

Maintainability of equipment —

Part 5: Guide to diagnostic testing

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee QMS/23, Reliability and maintainability systems, upon which the following bodies were represented:

- AEA Technology
- Association of Consulting Engineers
- Association of Project Managers
- British Gas plc
- British Railways Board
- British Telecommunications plc
- City University
- Civil Aviation Authority
- Consumers' Association
- Cranfield University
- Design Council
- Electricity Association
- Federation of the Electronics Industry
- GAMBICA (BEAMA Ltd.)
- Institute of Quality Assurance
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- Institution of Electrical Engineers
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- London Underground Ltd.
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- Royal Institution of Chartered Surveyors
- Royal Statistical Society
- Safety and Reliability Society
- Society of Environmental Engineers
- Society of Motor Manufacturers and Traders Limited
- University of Bradford
- University of Technology, Loughborough
- West Midlands Enterprise Board

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National foreword

This Part of BS 6548 has been prepared by Technical Committee QMS/23, Reliability and maintainability systems. It is identical with IEC 706-5:1994 *Guide on maintainability of equipment — Part 5-4: Diagnostic testing*, published by the International Electrotechnical Commission (IEC).

Five Parts of this Standard have been published and these may be summarized as follows.

Part 1: Guide to specifying and contracting for maintainability. This Part introduces the concept of maintainability and provides guidance on the definition of maintainability requirements and on the programmes needed to achieve them.

Part 2: Guide to maintainability studies during the design phase. This Part provides guidance on studies that should be carried out during the design phase and on the relationship of these studies to maintainability and maintenance support tasks. The purpose of the studies is to assist design decision making, to predict the quantitative maintainability characteristics of an item and to help in the evaluation of alternative design options.

Part 3: Guide to maintainability, verification and the collection, analysis and presentation of maintainability data. This Part provides guidance on the various aspects of verification necessary to ensure that specified maintainability requirements have been met and outlines suitable procedures and test methods. Guidance is also given on the collection, analysis and presentation of maintainability data.

Part 4: Guide to the planning of maintenance and maintenance support. This Part provides guidance on the planning of maintenance and maintenance support during the system acquisition phase to ensure that availability objectives are met in the operational phase. The interrelationships with reliability and maintainability programmes are also described.

Part 5: Guide to diagnostic testing. This Part provides guidance on the consideration of testability characteristics during the design and development of equipment. It will assist in determining effective test procedures as an integral part of operation and maintenance.

Further Parts are envisaged in order to provide guidance on other techniques of maintainability management. At present one further Part is in the process of being drafted and this is as follows.

Part 6: Guide to statistical procedures in maintainability. This Part will provide guidance on statistical methods for use when allocating maintainability requirements to the various parts of a system, and when carrying out maintainability demonstrations and evaluations.

Guidance on many studies closely related to maintainability is also contained in the various Parts of BS 5760 *Reliability of systems, equipment and components*.

Many terms used in this standard are defined in BS 4778 *Quality vocabulary — Section 3.1 Guide to concepts and related definitions*.

Cross-references

International standard	Corresponding British Standard
IEC 50 (191):1990	BS 4778 <i>Quality vocabulary</i> Section 3.2:1991 <i>Glossary of international terms</i> (Identical)
IEC 706-3:1987	BS 6548 <i>Maintainability of equipment</i> Part 3:1992 <i>Guide to maintainability, verification and the collection, analysis and presentation of maintainability data</i> (Identical)
ISO 3534-1:1993	BS ISO 3534 <i>Statistics. Vocabulary and symbols</i> Part 1:1993 <i>Probability and general statistical terms</i> (Identical)

The Technical Committee has reviewed the provisions of IEC 812, to which normative reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. A related British Standard to IEC 812:1985 is BS 5760 *Reliability of systems, equipment and components — Part 5:1991 Guide to failure modes, effects and criticality analysis (FMEA and FMECA)*.

Reference to Sections of IEC 706

The various Parts of IEC 706 each contain one or more Sections. References to these Sections are sometimes made in the text. The Sections are reproduced in the Parts of BS 6548 as follows.

