

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

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## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 61709:2011 sisaldab Euroopa standardi EN 61709:2011 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 31.08.2011 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 12.08.2011.

Standard on kättesaadav Eesti standardiorganisatsioonist.

This Estonian standard EVS-EN 61709:2011 consists of the English text of the European standard EN 61709:2011.

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.

Date of Availability of the European standard text 12.08.2011.

The standard is available from Estonian standardisation organisation.

ICS 31.020

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

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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)

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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

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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.

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## 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.

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## 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.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
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

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	9
2 Normative references .....	9
3 Terms, definitions and symbols .....	10
3.1 Terms and definitions .....	10
3.2 Symbols .....	12
4 Context and conditions .....	13
4.1 Failure modes .....	13
4.2 Operating profile considerations .....	14
4.3 Storage conditions .....	14
4.4 Environmental conditions .....	14
5 Generic reference conditions and stress models.....	16
5.1 Recommended generic reference conditions .....	16
5.2 Generic stress models.....	17
5.2.1 General .....	17
5.2.2 Stress factor for voltage dependence, $\pi_U$ .....	18
5.2.3 Stress factor for current dependence, $\pi_I$ .....	18
5.2.4 Stress factor for temperature dependence, $\pi_T$ .....	18
5.2.5 Environmental application factor, $\pi_E$ .....	20
5.2.6 Other factors of influence .....	21
6 Specific reference conditions and stress models.....	21
6.1 Integrated semiconductor circuits .....	21
6.1.1 Reference conditions .....	21
6.1.2 Stress factors .....	23
6.2 Discrete semiconductors .....	27
6.2.1 Reference conditions .....	27
6.2.2 Stress factors .....	28
6.3 Optoelectronic components .....	32
6.3.1 Reference conditions .....	32
6.3.2 Stress factors .....	34
6.4 Capacitors.....	38
6.4.1 Reference conditions .....	38
6.4.2 Stress factors .....	38
6.5 Resistors and resistor networks.....	41
6.5.1 Reference conditions .....	41
6.5.2 Stress factors .....	42
6.6 Inductors, transformers and coils.....	43
6.6.1 Reference conditions .....	43
6.6.2 Stress factors .....	43
6.7 Microwave devices .....	44
6.7.1 Reference conditions .....	44
6.7.2 Stress factors .....	45
6.8 Other passive components .....	45
6.8.1 Reference conditions .....	45

6.8.2 Stress factors .....	45
6.9 Electrical connections.....	45
6.9.1 Reference conditions.....	45
6.9.2 Stress factors .....	46
6.10 Connectors and sockets .....	46
6.10.1 Reference conditions.....	46
6.10.2 Stress factors .....	46
6.11 Relays.....	46
6.11.1 Reference conditions.....	46
6.11.2 Stress factors .....	47
6.12 Switches and push-buttons.....	49
6.12.1 Reference conditions.....	49
6.12.2 Stress factors .....	50
6.13 Signal and pilot lamps .....	51
6.13.1 Reference conditions.....	51
6.13.2 Stress factors .....	51
Annex A (normative) Failure modes of components .....	53
Annex B (informative) Failure rate prediction .....	55
Annex C (informative) Considerations for the design of a data base on failure rates .....	65
Annex D (informative) Potential sources of failure rate data and methods of selection .....	68
Annex E (informative) Overview of component classification .....	74
Annex F (informative) Examples .....	86
Bibliography.....	88
Figure 1 – Selection of stress regions in accordance with current and voltage-operating conditions .....	48
Figure 2 – Selection of stress regions in accordance with current and voltage-operating conditions .....	50
Figure B.1 – Stress profile .....	59
Figure B.2 – Averaging failure rates .....	60
Table 1 – Basic environments .....	15
Table 2 – Values of environmental parameters for basic environments .....	15
Table 3 – Recommended reference conditions for environmental and mechanical stresses .....	17
Table 4 – Environmental application factor, $\pi_E$ .....	20
Table 5 – Memory.....	21
Table 6 – Microprocessors and peripherals, microcontrollers and signal processors .....	22
Table 8 – Analog integrated circuits (IC) .....	23
Table 9 – Application-specific ICs (ASICs).....	23
Table 10 – Constants for voltage dependence .....	24
Table 11– Factor $\pi_U$ for digital CMOS-family ICs.....	24
Table 12 – Factor $\pi_U$ for bipolar analog ICs .....	24
Table 13 – Constants for temperature dependence .....	24

