

Dependability management —

Part 3-10: Application guide — Maintainability

ICS 03.100

National foreword

This British Standard reproduces verbatim IEC 60300-3-10:2001 and implements it as the UK national standard. It supersedes BS 6548-1:1984, sections 1 and 3, which are to be withdrawn by amendment to BS 6548-1:1984. The UK participation in its preparation was entrusted to Technical Committee DS/1, Dependability and terotechnology, which has the responsibility to:

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Guide d'application – Maintenabilité**

Dependability management –

**Part 3-10:
Application guide – Maintainability**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DEPENDABILITY MANAGEMENT –

Part 3-10: Application guide –
Maintainability

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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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International Standard IEC 60300-3-10 has been prepared by IEC technical committee 56: Dependability.

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

FDIS	Report on voting
56/708/FDIS	56/718/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.

IEC 60300 consists of the following parts, under the general title: Dependability management:

- Part 1: Dependability programme management
- Part 2: Dependability programme elements and tasks
- Part 3: Application guide

This standard is intended to be used in conjunction with IEC 60300-2 and is laid out in the same format. It is also necessary that this standard can be used without reference to IEC 60300-2. There are therefore some instances in the standard where there are clauses which have some similar content to IEC 60300-2 in order to provide continuity, but this has been kept to a minimum.

This standard cancels and replaces sections 1 and 3 of IEC 60706-1 (1982).

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

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- withdrawn;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

0 Introduction

0.1 Purpose

The IEC 60300¹⁾ series of standards and guides explain the procedures for implementing a Dependability Programme during the design and development of a product in order to achieve specified levels of dependability.

IEC 60300-1 is the top-level standard which provides guidance on dependability programme management.

IEC 60300-2 is the next level down which defines the tasks that need to be carried out and gives guidance on how they should be undertaken.

IEC 60300-3 encompasses a series of application guides which develop the tasks in IEC 60300-2 into specific areas. These then lead to further documents which describe the "tools" to be used when applying a guide.

IEC 60300-1 and IEC 60300-2 are written to provide a guide on dependability, and are predominantly centred on the reliability aspects. It was considered that a guide was required to link IEC 60300-2 to the existing standards on maintainability, that is the IEC 60706 series of guides on maintainability of equipment and other standards covering specific procedures used in maintainability programmes. The original IEC 60706 series is being updated to ensure that there is no undue duplication with this guide, and IEC 60706 is intended to provide the tools for the procedures specified here. The relevant parts of IEC 60706 are referenced where they will provide further guidance.

0.2 Concept of maintainability

Maintainability refers to the ease with which maintenance work can be done. It involves the process of ensuring that products can be easily and safely maintained and that the maintenance support requirement is minimized.

When a product has a reasonably long life, the cost of operation and support during that life can greatly exceed the initial capital cost. The value to the customer of optimizing maintainability should be evident. Some effort and expense applied to achieving a product which can be easily and cheaply maintained will make very significant savings in the life cycle costs.

The maintenance costs of a product are also dependent on the quantity in use. For a large fleet of equipment, such as trucks, even a small improvement in maintainability can render significant cost savings in the long term.

When a product is to be sold on the open market, the concept of easy maintenance at low cost is an important consideration in the selection by the customer of equipment with low operating costs.

¹⁾ IEC 60300 (all parts), *Dependability management*.

DEPENDABILITY MANAGEMENT –

Part 3-10: Application guide – Maintainability

1 Scope

This International Standard, which forms part of the series of standards in the IEC 60300-3 series, is the application guide for maintainability. It can be used to implement a maintainability programme covering the initiation, development and in-service phases of a product, which form part of the tasks described in IEC 60300-2.

It provides guidance on how the maintenance aspects of the tasks should be considered in order to achieve optimum maintainability. It should be noted that the full programme described in this standard would only be applied to a major complex product with the potential for long-term usage.

For less complex maintainable products, a simpler programme should be adopted by tailoring the programme to suit the degree of complexity and the requirements of the customer. The standard uses other IEC standards and guides, notably IEC 60706, as reference documents or tools to provide more detail as to how a task should be undertaken.

Contracts between customer and supplier will vary widely according to conditions and circumstances in different industries. This standard is written on the premise that a product is to be developed by a contractor from a basic concept for the particular requirements of a user when the product is considered to be a development item (DI). However, in many instances, where a product already exists and needs little or no development effort; it is a Non-development item (NDI) and the full maintainability programme as described in this standard will not be required. However, the principles laid down in the standard can be applied as required, by tailoring the maintainability programme to suit the needs of the project.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60300. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60300 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 60050(191), *International Electrotechnical Vocabulary (IEV) – Chapter 191: Dependability and quality of service*

IEC 60300-1, *Dependability management – Part 1: Dependability programme management*

IEC 60300-2:1995, *Dependability management – Part 2: Dependability programme elements and tasks*

IEC 60300-3 (all sections), *Dependability management – Part 3: Application guide*

