

Australian Standard™

Dependability management

**Part 3.14: Application guide—
Maintenance and maintenance support**



This Australian Standard was prepared by Committee QR-005, Dependability. It was approved on behalf of the Council of Standards Australia on 8 April 2005. This Standard was published on 5 May 2005.

The following are represented on Committee QR-005:

AirServices Australia
Australian Organisation for Quality
Department of Defence (Australia)
Engineers Australia
The University of New South Wales

Additional Interests:

Australian Bankers Association
Australian Chamber of Commerce and Industry
Australian Electrical and Electronic Manufacturers Association
Australian Industry Group
Australian Nuclear Science & Technology Organisation
Certification Interests (Australia)
Commonwealth Department of Transport and Regional Services
Energy Supply Association of Australia
Federal Chamber of Automotive Industries
Federation of Automotive Products Manufacturers
QSA International

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about Standards can be found by visiting the Standards Web Shop at www.standards.com.au and looking up the relevant Standard in the on-line catalogue.

Alternatively, the printed Catalogue provides information current at 1 January each year, and the monthly magazine, *The Global Standard*, has a full listing of revisions and amendments published each month.

Australian Standards™ and other products and services developed by Standards Australia are published and distributed under contract by SAI Global, which operates the Standards Web Shop.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.org.au, or write to the Chief Executive, Standards Australia, GPO Box 5420, Sydney, NSW 2001.

This Standard was issued in draft form for comment as DR 04320.

STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS IEC 60300.3.14—2005

Dependability management

Part 3.14: Application guide—Maintenance and maintenance support

RECONFIRMATION NOTICE

Technical Committee QR-005 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 07 December 2015.

The following are represented on Technical Committee QR-005:

Asset Management Council
Australian Industry Group
Department of Defence (Australian Government)
Engineers Australia
Independent Transport Safety & Reliability Regulator
Institution of Professional Engineers New Zealand
New Zealand Institute of Safety Management
New Zealand Society for Risk Management
Risk Management Institution of Australasia
The University of New South Wales
University of Wollongong

NOTES

Australian Standard™

Dependability management

Part 3.14: Application guide— Maintenance and maintenance support

First published as AS IEC 60300.3.14—2005.

COPYRIGHT

© Standards Australia

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Published by Standards Australia GPO Box 5420, Sydney, NSW 2001, Australia

ISBN 0 7337 6668 4

PREFACE

This Standards was prepared by Standards Australia Committee QR-005, Dependability.

It is identical with, and has been reproduced from, IEC 60300-3-14, Ed.1.0 (2004), *Dependability management, Part 3-14: Application guide—Maintenance and maintenance support*.

‘Dependability’ is a collective term for performance characteristics (reliability, availability, maintainability) of simple or complex products and systems. This Standard is part of the AS IEC 60300 series of dependability management Standards, which provide general guidelines for establishing a dependability management system to meet most organizational or project needs, supported by a ‘tool kit’ of non-prescriptive standards on a range of dependability application guidelines and methods, and outlines maintenance and maintenance support process as a major component of dependability.

The objective of this Standard is to provide an outline of the maintenance, maintenance support and management processes and techniques that can be applied to achieve adequate dependability and meet operational needs throughout the life cycle of systems, products and equipment.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
- (b) The page numbers do not correspond to the IEC dual language (English/French) version.
- (c) In the source text ‘this part of IEC 60300’ should read ‘this Australian Standard’.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
IEC		AS IEC	
60300	Dependability management	60300	Dependability management
60300-1	Part 1: Dependability systems management	60300.1	Part 1: Dependability systems management
60300-2	Part 2: Guidelines for dependability management	60300.2	Part 2: Guidelines for dependability management
60300-3-3	Part 3-3: Application guide – Life cycle costing	60300.3.3	Part 3.3: Application guide – Life cycle costing
60300-3-10	Part 3-10: Application guide – Maintainability	60300.3.10	Part 3.10: Application guide – Maintainability
60300-3-11	Part 3-11: Application guide – Reliability centred maintenance	60300.3.11	Part 3.11: Application guide – Reliability centred maintenance
60300-3-12	Part 3-12: Application guide – Integrated logistic support	60300.3.12	Part 3.12: Application guide – Integrated logistic support

Only international references identical to Australian or Australian/New Zealand Standards have been listed.

