

Irish Standard I.S. EN IEC 61123:2020

Reliability testing - Compliance test plans for success ratio

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I.S. EN IEC 61123:2020

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EN IEC 61123

NORME EUROPÉENNE

EUROPÄISCHE NORM

February 2020

ICS 03.120.01; 03.120.30; 21.020

English Version

Reliability testing - Compliance test plans for success ratio (IEC 61123:2019)

Essais de fiabilité - Plans d'essai de conformité pour une proportion de succès (IEC 61123:2019)

Prüfung der Zuverlässigkeit - Konformitätsprüfpläne für den Erfolgsquotienten (IEC 61123:2019)

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EN IEC 61123:2020 (E)

European foreword

The text of document 56/1852/FDIS, future edition 2 of IEC 61123, prepared by IEC/TC 56 "Dependability" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61123:2020.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2020-09-27 level by publication of an identical national standard or by endorsement
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IEC 61124 NOTE Harmonized as EN 61124

EN IEC 61123:2020 (E)

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

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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.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	EN/HD	<u>Year</u>
IEC 60050-192	2015	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	-	-

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IEC 61123

Edition 2.0 2019-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Reliability testing - Compliance test plans for success ratio

Essais de fiabilité - Plans d'essai de conformité pour une proportion de succès





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IEC 61123

Edition 2.0 2019-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Reliability testing - Compliance test plans for success ratio

Essais de fiabilité - Plans d'essai de conformité pour une proportion de succès

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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CONTENTS

FOREWORD	4
INTRODUCTION	6
1 Scope	8
2 Normative references	8
3 Terms, definitions, abbreviated terms and symbols	8
3.1 Terms and definitions	
3.2 Abbreviated terms and symbols	
3.2.1 Abbreviated terms	
3.2.2 Symbols	9
4 General requirements and area of application	10
4.1 Reliability requirement	10
4.2 Repair and replacement	10
4.3 Types of test plans	10
4.3.1 General	10
4.3.2 Features of the test plan types	10
4.4 General test procedure	11
4.5 General decision criteria	
5 Truncated sequential probability ratio test plans (SPRT)	13
5.1 Characteristics	13
5.2 Decision criteria	13
5.3 Operating characteristic curve (OC)	14
5.4 Expected number of trials to decision (ENT)	15
6 Fixed trial/failure terminated test plans (FTFT)	16
6.1 Characteristics	16
6.2 Decision criteria	16
7 Design of fixed trial/failure terminated test plans	17
7.1 Characteristics	17
7.2 Approach	17
7.3 Common case	18
7.4 Other cases	18
7.5 Example of application	18
7.6 Procedure to determine D and c or n and c	18
7.6.1 Figure and table readings	18
7.6.2 Use of figures and tables	19
7.7 Decision criteria	19
Annex A (informative) Additional information on sequential test plans	20
A.1 Example	20
A.2 Extension of the test set (through interpolation and extrapolation)	21
A.2.1 General	21
A.2.2 Extrapolation for $p_0 < 0.001$	21
A.2.3 Interpolation	21
Annex B (informative) Design of fixed trial/failure terminated test plans – Examples	
B.1 Use of figures and tables	
B.2 Case where number of events, <i>n</i> , is not known, but is predictable	
Annex C (informative) Design of fixed trial/failure terminated test plans – Mathematical	2
procedures and formulas	26

C.1	General	26
C.2	Symbols	26
C.3	Computation	26
C.3.1	Determination of D versus n	26
C.3.2	Determination of n and c versus p_0 , D , α , β	27
C.3.3	Test without failures – Determination of n and D versus p_0 , α , β	27
C.3.4	Determination of OC curves	28
C.3.5		
C.4	Accuracy	
C.5	Tables of cumulative normal distribution and its Inverse	
•	normative) Truncated sequential test plans	31
	informative) Design of fixed trial/failure terminated test plans – Figures and determine D and c or n and c	40
	hy	
9 -	7	
Figure 1 -	Expected and maximal number of trials for SPRT and FTFT with the same ris	sks11
Figure 2 -	- SPRT diagram	14
Figure 3 -	OC curve	15
Figure 4 -	SPRT – Curve of expected number of trials to decision (ENT)	15
_	Principal layout of Tables E.1 to E.3	
	– Example of a truncated sequential test	
-		
	2 – Discrimination ratio, D , versus number of events, n for p_0 = 0,10	
	B – Discrimination ratio, D , versus number of events, n for p_0 = 0,15	
5	, , , , , , , , , , , , , , , , , , , ,	
Table 1 –	Overview – Maximal number of trials and expected number of trials at p_0 for	
	FTFT	12
	Range of the test parameters	
	OC curve	
	ENT (n_e) versus true failure ratio (p)	
Table 5 –	Fixed trial/failure terminated test plans	16
	– Example for interpolation by $lpha$ and eta	
	– Cumulative normal distribution for fixed u_{γ} values	
	- Inverse cumulative normal distribution for fixed 1 - γ values	
	- Truncated sequential test plans	
	- Acceptable number of failures, c , versus number of events, n for p_0 = 0,05	
	- Acceptable number of failures, c , versus number of events, n for p_0 = 0,10	
	- Acceptable number of failures c versus number of events n for $n_0 = 0.15$	

-4 -

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RELIABILITY TESTING – COMPLIANCE TEST PLANS FOR SUCCESS RATIO

FOREWORD

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International Standard IEC 61123 has been prepared by IEC technical committee 56, Dependability.

