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

Essais de fiabilité – Plan d’essais de conformité d’un taux de défaillance constant et d’une intensité de défaillance constante



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RELIABILITY TESTING –
COMPLIANCE TESTS FOR CONSTANT FAILURE RATE
AND CONSTANT FAILURE INTENSITY**

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International Standard IEC 61124 has been prepared by IEC technical committee 56: Dependability.

This third edition of IEC 61124 cancels and replaces the second edition, published in 2006, and constitutes a technical revision.

The main changes with respect to the previous edition are as follows:

- A number of new test plans have been added based on the Russian standard GOST R 27.402 [1]¹, and it is intended to align the new edition of MIL-HDBK-781 [2] with this edition. Algorithms for optimizing test plans using a spreadsheet program are given and a number of optimized test plans are listed. Furthermore, emphasis is laid on the fact that the test should be repeated following design changes.

¹ Figures in square brackets refer to the bibliography.

- Discrepancies in test plans A, B as well as Annexes A and B that originated in IEC 60605-7 [3], now withdrawn, have been corrected so these test plans differ from those given in previous editions of IEC 61124. As requested by the National Committees, mathematical background material and spreadsheet program information has been moved to informative annexes. In addition, the symbol lists have been divided, so that some annexes have separate lists of symbols.
- Guidance on how to choose test plans has been added as well as guidance on how to use spreadsheet programs to create them. Test plans A.1 to A.9 and B.1 to B.13 have been corrected.
- Subclauses 8.1, 8.2, 8.3, Clause 9, Annex C, Clauses G.2, I.2, I.3 and Annex J are unchanged, except for updated terminology and references.
- Corrections to the second edition proposed by National Committees have been implemented.

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

FDIS	Report on voting
56/1461/FDIS	56/1468/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.

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RELIABILITY TESTING – COMPLIANCE TESTS FOR CONSTANT FAILURE RATE AND CONSTANT FAILURE INTENSITY

1 Scope

This International Standard gives a number of optimized test plans, the corresponding operating characteristic curves and expected test times. In addition the algorithms for designing test plans using a spreadsheet program are also given, together with guidance on how to choose test plans.

This standard specifies procedures to test whether an observed value of

- failure rate,
- failure intensity,
- mean time to failure (MTTF),
- mean operating time between failures (MTBF),

conforms to a given requirement.

It is assumed, except where otherwise stated, that during the accumulated test time, the times to failure or the operating times between failures are independent and identically exponentially distributed. This assumption implies that the failure rate or failure intensity is constant.

Four types of test plans are described as follows:

- truncated sequential tests;
- time/failure terminated tests;
- fixed calendar time terminated tests without replacement;
- combined test plans.

This standard does not cover guidance on how to plan, perform, analyse and report a test. This information can be found in IEC 60300-3-5.

This standard does not describe test conditions. This information can be found in IEC 60605-2 and in IEC 60300-3-5.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 (IEV) – Chapter 191: Dependability and quality of service*

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 61123:1991, *Reliability testing – Compliance test plans for success ratio*

3 Terms, definitions, abbreviations and symbols

3.1 Terms and definitions

For the purposes of this document the terms and definitions given in IEC 60050-191 apply.

The terms "failure rate" and "failure intensity" are used as meaning constant failure rate and constant failure intensity.

3.2 Abbreviations and symbols

3.2.1 Abbreviations

MTBF	mean operating time between failures
MTTF	mean time to failure
OC	operating characteristic
SPRT	sequential probability ratio test (in some literature called probability ratio sequential test (PRST)).

3.2.2 Symbols

The generic symbol λ is used in the following for failure rate and failure intensity.

The symbol m is used to denote both the following reliability measures:

- mean operating time between failures, MTBF;
- mean time to failure, MTTF.

When used, the relationship between the above quantities, under the given assumptions, is:

$$\lambda = \frac{1}{m}$$

Sequential test plans (see Clause 6) and fixed time/failure terminated test plans (see Clause 7) are based on m as a reliability measure, thus in these cases:

$$m = \frac{1}{\lambda}$$

c	acceptable number of failures during the test
D	discrimination ratio; $D = m_0/m_1$ or $D = \lambda_1/\lambda_0$
k	summation variable for failures