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**Raumfahrtproduktsicherung –
Reinheit und Verunreinigungskontrolle;
Englische Fassung EN 16602-70-01:2014**

Space product assurance –
Cleanliness and contamination control;
English version EN 16602-70-01:2014

Assurance produit des projets spatiaux –
Contrôle de la propreté et de la contamination;
Version anglaise EN 16602-70-01:2014

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Nationales Vorwort

Dieses Dokument (EN 16602-70-01:2014) 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 (EN 16602-70-01:2014) basiert auf ECSS-Q-ST-70-01C.

Dieses Dokument enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Originalfassung von EN 16602-70-01:2014.

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.

Nationaler Anhang NA (informativ)

Begriffe, Symbole und Abkürzungen

3 Begriffe, Symbole und Abkürzungen

3.1 Begriffe aus anderen Normen

Für die Anwendung dieser Norm gelten die Begriffe nach ECSS-ST-00-01 und ECSS-Q-ST-70.

3.2 Für diese Norm spezifische Begriffe

3.2.1

luftgetragene Partikel

in der Luft schwebende Partikel

3.2.2

Partikelreinheitsklasse der Luft

Reinheitsgrad, festgelegt als höchstzulässige Anzahl an Partikeln je Kubikmeter (oder Kubikfuß) der Luft

3.2.3

Ausheizen

Erhöhen der Temperatur der Hardware zur Beschleunigung ihrer Ausgasung mit der Absicht, den Gehalt an molekularen Verunreinigungen in der Hardware zu verringern

ANMERKUNG Ausheizen wird üblicherweise im Vakuum durchgeführt, kann jedoch auch in einer geregelten Atmosphäre vorgenommen werden.

3.2.4

Biokontamination

Kontamination von Rohstoffen, Geräten, Personen, Oberflächen, Flüssigkeiten, Gasen oder Luft mit lebensfähigen Partikeln

[QUELLE: ISO 14698-1:2003, 3.1.4; ISO 14698-2:2003, 3.4]

3.2.5

Reinigung

Tätigkeiten zum Verringern des Verunreinigungsgrades

3.2.6

Reinheitskontrolle (Verunreinigungs kontrolle)

jegliche organisierte Tätigkeit zur Kontrolle des Verunreinigungsgrades

3.2.7

Reinheitsgrad

quantitativer Verunreinigungsgrad

3.2.8

Reinheitsüberprüfung

Tätigkeit zur Überprüfung, ob die tatsächlichen Bedingungen für die Reinheit des Raumfahrtssystems, der Reinräume oder der Vakuumkammern die geltenden Spezifikationen und weitere Reinheitsanforderungen erfüllen

3.2.9

Reinraum

Raum, in dem die Konzentration luftgetragener Partikeln geregelt wird, der so konstruiert und verwendet wird, dass die Anzahl der in den Raum eingeschleppten bzw. im Raum entstehenden und abgelagerten Partikeln kleinstmöglich ist, und in dem andere reinheitsrelevante Parameter wie Temperatur, Feuchte und Druck nach Bedarf geregelt werden

[QUELLE: ISO 14644-6]

3.2.10

reiner Bereich

zugeordneter Bereich, in dem die Konzentration luftgetragener Partikeln geregelt wird, der so konstruiert und verwendet wird, dass die Anzahl der in den Raum eingeschleppten bzw. im Raum entstehenden und abgelagerten Partikeln kleinstmöglich ist, und in dem andere reinheitsrelevante Parameter wie Temperatur, Feuchte und Druck nach Bedarf geregelt werden

[QUELLE: ISO 14644-6]

ANMERKUNG Dieser Bereich kann offen oder eingeschlossen sein und kann innerhalb bzw. außerhalb eines Reinraums liegen.

