SLOVENSKI STANDARD

SIST EN 61014:2004

september 2004

Programi za rast zanesljivosti (IEC 61014:2003)

Programmes for reliability growth (IEC 61014:2003)

ICS 03.100.40; 21.020

Referenčna številka
SIST EN 61014:2004(en)

EUROPEAN STANDARD **EN 61014**

NORME EUROPÉENNE

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English version

Programmes for reliability growth
(IEC 61014:2003)

Programmes de croissance de fiabilité
(CEI 61014:2003)

Programme für das
Zuverlässigkeitswachstum
(IEC 61014:2003)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Foreword

The text of document 56/859/FDIS, future edition 2 of IEC 61014, prepared by IEC TC 56, Dependability, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61014 on 2003-09-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2004-06-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2006-09-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annex ZA is normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61014:2003 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61703	NOTE	Harmonized as EN 61703:2002 (not modified).
ISO 9000	NOTE	Harmonized as EN ISO 9000:2000 (not modified).
ISO 9001	NOTE	Harmonized as EN ISO 9001:2000 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60300-1	- [1)]	Dependability management Part 1: Dependability management systems	EN 60300-1	2003 [2)]
IEC 60300-2	- [1)]	Part 2: Dependability programme elements and tasks	EN 60300-2	1996 [2)]
IEC 60300-3-1	- [1)]	Part 3-1: Application guide - Analysis techniques for dependability - Guide on methodology	-	-
IEC 60300-3-5	2001	Part 3-5: Application guide - Reliability test conditions and statistical test principles	-	-
IEC 60605-2	- [1)]	Equipment reliability testing - Part 2: Design of test cycles	-	-
IEC 60605-3	Series	Equipment reliability testing - Part 3: Preferred test conditions	-	-
IEC 60605-4	- [1)]	Part 4: Statistical procedures for exponential distribution - Point estimates, confidence intervals, prediction intervals and tolerance intervals	-	-
IEC 60812	- [1)]	Analysis techniques for system reliability - Procedure for failure mode and effects analysis (FMEA)	HD 485 S1	1987 [2)]
IEC 61025	- [1)]	Fault tree analysis (FTA)	HD 617 S1	1992 [2)]
IEC 61160	- [1)]	Formal design review	-	-

[1)] Undated reference.

[2)] Valid edition at date of issue.

Publication	Year	Title	EN/HD	Year
IEC 61164	– [1)]	Reliability growth - Statistical test and estimation methods	-	-

NORME INTERNATIONALE

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Programmes de croissance de fiabilité

Programmes for reliability growth

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PROGRAMMES FOR RELIABILITY GROWTH

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, 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 61014 has been prepared by IEC technical committee 56: Dependability.

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

FDIS	Report on voting
56/859/FDIS	56/863/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.

This second edition of IEC 61014 cancels and replaces the first edition, published in 1989, and constitutes a technical revision.

The main changes with respect to the previous edition are listed below.

- References to dependability management standards have been inserted.
- Terms and definitions related to the reliability growth during the product design have been added.
- Flow diagrams for reliability growth in 4.4 and 6.4.8 (see Figures 1 and 8) have been corrected.
- A subclause on planning reliability growth in the design phase has been added (see 4.5).
- A subclause on management aspects covering both reliability growth in design and the test phase has been added (see Clause 5).
- Clause 6 has been extended to include reliability growth in the design phase with its analytical and test aspects.
- The figure showing projected failure intensity estimated by modelling (see Figure 10) has been corrected.
- A clause on reliability growth in the field (see Clause 7) has been added.

The committee has decided that the contents of this publication will remain unchanged until 2011. At this date, the publication will be

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

INTRODUCTION

Reliability improvement by a growth programme should be part of an overall reliability activity in the development of a product. This is especially true for a design that uses novel or unproven techniques, components, or a substantial content of software. In such a case the programme may expose, over a period of time, many types of weaknesses having design-related causes. It is essential to reduce the probability of failure due to these weaknesses to the greatest extent possible to prevent their later appearance in formal tests or in the field. At that late stage, design correction is often highly inconvenient, costly and time-consuming.

