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Process management for avionics – Atmospheric radiation effects – Part 1: Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PROCESS MANAGEMENT FOR AVIONICS – ATMOSPHERIC RADIATION EFFECTS –

Part 1: Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment

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This Redline version provides you with a quick and easy way to compare all the changes between this standard and its previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 62396-1 has been prepared by IEC technical committee 107: Process management for avionics.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) removed, in Clause 7 related to system design, reference to level A Type I and Type II (system and references). As Clause 7 is now for guidance, ”shall” statements have been changed to “should” and in 9.5.2 the requirement for electronic component management is clarified;
b) all current definitions included in Clause 3 are those used within the IEC 62396 family of documents;
c) incorporated in Annex G related to new technology or latest news reference to some new papers and issues which have appeared since 2011;
d) solar flares and extreme space weather reference added in 5.6 to a proposed future Part 6;
e) reference added in 7.1 to a proposed new Part 7 on incorporating atmospheric radiation effects analysis into the system design process;
f) reference added in 6.2.10 d) to a proposed future Part 8 on other particles including protons, pions and muons;
g) clarification on calculating event rates where cross-sections have been obtained with non-atmospheric radiation like neutron sources, addition of a new Annex H, and changes to 5.3 and 8.2.

The text of this standard is based on the following documents:

FDIS	Report on voting
107/271/FDIS	107/275/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 62396 series, published under the general title *Process management for avionics – Atmospheric radiation effects*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This industry-wide ~~technical specification~~ International Standard informs avionics systems designers, electronic equipment manufacturers, component manufacturers and their customers of the kind of ionising radiation environment that their devices will be subjected to in aircraft, the potential effects this radiation environment can have on those devices, and some general approaches for dealing with these effects.

The same atmospheric radiation (neutrons and protons) that is responsible for the radiation exposure that crew and passengers acquire while flying is also responsible for causing the single event effects (SEE) in the avionics electronic equipment. There has been much work carried out over the last few years related to the radiation exposure of aircraft passengers and crew. A standardised industry approach on the effect of the atmospheric neutrons on electronics should be viewed as consistent with, and an extension of, the on-going activities related to the radiation exposure of aircraft passengers and crew.

Atmospheric radiation effects are one factor that could contribute to equipment hard and soft fault rates. From a system safety perspective, using derived fault rate values, the existing methodology described in ARP4754A (accommodation of hard and soft fault rates in general) will also accommodate atmospheric radiation effect rates.

In addition, this International Standard refers to the JEDEC Standard JESD 89A, which relates to soft errors in electronics by atmospheric radiation at ground level (at altitudes less than 10 000 ft (3 040 m)).

PROCESS MANAGEMENT FOR AVIONICS – ATMOSPHERIC RADIATION EFFECTS –

Part 1: Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment

1 Scope

This part of IEC 62396 is intended to provide guidance on atmospheric radiation effects on avionics electronics used in aircraft operating at altitudes up to 60 000 ft (18,3 km). It defines the radiation environment, the effects of that environment on electronics and provides design considerations for the accommodation of those effects within avionics systems.

This International Standard is intended to help ~~aerospace~~ avionics equipment manufacturers and designers to standardise their approach to single event effects in avionics by providing guidance, leading to a standard methodology.

Details of the radiation environment are provided together with identification of potential problems caused as a result of the atmospheric radiation received. Appropriate methods are given for quantifying single event effect (SEE) rates in electronic components. The overall system safety methodology should be expanded to accommodate the single event effects rates and to demonstrate the suitability of the electronics for the application at the component and system level.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC/TS 62239:2008, *Process management for avionics – Preparation of an electronic components management plan*~~

~~NOTE~~ IEC TS 62239-1:2015, *Process management for avionics – Management plan – Part 1: Preparation and maintenance of an electronic components management plan* ~~is under study and will supersede IEC/TS 62239.~~

IEC~~/TS~~ 62396-2:~~2008~~ 2012, *Process management for avionics – Atmospheric radiation effects – Part 2: Guidelines for single event effects testing for avionics systems*

IEC~~/TS~~ 62396-3, *Process management for avionics – Atmospheric radiation effects – Part 3: ~~Optimising~~ System design optimization to accommodate the single event effects (SEE) of atmospheric radiation*

IEC~~/TS~~ 62396-4:~~2008~~ 2013, *Process management for avionics – Atmospheric radiation effects – Part 4: ~~Guidelines for designing with~~ Design of high voltage aircraft electronics managing ~~and~~ potential single event effects*

IEC~~/TS~~ 62396-5, *Process management for avionics – Atmospheric radiation effects – Part 5: ~~Guidelines for assessing~~ Assessment of thermal neutron fluxes and single event effects in avionics systems*

EIA-4899, *Standard for Preparing an Electronic Components Management Plan*

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INTERNATIONAL STANDARD

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Process management for avionics – Atmospheric radiation effects – Part 1: Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment



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PROCESS MANAGEMENT FOR AVIONICS – ATMOSPHERIC RADIATION EFFECTS –

Part 1: Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62396-1 has been prepared by IEC technical committee 107: Process management for avionics.

