SLOVENSKI STANDARD
SIST EN 16603-35-06:2014

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Vesoljska tehnika - Zahteve za čistočo pogonske tehnike vesoljskih plovil

Space engineering - Cleanliness requirements for spacecraft propulsion hardware

Raumfahrttechnik - Sauberkeitsanforderungen für die Antriebstechnik von Raumfahrtzeugen

Ingénierie spatiale - Exigences de propreté des éléments de propulsion des véhicules spatiaux

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49.140	Vesoljski sistemi in operacije	Space systems and operations

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Space engineering - Cleanliness requirements for spacecraft propulsion hardware

Ingénierie spatiale - Exigences de propreté des éléments de propulsion des véhicules spatiaux

Raumfahrttechnik - Sauberkeitsanforderungen für die Antriebstechnik von Raumfahrtzeugen

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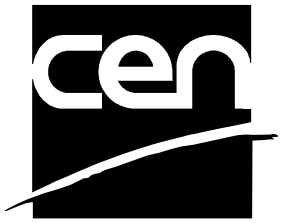

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Foreword

This document (EN 16603-35-06:2014) has been prepared by Technical Committee CEN/CLC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16603-35-06:2014) originates from ECSS-E-ST-35-06C 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of an identical text or by endorsement, at the latest by March 2015, and conflicting national standards shall be withdrawn at the latest by March 2015.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 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

ECSS-E-ST-35-06 belongs to the Propulsion field of the mechanical discipline, and concerns itself with the cleanliness of propulsion components, sub-systems and systems

The standard

- defines design requirements which allow for cleaning of propulsion components sub-systems and systems and which avoid generation or unwanted collection of contamination,
- identifies cleanliness requirements (e.g. which particle / impurity / wetness level can be tolerated),
- defines requirements on cleaning to comply with the cleanliness level requirements, and the requirements on verification,
- identifies the cleanliness approach, cleaning requirements, (e.g. what needs to be done to ensure the tolerable level is not exceeded, compatibility requirements),
- identifies, specifies and defines the requirements regarding conditions under which cleaning or cleanliness verification takes place (e.g. compatibility, check after environmental test).

The standard is applicable to the most commonly used propulsion systems and their related storable propellant combinations: Hydrazine (N_2H_4), Mono Methyl Hydrazine ($CH_3N_2H_3$), MON (Mixed Oxides of Nitrogen), Nitrogen (N_2), Helium (He), Propane (C_3H_8), Butane (C_4H_{10}) and Xenon (Xe).

This standard is the basis for the European spacecraft and spacecraft propulsion industry to define, achieve and verify the required cleanliness levels in spacecraft propulsion systems.

This standard is particularly applicable to spacecraft propulsion as used for satellites and (manned) spacecraft and any of such projects including its ground support equipment.

External cleanliness requirements, e.g. outside of tanks, piping and aspects such as fungus and outgassing are covered by ECSS-Q-ST-70-01.

This standard may be tailored for the specific characteristic 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 revisions 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 most 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 16603-35	ECSS-E-ST-35	Space engineering — Propulsion general requirements
EN 16602-40	ECSS-Q-ST-40	Space product assurance — Safety
EN 16602-70-01	ECSS-Q-ST-70-01	Space product assurance — Cleanliness and contamination control.
EN 16602-70	ECSS-Q-ST-70	Space product assurance — Materials, mechanical parts and processes
	ISO 2210:1972	Liquid halogenated hydrocarbons for industrial use-Determination of residue on evaporation
	ISO 5789:1979	Fluorinated hydrocarbons for industrial use — Determination of non-volatile residue
	ISO 5884:1978	Aerospace — Fluid systems and components — Methods for system sampling and measuring the solid particle contamination of hydraulic fluids
	ISO 14951-3:2000	Space systems —Fluid characteristics —Part 3: Nitrogen
	ISO 14951-4:2000	Space systems — Fluid characteristics —Part 4: Helium
	ISO 14951-10:2000	Space systems — Fluid characteristics —Part 10: Water
	ISO 14952-3:2003	Space systems — Surface cleanliness of fluid systems — Part 3: Analytical procedures for the determination of non-volatile residues and particulate contamination

	ASTM D257(99) 2005	Standard Test Method for DC Resistance or Conductance of Insulating Materials
	ASTM D329 10 Dec 2002	Standard specification for Acetone
	ASTM D740 15 May 2005	Standard specification for Methyl Ethyl Ketone
	ASTM D770-05 15 May 2005	Standard specification for Isopropyl Alcohol
	ASTM D1152 1 Apr 2006	Standard specification for Methanol (Methyl Alcohol)
	ASTM D1293 10 Dec 1999	Standard test methods for pH of water
	ASTM D4376	Standard specification for vapor-degreasing grade Perchloroethylene
	MIL-PRF-27415B 8 Feb 2007	Performance specification, propellant pressurizing agent, Argon
	O-E-760D 28 May 1987	Federal specification
	SEMI C47-0699 May 1999	Guideline for Trans 1,2 Dichloroethylene

3
Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 and ECSS-E-ST-35 apply.