IEC 60300-3-2, *Dependability management – Part 3: Application guide – Section 2: Collection of dependability data from the field*

IEC 60300-3-3, *Dependability management – Part 3: Application guide – Section 3: Life cycle costing*

IEC 60300-3-9, *Dependability management – Part 3: Application guide – Section 9: Risk analysis of technological systems*

IEC 60300-3-11, *Dependability management – Part 3-11: Application guide – Reliability centred maintenance*

IEC 60706 (all parts), *Guide on maintainability of equipment*

IEC 60706-2, *Guide on maintainability of equipment. Part 2 – Section Five: Maintainability studies during the design phase*

IEC 60706-3, *Guide on maintainability of equipment. Part 3 – Sections Six and Seven. Verification and collection, analysis and presentation of data*

IEC 60706-4, *Guide on maintainability of equipment – Part 4 – Section 8: Maintenance and maintenance support planning*

IEC 60706-5, *Guide on maintainability of equipment – Part 5: Section 4: Diagnostic testing*

IEC 60812, *Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)*

IEC 60863, *Presentation of reliability, maintainability and availability predictions*

IEC 61025, *Fault tree analysis (FTA)*

IEC 61160:1992, *Formal design review*
Amendment 1 (1994)

3 Definitions and acronyms

For the purposes of this standard, the definitions given in IEC 60050(191) and the following apply.

3.1 Definitions

3.1.1

maintainability (performance)

the ability of an item under given conditions of use, to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources

NOTE The term "maintainability" is also used as a measure of maintainability performance (see 191-13-01).

[IEV 191-02-07]

3.1.2**maintainability**

the probability that a given active maintenance action, for an item under given conditions of use can be carried out within a stated time interval, when the maintenance is performed under stated conditions and using stated procedures and resources

NOTE The term "maintainability" is also used to denote the maintainability performance quantified by this probability (see 191-02-07).

[IEV 191-13-01]

3.1.3**maintenance**

the combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function

[IEV 191-07-01]

3.1.4**maintenance echelon (line of maintenance)**

a position in an organization where specified levels of maintenance are to be carried out on an item

NOTE 1 Examples of maintenance echelons are: field, repair shop, manufacturer.

NOTE 2 The maintenance echelon is characterized by the skill of the personnel, the facilities available, the location, etc.

[IEV 191-07-04]

3.1.5**level of maintenance**

the set of maintenance actions to be carried out at a specified indenture level

NOTE Examples of a maintenance action are replacing a component, a printed circuit board, a subsystem, etc.

[IEV 191-07-06]

3.1.6**maintenance concept**

application of a general maintenance policy to a specific item

3.1.7**maintenance policy**

general interrelationship between levels of maintenance, lines of maintenance and maintenance conditions to be applied for the maintenance of an item

3.1.8**provisioning**

process of determining and acquiring the range and quantity (depth) of spares and repair parts, and support and test equipment required to operate and maintain a product for an initial period of service

3.1.9**supportability**

degree to which system design characteristics and planned logistic resources, including manpower, meet system operational utilization requirements

3.2 Acronyms

ATE	automatic test equipment
BIT	built-in test
BITE	built-in test equipment
DI	development item
FMEA	fault modes and effects analysis
FMECA	fault modes, effects and criticality analysis
FTA	fault tree analysis
LCC	life cycle cost
LRU	line replaceable unit
MAMT	mean active maintenance time
MTTR	mean time to repair (or restoration or recovery)
NDI	non development item
RCM	reliability centred maintenance

4 Maintainability overview

4.1 General

Maintainability is the ease, economy, safety and accuracy with which the necessary maintenance of a product can be undertaken and can be measured either in terms of a probability or in the level of resources required to maintain the item. It therefore has a direct effect on the ability of a product to satisfy the performance required from it. Maintenance is the action taken to retain or restore that ability.

This distinction is seen in the definitions of maintainability and maintenance extracted from IEC 60050(191) in clause 3.

In the design of a product, the designer should consider how the system and its component parts will have to be maintained. Maintainability and the achievement of performance objectives are therefore directly affected by design activities and decisions.

The need for designers to consider how people interact with systems and equipment requires that factors such as industrial safety, human factors and ease of access are also addressed in the design process.

In order to integrate these factors into the associated areas of maintenance support, the provision of spare parts, technical publications, training, etc., a maintainability programme should be developed. Such a programme consists of a systematic and deliberate set of tasks which need to be integrated with design activities, and is an essential part of the dependability programme, which plays a crucial role in the overall management of the project.

4.2 Product life cycle

Clause 4 of IEC 60300-2 explains the life cycle of a product from concept to disposal. The life cycle costs are strongly influenced by maintenance requirements and these should be fully considered at each stage of the life cycle. Such consideration is critical to ultimately achieving the required maintainability targets or required profit margins. If the maintainability targets are not achieved, the availability of a product, and possibly its economic or operational viability, will be adversely affected. Each life cycle phase is discussed in the following clauses.