

Space engineering - Spacecraft charging

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EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

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| See Eesti standard EVS-EN 16603-20-06:2014 sisaldab Euroopa standardi EN 16603-20-06:2014 inglisekeelset teksti. | This Estonian standard EVS-EN 16603-20-06:2014 consists of the English text of the European standard EN 16603-20-06:2014. |
| Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas. | This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation. |
| Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 09.07.2014. | Date of Availability of the European standard is 09.07.2014. |
| Standard on kättesaadav Eesti Standardikeskusest. | The standard is available from the Estonian Centre for Standardisation. |

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ICS 49.140

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English version

Space engineering - Spacecraft charging

Ingénierie spatiale - Charges électrostatique des véhicules
spatiales

Raumfahrttechnik - Aufladung von Raumfahrzeugen

This European Standard was approved by CEN on 10 February 2014.

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Table of contents

| | |
|---|-----------|
| Foreword | 9 |
| Introduction | 10 |
| 1 Scope | 12 |
| 2 Normative references | 13 |
| 3 Terms, definitions and abbreviated terms | 14 |
| 3.1 Terms defined in other standards | 14 |
| 3.2 Terms specific to the present standard | 14 |
| 3.3 Abbreviated terms | 17 |
| 4 Overview | 19 |
| 4.1 Plasma interaction effects | 19 |
| 4.1.1 Presentation | 19 |
| 4.1.2 Most common engineering concerns | 19 |
| 4.1.3 Overview of physical mechanisms | 20 |
| 4.2 Relationship with other standards | 22 |
| 5 Protection programme | 24 |
| 6 Surface material requirements | 25 |
| 6.1 Overview | 25 |
| 6.1.1 Description and applicability | 25 |
| 6.1.2 Purpose common to all spacecraft | 26 |
| 6.1.3 A special case: scientific spacecraft with plasma measurement instruments | 26 |
| 6.2 General requirements | 26 |
| 6.2.1 Maximum permitted voltage | 26 |
| 6.2.2 Maximum resistivity | 27 |
| 6.3 Electrical continuity, including surfaces and structural and mechanical parts | 27 |
| 6.3.1 Grounding of surface metallic parts | 27 |
| 6.3.2 Exceptions | 28 |
| 6.3.3 Electrical continuity for surface materials | 29 |

| | | |
|-----------|--|-----------|
| 6.4 | Surface charging analysis..... | 32 |
| 6.5 | Deliberate potentials..... | 32 |
| 6.6 | Testing of materials and assemblies..... | 32 |
| 6.6.1 | General..... | 32 |
| 6.6.2 | Material characterization tests..... | 33 |
| 6.6.3 | Material and assembly qualification..... | 34 |
| 6.7 | Scientific spacecraft with plasma measurement instruments | 34 |
| 6.8 | Verification..... | 35 |
| 6.8.1 | Grounding | 35 |
| 6.8.2 | Material selection | 35 |
| 6.8.3 | Environmental effects..... | 35 |
| 6.8.4 | Computer modelling..... | 36 |
| 6.9 | Triggering of ESD..... | 36 |
| 7 | Secondary arc requirements | 37 |
| 7.1 | Description and applicability | 37 |
| 7.2 | Solar arrays | 38 |
| 7.2.1 | Overview..... | 38 |
| 7.2.2 | General requirement..... | 38 |
| 7.2.3 | Testing of solar arrays..... | 38 |
| 7.3 | Other exposed parts of the power system including solar array drive mechanisms | 42 |
| 8 | High voltage system requirements | 44 |
| 8.1 | Description | 44 |
| 8.2 | Requirements | 44 |
| 8.3 | Validation..... | 44 |
| 9 | Internal parts and materials requirements | 45 |
| 9.1 | Description | 45 |
| 9.2 | General..... | 45 |
| 9.2.1 | Internal charging and discharge effects..... | 45 |
| 9.2.2 | Grounding and connectivity..... | 45 |
| 9.2.3 | Dielectric electric fields and voltages..... | 46 |
| 9.3 | Validation..... | 47 |
| 10 | Tether requirements | 50 |
| 10.1 | Description | 50 |
| 10.2 | General..... | 50 |