Life-cycle costs can be minimized if the necessary design changes are made at the earliest possible stage.

IEC 60300-3-5, Clause 1 refers to a “reliability growth (or improvement) programme” employing equipment reliability design analysis and reliability testing, with the principal objective to realize reliability growth. Reliability design analysis applies analytical methods and techniques described in IEC 60300-3-1. Reliability design analysis is of a particular value, as it allows early identification of potential design weakness, well before design completion. This allows introduction of design modifications that are inexpensive and relatively easy to implement without consequences such as major design changes, programme delays, modification of tooling and manufacturing processes. The reliability growth testing and environmental arrangements for the test part of this programme are essentially the same as those covered by IEC 60300-3-5, IEC 60605-2 and IEC 60605-3.

The importance of the reliability growth programme, integrated into the design or product development process, and known as integrated reliability engineering, is driven by limited time to market, programme costs and striving for product cost reduction.

Although effective for disclosure of potential field problems, a reliability growth testing programme alone is typically expensive, requiring extensive test time and resources, and the corrective actions are considerably more costly than if they were found and corrected in the early stages of design. Additionally, the duration of these tests, sometimes lasting for a very long time, would seriously affect the marketing or deployment schedule of the system.

The cost-effective solution to these challenges is a reliability growth programme fully integrated in both the design and evaluation phase as well as the testing phase. This effort is enabled by strong project management, by design engineering and often by customer participation and involvement. Over the past few years, leading industry organizations have developed and applied analytical and test methods fully integrated with the design efforts for increasing the reliability during the product design phase. This reduces reliance on formal and lengthy reliability growth testing. This technology is the basis for the integrated reliability growth strategy in this standard and will be discussed further in Clause 6. Some definitions and concepts are given first in order to lay the groundwork for discussing the integrated reliability growth methodologies.

PROGRAMMES FOR RELIABILITY GROWTH

1 Scope

This International Standard specifies requirements and gives guidelines for the exposure and removal of weaknesses in hardware and software items for the purpose of reliability growth.

It applies when the product specification calls for a reliability growth programme of equipment (electronic, electromechanical and mechanical hardware as well as software) or when it is known that the design is unlikely to meet the requirements without improvement.

A statement of the basic concepts is followed by descriptions of the management, planning, testing (laboratory or field), failure analysis and corrective techniques required. Mathematical modelling, to estimate the level of reliability achieved, is outlined briefly.

2 Normative references

The following referenced documents are indispensable for the application 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.

IEC 60300-1, *Dependability management – Part 1: Dependability management systems*[1]

IEC 60300-2, *Dependability management – Part 2: Guidance for dependability programme management*[2]

IEC 60300-3-1, *Dependability management – Part 3-1: Application guide – Analysis techniques for dependability – Guide on methodology*

IEC 60300-3-5:2001, *Dependability management – Part 3-5: Application guide – Reliability test conditions and statistical test principles*

IEC 60605-2, *Equipment reliability testing – Part 2: Design of test cycles*

IEC 60605-3 (all parts), *Equipment reliability testing – Part 3: Preferred test conditions*

IEC 60605-4, *Equipment reliability testing – Part 4: Statistical procedures for exponential distribution – Point estimates, confidence intervals, prediction intervals and tolerance intervals*

IEC 60812, *Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)*

IEC 61025, *Fault tree analysis (FTA)*

IEC 61160, *Formal design review*

IEC 61164, *Reliability growth – Statistical test and estimation methods*

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[1] Second edition to be published.

[2] Second edition to be published.

3 Terms and definitions

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

NOTE 1 Certain terms come from IEC 60050(191) and, where this is the case, the concept from that publication is referenced in square brackets after the definition. ISO 9000:2000 is used as referenced to quality vocabulary.

NOTE 2 For analysis of the reliability growth test data, it is important to distinguish between the terms “failure intensity” (for repaired items) and “failure rate” or “instantaneous failure rate” (for non-repaired or one-shot items) defined in IEC 60050(191).