The term ‘informative’ has been used in this Standard to define the application of the annex to which it applies. An ‘informative’ annex is only for information and guidance.

CONTENTS

	<i>Page</i>
1 Scope	1
2 Normative references	1
3 Terms, definitions and acronyms	2
3.1 Terms and definitions	2
3.2 Acronyms	5
4 Maintenance and maintenance support overview	5
4.1 Life cycle aspects	5
4.1.1 General	5
4.1.2 Scenarios for maintenance and maintenance support	6
4.1.3 Concept and definition phase	7
4.1.4 Design and development phase	7
4.1.5 Manufacturing phase	8
4.1.6 Installation phase	8
4.1.7 Operation and maintenance phase	8
4.1.8 Disposal phase	9
4.2 Description of maintenance	9
4.2.1 General	9
4.2.2 Maintenance policy and concept	9
4.2.3 Indenture levels	10
4.2.4 Maintenance echelons	10
4.2.5 Preventive and corrective maintenance	10
4.3 Description of maintenance support	11
5 Management responsibility	11
5.1 Management commitment	11
5.2 Customers	12
5.3 Maintenance policy	12
5.4 Planning of maintenance and maintenance support	12
5.5 Responsibility, authority and communication	12
6 Maintenance process implementation	13
6.1 General	13
6.2 Maintenance management	13
6.3 Maintenance and maintenance support planning	14
6.3.1 General	14
6.3.2 Determination of maintenance support	15
6.3.3 Maintenance task identification	16
6.3.4 Maintenance task analysis	17
6.3.5 Identification of maintenance support resources	17
6.4 Maintenance preparation	18
6.5 Maintenance execution	18
7 Resource management	19
7.1 Provision of resources	19
7.2 Human resources	19
7.2.1 General	19

7.2.2	Training	20
7.3	Infrastructure	20
7.3.1	General	20
7.3.2	Support equipment	21
7.3.3	Built-in test equipment (BITE)	22
7.3.4	Maintenance facilities	23
7.3.5	Administration and technical facilities	23
7.3.6	Computerized maintenance information systems	24
7.4	Information resources	24
7.4.1	General	24
7.4.2	Documentation	24
7.4.3	Maintenance information	26
7.5	Materials and spare parts	28
7.5.1	General	28
7.5.2	Spare parts quantification	28
7.5.3	Spare parts identification	30
8	Measurement, analysis and improvement	30
8.1	General	30
8.2	Monitoring and measurement	30
8.2.1	General	30
8.2.2	Customer-related measurement	30
8.2.3	Maintenance-related measurement	31
8.3	Maintenance assessment	31
8.4	Maintenance improvement	32
8.5	Modifications	32
Annex A (informative)	Factors affecting maintenance and maintenance support	33
Bibliography		36
Figure 1 – Maintenance and maintenance support during the life cycle		6
Figure 2 – Interrelationship of maintenance terms		9
Figure 3 – Types of maintenance tasks		11
Figure 4 – Maintenance processes		13
Figure 5 – Maintenance and maintenance support planning process		15
Figure 6 – Spare parts provisioning process		29

INTRODUCTION

The provision of maintenance and maintenance support is a key element in ensuring the dependability of items (products, equipment and systems) throughout their life cycle. Proper functionality, capability and dependability performance are achieved by providing the necessary maintenance and maintenance support in conjunction with appropriate design, quality manufacturing, and sound operating practices.

The amount and type of maintenance and maintenance support depends on customer needs, the nature of the item, its condition, required availability and other factors. As these factors change, especially during the operation and maintenance phase, maintenance and maintenance support may need to be adjusted.

A number of different functions, such as maintenance management and asset management, include maintenance and maintenance support. This standard does not preclude their use, but does indicate what should be addressed under these headings.