| | | |
|----------------|--|-----------|
| 10.2.1 | Hazards arising on tethered spacecraft due to voltages generated by conductive tethers | 50 |
| 10.2.2 | Current collection and resulting problems | 50 |
| 10.2.3 | Hazards arising from high currents flowing through the tether and spacecraft structures..... | 51 |
| 10.2.4 | Continuity of insulation..... | 51 |
| 10.2.5 | Hazards from undesired conductive paths | 51 |
| 10.2.6 | Hazards from electro-dynamic tether oscillations | 51 |
| 10.2.7 | Other effects | 51 |
| 10.3 | Validation..... | 52 |
| 11 | Electric propulsion requirements | 53 |
| 11.1 | Overview | 53 |
| 11.1.1 | Description..... | 53 |
| 11.1.2 | Coverage of the requirements..... | 53 |
| 11.2 | General..... | 55 |
| 11.2.1 | Spacecraft neutralization..... | 55 |
| 11.2.2 | Beam neutralization | 56 |
| 11.2.3 | Contamination..... | 56 |
| 11.2.4 | Sputtering | 57 |
| 11.2.5 | Neutral gas effects | 57 |
| 11.3 | Validation..... | 57 |
| 11.3.1 | Ground testing | 57 |
| 11.3.2 | Computer modelling characteristics | 58 |
| 11.3.3 | In-flight monitoring..... | 58 |
| 11.3.4 | Sputtering | 58 |
| 11.3.5 | Neutral gas effects | 58 |
| Annex A | (normative) Electrical hazard mitigation plan - DRD | 60 |
| A.1 | DRD identification | 60 |
| A.1.1 | Requirement identification and source document..... | 60 |
| A.1.2 | Purpose and objective..... | 60 |
| A.2 | Expected response | 60 |
| A.2.1 | Scope and content | 60 |
| A.2.2 | Special remarks | 61 |
| Annex B | (informative) Tailoring guidelines | 62 |
| B.1 | Overview | 62 |
| B.2 | LEO | 62 |
| B.2.1 | General..... | 62 |

| | | |
|----------------|--|-----------|
| B.2.2 | LEO orbits with high inclination | 63 |
| B.3 | MEO and GEO orbits..... | 63 |
| B.4 | Spacecraft with onboard plasma detectors | 63 |
| B.5 | Tethered spacecraft..... | 64 |
| B.6 | Active spacecraft | 64 |
| B.7 | Solar Wind | 64 |
| B.8 | Other planetary magnetospheres..... | 64 |
| Annex C | (informative) Physical background to the requirements | 65 |
| C.1 | Introduction..... | 65 |
| C.2 | Definition of symbols..... | 65 |
| C.3 | Electrostatic sheaths..... | 65 |
| C.3.1 | Introduction | 65 |
| C.3.2 | The electrostatic potential | 66 |
| C.3.3 | The Debye length..... | 66 |
| C.3.4 | Presheath | 67 |
| C.3.5 | Models of current through the sheath..... | 68 |
| C.3.6 | Thin sheath – space-charge-limited model..... | 68 |
| C.3.7 | Thick sheath – orbit motion limited (OML) model | 69 |
| C.3.8 | General case..... | 70 |
| C.3.9 | Magnetic field modification of charging currents..... | 70 |
| C.4 | Current collection and grounding to the plasma | 70 |
| C.5 | External surface charging | 71 |
| C.5.1 | Definition..... | 71 |
| C.5.2 | Processes | 71 |
| C.5.3 | Effects..... | 72 |
| C.5.4 | Surface emission processes | 72 |
| C.5.5 | Floating potential..... | 73 |
| C.5.6 | Conductivity and resistivity | 74 |
| C.5.7 | Time scales..... | 76 |
| C.6 | Spacecraft motion effects | 76 |
| C.6.1 | Wakes..... | 76 |
| C.6.2 | Motion across the magnetic field | 79 |
| C.7 | Induced plasmas | 80 |
| C.7.1 | Definition..... | 80 |
| C.7.2 | Electric propulsion thrusters | 81 |
| C.7.3 | Induced plasma characteristics | 81 |
| C.7.4 | Charge-exchange effects | 82 |