3.2.11

Verunreinigung

jeglicher unerwünschter molekularer oder partikelförmiger Stoff (einschließlich mikrobiologischer Stoffe) auf der untersuchten Oberfläche oder in der untersuchten Umgebung, der die betreffende Leistungsfähigkeit oder Lebensdauer beeinträchtigen oder herabsetzen kann

3.2.12

Verunreinigen

Einschleppen von Verunreinigungen

3.2.13

Verunreinigungsbudget

zulässige Verunreinigungsgrade, die für verschiedene Stadien der Lebensdauer des Gerätes und Satelliten definiert sind

3.2.14

Verunreinigungspotential

potentielle Menge an Verunreinigungen in der Quelle, die eine Verunreinigung bewirken kann

3.2.15

kontrollierter Bereich

umgebungskontrollierter Bereich, betrieben als Reinraum, mit zwei Vorfilter-Stufen, jedoch ohne die Endstufe von HEPA-Filtern (oder besseren Filtern), die in Reinräumen angewendet werden

3.2.16

Faser

Partikel mit einem Verhältnis von Länge zu Durchmesser von 10 oder mehr

3.2.17

FTIR-Spektrometer

Analysator (chemische Identifizierung) zur Identifizierung organischer und anorganischer Verunreinigungen mittels Infrarot-Wellenlängen

3.2.18

HEPA-Filter

in einen starren Rahmen integrierter Extended-Medium-Einweg-Trockenfilter, der für ein thermisch erzeugtes DOP oder ein vorgegebenes alternatives Aerosol mit einer Partikelgröße von 0,3 µm einen Mindestabscheidegrad für Partikeln von 99,97 % (d. h. einen maximalen Partikeldurchlassgrad von 0,03 %) aufweist

3.2.19**induzierte Verunreinigungs Umgebung**

Umgebung, die durch das Vorliegen verunreinigender Bauteile geschaffen wird

3.2.20**molekulare Verunreinigung**

Luft- oder Oberflächenverunreinigung (Dampf, Gas, Flüssigkeit oder Feststoff) ohne feststellbare Abmessungen (d. h. mit Abmessungen auf molekularer Ebene)

3.2.21**Überwachung**

Durchführung laufender quantitativer Messungen von Umgebungsparametern in Reinräumen, Reinheitszonen und sonstigen Reinbereichen und um diese herum, einschließlich Verunreinigungsparameter

3.2.22**nichtflüchtiger Rückstand****NVR**

Menge an restlichen löslichen und suspendierten Stoffen und Schwebstoffen, die nach einer kontrollierten Verdampfung einer flüchtigen Flüssigkeit bei einer festgelegten Temperatur verbleibt

3.2.23**Verdunkelungsfaktor****OF**

Verhältnis der projizierten Fläche aller Partikeln zur gesamten Oberfläche, auf der diese abgelagert sind

3.2.24**Fremdstoffabgabe**

Abgabe gasförmiger Substanzen von einem flüssigen oder festen Stoff in eine Atmosphäre

3.2.25**ausgegaste Menge**

Gesamtmenge an ausgegasten Stoffen, angegeben als Masse (z. B. Gramm oder Prozent des ursprünglichen Probekörpers) oder als Druck $\times$ Volumen (z. B. hPa $\times$ m³)

3.2.26**Ausgasung**

Freisetzung gasförmiger Stoffe aus einem Material, üblicherweise im Vakuum

ANMERKUNG Ausgasung findet auch in einer Umgebung mit höherem Druck statt.

3.2.27**Partikel**

Einheit eines Stoffes mit feststellbarer Länge, Breite und Dicke

3.2.28**Partikelniederschlag**

angesammelte Ablagerung von Schwebstoffen auf einer Oberfläche

3.2.29**Partikelgröße**

scheinbare maximale lineare Abmessung einer Partikel, die in der Betrachtungsebene mit einem optischen Mikroskop beobachtet wird, oder der äquivalente Durchmesser einer Partikel, der durch automatische Messgeräte ermittelt wird

ANMERKUNG Der äquivalente Durchmesser ist der Durchmesser einer Referenzkugel mit bekannten Eigenschaften, die die gleiche Response im Messgerät wie die zu messende Partikel erzeugt.

