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Preskušanje zanesljivosti - Ustreznostni preskusi za konstantno pogostost odpovedi in konstantno intenzivnost odpovedi (IEC 61124:2023)

Reliability testing - Compliance tests for constant failure rate and constant failure intensity (IEC 61124:2023)

Prüfungen der Funktionsfähigkeit - Prüfpläne für konstante Ausfallrate und konstante Ausfalldichte (IEC 61124:2023)

Essais de fiabilité - Plan d'essais de conformité d'un taux de défaillance constant et d'une intensité de défaillance constante (IEC 61124:2023)

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19.020	Preskuševalni pogoji in postopki na splošno	Test conditions and procedures in general
21.020	Značilnosti in načrtovanje strojev, aparatov, opreme	Characteristics and design of machines, apparatus, equipment

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**Reliability testing - Compliance tests for constant failure rate and
constant failure intensity
(IEC 61124:2023)**

Essais de fiabilité - Plans d'essai de conformité pour un
taux de défaillance constant et une intensité de défaillance
constante
(IEC 61124:2023)

Prüfungen der Funktionsfähigkeit - Prüfpläne für konstante
Ausfallrate und konstante Ausfalldichte
(IEC 61124:2023)

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

EN IEC 61124:2023 (E)**European foreword**

The text of document 56/1980/FDIS, future edition 4 of IEC 61124, prepared by IEC/TC 56 "Dependability" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61124:2023.

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- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-03-31

This document supersedes EN 61124:2012 and all of its amendments and corrigenda (if any).

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

IEC 62506	NOTE	Approved as EN 62506
IEC 61014	NOTE	Approved as EN 61014
IEC 61710	NOTE	Approved as EN 61710
IEC 61649	NOTE	Approved as EN 61649

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-192	-	International electrotechnical vocabulary - Part 192: Dependability	-	-
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 60605-4	2001	Equipment reliability testing - Part 4: Statistical procedures for exponential distribution - Point estimates, confidence intervals, prediction intervals and tolerance intervals	-	-
IEC 60605-6	-	Equipment reliability testing - Part 6: Tests for the validity and estimation of the constant failure rate and constant failure intensity	-	-
IEC 61123	2019	Reliability testing - Compliance test plans for success ratio	EN IEC 61123	2020



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Reliability testing – Compliance tests for constant failure rate and constant failure intensity

Essais de fiabilité – Plans d’essai de conformité pour un taux de défaillance constant et une intensité de défaillance constante

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CONTENTS

FOREWORD.....	6
INTRODUCTION.....	8
1 Scope.....	10
2 Normative references	10
3 Terms, definitions, abbreviated terms and symbols.....	11
3.1 Terms and definitions.....	11
3.2 Abbreviated terms and symbols	11
3.2.1 Abbreviated terms	11
3.2.2 Symbols	11
4 General requirements and area of application.....	13
4.1 Requirements and characteristics	13
4.2 Applicability to replaced and repaired items	13
4.3 Types of test plans.....	14
4.3.1 General	14
4.3.2 Advantages and disadvantages of the different test plan types	14
5 General test procedure	16
5.1 Test conditions	16
5.2 General characteristics of the test plans	17
5.3 Data to be recorded	17
5.4 Calculation of accumulated test time, T^*	17
5.5 Number of failures	18
6 Truncated sequential probability ratio test (SPRT) plans.....	18
6.1 General.....	18
6.2 Common test procedure	19
6.3 Decision criteria	19
6.4 Operating characteristic (OC) curve	20
6.5 Expected accumulated test time to decision (ETT)	21
6.6 Overview of test plans.....	22
7 Fixed time/failure terminated test plans – Fixed duration (to acceptance) test plans	25
7.1 General.....	25
7.2 Common test procedure	26
7.3 Decision criteria	26
7.4 Test plans	26
8 Design of alternative time/failure terminated test plans (FTFT)	27
8.1 General.....	27
8.2 Design procedures	27
8.3 Common FTFT procedure	28
8.4 Decision criteria	28
9 Calendar time/failure terminated test plans (FTFT) for non-replaced items	28
9.1 General.....	28
9.2 Common test procedure	29
9.3 Decision criteria	29
9.4 Use of IEC 61123:2019, Table 5 for fixed calendar time tests	29
9.4.1 General	29
9.4.2 Procedure when the test time is given	30

