Electronic components - Reliability - Reference conditions for failure rates and stress models for conversion

EESTI STANDARDIKESKUS
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NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 61709:2011 sisaldab Euroopa standardi EN 61709:2011 ingliskeelset teksti.	This Estonian standard EVS-EN 61709:2011 consists of the English text of the European standard EN 61709:2011.
Standard on kinnitatud Eesti Standardikeskuse 31.08.2011 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.	This standard is ratified with the order of Estonian Centre for Standardisation dated 31.08.2011 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.
Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 12.08.2011.	Date of Availability of the European standard text 12.08.2011.
Standard on kättesaadav Eesti standardiorganisatsioonist.	The standard is available from Estonian standardisation organisation.

ICS 31.020

Inglisekeelsed võtmesõnad: electronic components, failure rates, reference conditions, reliability, stress models,

EUROPEAN STANDARD

NORME EUROPÉENNE

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EN 61709

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ICS 31.020

Supersedes EN 61709:1998

English version

Electric components - Reliability - Reference conditions for failure rates and stress models for conversion

(IEC 61709:2011)

Composants électriques - Fiabilité - Conditions de référence pour les taux de défaillance et modèles de contraintes pour la conversion (CEI 61709:2011)

Elektrische Bauelemente - Zuverlässigkeit - Referenzbedingungen für Ausfallraten und Beanspruchungsmodelle zur Umrechnung (IEC 61709:2011)

This European Standard was approved by CENELEC on 2011-07-29. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

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Foreword

The text of document 56/1422/FDIS, future edition 2 of IEC 61709, prepared by IEC TC 56, Dependability, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61709 on 2011-07-29.

This European Standard supersedes EN 61709:1998.

EN 61709:2011 includes the following significant technical changes with respect to EN 61709:1998:

– the addition of a number of component types and the updating of models for a large number of component types;

– the addition of annexes on reliability prediction, sources of failure rate data and component classification information.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

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)	2012-04-29
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-07-29

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61709:2011 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 60300-3-2:2004	NOTE	Harmonized as EN 60300-3-2:2005 (not modified).
IEC 60721 series	NOTE	Harmonized in EN 60721 series.
IEC 61360 series	NOTE	Harmonized in EN 61360 series.
IEC 61360-1:2009	NOTE	Harmonized as EN 61360-1:2010 (not modified).
IEC 61360-4:2005	NOTE	Harmonized as EN 61360-4:2005 (not modified).
IEC 61649:2008	NOTE	Harmonized as EN 61649:2008 (not modified).
IEC 61703	NOTE	Harmonized as EN 61703.
IEC 62308	NOTE	Harmonized as EN 62308.
ISO 10303-11:1994	NOTE	Harmonized as EN ISO 10303-11:1995 (not modified).
ISO 10303-31	NOTE	Harmonized as EN ISO 10303-31.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

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 60050-191	-	International Electrotechnical Vocabulary (IEV) - Chapter 191: Dependability and quality of service	-	-
IEC 60605-6	-	Equipment reliability testing - Part 6: Tests for the validity and estimation of the constant failure rate and constant failure intensity	-	-
IEC 60721-3-3	-	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weatherprotected locations	EN 60721-3-3	-
IEC 60721-3-4	-	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weatherprotected locations	EN 60721-3-4	-
IEC 60721-3-5	-	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 5: Ground vehicle installations	EN 60721-3-5	-
IEC 60721-3-7	-	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 7: Portable and non-stationary use	EN 60721-3-7	-

CONTENTS

INTRODUCTION

This International Standard is intended for the reliability prediction of components as used in equipment and is aimed at organizations that have their own data and describes how to state and use that data in order to perform reliability predictions.

It can also be used to allow an organization to set up a failure rate database and describes the reference conditions for which field failure rates should be stated. The reference conditions adopted in this standard are typical of the majority of applications of components in equipment however when components operate under other conditions the users may consider stating these conditions as their reference conditions.

