

Reliability of systems, equipment and components —

Part 1: Dependability programme elements and tasks

ICS 03.120.10; 29.020

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National foreword

This British Standard has been prepared by Technical Committee DS/1 and is the English language version of EN 60300-2:1996 *Dependability management — Part 2: Dependability programme elements and tasks*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 300-2:1995 published by the International Electrotechnical Commission (IEC).

This standard forms Part 1 of the BS 5760 series and supersedes BS 5760-1:1985 which is withdrawn. It introduces restructured clauses to correspond with BS 5750-14, with clauses extended to provide more detailed guidance.

This Part of BS 5760 describes elements of a dependability programme and gives guidance on tasks necessary to achieve specified dependability of products. It is applicable to hardware and systems containing software products. This standard cross-references and complements BS EN ISO 9004-1:1994.

This standard is a guide and the use of the verbal forms “must” and “shall” in the text does not indicate mandatory requirements.

BS 5760 provides comprehensive guidance on many aspects of reliability management. Sixteen parts of this standard have been published and these may be summarized as follows:

Part 0: Introductory guide to reliability. This Part provides guidance for senior management and non-specialists on the importance of reliability and explains how measures to achieve reliability should be integrated with other aspects of project management.

Part 2: Guide to the assessment of reliability. This Part explains the purpose and problems of assessing reliability. A range of available assessment techniques is reviewed and the principle advantages and limitations are outlined. Sections are included on the assessment of software reliability, human reliability and one-shot devices. The extension of these techniques to the assessment of availability and to the assessment of reliability of services is considered. This use of a range of statistical distributions to analyse reliability data is described.

Part 3: Guide to reliability practices : examples. This Part contains authentic practical examples illustrating the principles established in BS 5760-1 and BS 5760-2.

Part 4: Guide to specification clauses relating to the achievement and development of reliability in new and existing items. This Part provides detailed guidance on the specification of reliability.

Part 5: Guide to failure modes, effects, and criticality analysis (FMEA and FMECA). This Part gives guidance on the application of these techniques.

Part 6: Guide to programmes for reliability growth. This Part describes procedures for exposing and removing weaknesses in hardware and software items in order to achieve acceptable reliability in a product. It explains basic concepts, management and test procedures and describes techniques for analysis and correction of failures.

Part 7: Guide to fault tree analysis. This Part gives guidance on the application of fault tree analysis. This technique may be used to identify factors affecting the reliability, performance and safety characteristics of a system.

Part 9: Guide to the block diagram technique. This Part describes the use of the block diagram technique for modelling and evaluating the reliability of both elementary and more complex systems. The extension of the method to calculate availability is also outlined.

Part 10: Guide to reliability testing.

Section 10.1: General requirements. This Section provides guidance on general principles, procedures and considerations for reliability testing in the laboratory and in the field.

Section 10.2: Design of test cycles. This Section provides a general procedure for design of test cycles, where no applicable preferred test cycles can be found.

Section 10.3: Compliance test procedures for standby-state availability. This Section provides guidance on techniques for testing the availability performance of frequently maintained items under defined conditions.

Section 10.5: Compliance test plans for success ratio. This Section gives procedures for preparing and applying compliance test plans for success ratio or failure ratio. Plans are provided for three main types of test.

NOTE 1 Further Sections of Part 10 based on other Parts of IEC 605 and related IEC standards are planned.

Part 11: Guide to the collection of reliability, maintainability, availability and maintenance support data from the field. This Part provides guidance for the collection of data relating to reliability, maintainability, availability and maintenance support performance of items operating in the field. It deals in general terms with the practical aspects of data collection and presentation and briefly explores the related topics of data analysis and presentation of results.

Part 12: Guide to the presentation of reliability, maintainability and availability predictions. This Part gives guidance on the presentation of quantitative predictions of reliability, maintainability and availability. The items to be included when presenting prediction information are listed and explained with the object of facilitating comparisons between projects and reports.

Part 13: Guide to preferred test conditions for equipment reliability testing.

Section 13.1: Indoor portable equipment: low degree of simulation.

Section 13.2: Equipment for stationary use in weather protected locations: high degree of simulation.

Section 13.3: Equipment for stationary use in partially weather protected locations: low degree of simulation.

Section 13.4: Equipment for portable and non-stationary use: low degree of simulation.

Part 14: Guide to formal design review. This Part provides guidelines for planning and conducting design reviews. Much of the guidance given is widely applicable and relevant to the general conduct of design reviews but it also includes details of the specific contributions to be made by various specialists.