IEC 706 Section number and title	Corresponding Part of BS 6548
<i>Section 1 Introduction to maintainability</i>	BS 6548-1
<i>Section 2 Maintainability requirements in specifications and contracts</i>	BS 6548-1
<i>Section 3 Maintainability programme</i>	BS 6548-1
<i>Section 4 Diagnostic testing</i>	BS 6548-5
<i>Section 5 Maintainability studies during the design phase</i>	BS 6548-2
<i>Section 6 Maintainability verification</i>	BS 6548-3
<i>Section 7 Collection, analysis and presentation of data related to maintainability</i>	BS 6548-3
<i>Section 8 Maintenance and maintenance support planning</i>	BS 6548-4
<i>Section 9 Statistical methods in maintainability evaluation</i>	Planned for publication in BS 6548-6

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 14, 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.

Introduction

Diagnostic testing is an important feature in the operation and maintenance of a system or equipment and has a significant effect on its maintainability. Such testing may be carried out manually or with test equipment which may contain various levels of automation. Optimum design of a diagnostic testing process requires close cooperation between the design, operation and maintenance organizations. This guide is intended to highlight the various requirements and to assist in their timely coordination.

1 Scope

This International Standard is being issued as Section 4 of the guide on maintainability of equipment. Its purpose is to:

- provide guidance for the early consideration of testability aspects in design and development;

NOTE The design of an item should facilitate and support diagnostic testing, and this can be achieved most efficiently by considering testability aspects as early as possible in the design process, usually in conjunction with a fault mode and effects analysis (FMEA). If left till later project phases, when the design has been finalized, only very limited testability features may be added. These will be less effective and will involve disproportionately high costs.

- assist in determining effective test procedures as an integral part of operation and maintenance.

NOTE The operational and maintenance concept will depend to a certain extent on the design philosophy, and therefore to ensure that full use can be made of the diagnostic testing possibilities, test requirements should be included in the operational and maintenance policy and be developed as an integral part of the design process.

This section of IEC 706 is applicable to all categories of equipment in their concept and principles, although many of the techniques described are clearly more applicable to the electrical and electronic fields, as it is in those areas where there is the greatest opportunity for them to be applied. For mechanical equipment, the traditional diagnostic techniques can still be used, but here too the advances being made in electronic measuring and monitoring devices mean that much improved diagnostic testing facilities can now be applied to mechanical components and complex systems. This makes it particularly important that the structured approach given for the provision of diagnostic testing facilities is used for a wide range of tasks.

Reference is made in this section to condition monitoring. This is a facility which closely relates to the concepts covered in this guide on diagnostic testing, and cannot, and should not, be dissociated from it. However, it is not the intention that full coverage of condition monitoring should be part of this standard.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 706-5. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 706-5 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50(191):1990, *International Electrotechnical Vocabulary (IEV) — Chapter 191: Dependability and quality of service*.

IEC 706-3:1987, *Guide on maintainability of equipment — Part 3: Sections 6 and 7 — Verification and collection, analysis and presentation of data*.

IEC 812:1985, *Analysis techniques for system reliability — Procedure for failure mode and effects analysis (FMEA)*.

ISO 3534-1:1993, *Statistics — Vocabulary and symbols — Part 1: Probability and general statistical terms*.

3 Definitions and acronyms

3.1 Definitions

For the purposes of this section of IEC 706-5, the terms and definitions of IEC 50(191) and ISO 3534-1 apply. In addition, the following terms and definitions are used.

3.1.1

built-in test (BIT)

an intrinsic capability of the mission system or equipment which provides a test capability to recognize and localize faults or deterioration of performance

3.1.2

built-in test equipment (BITE)

any permanently mounted device intended to perform the built-in test function

3.1.3

diagnosis

the art or act of deciding from symptoms the nature of a fault

3.1.4

diagnostic correctness

the proportion of faults of an item which can be correctly diagnosed under given conditions