This second edition cancels and replaces the first edition published in 1991. This edition constitutes a technical revision.

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

- a) The sequential probability ratio test (SPRT) [1, 2]¹ has been significantly developed in recent years [3, 4, 5]. This edition contains shorter and accurate tests, a wide range of test plans, and significant additional characteristic data, as follows:
 - the tests are significantly truncated (the maximum trial numbers are low) without substantially increasing the expected number of trials to decision (ENT);
 - the true producer's and consumer's risks (α' , β') are given and very close to the nominal (α , β);

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Numbers in square brackets refer to the bibliography.

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- 5 -

- the range of the test parameters is wide (failure ratio, risks and discrimination ratio);
- the test plans include various risk ratios (not restricted to equal risks only);
- the values of ENT are accurate and given in the relevant region (for practical use);
- guidelines for extension of the test sets (interpolation and extrapolation) are included.
- b) In Annex C, the use of the cumulative binomial distribution function of Excel that simplifies the procedure of designing has been added (Clause C.3).

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

FDIS	Report on voting	
56/1852/FDIS	56/1873/RVD	

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

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

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INTRODUCTION

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

The test serves to verify the compliance with the specified probability that an item will perform as required. The outcome of each trial of the test is either success or failure.

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

This document is dedicated to sampling plans for the tests.

The procedures are based on the assumption that trials of the test are statistically independent and the probability of success, q in them is constant. This document also applies the probability of failure p = 1 - q.

The tests are characterized by operating characteristic (OC) and number of trials to decision.

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):

- $(p_0, 1 \alpha)$ are the coordinates of the producer's risk point (PRP);
- (p_1, β) are the coordinates of the consumer's risk point (CRP).

The number of trials to reaching a decision regarding the test is a random value and in this document is usually characterized by its expected (ENT) and maximum (MaxNT) values.

This document contains two types of tests:

- truncated sequential probability ratio test (SPRT);
- fixed trial/failure terminated test (FTFT).

The FTFT is characterized by decision rules for accepting or rejecting compliance when the termination trials number $n_{\rm f}$ (MaxNT) has been reached, or the acceptable number of failures c has been exceeded. This test has the smallest $n_{\rm f}$ among all tests with specified PRP and CRP. When testing objects with $p \leq p_0$, ENT is close to $n_{\rm f}$, and for $p > p_0$, ENT decreases significantly. Another advantage of the FTFT is the ability to conduct all trials simultaneously, but ENT increases and becomes equal to $n_{\rm f}$.

In the SPRT, the decision is made after each trial: accept or reject compliance, or continue testing. This document contains a truncated SPRT with MaxNT = $n_{\rm t}$. This $n_{\rm t}$ is 1,1 to 1,2 times greater than $n_{\rm f}$ of the FTFT with the same PRP and CRP. However, the ENT of the SPRT is significantly smaller than that of the corresponding FTFT, and for $p \le p_0$ it can be 1,4 to 1,8 times smaller. This is a great advantage of the SPRT. If it is necessary to shorten the calendar time of the SPRT, it is possible to run the trials by small portions of $n_{\rm t}$, while the OC and ENT will not change significantly.

The planning of the SPRT is quite complicated so this document contains extensive tables with ready-to-use test plans and their characteristics. Tests are listed for $\alpha = \beta$ as well as for $\alpha \neq \beta$. The tables also allow the design of additional tests by simple interpolation and, for small p_0 , by extrapolation.

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-7 -

Some of the tests have a very large sample size, which will probably be used rarely. However, the data allow 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.

The test is used for reliability testing; for example, to check compliance of the reliability of a non-repairable item for a given time interval (warranty period or designed lifetime). The test makes no assumption on whether the failure rate is constant or non-constant. IEC 61124 assumes a constant failure rate and is more statistically efficient since it takes the accumulated operating time into account.

Clause 4 presents the types of tests and recommendations for their selection. It also discusses the ability to reuse items during the test. Clause 5 explains the parameters of the stopping boundaries and the characteristics of the SPRT (their values are given in Annex D). Clause 6 is devoted to the FTFT, a table with parameters of stopping boundaries and characteristics is given. Annex A is devoted to the SPRT and provides examples of choosing a test by cost-benefit considerations, extension of the test set of Clause 5 by extra- and interpolation.

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RELIABILITY TESTING – COMPLIANCE TEST PLANS FOR SUCCESS RATIO

1 Scope

This international standard is intended to define a procedure to verify if a reliability of an item/system complies with the stated requirements. The requirement is assumed to be specified as the percentage of success (success ratio) or the percentage of failures (failure ratio).

This document can be used where a number of items are tested (number of trials performed) and classified as passed or failed. It can also be used where one or a number of items are tested repeatedly. The procedures are based on the assumption that the probability of success or failure is the same from trial to trial (statistically independent events). Plans for fixed trial/failure terminated tests as well as truncated sequential probability ratio tests (SPRTs) are included. This document contains extensive tables with ready-to-use SPRT plans and their characteristics for equal and non-equal risks for supplier and customer.

In the case of the reliability compliance tests for constant failure rate/intensity, IEC 61124 applies.

2 Normative references

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.

IEC 60050-192:2015, International Electrotechnical Vocabulary – Part 192: Dependability (available at http://www.electropedia.org)

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

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1

success ratio

probability that an item will perform as required or that a trial will be successful under stated conditions

Note 1 to entry: An observed success ratio is the ratio of the number of non-faulty items or of successful trials at the completion of testing, to the total number of test items or number of trials.

- 8 -



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