| | | |
|----------------|--|------------|
| C.7.5 | Neutral particle effects | 83 |
| C.7.6 | Effect on floating potential..... | 83 |
| C.8 | Internal and deep-dielectric charging | 83 |
| C.8.1 | Definition..... | 83 |
| C.8.2 | Relationship to surface charging | 84 |
| C.8.3 | Charge deposition | 85 |
| C.8.4 | Material conductivity..... | 85 |
| C.8.5 | Time dependence | 88 |
| C.8.6 | Geometric considerations..... | 88 |
| C.8.7 | Isolated internal conductors | 89 |
| C.8.8 | Electric field sensitive systems | 89 |
| C.9 | Discharges and transients | 90 |
| C.9.1 | General definition..... | 90 |
| C.9.2 | Review of the process..... | 90 |
| C.9.3 | Dielectric material discharge. | 91 |
| C.9.4 | Metallic discharge | 93 |
| C.9.5 | Internal dielectric discharge..... | 94 |
| C.9.6 | Secondary powered discharge..... | 95 |
| C.9.7 | Discharge thresholds | 95 |
| Annex D | (informative) Charging simulation..... | 97 |
| D.1 | Surface charging codes | 97 |
| D.1.1 | Introduction | 97 |
| D.2 | Internal charging codes | 99 |
| D.2.1 | DICTAT..... | 99 |
| D.2.2 | ESADDC..... | 99 |
| D.2.3 | GEANT-4 | 100 |
| D.2.4 | NOVICE..... | 100 |
| D.3 | Environment model for internal charging..... | 100 |
| D.3.1 | FLUMIC | 100 |
| D.3.2 | Worst case GEO spectrum..... | 100 |
| Annex E | (informative) Testing and measurement. | 101 |
| E.1 | Definition of symbols..... | 101 |
| E.2 | Solar array testing..... | 101 |
| E.2.1 | Solar cell sample..... | 101 |
| E.2.2 | Pre-testing of the solar array simulator (SAS) | 102 |
| E.2.3 | Solar array test procedure..... | 104 |
| E.2.4 | Other elements | 108 |

| | | |
|---------------------|---|------------|
| E.2.5 | The solar panel simulation device | 109 |
| E.3 | Measurement of conductivity and resistivity | 110 |
| E.3.1 | Determination of intrinsic bulk conductivity by direct measurement | 110 |
| E.3.2 | Determination of radiation-induced conductivity coefficients by direct measurement | 112 |
| E.3.3 | Determination of conductivity and radiation-induced conductivity by electron irradiation..... | 113 |
| E.3.4 | The ASTM method for measurement of surface resistivity and its adaptation for space used materials..... | 113 |
| References | | 115 |
| Bibliography | | 119 |

Figures

| | |
|--|-----|
| Figure 6-1: Applicability of electrical continuity requirements | 29 |
| Figure 7-1: Solar array test set-up | 41 |
| Figure C-1 : Schematic diagram of potential variation through sheath and pre-sheath. | 67 |
| Figure C-2 : Example secondary yield curve | 73 |
| Figure C-3 : Schematic diagram of wake structure around an object at relative motion with respect to a plasma..... | 77 |
| Figure C-4 : Schematic diagram of void region..... | 78 |
| Figure C-5 : Schematic diagram of internal charging in a planar dielectric..... | 84 |
| Figure C-6 : Dielectric discharge mechanism. | 92 |
| Figure C-7 :Shape of the current in relation to discharge starting point..... | 92 |
| Figure C-8 : Example of discharge on pierced aluminized Teflon® irradiated by electrons with energies ranging from 0 to 220 keV. | 93 |
| Figure C-9 : Schematic diagram of discharge at a triple point in the inverted voltage gradient configuration with potential contours indicated by colour scale. | 94 |
| Figure E-1 : Photograph of solar cells sample – Front face & Rear face (Stentor Sample. Picture from Denis Payan - CNES®)..... | 102 |
| Figure E-2 : Schematic diagram of power supply test circuit..... | 103 |
| Figure E-3 : Example of a measured power source switch response..... | 103 |
| Figure E-4 : Example solar array simulator..... | 104 |
| Figure E-5 : Absolute capacitance of the satellite | 105 |
| Figure E-6 : Junction capacitance of a cell versus to voltage..... | 107 |
| Figure E-7 : The shortened solar array sample and the missing capacitances | 108 |
| Figure E-8 : Discharging circuit oscillations | 109 |
| Figure E-9 : Effect of an added resistance in the discharging circuit (SAS + resistance) | 109 |
| Figure E-10 : Setup simulating the satellite including flashover current | 110 |

| | |
|--|-----|
| Figure E-11 : Basic arrangement of apparatus for measuring dielectric conductivity in planar samples..... | 111 |
| Figure E-12 : Arrangement for measuring cable dielectric conductivity and cross-section through co-axial cable | 111 |
| Figure E-13 : Arrangement for carrying out conductivity tests on planar samples under irradiation | 112 |
| Figure E-14 : Basic experimental set up for surface conductivity | 114 |

