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Space systems — Electromagnetic compatibility requirements

Systèmes spatiaux — Exigences relatives à la compatibilité électromagnétique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

This second edition cancels and replaces the first edition (ISO 14302:2002), which has been technically revised.

The main changes are as follows:

— updating related standard documents such as AIAA, ECSS, MIL-STD and etc., considering with new work has been accomplished over the past 10 years in this field within the US AIAA and ECSS. Particularly in space - there are many more orbiting transmitters and receivers exploiting the EM spectrum for earth observation, communications etc.;

— the inclusion of EMC flow chart to clarify timeline for EMC plan, design, analysis and test/evaluation phase of project;

— the inclusion of technical requirements for multipaction, intermodulation and electrostatic discharge with consideration of changes of electronic equipment with higher speed digital devices, data bus & clock frequencies, and switch mode Power supplies by PWM signalling;

— updating of technical requirements, taking into account that equipment is still being qualified or qualified by similarity to heritage specifications from the 80's.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document addresses the equipment-level requirements, verification and rationale of system-level compatibility concerns used in the development and procurement of complete space systems.

This document includes requirements at all the following levels:

— general system requirements;

— specific system requirements;

— equipment-level electromagnetic interference requirements.

The equipment-level requirements are summarized in Tables 1 and 2.

This document does not include detailed design requirements. Instead, engineering issues to be addressed during execution of the electromagnetic compatibility (EMC) control programme are presented. Requirements in this document may be tailored based on contractual agreements.

This document references civilian equipment-level electromagnetic interference (EMI) test methods to minimize cost and allow the use of standard test methods. This document does not contain EMI test limits. Test limits should be developed based on the environment, power quality definition and operational requirements.

Annex A presents the rationale behind each requirement/test technique, guidance for meeting requirements and test procedures where an acceptable reference is not available. Use of Annex A is advised in order to allow for optimal tailoring of this document for individual programmes.

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Space systems — Electromagnetic compatibility requirements

1 Scope

This document contains a process to establish performance requirements for the purpose of ensuring space systems electromagnetic compatibility (EMC). The engineering issues to be addressed in order to achieve system-level EMC are identified herein, with guidance and rationale towards achieving specification conformance. The method for the derivation of typical equipment-level requirements from a space-system-level requirement is illustrated. This document also aids in the selection of tailored requirements for a specific mission (see Annex A).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7137:1995, *Aircraft — Environmental conditions and test procedures for airborne equipment*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

ISO 24637, *Space systems — Electromagnetic interference (EMI) test reporting requirements*

ECSS-E-20-01A, *Multipaction Design and Test*

Aerospace Report No. TOR-2014-02198, *Standard/Handbook for Multipactor Breakdown Prevention in Spacecraft Components*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
break-out box
non-flight piece of test support equipment that is connected in-line with a cable that accommodates external connection (usually binding posts) of instrumentation or series/parallel test networks to the wiring in that cable

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3.1.2
complete space system
suite of equipment, subsystems, skills, and techniques capable of performing or supporting an operational role

Note 1 to entry: A complete space system includes related facilities, equipment, subsystems, materials, services, and personnel required for its operation to the degree that it can be considered self-sufficient within its operational or support environment.

Note 2 to entry: The complete space system normally refers to the spacecraft or launch vehicle itself.

3.1.3
dead-facing
removal of power from a circuit prior to mating/de-mating of the circuit interface (usually to prevent arcing or inadvertent short circuits)

3.1.4
electromagnetic compatibility
EMC
ability of a space equipment or system to function satisfactorily in its intended electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment

3.1.5
electromagnetic interference
EMI
degradation of the performance of a space *equipment* (3.1.6), transmission, channel, or system caused by an electromagnetic disturbance

3.1.6
equipment
integrated set of parts, and components

Note 1 to entry: An equipment accomplishes a specific function.

Note 2 to entry: An equipment is self-contained and classified as such for the purposes of separate manufacture, procurement, drawings, specification, storage, issue, maintenance, or use.

SOURCE: ISO 10795 3.93

3.1.7
faying surface
prepared conductive surface of sufficient area and conductivity that, when joined under pressure contact, ensures a low electrical bond impedance for the required life of the connection

3.1.8
floating
status of a circuit isolated from another one, which is characterized by a resistance of strong value in parallel with a capacity.

Note 1 to entry: In low frequency, the circuit is actually high impedance; it is not the case in HF considering the parasitic capacitor. “Floating” is therefore to use for a frequency domain that it is then necessary to specify.

3.1.9
immunity
ability of a device, *equipment* (3.1.6), or system to perform without degradation in the presence of an electromagnetic disturbance

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3.1.10
internal charging
phenomenon caused by penetration of high-energy electrons through spacecraft structures and/or component walls so that these particles are incident on ungrounded metallic or dielectric internal surfaces

3.1.11
line impedance stabilization network
LISN
network inserted in the supply mains lead of an apparatus to be tested which provides, in a given frequency range, specified source or load impedance for the measurement of disturbance currents and voltages and which may isolate the apparatus from the supply mains in that frequency range

3.1.12
power quality requirement
requirement developed for the space system that defines the conducted voltage and current noise (from load regulation, spikes, sags, etc.) the power user can expect

3.1.13
procuring authority
agency or organization funding or administering a contract for the development of the space system

3.1.14
radio frequency interference
RFI
degradation of the reception of a wanted signal caused by a radio frequency disturbance

3.1.15
safety margin
ratio of circuit threshold of *susceptibility* (3.1.18) to induced circuit noise under worse-case expected environmental conditions (intrasystem and intersystem)

3.1.16
subsystem
set of interdependent elements constituted to achieve a given objective by performing a specified function, but that does not, on its own, satisfy the customer's requirement

Note 1 to entry: Generally, a piece of equipment is housed within a single enclosure, while a subsystem may consist of several interconnected units.

Note 2 to entry: ISO 10795 3.231, modified — Note 1 to entry added.

3.1.17
susceptibility
correct operation of electrical *equipment* (3.1.6), referred to as the victim, in the presence of unplanned electromagnetic disturbances

Note 1 to entry: A victim is a component/subsystem that is susceptible to interference.

3.1.18
suppression
act of eliminating electromagnetic noise through the process of filtering, shielding, or other methods that reduce the impact of noise on a system

3.2 Abbreviated terms

ACS attitude control system

BCI bulk current injection

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