3.1
item
entity
any part, component, device, subsystem, functional unit, equipment or system that can be individually considered

NOTE An item may consist of hardware, software or both, and may also, in particular cases, include people.

[IEC 60050, 191-01-01]

3.2
reliability improvement
process undertaken with the deliberate intention of improving the reliability performance by eliminating causes of systematic failures and/or by reducing the probability of occurrence of other failures

[IEC 60050, 191-17-05]

NOTE 1 The method described in this standard is aimed at making corrective modifications aimed at reducing systematic weaknesses or reducing their likelihood of occurrence.

NOTE 2 For any item, there are limits to practicable and economic improvement and to achievable growth.

3.3
reliability growth
condition characterized by a progressive improvement of a reliability performance measure of an item with time

[IEC 60050, 191-17-04]

NOTE Modelling (projection) and analysis of reliability improvement during the design phase is based on the standard estimation of the expected product reliability within a given time period.

3.4
integrated reliability engineering
engineering tool, consisting of a multitude of reliability/dependability methods integrated into all engineering stages and activities regarding a product, from the conceptual phase through its use in the field by a combination of contributions from all relevant stakeholders

3.5
product reliability goal
reliability goal for a product based on certain corporate targets, market requirements or desired mission success probability that is reasonably achievable according to the past history and technical evolution

NOTE For some projects, the reliability goal is set by the customer. The product specific goal is the target value of the reliability growth process.

3.6
systematic weakness
weakness, which can be eliminated, or its effects reduced, only by a modification of the design or manufacturing process, operational procedures, documentation or other relevant factors, or by replacement of substandard components by components of proven superior reliability

NOTE 1 A systematic weakness often results in a failure that is related to a weakness in the design or a weakness of the manufacturing process or documentation.

NOTE 2 Repair or replacement (or re-run in case of software) without modification is likely to lead to recurrent failures of a similar kind.

NOTE 3 Software weaknesses are always systematic.

3.7
residual weakness
weakness, which is not systematic

NOTE 1 In this case, risk of recurrent failure of a similar kind is small or even negligible, within the expected test time scale.

NOTE 2 Software weaknesses cannot be residual.

3.8
failure
termination of the ability of an item to perform a required function

NOTE 1 After failure the item has a fault.

NOTE 2 "Failure" is an event, as distinguished from "fault", which is a state.

[IEC 60050,191-04-01]

NOTE 3 The term "termination" implies that the product had the ability to perform a required function and then lost it. Once the system design is capable of meeting the specified performance requirement, then reliability failure is the termination of this capability.

3.9
failure mode
manner in which any system or component ceases to perform its respective designed operation

NOTE 1 A failure mode may be characterized by its frequency of occurrence or by probability of its occurrence to include into the system's or component's reliability.

NOTE 2 To address the reliability of a system, fundamentally its corresponding failure modes, the causes of these failure modes, and the frequency or probability of occurrence of these modes under the system's intended use environment need to be addressed.

3.10
relevant failure
failure that should be included in interpreting test or operational results or in calculating the value of a reliability performance measure

NOTE 1 The criteria for inclusion should be stated.

[IEC 60050, 191-04-13]

NOTE 2 The criteria for inclusion are stated in 6.4.6.

3.11
non-relevant failure
failure that should be excluded in interpreting test or operational results or in calculating the value of a reliability performance measure

[IEC 60050, 191-04-14]

NOTE The criteria for classifying failures as not relevant are stated in 6.4.5.

3.12
systematic failure
failure that exhibits, after a physical, circumstantial or design analysis, a condition or pattern of failure that may be expected to cause recurrence

NOTE 1 Corrective maintenance without modification does not usually eliminate the failure cause.

NOTE 2 A systematic failure can be induced at will by simulating the failure cause.

NOTE 3 In this standard, a systematic failure is interpreted as a failure resulting from a systematic weakness.

3.13
residual failure
failure resulting from a residual weakness