3.2.30**partikelbezogen**

von oder in Bezug auf die kleinsten einzelnen Partikeln

3.2.31

Verunreinigung durch Partikeln

PAC

Luft- oder Oberflächenverunreinigung durch Partikeln

3.2.32

Abgasfahne

Abgase (Moleküle oder Partikeln) von Schubdüsen und Triebwerken

3.2.33

Spülen

Zuleitung von reinem Gas zum Schutz der kritischen Hardware vor Verunreinigung

3.2.34

Quarzmikrowaage

QCM

Gerät zur Messung kleiner auf einem Quarz abgeschiedener Massemengen unter Verwendung der Eigenschaften eines Quarzoszillators

3.2.35

Staustrahl-Richtung

Richtung des Geschwindigkeitsvektors

3.2.36

empfindliches Bauteil

Bauteil, dessen Leistungsfähigkeit oder Lebensdauer durch Verunreinigung beeinträchtigt werden kann

3.2.37

ULPA-Partikelfilter

in einen starren Rahmen integrierter Extended-Medium-Einweg-Trockenfilter, der für Partikeln im Größenbereich von 0,1 µm bis 0,2 µm einen Mindestabscheidegrad von 99,999 % (d. h. einen maximalen Partikeldurchlassgrad von 0,001 %) aufweist

3.2.38

Entlüften

Ableiten unerwünschter gasförmiger Produkte durch eine Öffnung

3.2.39

sichtbar rein

Nichtvorhandensein einer Oberflächenverunreinigung bei einer Prüfung mit einer bestimmten Lichtquelle, unter einem bestimmten Einfallwinkel und in einem bestimmten Sichtabstand, untersucht durch Sichtprüfung oder mit Vergrößerung

3.2.40

Richtung der Wirbelschleppe

zum Geschwindigkeitsvektor entgegengesetzte Richtung

3.2.41

repräsentative Probe

Probe zum Sammeln von Kontaminanten während der Beanspruchung, üblicherweise in einem umgebungskontrollierten Bereich, die anschließend analysiert wird oder an der Messungen vorgenommen werden

3.3 Abkürzungen

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

Abkürzung	Bedeutung
ACS	American Chemical Society (en: American Chemical Society)
AIT	Baugruppe, Integration und Test (en: assembly, integration and testing)
AIV	Baugruppe, Integration und Verifizierung (en: assembly, integration and verification)
AO	atomarer Sauerstoff (en: atomic oxygen)
BOL	Beginn der Lebensdauer (en: beginning of life)
CC	Verunreinigungskontrolle (en: contamination control)
C&CCP	Plan für Reinheits- und Verunreinigungskontrolle (en: cleanliness and contamination control plan)
CRS	Spezifikation der Reinheitsanforderungen (en: cleanliness requirement specification)
CVCM	gesamelter kondensierbarer flüchtiger Stoff (en: collected volatile condensable material)
DIW	entionisiertes Wasser (en: deionised water)
DML	deklarierte Material-Liste (en: declared materials list)
DOP	Diocetylphthalat (en: dioctylphthalate)
ECLS	Überwachung der Umgebungsbedingungen und Lebenserhaltung (en: environmental control and life support)
EGSE	elektrisches Bodendienstgerät (en: electrical ground support equipment)
EMC	elektromagnetische Verträglichkeit (en: electromagnetic compatibility)
EOL	Ende der Lebensdauer (en: end of life)
EVA	Außenbordeinsatz (en: extra vehicular activity)
FTIR	Fourier Transform Infrarot Spektrometrie (en: Fourier transform infrared)
GSE	Bodendienstgerät (en: ground support equipment)
HEPA	hochwirksamer Schwebstofffilter (en: high-efficiency particulate air filter)
ICC	interne Verunreinigungskontrolle (en: internal contamination control)
IPA	Isopropanol (en: isopropyl alcohol)
IR	Infrarot (en: infrared)

