

**Dependability management -- Part 3-11: Application
guide - Reliability centred maintenance**

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 60300-3-11:2009 sisaldab Euroopa standardi EN 60300-3-11:2009 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 31.12.2009 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 25.11.2009.

Standard on kättesaadav Eesti standardiorganisatsioonist.

This Estonian standard EVS-EN 60300-3-11:2009 consists of the English text of the European standard EN 60300-3-11:2009.

This standard is ratified with the order of Estonian Centre for Standardisation dated 31.12.2009 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

Date of Availability of the European standard text 25.11.2009.

The standard is available from Estonian standardisation organisation.

ICS 03.100.40, 03.120.01

Standardite reprodutseerimis- ja levitamiseõigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:
Aru 10 Tallinn 10317 Eesti; www.evs.ee; Telefon: 605 5050; E-post: info@evs.ee

Right to reproduce and distribute Estonian Standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without permission in writing from Estonian Centre for Standardisation.

If you have any questions about standards copyright, please contact Estonian Centre for Standardisation:
Aru str 10 Tallinn 10317 Estonia; www.evs.ee; Phone: +372 605 5050; E-mail: info@evs.ee

**Dependability management -
Part 3-11: Application guide -
Reliability centred maintenance
(IEC 60300-3-11:2009)**

Gestion de la sûreté de fonctionnement -
Partie 3-11: Guide d'application -
Maintenance basée sur la fiabilité
(CEI 60300-3-11:2009)

Zuverlässigkeitsmanagement -
Teil 3-11: Anwendungsleitfaden -
Auf die Funktionsfähigkeit bezogene
Instandhaltung
(IEC 60300-3-11:2009)

This European Standard was approved by CENELEC on 2009-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 56/1312/FDIS, future edition 2 of IEC 60300-3-11, prepared by IEC TC 56, Dependability, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60300-3-11 on 2009-09-01.

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) 2010-06-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2012-09-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60300-3-11:2009 was approved by CENELEC as a European Standard without any modification.

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

| | |
|-----------|---|
| IEC 61164 | NOTE Harmonized as EN 61164:2004 (not modified). |
| IEC 61649 | NOTE Harmonized as EN 61649:2008 (not modified). |
| IEC 61709 | NOTE Harmonized as EN 61709:1998 (not modified). |
| IEC 62308 | NOTE Harmonized as EN 62308:2006 (not modified). |
| ISO 9000 | NOTE Harmonized as EN ISO 9000:2005 (not modified). |

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

| <u>Publication</u> | <u>Year</u> | <u>Title</u> | <u>EN/HD</u> | <u>Year</u> |
|--------------------|-----------------|--|---------------|--------------------|
| IEC 60050-191 | 1990 | International Electrotechnical Vocabulary (IEV) - Chapter 191: Dependability and quality of service | - | - |
| IEC 60300-3-2 | - ¹⁾ | Dependability management - Part 3-2: Application guide - Collection of dependability data from the field | EN 60300-3-2 | 2005 ²⁾ |
| IEC 60300-3-10 | - ¹⁾ | Dependability management - Part 3-10: Application guide - Maintainability | - | - |
| IEC 60300-3-12 | - ¹⁾ | Dependability management - Part 3-12: Application guide - Integrated logistic support | EN 60300-3-12 | 2004 ²⁾ |
| IEC 60300-3-14 | - ¹⁾ | Dependability management - Part 3-14: Application guide - Maintenance and maintenance support | EN 60300-3-14 | 2004 ²⁾ |
| IEC 60812 | - ¹⁾ | Analysis techniques for system reliability - Procedure for failure mode and effects analysis (FMEA) | EN 60812 | 2006 ²⁾ |

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

CONTENTS

| | |
|---|----|
| FOREWORD..... | 4 |
| INTRODUCTION..... | 6 |
| 1 Scope..... | 7 |
| 2 Normative references..... | 7 |
| 3 Terms, definitions and abbreviations..... | 7 |
| 3.1 Definitions..... | 8 |
| 3.2 Abbreviations..... | 11 |
| 4 Overview..... | 11 |
| 4.1 General..... | 11 |
| 4.2 Objectives..... | 12 |
| 4.3 Types of maintenance..... | 14 |
| 5 RCM initiation and planning..... | 15 |
| 5.1 Objectives for conducting an RCM analysis..... | 15 |
| 5.2 Justification and prioritization..... | 16 |
| 5.3 Links to design and maintenance support..... | 16 |
| 5.4 Knowledge and training..... | 17 |
| 5.5 Operating context..... | 17 |
| 5.6 Guidelines and assumptions..... | 18 |
| 5.7 Information requirements..... | 19 |
| 6 Functional failure analysis..... | 20 |
| 6.1 Principles and objectives..... | 20 |
| 6.2 Requirements for definition of functions..... | 20 |
| 6.2.1 Functional partitioning..... | 20 |
| 6.2.2 Development of function statements..... | 20 |
| 6.3 Requirements for definition of functional failures..... | 21 |
| 6.4 Requirements for definition of failure modes..... | 21 |
| 6.5 Requirements for definition of failure effects..... | 22 |
| 6.6 Criticality..... | 22 |
| 7 Consequence classification and RCM task selection..... | 23 |
| 7.1 Principles and objectives..... | 23 |
| 7.2 RCM decision process..... | 23 |
| 7.3 Consequences of failure..... | 26 |
| 7.4 Failure management policy selection..... | 26 |
| 7.5 Task interval..... | 27 |
| 7.5.1 Data sources..... | 27 |
| 7.5.2 Condition monitoring..... | 28 |
| 7.5.3 Scheduled replacement and restoration..... | 29 |
| 7.5.4 Failure finding..... | 30 |
| 8 Implementation..... | 30 |
| 8.1 Maintenance task details..... | 30 |
| 8.2 Management actions..... | 30 |
| 8.3 Feedback into design and maintenance support..... | 30 |
| 8.4 Rationalization of tasks..... | 33 |
| 8.5 Implementation of RCM recommendations..... | 34 |
| 8.6 Age exploration..... | 34 |
| 8.7 Continuous improvement..... | 34 |