9.4.3	Procedure when the number of items is given	30
10	Combined test plans	30
10.1	General	30
10.2	Common test procedure	30
10.3	Decision criteria	31
10.4	Test plans	31
11	Performing the test and presenting the results	32
Annex A	(normative) Tables for border lines of SPRT plans (types A and C)	33
A.1	Symbols	33
A.2	Border lines	33
A.3	Example of the SPRT plan from Clause 6	37
Annex B	(normative) Tables and graphs for combined test plans (type D)	39
B.1	General	39
B.2	Test plans D.3 and C.3 ($\alpha = \beta = 10\%$, $D = 1,7$)	41
Annex C	(informative) Extension of the set of SPRTs type A	44
C.1	Symbols	44
C.2	Extension of the set of type A tests (through interpolation by α and β)	44
Annex D	(informative) Approximation of operating characteristic for type A SPRTs by Wald's formula	47
D.1	Symbols	47
D.2	Approximations of OC in this document	47
D.3	Approximation of OC for type A SPRT by Wald's formula	47
D.4	Construction of the approximated OC curve using a spreadsheet	49
Annex E	(informative) Mathematical references and examples for fixed time/failure terminated test (FTFT) plans	51
E.1	Symbols	51
E.2	Mathematical references	51
E.2.1	General	51
E.2.2	Mathematical references	51
E.2.3	Design procedure {a}	54
E.2.4	Design procedure {b}	55
E.2.5	Design procedure {c}	55
E.2.6	Design procedure {d}	56
E.3	Examples of FTFT design using test plans B	56
E.3.1	Example 1	56
E.3.2	Example 2	57
E.4	Test OC approximation using formula for FTFT	58
Annex F	(informative) Examples of FTFT design using a spreadsheet program	59
F.1	General	59
F.2	Finding the test border lines using optimization on the example of the design procedure {b}	61
F.3	ETT and OC curves	63
F.4	Example of FTFT design by procedure {a}	65
F.5	Example of FTFT design by procedure {c}	67
F.6	Example of FTFT design by procedure {d}	69
F.7	Example of a test with replacement of failed items	72
F.8	Evaluation of an approximate OC for non-FTFT plans using a spreadsheet	73
Annex G	(informative) Examples and mathematical references for the calendar time terminated test plans	78

G.1	Examples	78
G.1.1	Example 1	78
G.1.2	Example 2	78
G.2	Mathematical background	79
Annex H (informative)	Derivation and mathematical reference for the optimized test plans of GOST R 27 402 [12]	80
H.1	Symbols	80
H.2	Test plan types and terminology	81
H.3	Introductory remarks	81
H.4	Procedure used for developing the optimized test plans	82
Bibliography	89
Figure 1	– Relative ETT (T_e^*/m_0) and MaxTT (T_t^*/m_0) of various tests with the same risks	16
Figure 2	– SPRT diagram and test example	20
Figure 3	– OC curve, P_a	21
Figure 4	– SPRT – Curve of expected accumulated test time to decision (ETT)	22
Figure 5	– Example of a decision graph for combined test plan (type D) and for SPRT type C	31
Figure A.1	– Decision graph of SPRT plan	34
Figure B.1	– Expected accumulated test time to acceptance decision, $T_e^{*(+)}$ for D.3 and C.3 test plans	43
Figure B.2	– Operating characteristic P_a for D.3 and C.3 test plans	43
Figure D.1	– Approximation of OC for type A SPRT using Wald's formula	48
Figure E.1	– Example 1 – Expected accumulated test time to decision (ETT) of tests B.2 and A.25	57
Figure E.2	– Example 1 – Operating characteristic of tests B.2 and A.25	58
Figure F.1	– Using Solver to find T_t^*/m_0 – Accumulated test truncation time in terms of m_0	63
Figure F.2	– ETT plotted from the spreadsheet calculations	64
Figure F.3	– OC curve plotted from the spreadsheet calculations	64
Figure F.4	– Using Solver to find T_t^*/m_0 and c in Step {a1}	66
Figure F.5	– Using Solver to find T_t^*/m_0 in Step {a2}	67
Figure F.6	– Using Solver to find T_t^*/m_0 in Step {c2}	69
Figure F.7	– Using Solver to find D and c in Step {d1}	71
Figure F.8	– Using Solver to find D and T_t^* in Step {d2}	72
Figure F.9	– Using Solver to find c and T_t^*/m_0 from Clause F.8	75
Figure F.10	– OC approximated by formula for FTFT (example from Clause F.8)	77
Figure H.1	– Test plan types and terminology	81
Figure H.2	– Principle of test plans	83
Figure H.3	– Partitioning of the test plan graph	83
Figure H.4	– Interior nodes and border nodes	83
Figure H.5	– Paths to the accept line	84