LEO	niedrige Erdumlaufbahn (en: low Earth orbit)
MGSE	mechanisches Bodendienstgerät (en: mechanical ground support equipment)
MLI	Mehrschichtisolierung (en: multi layer insulation)
MOC	molekulare Verunreinigung (en: molecular contamination)
MRR	Produktionsreifebewertung (en: manufacturing readiness review)
NVR	nichtflüchtiger Rückstand (en: non-volatile residue)
OF	Verdunkelungsfaktor (en: obscuration factor)
PAC	Verunreinigung durch Partikeln (en: particulate contamination)
PDR	Bewertung der Produktdefinition (en: product definition review)
PFO	Partikelniederschlag (en: particle fallout)
PMP	Teile, Materialien und Prozesse (en: parts, materials and processes)
QCM	Quarzkristall-Mikrowaage (en: quartz crystal microbalance)
RH	relative Luftfeuchte (en: relative humidity)
RT	Raumtemperatur (en: room temperature)
RML	Masseverlust ohne Wasser (en: recovered mass loss)
SRR	Systemanforderungs-Review (en: system requirement review)
TB	Wärmebilanz (en: thermal balance)
TML	Gesamtmassenverlust (en: total mass loss)
TRR	Testbereitschafts-Review (en: test readiness review)
TV	Thermalvakuum (en: thermal vacuum)
UV	ultraviolett (en: ultra-violet)
ULPA	Hochleistungs-Schwebstofffilter (en: ultra-low-particle air filter)
VBQC	Vakuumwaage-Quarzkristall (en: vacuum balance quartz crystal)
VCM	flüchtiges kondensierbares Material (en: volatile condensable material)

English version

Space product assurance - Cleanliness and contamination control

Assurance produit des projets spatiaux - Contrôle de la propreté et de la contamination

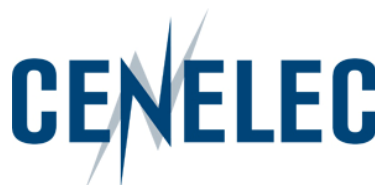
Raumfahrtproduktsicherung - Reinheit und Verunreinigungskontrolle

This European Standard was approved by CEN on 13 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.

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Foreword

This document (EN 16602-70-01:2014) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN.

This standard (EN 16602-70-01:2014) originates from ECSS-Q-ST-70-01C.

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 April 2015, and conflicting national standards shall be withdrawn at the latest by April 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 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.

Introduction

The objective of this Standard is to ensure a successful mission by the definition of acceptable contamination levels for space system elements, their achievement, and maintenance, throughout

- performance assessment versus contamination,
- facilities and tools definition for contamination control and monitoring,
- materials and processes selection, and
- planning of activities.

1

Scope

The purpose of this standard is to define:

- The selection of critical items, the definition of cleanliness requirements to satisfy the mission performance requirements and control the levels to be met by personnel, items, facilities and operations of space projects.
- The management, including organization, reviews and audits, acceptance status and documentation control.

It covers design, development, production, testing, operation of space products, launch and mission.

In this standard are also guidelines given for identification of possible failures and malfunctions due to contamination and guidelines for achieving and maintaining the required cleanliness levels during ground activities, launch and mission.

This Standard applies to all types and combinations of projects, organizations and products, and during all the project phases, except manned missions.

It also applies to those ground systems that have a hardware interface to space systems, such as MGSE integration stands.

This Standard does not address magnetic, electrical or electrostatic cleanliness.

This Standard does not address completely biocontamination aspects. However, references to relevant ECSS standards are provided.

This standard may be tailored for the specific characteristic 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 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 16602-20-07	ECSS-Q-ST-20-07	Space product assurance — Quality assurance for test centres
EN 16602-70	ECSS-Q-ST-70	Space product assurance — Materials, mechanical parts and processes
EN 16602-70-02	ECSS-Q-ST-70-02	Space product assurance — Thermal vacuum outgassing test for the screening of space materials
EN 16602-70-29	ECSS-Q-ST-70-29	Space product assurance — Determination of offgassing products from materials and assembled articles to used in manned space vehicle crew compartment
EN 16602-70-50	ECSS-Q-ST-70-50	Space product assurance — Particle contamination monitoring for spacecraft systems and cleanrooms
EN 16602-70-53	ECSS-Q-ST-70-53	Space product assurance — Material and hardware compatibility test for sterilization processes
EN 16602-70-55	ECSS-Q-ST-70-55	Space product assurance — Microbial examination of flight hardware and cleanrooms
EN 16602-70-58	ECSS-Q-ST-70-58	Space product assurance — Bioburden control of cleanrooms
	ISO 14644	Cleanrooms and associated controlled environments
	IEST-STD-CC1246D	Product cleanliness levels and contamination control program

Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-ST-00-01 and ECSS-Q-ST-70 apply.