This second edition cancels and replaces the first edition published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) removed, in Clause 7 related to system design, reference to level A Type I and Type II (system and references). As Clause 7 is now for guidance, "shall" statements have been changed to "should" and in 9.5.2 the requirement for electronic component management is clarified;

b) all current definitions included in Clause 3 are those used within the IEC 62396 family of documents;

c) incorporated in Annex G related to new technology or latest news reference to some new papers and issues which have appeared since 2011;

d) solar flares and extreme space weather reference added in 5.6 to a proposed future Part 6;

e) reference added in 7.1 to a proposed new Part 7 on incorporating atmospheric radiation effects analysis into the system design process;

f) reference added in 6.2.10 d) to a proposed future Part 8 on other particles including protons, pions and muons;

g) clarification on calculating event rates where cross-sections have been obtained with non-atmospheric radiation like neutron sources, addition of a new Annex H, and changes to 5.3 and 8.2.

The text of this standard is based on the following documents:

FDIS	Report on voting
107/271/FDIS	107/275/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 62396 series, published under the general title *Process management for avionics – Atmospheric radiation effects*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This industry-wide International Standard informs avionics systems designers, electronic equipment manufacturers, component manufacturers and their customers of the kind of ionising radiation environment that their devices will be subjected to in aircraft, the potential effects this radiation environment can have on those devices, and some general approaches for dealing with these effects.

The same atmospheric radiation (neutrons and protons) that is responsible for the radiation exposure that crew and passengers acquire while flying is also responsible for causing the single event effects (SEE) in the avionics electronic equipment. There has been much work carried out over the last few years related to the radiation exposure of aircraft passengers and crew. A standardised industry approach on the effect of the atmospheric neutrons on electronics should be viewed as consistent with, and an extension of, the on-going activities related to the radiation exposure of aircraft passengers and crew.

Atmospheric radiation effects are one factor that could contribute to equipment hard and soft fault rates. From a system safety perspective, using derived fault rate values, the existing methodology described in ARP4754A (accommodation of hard and soft fault rates in general) will also accommodate atmospheric radiation effect rates.

In addition, this International Standard refers to the JEDEC Standard JESD 89A, which relates to soft errors in electronics by atmospheric radiation at ground level (at altitudes less than 10 000 ft (3 040 m)).

PROCESS MANAGEMENT FOR AVIONICS – ATMOSPHERIC RADIATION EFFECTS –

Part 1: Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment

1 Scope

This part of IEC 62396 is intended to provide guidance on atmospheric radiation effects on avionics electronics used in aircraft operating at altitudes up to 60 000 ft (18,3 km). It defines the radiation environment, the effects of that environment on electronics and provides design considerations for the accommodation of those effects within avionics systems.

This International Standard is intended to help avionics equipment manufacturers and designers to standardise their approach to single event effects in avionics by providing guidance, leading to a standard methodology.

Details of the radiation environment are provided together with identification of potential problems caused as a result of the atmospheric radiation received. Appropriate methods are given for quantifying single event effect (SEE) rates in electronic components. The overall system safety methodology should be expanded to accommodate the single event effects rates and to demonstrate the suitability of the electronics for the application at the component and system level.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TS 62239-1:2015*, Process management for avionics – Management plan – Part 1: Preparation and maintenance of an electronic components management plan*

IEC 62396-2:2012, *Process management for avionics – Atmospheric radiation effects – Part 2: Guidelines for single event effects testing for avionics systems*

IEC 62396-3, *Process management for avionics – Atmospheric radiation effects – Part 3: System design optimization to accommodate the single event effects (SEE) of atmospheric radiation*

IEC 62396-4:2013, *Process management for avionics – Atmospheric radiation effects – Part 4: Design of high voltage aircraft electronics managing potential single event effects*

IEC 62396-5, *Process management for avionics – Atmospheric radiation effects – Part 5: Assessment of thermal neutron fluxes and single event effects in avionics systems*

EIA-4899, *Standard for Preparing an Electronic Components Management Plan*