Tables

| | |
|--|----|
| Table 4-1: List of electrostatic and other plasma interaction effects on space systems..... | 21 |
| Table 7-1: Tested voltage-current combinations | 38 |
| Table 7-2: Typical inductance values for cables | 42 |
| Table C-1 : Parameters in different regions in space | 67 |
| Table C-2 : Typical plasma parameters for LEO and GEO | 78 |
| Table C-3 : Plasma conditions on exit plane of several electric propulsion thrusters | 82 |
| Table C-4 : Emission versus backflow current magnitudes for several electric propulsion thrusters..... | 82 |
| Table C-5 : Value of E_a for several materials | 86 |

Foreword

This document (EN 16603-20-06:2014) has been prepared by Technical Committee CEN/CLC/TC 5 "Space", the secretariat of which is held by DIN.

This standard (EN 16603-20-06:2014) originates from ECSS-E-ST-20-06C.

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 January 2015, and conflicting national standards shall be withdrawn at the latest by January 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 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 subject of spacecraft plasma interactions has been part of the spacecraft design process since spacecraft surface charging was first encountered as a problem in the earliest geostationary spacecraft. However, spacecraft surface charging is only one of the ways in which the space environment can adversely affect the electrical state of spacecraft and satellite technology has evolved over the years.

A need was identified for a standard that is up to date and comprehensive in its treatment of all the main environment-induced plasma and charging processes that can affect the performance of satellites in geostationary and medium and low Earth orbits. This standard is intended to be used by a number of users, with their own design rules, and therefore it has been done to be compatible with different alternative approaches.

This document aims to satisfy these needs and provides a consistent standard that can be used in design specifications. The requirements are based on the best current understanding of the processes involved and are not radical, building on existing de-facto standards in many cases.

As well as providing requirements, it aims to provide a straightforward brief explanation of the main effects so that interested parties at all stages of the design chain can have a common understanding of the problems faced and the meaning of the terms used. Guide for tailoring of the provisions for specific mission types are described in Annex B. Further description of the main processes are given in Annex C. Some techniques of simulation, testing and measurement are described in Annex D and Annex E.

Electrical interactions between the space environment and a spacecraft can arise from a number of external sources including the ambient plasma, radiation, electrical and magnetic fields and sunlight. The nature of these interactions and the environment itself can be modified by emissions from the spacecraft itself, e.g. electric propulsion, plasma contactors, secondary emission and photoemission. The consequences, in terms of hazards to spacecraft systems depend strongly on the sensitivity of electronic systems and the potential for coupling between sources of electrical transients and fields and electronic components.

Proper assessment of the effects of these processes is part of the system engineering process as defined in ECSS-E-ST-20. General assessments are performed in the early phases of a mission when consideration is given to e.g. orbit selection, mass budget, thermal protection, and materials and component selection policy. Further into the design of a spacecraft, careful consideration is given to material selection, coatings, radiation shielding and electronics protection.

This standard begins with an overview of the electrical effects occurring in space (Clause 4). The requirements, in terms of spacecraft testing, analysis and design that arise from these processes (Clause 5 to Clause 11) form the core of this document. Annex B holds a discussion of types of orbits and how to tailor the requirements according to the mission. Annex C discusses the quantitative assessment of the physical processes behind these main effects. Annex D describes computer simulations and Annex E describes testing and measurement.

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Scope

This standard is a standard within the ECSS hierarchy. It forms part of the electrical and electronic engineering discipline (ECSS-E-ST-20) of the engineering branch of the ECSS system (ECSS-E). It provides clear and consistent provisions to the application of measures to assess, in order to avoid and minimize hazardous effects arising from spacecraft charging and other environmental effects on a spacecraft's electrical behaviour.

This standard is applicable to any type of spacecraft including launchers, when above the atmosphere.

Although spacecraft systems are clearly subject to electrical interactions while still on Earth (e.g. lightning and static electricity from handling), these aspects are not covered, since they are common to terrestrial systems and covered elsewhere. Instead this standard covers electrical effects occurring in space (i.e. from the ionosphere upwards).

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 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 |