Table 14 – Factor $\pi_T$ for ICs (without EPROM; FLASH-EPROM; OTPROM; EEPROM; EAROM) .....	26
Table 15 – Factor $\pi_T$ for EPROM, FLASH-EPROM, OTPROM, EEPROM, EAROM.....	26
Table 16 – Transistors common, low frequency.....	27
Table 17 – Transistors, microwave, e.g. RF >800 MHz.....	27
Table 18 – Diodes.....	28
Table 19 – Power semiconductors .....	28
Table 20 – Constants for voltage dependence of transistors .....	29
Table 21 – Factor $\pi_U$ for transistors .....	29
Table 22 – Constants for temperature dependence of discrete semiconductors .....	29
Table 23 – Factor $\pi_T$ for transistors, reference and microwave diodes .....	31
Table 24 – Factor $\pi_T$ for diodes (without reference and microwave diodes) and power semiconductors.....	31
Table 25 – Optoelectronic semiconductor signal receivers .....	32
Table 26 – LEDs, IREDs, laser diodes and transmitter components .....	33
Table 27 – Optocouplers and light barriers.....	33
Table 28 – Passive optical components .....	34
Table 29 – Transceiver, transponder and optical sub-equipment.....	34
Table 30 – Constants for voltage dependence of phototransistors.....	35
Table 31 – Factor $\pi_U$ for phototransistors.....	35
Table 32 – Constants for current dependence of LEDs and IREDs.....	35
Table 33 – Factor $\pi_I$ for LEDs and IREDs.....	35
Table 34 – Constants for temperature dependence of optoelectronic components .....	36
Table 35 – Factor $\pi_T$ for optical components.....	37
Table 36 – Capacitors .....	38
Table 37 – Constants for voltage dependence of capacitors.....	39
Table 38 – Factor $\pi_U$ for capacitors.....	39
Table 39 – Constants for temperature dependence of capacitors .....	40
Table 40 – Factor $\pi_T$ for capacitors.....	41
Table 41 – Resistors and resistor networks.....	42
Table 42 – Constants for temperature dependence of resistors.....	42
Table 43 – Factor $\pi_T$ for resistors .....	43
Table 44 – Inductors, transformers and coils.....	43
Table 45 – Constants for temperature dependence of inductors, transformers and coils .....	43
Table 46 – Factor $\pi_T$ for inductors, transformers and coils .....	44
Table 47 – Microwave devices .....	44
Table 48 – Other passive components .....	45
Table 49 – Electrical connections.....	46
Table 50 – Connectors and sockets .....	46
Table 51 – Relays.....	47
Table 52 – Factor $\pi_{ES}$ for low current relays.....	48

Table 53 – Factor $\pi_{ES}$ for general purpose relays .....	48
Table 54 – Factor $\pi_{ES}$ for automotive relays.....	49
Table 55 – Constants for temperature dependence of relays.....	49
Table 56 – Facteur $\pi_T$ for relays .....	49
Table 57 – Switches and push-buttons.....	50
Table 58 – Factor $\pi_{ES}$ for switches and push-buttons for low electrical stress .....	51
Table 59 – Factor $\pi_{ES}$ for switches and push-buttons for higher electrical stress.....	51
Table 60 – Signal and pilot lamps .....	51
Table 61 – Factor $\pi_U$ for signal and pilot lamps.....	52
Table A.1 – Failure modes – Integrated circuits (ICs)(digital) .....	53
Table A.2 – Failure modes – Transistors, diodes, optocouplers.....	53
Table A.3 – Failure modes – Capacitors .....	54
Table A.4 – Failure modes – Resistors, inductive devices, relays.....	54
Table C.1 – Reliability prediction database attributes.....	66
Table D.1 – Sources of reliability data (in alphabetical order).....	70
Table E.1 – Classification tree (IEC 61360).....	75

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## 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 definitions

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  $\Delta t$  when  $\Delta t$  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:

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

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.