3.2 Terms specific to the present standard

3.2.1 airborne particle

particle suspended in air

3.2.2 airborne particle cleanliness class

level of cleanliness specified by the maximum allowable number of particles per cubic metre (or cubic foot) of air

3.2.3 bakeout

activity of increasing the temperature of hardware to accelerate its outgassing rates with the intent of reducing the content of molecular contaminants within the hardware

NOTE Bakeout is usually performed in a vacuum environment, but can be done in a controlled atmosphere.

3.2.4 biocontamination

contamination of materials, devices, individuals, surfaces, liquids, gases or air with viable particles

[ISO 14698-1:2003, 3.1.4] [ISO 14698-2:2003, 3.4]

3.2.5 cleaning

actions to reduce the contamination level

3.2.6 cleanliness (contamination) control

any organized action to control the level of contamination

3.2.7 cleanliness level

quantitative level of contamination

3.2.8 cleanliness verification

activity intended to verify that the actual cleanliness conditions of the space system, the cleanrooms or the vacuum chambers are in conformance with the applicable specifications and other cleanliness requirements

3.2.9 cleanroom

room in which the concentration of airborne particles is controlled, and which is constructed and used in a manner to minimize the introduction, generation and retention of particles inside the room, and in which other relevant parameters, e.g. temperature, humidity and pressure, are controlled as necessary

[ISO 14644-6]

3.2.10 clean zone

dedicated space in which the concentration of airborne particles is controlled, and which is constructed and used in a manner to minimize the introduction, generation and retention of particles inside the room, and in which other relevant parameters, e.g. temperature, humidity and pressure, are controlled as necessary

[ISO 14644-6]

NOTE This zone can be open or enclosed and can or can not be located within a cleanroom.

3.2.11 contaminant

any unwanted molecular or particulate matter (including microbiological matter) on the surface or in the environment of interest, that can affect or degrade the relevant performance or life time

3.2.12 contaminate, to

act of introducing any contaminant

3.2.13 contamination budget

permissible contamination levels defined at different stages of the life of the instrument and satellite

3.2.14 contamination potential

potential amount of contaminant in the source which can produce contamination

3.2.15 controlled area

environmentally controlled area, operated as a cleanroom, with two pre-filter stages but without the final stage of HEPA (or better) filters used in cleanrooms

3.2.16 fibre

particle with a length to diameter ratio of 10 or more

3.2.17 FTIR spectrometer

analyser (chemical identification) of organic and inorganic contamination using infrared wavelengths

3.2.18 HEPA particle filter

throwaway, extended-medium, dry type filter in a rigid frame that has a minimum particle-collection efficiency of 99,97 % (that is a maximum particle penetration of 0,03 %) for 0,3 µm thermally generated DOP or specified alternative aerosol

3.2.19 induced contaminant environment

environment created by the presence of contaminating items

3.2.20 molecular contamination

airborne or surface contamination (vapour, gas, liquid, or solid) without observable dimensions (i.e. with dimensions at molecular level)

3.2.21 monitoring

to perform routine, quantitative measurements of environmental parameters in and around cleanrooms, clean zones, and other clean areas, including contamination parameters

3.2.22 non-volatile residue (NVR)

quantity of residual soluble, suspended, and particulate matter remaining after the controlled evaporation of a volatile liquid at a specified temperature

3.2.23 obscuration factor (OF)

ratio of the projected area of all particles to the total surface area on which they rest

3.2.24 offgassing

evolution of gaseous products from a liquid or solid material into an atmosphere

3.2.25 outgassed quantity

total quantity of outgassed species expressed as a mass (e.g. gram or percent of the initial specimen) or as pressure × volume (e.g. hPa × m³)

3.2.26 outgassing

evolution of gaseous species from a material, usually in vacuum

NOTE Outgassing also occurs in a higher-pressure environment.

3.2.27 particle

unit of matter with observable length, width and thickness

3.2.28 particle fallout

accumulated deposit of particulate matter on a surface

3.2.29 particle size

apparent maximum linear dimension of a particle in the plane of observation as observed with an optical microscope, or the equivalent diameter of a particle detected by automatic instrumentation

NOTE The equivalent diameter is the diameter of a reference sphere having known properties and producing the same response in the sensing instrument as the particle being measured.