Figure H.6 – Paths to the reject line	84
Figure H.7 – Probabilities of paths transfer between nodes	85
Figure H.8 – Recurrent element – Two cases	88
Table 1 – Advantages and disadvantages for the different test plan types	15
Table 2 – OC curve	20
Table 3 – Relative ETT versus m/m_0	21
Table 4 – Overview of type A SPRT plans	23
Table 5 – Overview of type C SPRT plans	25
Table 6 – Type B FTFT plans	27
Table 7 – Overview of type D combined plans	32
Table A.1 – Constants for border line formulae and their coordinates for type A SPRT plans	35
Table A.2 – Constants for border line formulae and their coordinates for type C SPRT plans	36
Table A.3 – Example for SPRT using test plan A.41 (with example data)	38
Table B.1 – Combined test plans in Annex B	39
Table B.2 – Type D test plans – Accept and reject lines	40
Table B.3 – Expected accumulated test time to acceptance decision, $T_e^*(+)$, for D and C test plans	41
Table B.4 – Accept and reject lines for D.3 and C.3 test plans	42
Table C.1 – Example for interpolation by α and β	46
Table D.1 – Spreadsheet set-up for construction of the OC curve by Wald	50
Table D.2 – Formulae embedded in the spreadsheet	50
Table E.1 – List of the typical FTFT design procedures	54
Table F.1 – Set-up of the spreadsheet with embedded formulae	60
Table F.2 – Formulae embedded in the spreadsheet	61
Table F.3 – Fragment from Table 6	62
Table F.4 – Set-up 1 of the spreadsheet for example by procedure {a}	65
Table F.5 – Set-up 2 of the spreadsheet for example by procedure {a}	66
Table F.6 – Set-up 3 (final solution) for example by procedure {a}	67
Table F.7 – Set-up 2 for example by procedure {c}	68
Table F.8 – Set-up 3 (final solution) for example by procedure {c}	69
Table F.9 – Set-up 1 of the spreadsheet for example by procedure {d}	70
Table F.10 – Set-up 2 of the spreadsheet for example by procedure {d}	71
Table F.11 – Set-up 3 (final solution) for example by procedure {d}	72
Table F.12 – Set-up of the spreadsheet with embedded formulae from Clause F.8	74
Table F.13 – Set-up 1 of the spreadsheet from Clause F.8	75
Table F.14 – Set-up 2 of the spreadsheet for example from Clause F.8	76

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RELIABILITY TESTING –
COMPLIANCE TESTS FOR CONSTANT FAILURE RATE
AND CONSTANT FAILURE INTENSITY****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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IEC 61124 has been prepared by IEC technical committee 56: Dependability. It is an International Standard.

This fourth edition cancels and replaces the third 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) The truncated sequential probability ratio test (SPRT) [1], [2], [3]¹ has been significantly developed in recent years [4], [5], [6]. In this edition, type A test plans (optimally truncated SPRT) have been significantly changed, as follows:

¹ Numbers in square brackets refer to the Bibliography.

- the tests are significantly truncated (the maximal test time is low) without substantially increasing the expected accumulated test time to decision (ETT);
 - the true producer's and consumer's risks (α' , β') are given and are very close to the nominal values;
 - the range of the test parameters is wide (risks and discrimination ratio);
 - the test plans include various risk ratios (not restricted to equal risks only);
 - the values of the ETT are accurate and given in the relevant region (for practical use);
 - guidelines for extension of the tests set (using accurate interpolation) are included.
- b) Other ready-to-use test plans (types B, C, D) are not changed, only the form of presentation of the data on their border lines and the characteristics has been changed. This form is made unified for all types of test plans, which helps the comparison of different plans and, accordingly, to facilitate the selection of the most appropriate.
- c) FTFT design procedures, to extend the set of test plans B, are significantly changed and make the design accurate and simple. The implementation of this design is given on a spreadsheet program. A unified approach to the calculation of the operational characteristics of all types of test plans is introduced.

The text of this International Standard is based on the following documents:

Draft	Report on voting
56/1980/FDIS	56/1985/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

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

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INTRODUCTION

A compliance test is an essential part of the reliability assurance system [7], [8], [9]. Reliability is affected by many random factors, so its prediction is not accurate. The direct way to check if the item meets its reliability specifications is to perform a compliance test.

The tests described in this document can be applied to items that have a failure rate or failure intensity (denoted by λ) which can be considered as a constant. The procedures are based on the assumption that trials of the test are statistically independent. If it is necessary to test the constant failure rate and constant failure intensity assumption, the procedures given in IEC 60605-6 should be used.