Using the presented stress models allows extrapolation of failure rates to other operating conditions which in turn permits the prediction of failure rates at assembly level. This allows estimation of the effect of design changes or changes in the environmental conditions on component reliability. Reliability prediction is most useful in the early design phase of electrical equipment. It can be used, for example, to identify potential reliability problems, the planning of logistic support strategies and the evaluation of designs.

The stress models contained herein are generic and are as simple as possible while still being comparable with more complex equations contained in other models.

This standard does not contain failure rates, but it describes how they can be stated and used. This approach allows a user to select the most relevant and up to date failure rates for the prediction from a source that they select. This standard also contains information on how to select the data that can be used in the presented models.

ELECTRIC COMPONENTS – RELIABILITY – REFERENCE CONDITIONS FOR FAILURE RATES AND STRESS MODELS FOR CONVERSION

1 Scope

This International Standard gives guidance on how failure rate data can be employed for reliability prediction of electric components in equipment.

Reference conditions are numerical values of stresses that are typically observed by components in the majority of applications. Reference conditions are useful since they are the basis of the calculation of failure rate under any conditions by the application of stress models that take into account the actual operating conditions. Failure rates stated at reference conditions allow realistic reliability predictions to be made in the early design phase.

The stress models described herein are generic and can be used as a basis for conversion of the failure rate data at these reference conditions to actual operating conditions when needed and this simplifies the prediction approach. Conversion of failure rate data is only permissible within the specified functional limits of the components.

This standard also gives guidance on how a database of component failure data can be constructed to provide failure rates that can be used with the included stress models. Reference conditions for failure rate data are specified, so that data from different sources can be compared on a uniform basis. If failure rate data are given in accordance with this International Standard then no additional information on the specified conditions is required.

This standard does not provide base failure rates for components – rather it provides models that allow failure rates obtained by other means to be converted from one operating condition to another operating condition.

The prediction methodology described in this standard assumes that the parts are being used within its useful life. The methods in this standard have a general application but are specifically applied to a selection of component types as defined in Clause 6 and Clause E.2.

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 60050-191, *International Electrotechnical Vocabulary – Part 191: Dependability and quality of service*

IEC 60605-6, *Equipment reliability testing – Part 6: Tests for the validity and estimation of the constant failure rate and constant failure intensity*

IEC 60721-3-3, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weather protected locations*

IEC 60721-3-4, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 4: Stationary use at non-weatherprotected locations*

IEC 60721-3-5, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 4: Ground vehicle installations*

IEC 60721-3-7, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 7: Portable and non-stationary use*

3 Terms, definitions and symbols

3.1 Terms and definitons

For the purpose of this document, the terms and definitions of IEC 60050-191, as well as the following terms and definitions apply.

3.1.1
electric component
component with conductive terminals through which voltages or currents may be applied or delivered

[IEC 61360-1:2009, 2.18]

NOTE The term electric component includes the commonly used terms “electronic component”, “electrical component” and “electro-mechanical component”.

3.1.2
failure (of an item)
loss of ability to perform as required

NOTE 1 When the loss of ability is caused by a pre-existing latent fault, the failure occurs when a particular set of circumstances is encountered.

NOTE 2 A failure of an item is an event that results in a fault in that item, which is a state.

3.1.3
failure mode
manner in which failure occurs

NOTE A failure mode may be defined by the function lost or the state transition that occurred.

3.1.4
instantaneous failure rate
failure rate

limit, if it exists, of the ratio of the conditional probability that the instant of a failure of a non-repairable item occurs within time interval (t, $t + \Delta t$) to Δt when Δt tends to zero, given that it has not failed within time interval (0,t)

NOTE 1 The instantaneous failure rate, $\lambda(t)$, is expressed by the formula:

$$\lambda(t) = \lim_{\Delta t \to 0} \frac{1}{\Delta t} \frac{F(t+\Delta t) - F(t)}{R(t)} = \frac{f(t)}{R(t)}$$

where $F(t)$ and $f(t)$ are respectively the distribution function and the probability density of the failure instant, and where $R(t)$ is the reliability function, related to the reliability $R(t_1, t_2)$ by $R(t) = R(0, t)$.

NOTE 2 See IEC 61703.