Part 15: Guide to the application of Markov techniques. This Part provides guidance on the application of Markov techniques to dependability analysis. Further information, including advice on the application, benefits and limitations of Markov techniques, is given in section 11 of BS 5760-2.

Part 17: Reliability growth — Statistical test and estimation methods. This Part describes the power law reliability growth model and related projection models. It provides procedures to estimate some or all of the quantities listed in clause 9 of BS 5760-6:1991.

Further Parts of BS 5760 are envisaged in order to provide guidance on other techniques of reliability management (see note 4).

Whilst mainly addressing system and equipment level reliability, many of the techniques described in the Parts of BS 5760 may also be applied at the component level. Further guidance on component reliability is given in CECC 00804.

Guidance on specific aspects of maintainability is provided in the various Parts of BS 6548 *Maintainability of equipment*.

NOTE 2 This standard makes reference to BS 4778 *Quality vocabulary*, and in particular to BS 4778-3.1, which contains definitions relating to concepts applicable to this Part of BS 5760. It is essential that these definitions and concepts should be fully understood if this guide is to be interpreted correctly. For this reason it is recommended that BS 5760-1 should be read in conjunction with BS 4778.

NOTE 3 BS 4778-3.2 deprecates the use of the terms “failure modes and effects analysis” and “failure modes, effects and criticality analysis”. It favours the use of “fault modes and effects analysis” and “fault modes, effects and criticality analysis”, and these terms are used throughout BS 5760-2. However, the older terms have been retained in BS 5760-5 in order to align it with the current versions of IEC 812.

NOTE 4 Part 8: *Guide to the assessment of reliability of systems containing software* is currently in preparation and is available as DD 198:1991.

Cross-references

Publication referred to	Corresponding British Standard
IEC 50(191):1990	BS 4778 <i>Quality vocabulary</i> Part 3: <i>Availability, reliability and maintainability terms</i> Section 3.1:1991 <i>Guide to concepts and related definitions</i> Section 3.2:1991 <i>Glossary of international terms</i>
EN 60300-1:1993 (IEC 300-1) (ISO 9000-4:1993)	BS 5750: <i>Quality Systems</i> Part 14:1993 <i>Guide to dependability programme management</i>
EN 28402:1991 (ISO 8402:1994)	BS 4778 <i>Quality vocabulary</i> Part 1:1993 <i>International terms</i>
EN ISO 9001:1994 (ISO 9001:1994)	BS EN ISO 9001:1994 <i>Quality Systems. Model for quality assurance in design, development, production, installation and servicing</i>
EN ISO 9004-1:1994 (ISO 9004-1:1994)	BS EN ISO 9004 <i>Quality Management and quality system elements</i> Part 1:1994 <i>Guidelines</i>
IEC 300-3-2:1993	BS 5760 <i>Reliability of systems, equipment and components</i> Part 11:1994 <i>Collection of reliability, availability, maintainability and maintenance support data from the field</i>
IEC 605 (series)	Part 10 (series) <i>Guide to reliability testing</i>
IEC 706 (series)	BS 6548 (series) <i>Maintainability of equipment.</i>
IEC 863:1986	BS 5760 <i>Reliability of systems, equipment and components</i> Part 12:1993 <i>Guide to the presentation of reliability, maintainability and availability predictions</i>
IEC 1014:1989	Part 6:1991 <i>Guide to programmes for reliability growth</i>
IEC 1025:1990	Part 7:1991 <i>Guide to fault tree analysis</i>
IEC 1070:1991	Part 10.3:1993 <i>Guide to reliability testing: Compliance test procedures for steady state availability</i>
EN 61078:1993 (IEC 1078:1991)	BS 61078:1994 <i>Guide to the block diagram technique</i>
IEC 1123:1991	Part 10.5:1993 <i>Guide to reliability testing. Compliance test plans for success ratio</i>
IEC 1160:1992	Part 14:1993 <i>Guide to formal design review</i>
IEC 1163-1:1995	Part 16: <i>Guide to Stress Screening</i> Section 16.1:1996 <i>Repairable items manufactured in lots</i>

