approved configuration baseline.

Special processes and new technologies are identified in a timely manner and adequate evaluation or qualification activities should be implemented in line with the overall schedule.

4.6 Testing principles

Test facilities and test equipment are validated prior to their use to ensure conformance to project requirements.

All tests are performed in accordance with documented and released procedures and results are comprehensively recorded.

4.7 Acceptance and delivery principles

The objective is to ensure that an acceptance and delivery process is implemented which allows demonstrating and documenting the conformance of the delivered item.

4.8 GSE principles

Design, production, delivery and maintenance requirements for GSE are defined and implemented allowing for testability, availability, safety, life duration, operability and ability to interface as necessary with space segment in a safe way.

Quality assurance requirements

5.1 QA management requirements

5.1.1 Quality assurance plan

- a. The supplier shall prepare, maintain and implement a QA plan in conformance with the DRD in Annex A.
- b. The QA plan shall be submitted to the customer for approval.

NOTE Information on the schedule for delivery of the QA plan is given in Annex I.

5.1.2 Personnel training and certification

- a. The supplier shall establish a documented training programme for the personnel whose performance determines or affects product quality.
- b. Personnel performing or evaluating special processes shall be trained and certified according to standards accepted by the customer.

NOTE The term “special process” is defined in ECSS-S-ST-00-01.

- c. Personnel performing non-destructive testing and evaluation shall be trained and certified according to standards accepted by the customer.
- d. The supplier shall maintain records of the training.

5.2 QA general requirements

5.2.1 Critical-items control

- a. The supplier shall implement Critical-items control in conformance with ECSS-Q-ST-10-04.

5.2.2 Nonconformance control system

- a. The supplier shall implement a nonconformance control system in conformance with ECSS-Q-ST-10-09.

5.2.3 Management of alerts

- a. The supplier shall manage alerts in conformance with ECSS-Q-ST-10, clause 5.2.9.

5.2.4 Acceptance authority media

- a. The supplier shall establish and maintain a documented acceptance authority media control system to ensure the correct and legitimate use of all fabrication and inspection authority media.
- b. Acceptance authority media shall be used to:
 - 1. signify the completion of operations and processes, and
 - 2. indicate inspection performance at source and incoming inspection, in process inspection and tests, final inspection, end point testing, storage and shipment.
- c. The use of acceptance authority media shall be restricted to authorized personnel as identified in the acceptance authority media control system.
- d. Acceptance authority media shall be traceable to individuals responsible for their use.
- e. Acceptance authority media shall be applied directly to parts and materials, when specified by engineering drawings and specifications, and associated documents, records, labels.
- f. Acceptance authority media materials and methods shall be compatible with the articles and their use.

NOTE Acceptance authority media include stamps and signatures as defined in EN9100.

- g. <<deleted>>

5.2.5 Traceability

- a. The supplier shall ensure that a bidirectional and unequivocal relationship between parts, materials or products and associated documentation or records is established and maintained.
- b. The supplier shall be capable to trace data, personnel and equipment related to procurement, manufacturing, inspection, test, assembly, integration and operations activities.
- c. The supplier shall be capable to trace backward the locations of materials, parts, sub-assemblies.
- d. The supplier shall be capable to trace forward the locations of materials from raw stock.
- e. The supplier shall establish controls to ensure that:
 - 1. identification numbers are assigned in a systematic manner,
 - 2. identification numbers of scrapped or destroyed items are not used again,

3. identification numbers, once allocated, are not changed, unless the change is authorized by the customer.

NOTE Requirements for identification are addressed in ECSS-M-ST-40.

5.2.6 Metrology and calibration

- a. The supplier shall control, calibrate and maintain inspection, measuring and test equipment, whether owned by the supplier, on loan, or provided by the customer to demonstrate the conformance of product to the specified requirements.
- b. The supplier shall use equipment in a manner which ensures that measurement uncertainty is known and is consistent with the specified measurement capability.
- c. The supplier shall include in the calculations of all measurements the total error in the measurement process attributable to the cumulative error from the calibration chain, measuring equipment and those contributed by personnel, procedures and the environment.
- d. The supplier shall record the basis for the calculation of the cumulative errors as specified in requirement 5.2.6c.
- e. The supplier shall select inspection, measuring and test equipment in conformance with the required measurement accuracy and precision.
- f. The supplier shall identify, calibrate and adjust all inspection, measuring and test equipment and devices that can affect product quality at prescribed intervals, or prior to use, against certified equipment.
- g. The supplier shall establish, document and maintain calibration procedures, including details of equipment type, identification number, location, frequency of checks, check method, acceptance criteria and the action to be taken when results exceed the specified accuracy.
- h. The supplier shall ensure that the inspection, measuring and test equipment is capable of the specified accuracy and precision.
- i. The supplier shall identify inspection, measuring and test equipment with a suitable indicator or approved identification record to show the calibration status.
- j. The supplier shall maintain calibration records for inspection, measuring and test equipment.
- k. The supplier shall assess and document the validity of previous inspection and test results when inspection, measuring or test equipment is found to be out of calibration.
- l. The supplier shall ensure that the environmental conditions are suitable for the calibrations, inspections, measurements and tests being carried out.
- m. The supplier shall ensure that inspection, measuring and test facilities, including both test hardware and test software are protected against adjustments, which can invalidate the calibration setting.