3.2.30 particulate

of or relating to minute separate particles

3.2.31 particulate contamination (PAC)

airborne or surface contamination due to particles

3.2.32 plume

exhaust (molecules or particles) of thrusters and engines

3.2.33 purging

supply of clean gas to protect the critical hardware from contamination

3.2.34 quartz crystal microbalance (QCM)

device for measuring small quantities of mass deposited on a quartz crystal using the properties of a crystal oscillator

3.2.35 ram direction

in the direction of velocity vector

3.2.36 sensitive item

item whose contamination may affect its performance or life time

3.2.37 ULPA particle filter

throwaway, extended-medium, dry-type filter in a rigid frame that has a minimum particle-collection efficiency of 99,999 % (that is, a maximum particle penetration of 0,001 %) for particles in the size range of 0,1 μm to 0,2 μm

3.2.38 venting

conveying unwanted gaseous products through an aperture

3.2.39 visibly clean

absence of surface contamination when examined with a specific light source, angle of incidence and viewing distance using normal or magnified vision

3.2.40 wake direction

direction opposite to the velocity vector

3.2.41 witness sample

sample used to collect contaminants during exposure, usually in an environmentally controlled area, and then analysed or measured

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
ACS	American Chemical Society
AIT	assembly, integration and testing
AIV	assembly, integration and verification
AO	atomic oxygen
BOL	beginning of life
CC	contamination control
C&CCP	cleanliness and contamination control plan
CRS	cleanliness requirement specification
CVCM	collected volatile condensable material
DIW	deionised water
DML	declared materials list
DOP	dioctylphthalate
ECLS	environmental control and life support
EGSE	electrical ground support equipment
EMC	electromagnetic compatibility
EOL	end of life
EVA	extra vehicular activity
FTIR	Fourier transform infrared
GSE	ground support equipment
HEPA	high-efficiency particulate air filter
ICC	internal contamination control
IPA	isopropyl alcohol
IR	infrared
LEO	low Earth orbit
MGSE	mechanical ground support equipment
MLI	multi layer insulation
MOC	molecular contamination
MRR	manufacturing readiness review

NVR	non-volatile residue
OF	obscuration factor
PAC	particulate contamination
PDR	product definition review
PFO	particle fallout
PMP	parts, materials and processes
QCM	quartz crystal microbalance
RH	relative humidity
RT	room temperature
RML	recovered mass loss
SRR	system requirement review
TB	thermal balance
TML	total mass loss
TRR	test readiness review
TV	thermal vacuum
UV	ultra-violet
ULPA	ultra-low-particle air filter
VBQC	vacuum balance quartz crystal
VCM	volatile condensable material

4 Principles

The cleanliness and contamination control process is applied all along the project life cycle, from the definition of the C&CCP programme during the early phases (see clause 5.1) until its implementation during phases B, C, D, E and F (see clause 5.2) through the systematic verification of the cleanliness requirements baseline including: predictions through contamination modelling and the establishment of agreed procedures (see clause 5.3 and 5.4) for: environments control (see clause 5.3) packaging, containerization, transportation and storage of the space system.

NOTE Figure C-1 of Annex C gives an overview of an example of a cleanliness and contamination process.

5 Requirements

5.1 Cleanliness and contamination control programme

5.1.1 General

- a. The supplier shall define and implement a cleanliness and contamination control programme for each level of configuration.

NOTE 1 Surveys can also be made to determine the contamination control requirements, based on mission objectives and scenarios.

NOTE 2 The objective of this programme is, starting from the mission performance requirements, to establish cleanliness and contamination levels to be achieved at different manufacturing, AIT and mission stages.

NOTE 3 In general, the organization of regular workshops dedicated to cleanliness and contamination control for a specific programme is a good practice.

- b. The supplier shall establish measures for the coordination and resolution of cleanliness and contamination control issues among the parties involved in the project.

5.1.2 Documentation

5.1.2.1 Contamination requirements specification

- a. The supplier shall define and document cleanliness requirements in a cleanliness requirement specification (CRS), in conformance with the DRD in Annex A.
- b. The CRS shall be defined as early as possible in the programme, in order to properly address it during the design phase and provided at the latest at SRR, as part of the review data package.

NOTE Cleanliness is of fundamental importance for the space system's performance.