

Maintainability of equipment —

Part 4: Guide to the planning of maintenance and maintenance support

Committees responsible for this British Standard

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- AEA Technology
- Association of Consulting Engineers
- Association of Project Managers
- British Gas plc
- British Railways Board
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- Civil Aviation Authority
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National foreword

This Part of BS 6548 has been prepared under the direction of the Quality Management and Statistics Standards Policy Committee. It is identical with IEC 706-4:1992 *Guide on maintainability of equipment — Part 4: Section 8 — Maintenance and maintenance support planning*, published by the International Electrotechnical Commission (IEC).

Four 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.

Further Parts are envisaged in order to provide guidance on other techniques of maintainability management. At present two further Parts are in the process of being drafted, and these are as follows.

Part 5: Guide to diagnostic testing. This Part will provide 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.

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) ^a	BS 4778 <i>Quality vocabulary</i> Section 3.2. <i>Glossary of international terms</i> (Identical)
IEC 812 ^a	BS 5760 <i>Reliability of systems, equipment and components</i> Part 5: <i>Guide to failure modes, effects and criticality analysis (FMEA and FMECA)</i> (Technically equivalent)

^a IEC 50(191) and IEC 812 are not listed as normative references but are quoted in the text.

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>	Planned for publication in 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 procedures in maintainability</i>	Planned for publication in BS 6548-6

Additional information. As this is a guide, where the words “shall” and “must” appear implying a requirement, they should be read as “should”.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 18, 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

It is generally recognized that a strong relationship exists between the areas of maintainability and maintenance. Achieving an item's maintainability objectives during the operational phase is largely dependent on appropriate maintenance and maintenance support procedures, and the provision of adequate maintenance resources. Efforts to reduce the active maintenance time by maintainability programme activities (see IEC 706-1, Section 3) should be accompanied by corresponding efforts to reduce the non-active maintenance time elements caused by technical, logistic and administrative delays. This presupposes adequate efforts in maintenance and maintenance support planning by developing the maintenance concept, performing maintenance planning analyses (repair level analysis, identification and analysis of maintenance tasks) and determining the maintenance support resource requirements (personnel and training, technical manuals, test and support equipment, spare parts provisioning, facilities).

Maintenance and maintenance support resources have a major influence on the life cycle costs (LCC) of an item, which should be considered throughout the planning process. Maintainability and maintenance support planning tasks should therefore be closely coordinated and performed iteratively.

It should be noted that the above activities are equally applicable to complex systems as to consumer products. However, the extent and depth of performing the various tasks will vary greatly with the application. Maturity of technology, complexity and risks involved in not meeting operational requirements should be considered when selecting the tasks for a particular application. The aim should be to select a minimum number of tasks to satisfy the need. Users may have their own maintenance support organization and systems with which new system/equipment should be compatible. Such constraints should be stated in the maintainability requirements.

1 Scope

This section of the guide describes the tasks required for planning of maintenance and maintenance support. They should be performed during the system acquisition phase in order to meet the availability objectives in the operational phase. The interfaces between reliability, maintainability and the maintenance support planning programme and their tasks are also described.

2 Terms, definitions and acronyms

Terms and definitions in this guide deviate from those of Chapter 191: Dependability and quality of service, of the International Electrotechnical Vocabulary (IEV). They will, however, be aligned on the recommendations of IEC 50(191) at a future revision comprising all parts of IEC 706.

The following acronyms are used in this standard:

FMEA	Fault Mode and Effects Analysis (IEV (50)191-16-03)
LCC	Life Cycle Cost
MSA	Maintenance Support Analysis
RCM	Reliability Centred Maintenance
RLA	Repair Level Analysis
SMR	Source, Maintenance and Recoverability
TM	Technical Manual
TI	Technical Information

3 Planning for maintenance and maintenance support in the design process

3.1 General

To bring a system efficiently into operation and to maintain it in the long term at an optimum life cycle cost, it is necessary to plan maintenance and maintenance support activities, and acquire the necessary resources. These activities start early in the concept and development phase and continue throughout the succeeding life cycle phases. The objectives in planning the maintenance and maintenance support activities are as follows:

- develop a maintenance concept, and integrate maintenance and maintenance support requirements into system requirements;
- determine the impact of the system maintainability design in terms of maintenance support requirements and optimize the maintenance concept;
- define maintenance support requirements and a maintenance plan;
- specify the necessary resources.

3.2 Maintenance concept

The development of a new system/equipment starts with the definition of operational requirements. The development of the maintenance concept follows, and provides a common basis for the definition of those maintainability and maintenance support requirements which best suit the design and satisfy its operational requirements. The development of the maintenance concept is one of the most important steps in the system acquisition cycle because it initiates maintenance and maintenance support planning, responsibility for which may be separated from that for maintainability engineering. The maintenance concept describes a plan for system/equipment maintenance and maintenance support in an operational environment in terms of:

- criteria for choosing lines and levels of maintenance;
- policies and requirements for basic maintenance support (logistics);
- criteria for monitoring and test equipment (built-in, automatic, monitoring).

In order to optimize a design and achieve the lowest life cycle costs, the maintenance concept and maintainability requirements should be developed in parallel.

3.3 Maintenance support planning

The purpose of this task is to develop the maintenance support programme plan and the means of controlling and reviewing the programme. A maintenance support plan should be prepared describing the following:

- management structure and responsibilities for the maintenance support programme;
- interfaces with other engineering programmes and tasks including interfaces with data resulting from these tasks: design, reliability, maintainability, human engineering, safety, standardization;
- methods of reviewing the design from the maintenance support point of view;
- identification of each task, its extent and depth, and how it will be performed;
- methods by which maintenance support related requirements will be disseminated to designers, contractors and subcontractors;
- methods and procedures for control of a programme and design review.

4 Maintenance support analysis

The specific tasks which are part of the maintenance support analysis (MSA) and which are performed in an iterative way throughout the acquisition cycle are described in this clause. The selection of these tasks, and their extent and depth for a particular application will vary with the programme needs and constraints. These tasks can be divided into the following general groups:

- use (mission) and maintenance support system definition;
- preparation and evaluation of maintenance support alternatives.

The documentation of MSA shall include all data resulting from analyses and other tasks, and shall provide maintenance support design data. It shall specify means of verifying maintenance support decisions and provide the basis for acquisition of resources. When the supplier performs MSA, provision of the data to the customer should be specified in the contract.

4.1 Use and maintenance support system definition

The purpose of the following tasks is to establish objectives for maintenance support and maintenance support related design.

4.1.1 Use study

Studies should be made on the use of the proposed system/equipment and should consider the following:

- operational pattern;
- environment;
- service life;
- human capabilities and limitations.

Pertinent maintenance support factors related to the intended use shall be identified and documented. Field visits should be made to those operational units and maintenance support activities which most closely represent the planned operational and maintenance support environment. Maintenance support factors relevant to the intended use of new system/equipment, quantitative data and field visit reports shall be documented.