The test serves to verify the compliance with a specified λ_0 , that is, to verify that $\lambda \leq \lambda_0$.

The probability of making the correct decision in the test depends on the test duration and on the sample size (number of failures). The tests usually require a large sample size and, accordingly, a large consumption of time and funds. The consumptions are especially high for reliability testing. For this reason, sampling plans of the tests should be carefully planned in order to reduce the consumption.

This document is dedicated to sampling plans for the tests.

The tests are characterized by the operating characteristic (OC) and test duration until the test stops with the accept/reject decision on the compliance.

OC is the probability of accepting an item as meeting the requirements. In this document, the OC is represented by the coordinates of its two points (see ISO 3534-2 [10]):

- $(\lambda_0, 1 - \alpha)$ are the coordinates of the producer's risk point (PRP);
- (λ_1, β) are the coordinates of the consumer's risk point (CRP);

where α and β are producer's and consumer's risks, and $\lambda_1 > \lambda_0$.

The test duration (test time) is a random value and in this document is usually characterized by its expected (ETT) and maximum (MaxTT) values.

This document contains the following types of tests:

- optimally truncated sequential probability ratio test (SPRT, type A);
- maximally truncated SPRT (type C);
- fixed time/failure terminated test (FTFT, type B);
- FTFT – calendar time terminated test without replacement;
- combined test plan (type D).

The tests can be used for testing equipment (repaired or non-repaired) as well as for components (replaced or not replaced when failing).

All the plans in this document are sequential, that is, every time an event occurs during the test, a decision is made to continue or stop the test. An event occurs in two cases: when a failure occurs, or when the acceptance boundary is crossed, which means that there is compliance with the requirements. The decision can be one of three types:

- accept the compliance and stop the test;
- reject the compliance and stop the test;
- continue the test, because there is not enough information to stop it.

The difference between the types of tests is in the shape of border lines.

The FTFT is characterized by decision rules for accepting or rejecting compliance when the MaxTT has been reached, or the acceptable number of failures has been exceeded. This test has the smallest MaxTT among all tests with specified PRP and CRP. If, for a tested item $\lambda \leq \lambda_0$, then ETT is close to MaxTT; otherwise, if $\lambda > \lambda_0$, then ETT decreases. In fact, the only advantage of the FTFT over the SPRT is the simplicity of designing new test plans. A detailed procedure for the design is provided in this document.

The optimally truncated SPRT (type A) has a MaxTT of 1,1 to 1,2 times greater than the FTFT with the same PRP and CRP. However, the ETT of the SPRT is significantly smaller than that of the corresponding FTFT, and for $\lambda \leq \lambda_0$ it can be 1,4 to 1,8 times smaller. This is a great advantage of the SPRT. This document contains an extensive set of ready-to-use type A plans. The set also allows the design of additional tests by simple interpolation according to the procedure provided in this document.

The maximally truncated SPRT (type C) has a MaxTT, like the FTFT; however, its ETT is less than that of the FTFT, but greater than that of the type A SPRT.

In the combined test plan (type D), test items with early failures will not be rejected in the initial stages of the test.

Some of the ready-to-use tests listed in this document have a very large maximal acceptable number of failures, which is why they are likely to be rarely used. However, the data allows the user of this document to assess the economic benefit of the OC test requirements and, in general, to assess the advisability of performing the test.

Accumulated test time can be reduced by accelerated testing (see IEC 62506 [11]).

An example of objects covered by this document can be electronic equipment and its components, which usually have a failure rate or failure intensity that can be considered constant.

Clause 4 presents the requirements and area of application of the tests and recommendations for their selection. Clause 5 explains the general elements of the test procedure. Clause 6 explains the characteristics of the ready-to-use SPRT and the parameters of the border lines (their values are given in Annex A). Extension of the set of SPRT tests are given in Annex C. Clause 7 is devoted to the ready-to-use FTFT. Clause 8 presents the design of FTFT plans that are not covered in the tables of this document. Mathematical references and procedures of the design of FTFT plans are given in Annex E and in Annex F. Clause 9 is devoted to the calendar FTFT for non-replaced items (examples and mathematical references of their design are given in Annex G). Clause 10 is devoted to the combined test plans (parameters of their border lines are given in Annex B). Clause 11 explains how to perform the test and presentation of results. Annex D presents the approximation of OC by Wald's formula. Annex H is devoted to the mathematical reference for the test plans of GOST R 27.402 [12].