Inadequate, excessive or incorrect maintenance can cause failures, which may significantly reduce the availability of items and result in greatly increased cost due to loss of performance and possible secondary damage. The reduced availability often produces operational penalties and a consequent loss of revenue, which can be significantly greater than the cost of maintenance or even the cost of the original failure. Safety may also be affected and in some industries this may be the most important consideration.

This standard provides a more general approach to maintenance and maintenance support than used in integrated logistic support (ILS). ILS is a method by which all logistic support services are considered and provided for customers as an integral part of product development. This standard addresses the case for complex systems where maintenance and maintenance support need to be adjusted to specific situations during both the design phase and the operation and maintenance phase.

NOTES

STANDARDS AUSTRALIA

Australian Standard
Dependability management**Part 3.14: Application guide—Maintenance and maintenance support**

1 Scope

This part of IEC 60300 describes a framework for maintenance and maintenance support and the various minimal common practices that should be undertaken. The purpose of this standard is to outline, in a generic manner, management, processes and techniques related to maintenance and maintenance support that are necessary to achieve adequate dependability to meet the operational needs of the customer.

NOTE 1 Maintenance and maintenance support are a major element of dependability as described in IEC 60300-1 and IEC 60300-2.

In some cases, regulatory and other mandatory requirements need to be considered. Maintenance and maintenance support requirements and obligations may therefore need to be specified in a contract, which cites this standard.

This standard is intended for use by a wide range of suppliers, maintenance support organizations and users and can be applied to all items.

This standard is applicable to items, which include all types of products, equipment and systems (hardware and associated software). Most of these require a certain level of maintenance to ensure that their required functionality, dependability, capability, economic, safety and regulatory requirements are achieved.

NOTE 2 For consistency, this standard will use the term “item” as defined in 3.1.5, except where the context requires otherwise.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60300-1:2003, *Dependability management – Part 1: Dependability management systems*

IEC 60300-2:2004, *Dependability management – Part 2: Guidelines for dependability management*

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 60300-3-10, *Dependability management – Part 3-10: Application guide – Maintainability*

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

IEC 60300-3-12, *Dependability management – Part 3-12: Application guide – Integrated logistic support*

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

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 61025, *Fault tree analysis (FTA)*

IEC 61649, *Goodness-of-fit tests, confidence intervals and lower confidence limits for Weibull distributed data*

3 Terms, definitions and acronyms

3.1 Terms and definitions

For the purposes of this document the following definitions apply.

3.1.1

corrective maintenance

maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function

NOTE In French, the term “dépannage” sometimes implies a provisional restoration.

[IEV 191-07-08:1990]

3.1.2

dependability

collective term used to describe the availability performance and its influencing factors: reliability performance, maintainability performance and maintenance support performance

NOTE Dependability is used only for general descriptions in non-quantitative terms.

[IEV 191-02-03:1990]

3.1.3

indenture level

level of subdivision of an item from the point of view of a maintenance action

NOTE 1 Examples of indenture levels could be a subsystem, a circuit board, a component.

NOTE 2 The indenture level depends on the complexity of the item's construction, the accessibility to subitems, skill level of maintenance personnel, test equipment facilities, safety considerations, etc.

[IEV 191-07-05:1990]

3.1.4

integrated logistic support

ILS

management method by which all the logistic support services required by a customer can be brought together in a structured way and in harmony with a product

3.1.5**item**

any part, component, device, subsystem, functional unit, equipment or system that can be individually considered

NOTE 1 An item may consist of hardware, software or both, and may also, in particular cases, include people.

NOTE 2 In French the term “entité” is preferred to the term “dispositif” due to its more general meaning. The term “dispositif” is also the common equivalent to the English term “device”.

NOTE 3 In French the term “individu” is used mainly in statistics.

NOTE 4 A number of items, e.g. a population of items or a sample, may itself be considered as an item.

