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Space engineering - Spacecraft charging

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

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Space engineering - Spacecraft charging

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Raumfahrttechnik - Aufladung von Raumfahrzeugen

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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

EN 16603-20-06:2014 (E)

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

EN 16603-20-06:2014 (E)

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

EN 16603-20-06:2014 (E)

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.

1 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

koniec náhľadu – text ďalej pokračuje v platenej verzii STN