3.2 Terms specific to the present standard

3.2.1 accuracy

measure of how close a value is to the "true" value

3.2.2 blank

result for an analytical sample of the virgin test fluid prior to use in performing a cleanliness verification test

3.2.3 cleanliness verification

activity intended to verify that the actual cleanliness conditions of an item are in conformance with the applicable specification

3.2.4 condensable hydrocarbon

hydrocarbon capable of going from a gaseous to a liquid or solid state at ambient temperature and pressure

3.2.5 crazing

creating microvoids in glassy thermoplastic polymers preceding the formation of cracks

3.2.6 critical surface

any surface of an item that contacts the service medium

NOTE Examples of service media are propellants and pressurants.

3.2.7 dewar

double-walled vessel with the annular space between the walls evacuated to provide insulation

3.2.8 dew point

temperature at which condensation of water vapour takes place at prevailing pressure

NOTE The prevailing pressure is usually atmospheric pressure.

3.2.9 fibre

flexible structure having a length-to-width ratio of 10 to 1 or greater

NOTE 1 A fibre is considered to be a particle, see clause 3.2.14.

NOTE 2 The size of a fibre is its maximum length.

3.2.10 field cleaning

processes of pre-cleaning and precision cleaning of components, subsystems and systems which cannot be processed in a controlled environment such as a clean room

3.2.11 generally clean

free from manufacturing residue, dirt, oil, grease, processing debris, or other extraneous contamination based on visual examination

3.2.12 high-efficiency particulate air filter

filter that is at least 99,97 % efficient by volume on 0,3 µm particles

3.2.13 non-volatile residue

soluble or suspended material and insoluble particulate matter remaining after temperature-controlled evaporation of a volatile liquid

NOTE See also clause 6.2.4.3

3.2.14 particle

unit of solid matter with observable size

NOTE 1 Various methods for defining its size may be used and are dependant upon the measurement technique.

NOTE 2 For the manual method the apparent maximum linear dimension of a particle in the plane of observation as observed with instruments such as optical, electron, or atomic force microscopes is the particle size.

NOTE 3 For the automatic method, the equivalent diameter of a particle detected by automatic instrumentation is the particle size.

NOTE 4 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.

NOTE 5 A fibre is considered a particle, see clause 3.2.9.

3.2.15 passivation

process by which a corrosion-resistant layer is formed on a metal surface by submersing the surface in an acid solution

3.2.16 pickling

chemical or electrochemical process by which surface oxides are removed from metals

3.2.17 precision cleaning

cleaning process used to achieve cleanliness levels more stringent than visibly clean

3.2.18 pre-cleaning

cleaning process normally used to achieve the visibly clean cleanliness level

3.2.19 reversion

decrease in viscosity, strength, or in rubber modulus due to heating or overworking, resulting in a tacky and soft material

3.2.20 silting

accumulation of particles of sufficient quantity to cause a haze or obscuring of any portion of a filter membrane when viewed visually or under 40-power maximum magnification

3.2.21 test fluid

specified fluid that is utilized to determine the fluid system wetted-surface cleanliness level

3.2.22 threshold limit value

maximum average daily dosage, based on an 8-h day, 5-day week, to which an average worker may be exposed to hazardous chemicals without harmful effect

NOTE 1 The TLV is a time-weighted average concentration.

NOTE 2 The TLV is normally expressed in parts of the gas or vapour in micro litres per litre.

3.2.23 visibly clean

absence of surface contamination when examined with a specific light source, angle of incidence, and viewing distance using normal or magnified vision up to ×20

3.2.24 visibly clean plus ultraviolet

cleaning level that is visibly clean and also meets the requirements for inspection with the aid of an ultraviolet light of wavelength 250 nm to 395 nm

3.2.25 volatile hydrocarbon

hydrocarbon capable of going from liquid or solid to a gaseous state at ambient temperature and pressure

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
CC	cleanliness certificate
CRA	cleaning requirement analysis
CTS	cleaning technique selection
GC	generally clean
HEPA	high-efficiency particulate air filter
HFE	hydro fluor ether (Per fluoro-n-butyl methyl ether)
IPA	isopropanol
MAIT	manufacturing, assembly, integration and test
MEK	methyl ethyl keton
MS	mass spectroscopy
NVR	non-volatile residue
ppmv	parts per million, volumetric
TLV	threshold limit value
US	ultra sonic
VC	visibly clean
VC + UV	visibly clean plus ultraviolet

3.4 Symbols

Symbol	Meaning
d_p	mean pore diameter of a filter