[IEV 191-01-01:1990]

3.1.6**level of maintenance**

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 191-07-06:1990]

3.1.7**maintainability (performance)**

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 191-02-07:1990]

3.1.8**maintenance**

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 191-07-01:1990]

3.1.9**maintenance action**

maintenance task

sequence of elementary maintenance activities carried out for a given purpose

NOTE Examples are fault diagnosis, fault localization, function check-out, or combinations thereof.

[IEV 191-07-18:1990]

3.1.10**maintenance concept**

interrelationship between the maintenance echelons, the indenture levels and the levels of maintenance to be applied for the maintenance of an item

3.1.11**maintenance echelon**

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 level of skill of the personnel, the facilities available, the location, etc.

[IEV 191-07-04:1990]

3.1.12**maintenance policy**

general approach to the provision of maintenance and maintenance support based on the objectives and policies of owners, users and customers

3.1.13**maintenance support**

resources required to maintain an item under a given maintenance concept and guided by a maintenance policy

NOTE Resources include human resources, support equipment, materials and spare parts, maintenance facilities, documentation, information and maintenance information systems.

3.1.14**maintenance support performance**

ability of a maintenance organization, under given conditions, to provide upon demand, the resources required to maintain an item, under a given maintenance concept and guided by a maintenance policy

NOTE The given conditions are related to the item itself and to the conditions under which the item is used and maintained.

[IEV 191-02-08:1990, modified]

3.1.15**preventive maintenance**

maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item

[IEV 191-07-07:1990]

NOTE 1 Preventive maintenance includes condition-based tasks that consist of condition monitoring, inspection and functional testing.

NOTE 2 Predetermined intervals apply to repair or replacement that are carried out at specific intervals such as elapsed time, operating hours, distance, number of cycles or other relevant measures.

3.1.16**product**

any specified deliverable goods or service

NOTE 1 In the context of dependability, a product may be simple (e.g. a device, a software algorithm) or complex (e.g. a system or an integrated network comprising of hardware, software and human elements and support facilities and activities).

NOTE 2 A product has its own life cycle phases.

3.1.17**scheduled maintenance**

preventive maintenance carried out in accordance with an established time schedule

[IEV 191-07-10:1990]

3.1.18**system**

set of interrelated or interacting elements

[ISO 9000:2000, 3.2.1]

NOTE 1 In the context of dependability, a system will have

- a) a defined purpose expressed in terms of required functions;
- b) stated conditions of operation/use (191-01-12);
- c) defined boundaries.

NOTE 2 The structure of a system may be hierarchical.

3.1.19**testability**

qualitative design characteristic which determines the degree to which an item can be tested under stated conditions

3.1.20**unscheduled maintenance**

maintenance carried out, not in accordance with an established time schedule, but after reception of an indication regarding the state of an item

[IEV 191-07-11:1990]

3.2 Acronyms

ATE	automatic test equipment
BITE	built-in test equipment
CBIT	continuous built-in test
COTS	commercial-off-the-shelf
FMEA	failure mode and effects analysis
FMECA	failure mode, effects and criticality analysis
ILS	integrated logistic support
IBIT	interruptive built-in test
LORA	level of repair analysis
MTBF	mean operating time between failures
MTTF	mean time to failure
POST	power on self test
RCM	reliability centred maintenance
STTE	special to type test equipment

4 Maintenance and maintenance support overview**4.1 Life cycle aspects****4.1.1 General**

Maintenance and maintenance support need to be considered during all phases of the life cycle. The specific tasks that need to be carried out are outlined in this clause and are illustrated in Figure 1.

The major maintenance driver is the initial design, which determines the maintainability of an item. Where an item is designed by one organization and used as part of a larger system or used within different applications or environments, the design of the system has to ensure that the inherent maintainability of the item is not degraded.

The dependability that can be achieved during operation is greatly influenced by decisions that are made during the early phases of the life cycle. Planning for maintenance and maintenance support should be considered as early as possible so that trade-offs can be considered between functional needs, capability, life cycle cost (see IEC 60300-3-3), reliability, maintainability and maintenance support.