| | |
|---|----|
| 8.8 In-service feedback | 35 |
| Annex A (informative) Criticality analysis | 37 |
| Annex B (informative) Failure finding task intervals..... | 40 |
| Annex C (informative) Failure patterns | 42 |
| Annex D (informative) Application of RCM to structures | 44 |
| Bibliography | 47 |
| Figure 1 – Overview of the RCM process..... | 12 |
| Figure 2 – Evolution of an RCM maintenance programme..... | 14 |
| Figure 3 – Types of maintenance tasks | 15 |
| Figure 4 – Relationship between RCM and other support activities..... | 17 |
| Figure 5 – RCM decision diagram..... | 25 |
| Figure 6 – P-F Interval | 28 |
| Figure 7 – ILS management process and relationship with RCM analysis..... | 32 |
| Figure 8 – Risk versus cost considerations for rationalization of tasks | 33 |
| Figure 9 – RCM continuous improvement cycle..... | 35 |
| Figure C.1 – Dominant failure patterns | 42 |
| Table A.1 – Example of a criticality matrix | 39 |
| Table C.1 – Failure pattern categories and frequency of occurrence | 43 |

Preview generated by EVS

INTRODUCTION

Reliability centred maintenance (RCM) is a method to identify and select failure management policies to efficiently and effectively achieve the required safety, availability and economy of operation. Failure management policies can include maintenance activities, operational changes, design modifications or other actions in order to mitigate the consequences of failure.

RCM was initially developed for the commercial aviation industry in the late 1960s, resulting in the publication of ATA-MGS-3 [1]². RCM is now a proven and accepted methodology used in a wide range of industries.

RCM provides a decision process to identify applicable and effective preventive maintenance requirements, or management actions, for equipment in accordance with the safety, operational and economic consequences of identifiable failures, and the degradation mechanism responsible for those failures. The end result of working through the process is a judgement as to the necessity of performing a maintenance task, design change or other alternatives to effect improvements.

The basic steps of an RCM programme are as follows:

- a) initiation and planning;
- b) functional failure analysis;
- c) task selection;
- d) implementation;
- e) continuous improvement.

All tasks are based on safety in respect of personnel and environment, and on operational or economic concerns. However, it should be noted that the criteria considered will depend on the nature of the product and its application. For example, a production process will be required to be economically viable, and may be sensitive to strict environmental considerations, whereas an item of defence equipment should be operationally successful, but may have less stringent safety, economic and environmental criteria.

Maximum benefit can be obtained from an RCM analysis if it is conducted at the design stage, so that feedback from the analysis can influence design. However, RCM is also worthwhile during the operation and maintenance phase to improve existing maintenance tasks, make necessary modifications or other alternatives.

Successful application of RCM requires a good understanding of the equipment and structure, as well as the operational environment, operating context and the associated systems, together with the possible failures and their consequences. Greatest benefit can be achieved through targeting of the analysis to where failures would have serious safety, environmental, economic or operational effects.

² Figures in square brackets refer to the bibliography.

DEPENDABILITY MANAGEMENT –

Part 3-11: Application guide – Reliability centred maintenance

1 Scope

This part of IEC 60300 provides guidelines for the development of failure management policies for equipment and structures using reliability centred maintenance (RCM) analysis techniques.

This part serves as an application guide and is an extension of IEC 60300-3-10, IEC 60300-3-12 and IEC 60300-3-14. Maintenance activities recommended in all three standards, which relate to preventive maintenance, may be implemented using this standard.

The RCM method can be applied to items such as ground vehicles, ships, power plants, aircraft, and other systems which are made up of equipment and structure, e.g. a building, airframe or ship's hull. Typically, equipment comprises a number of electrical, mechanical, instrumentation or control systems and subsystems which can be further broken down into progressively smaller groupings, as required.

This standard is restricted to the application of RCM techniques and does not include aspects of maintenance support, which are covered by the above-mentioned standards or other dependability and safety standards.

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 60050-191:1990, *International Electrotechnical Vocabulary – Chapter 191: Dependability and quality of service*

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

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

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

IEC 60300-3-14, *Dependability management – Part 3-14: Application guide – Maintenance and maintenance support*

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

3 Terms, definitions and abbreviations

For the purposes of this document, the terms and definitions of IEC 60050-191 apply, together with the following.