

<b>STN</b>	<b>Kozmická technika. Požiadavky na čistotu konštrukčných častí pohonu kozmických lodí.</b>	<b>STN EN 16603-35-06</b>  31 0543
------------	---	--

Space engineering - Cleanliness requirements for spacecraft propulsion hardware

Táto norma obsahuje anglickú verziu európskej normy.  
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 01/15

Obsahuje: EN 16603-35-06:2014

**120147**

---

Úrad pre normalizáciu, metrológiu a skúšobníctvo SR, odbor SÚTN, 2015  
Podľa zákona č. 264/1999 Z. z. v znení neskorších predpisov sa môžu slovenské technické normy rozmnožovať a rozširovať iba so súhlasom Úradu pre normalizáciu, metrológiu a skúšobníctvo SR.

ICS 49.140

English version

## 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 Raumfahrzeugen

This European Standard was approved by CEN on 1 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.

CEN and CENELEC members are the national standards bodies and national electrotechnical committees of 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 United Kingdom.



**CEN-CENELEC Management Centre:  
Avenue Marnix 17, B-1000 Brussels**

# Table of contents

---

<b>Foreword</b> .....	<b>6</b>
<b>1 Scope</b> .....	<b>7</b>
<b>2 Normative references</b> .....	<b>8</b>
<b>3 Terms, definitions and abbreviated terms</b> .....	<b>10</b>
3.1 Terms from other standards.....	10
3.2 Terms specific to the present standard .....	10
3.3 Abbreviated terms.....	13
3.4 Symbols.....	13
<b>4 Cleanliness requirements</b> .....	<b>14</b>
4.1 General.....	14
4.2 Design requirements.....	15
4.2.1 General .....	15
4.2.2 Components.....	15
4.2.3 System.....	17
4.2.4 Ground support equipment (GSE).....	17
4.3 Manufacturing.....	18
4.3.1 General.....	18
4.3.2 Manufacturing processes .....	18
4.3.3 Machined parts .....	18
4.3.4 Tubing and manifolds.....	18
4.3.5 Components.....	20
4.3.6 Subsystems and systems.....	21
4.3.7 Final rinsing solutions.....	21
4.4 Cleanliness classes definition .....	22
4.4.1 Particulate.....	22
4.4.2 Non-volatile residues (NVR).....	25
4.4.3 Dryness and liquid residuals .....	25
4.4.4 Requirements on process fluids to meet cleanliness classes .....	26
4.5 Test methods.....	27

4.6	Code usage .....	27
<b>5</b>	<b>Cleaning techniques .....</b>	<b>28</b>
5.1	General.....	28
5.2	Environment, health and safety.....	29
5.2.1	General .....	29
5.2.2	Hardware configuration requirements.....	29
5.2.3	Cleaning process approval.....	30
5.3	Pre-cleaning .....	30
5.3.1	General .....	30
5.3.2	Mechanical pre-cleaning .....	30
5.3.3	Chemical pre-cleaning .....	31
5.4	Precision cleaning.....	32
5.4.1	General .....	32
5.4.2	Re-cleaning operational systems .....	32
5.5	Drying methods .....	33
5.5.1	General.....	33
5.5.2	Gaseous purge-drying.....	33
5.5.3	Drying sample.....	34
5.5.4	Flow rates during purging.....	35
5.5.5	Vacuum drying procedure .....	35
5.6	Excepted components, subsystems and systems.....	36
<b>6</b>	<b>Cleanliness verification requirements .....</b>	<b>37</b>
6.1	Surface.....	37
6.1.1	Visual and UV inspection .....	37
6.1.2	pH-test .....	37
6.2	Acceptance inspection of items cleaned in a controlled environment.....	38
6.2.1	General .....	38
6.2.2	Test fluids .....	38
6.2.3	Test fluid volume for analysis .....	39
6.2.4	Analysis of test fluid-flush sample (solvent).....	39
6.2.5	Analysis of aqueous-based, liquid-flush sample.....	40
6.2.6	Drying .....	41
6.2.7	Vacuum drying .....	41
6.3	Maintaining cleanliness.....	42
6.3.1	Pressurant gas purge.....	42
6.3.2	Installation and marking of temporary hardware.....	42
6.3.3	Temporary hardware replacement .....	42

6.3.4	Component replacement .....	43
6.4	Dryness verification .....	43
6.4.1	General .....	43
6.4.2	Purge dryness .....	43
6.4.3	Vacuum dryness .....	43
6.4.4	Sample test and qualified procedure .....	44
<b>7</b>	<b>Acceptance inspection of packaging materials .....</b>	<b>45</b>
7.1	Environmental control .....	45
7.2	Sampling .....	45
7.3	Thickness of packaging film .....	45
7.4	Static electricity .....	46
7.5	Verification of cleanliness level .....	46
7.5.1	General .....	46
7.5.2	Minimum surface area for test .....	46
7.5.3	Sample preparation .....	46
7.5.4	Rinsing procedures .....	47
<b>8</b>	<b>Packaging and protection .....</b>	<b>48</b>
8.1	Approved coverings .....	48
8.2	Packaging operations .....	48
8.3	Certification labels .....	49
<b>9</b>	<b>Deliverables .....</b>	<b>50</b>
<b>10</b>	<b>Test procedures .....</b>	<b>51</b>
10.1	Test liquid-flush procedure (solvent) .....	51
10.2	Gas flow test procedure .....	51
<b>11</b>	<b>Sampling and analytical practices .....</b>	<b>52</b>
11.1	Cleanliness level test methods .....	52
11.1.1	General .....	52
11.1.2	Method I "Liquid Flush Test" .....	52
11.1.3	Method II "Liquid Flow Test" .....	53
11.1.4	Method III "Gas Flow Test" .....	53
11.1.5	Method IV "Liquid flow test under operating conditions" .....	53
<b>12</b>	<b>Determination of particle population and NVR analysis .....</b>	<b>55</b>
12.1	Microscopic particle population .....	55
12.2	Gravimetric NVR analysis method .....	56

<b>Annex A (normative) Cleanliness Requirements Analysis (CRA) for spacecraft propulsion components, subsystems and systems - DRD .....</b>	<b>57</b>
<b>Annex B (normative) Cleaning Technique Selection (CTS) for spacecraft propulsion components, subsystems and systems - DRD .....</b>	<b>59</b>
<b>Annex C (normative) Cleanliness Certificate (CC) for spacecraft propulsion components, subsystems and systems - DRD .....</b>	<b>61</b>
<b>Annex D (normative) Typical test and cleaning liquids.....</b>	<b>64</b>
<b>Annex E (informative) Pre-cleaning sequences.....</b>	<b>67</b>
<b>Annex F (informative) Cleanliness certificate .....</b>	<b>69</b>
<b>Bibliography.....</b>	<b>71</b>

## Figures

Figure F-1 : Example of a cleanliness certificate.....	70
--	----

## Tables

Table 4-1: Cleanliness classes .....	24
Table 4-2: NVR contamination levels.....	25
Table 4-3: Visible contamination levels.....	27
Table 7-1: Packaging materials .....	46
Table E-1 : Typical pre-cleaning sequence for common materials.....	67

## 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

**koniec náhľadu – text ďalej pokračuje v platenej verzii STN**