IEC 1164:1995	Part 17:1995 <i>Reliability growth, Statistical test and estimation methods.</i>
IEC 1165:1995	Part 15:1995 <i>Guide to the application of Markov techniques</i>
ISO 2859 (series)	BS 6001 (series) <i>Sampling procedures for inspection by attributes</i>
ISO 9000-3:1991	BS 5750: <i>Quality Systems</i> Part 13:1991 <i>Guide to the application of BS 5750-1 to the development, supply and maintenance of software</i>
ISO 10007:1995	BS ISO 10007:1995 <i>Quality management — Guidelines for configuration management</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, the EN title page, pages 2 to 24, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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English version

Dependability management
Part 2: Dependability programme elements and tasks
(IEC 300-2:1995)

Gestion de la sûreté de fonctionnement
Partie 2: Eléments et tâches du programme de
sûreté de fonctionnement
(CEI 300-2:1995)

Zuverlässigkeits-Management
Teil 2: Zuverlässigkeits-Programmelemente
und -aufgaben
(IEC 300-2:1995)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Foreword

The text of document 56/437/FDIS, future edition 1 of IEC 300-2, prepared by IEC TC 56, Dependability, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60300-2 on 1995-11-28.

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) 1996-09-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1996-09-01

Annexes designated “normative” are part of the body of the standard.

Annexes designated “informative” are given for information only.

In this standard, Annex A and Annex ZA are normative and Annex B, Annex C and Annex D are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 300-2:1995 was approved by CENELEC as a European Standard without any modification.

In the official version, for Annex D, Bibliography, the following notes have to be added for the standards indicated:

- | | |
|----------|--|
| IEC 812 | NOTE Harmonized as HD 485 SI:1987 (not modified) |
| IEC 1025 | NOTE Harmonized as HD 617 SI:1992 (not modified) |
| IEC 1078 | NOTE Harmonized as EN 61078:1993 (not modified) |

Introduction

Three factors are of fundamental importance to those responsible for developing a new product and to those who will be responsible for using or operating the product; they are:

Performance

Will the performance (including dependability) of the product meet the expectations and needs of the end user?

Cost

What will be the cost, not only of developing and producing the product, but also of operating and maintaining and eventually disposing of it, i.e. what will be its life-cycle cost?

Timescale

Will the product be available when required and appear on the market at the appropriate time?

The customer's satisfaction with a product, and the reputation of the product and of its supplier, depends to a considerable degree on how well these factors are managed and harmonized during the various phases of the product life cycle.

The term dependability embraces reliability, maintainability, availability and maintenance support. Reliability, availability and maintainability are themselves fundamental product performance characteristics and are frequently specified as key product requirements.

Maintenance support is the ability to provide the resources required to maintain the item.

The dependability characteristics of a product have a major influence on the overall ability of the product to satisfy the requirements of the user and may well be fundamental and dominating aspects of quality. Dependability also has a major effect on the cost of operating and maintaining the product in use and on the achievement of acceptable life-cycle cost.

The initial or purchase cost of a product is often the major factor influencing the user's selection but it is important to recognize that the purchase cost is only a part of the total cost of ownership of a product. The costs of operation and maintenance can be greatly reduced if the product is designed to be reliable and maintainable. Improving and developing a product in this way usually adds to the purchase cost, but the greater additional cost is often compensated by greatly reduced operating and maintenance costs. It is important to perform studies to trade off the cost of improving reliability and maintainability against the expected reduction in cost achieved over the whole life of the product.

It is important that both supplier and customer should recognize that dependability characteristics may have a major impact on product performance, cost and time scale as described above.

Dependability requirements are often complex and in order to achieve them it is necessary to allocate appropriate resources, carefully planned and coordinated, into a dependability programme. The object of such programmes is to ensure that all reliability, maintainability, availability and maintenance support requirements are met. A supplier will typically need to implement dependability programmes to ensure that product reliability and maintainability requirements are met; a user will need to implement a dependability programme designed to ensure that maintainability support requirements are satisfied.

The various dependability programmes (for example the reliability management programme and the maintainability management programme) should be fully integrated into the overall product programme and into the product quality programme.

The specified dependability requirements are often a major feature of the design of the product and of its maintenance support and the specification should therefore be prepared before the design work is started.

This standard provides general guidance on the establishment of dependability programmes and is applicable to hardware products and systems containing software. The elements selected to provide the programme for a specific product should be tailored according to the individual requirements, circumstances and conditions that apply.

The selection of individual elements, the emphasis to be given to each element and the scale of the overall dependability programme should take account of the conditions of the market, the requirements and expectations of users, the contractual situation and the overall requirements for the product and its support. Individual programme elements also need to be adjusted to the phase of the life cycle in which they are implemented.