

INTERNATIONAL STANDARD

IEC 60812

Second edition
2006-01

Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number
IEC 60812:2006(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site** (www.iec.ch)

- **Catalogue of IEC publications**

The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

This summary of recently issued publications (www.iec.ch/online_news/justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

Email: custserv@iec.ch
Tel: +41 22 919 02 11
Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

IEC 60812

Second edition
2006-01

Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA)

© IEC 2006 Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE

X

For price, see current catalogue

CONTENTS

FOREWORD.....	7
1 Scope.....	11
2 Normative references	11
3 Terms and definitions	11
4 Overview	15
4.1 Introduction	15
4.2 Purpose and objectives of the analysis.....	17
5 Failure modes and effects analysis.....	19
5.1 General considerations.....	19
5.2 Preliminary tasks.....	21
5.3 Failure mode, effects, and criticality analysis (FMECA)	41
5.4 Report of analysis	55
6 Other considerations	59
6.1 Common-cause failures	59
6.2 Human factors	59
6.3 Software errors	61
6.4 FMEA regarding consequences of system failure	61
7 Applications.....	61
7.1 Use of FMEA/FMECA	61
7.2 Benefits of FMEA	65
7.3 Limitations and deficiencies of FMEA	65
7.4 Relationships with other methods.....	67
Annex A (informative) Summary of procedures for FMEA and FMECA	71
Annex B (informative) Examples of analyses.....	79
Bibliography.....	93
Figure 1 – Relationship between failure modes and failure effects in a system hierarchy	25
Figure 2 – Analysis flowchart	39
Figure 3 – Criticality matrix	47
Figure A.1 – Example of the format of an FMEA worksheet.....	77
Figure B.1 – FMEA for a part of automotive electronics with RPN calculation.....	81
Figure B.2 – Diagram of subsystems of a motor generator set	83
Figure B.3 – Diagram of enclosure heating, ventilation and cooling systems	85
Figure B.4 – FMEA for sub-system 20.....	87
Figure B.5 – Part of a process FMECA for machined aluminium casting.....	91

Table 1 – Example of a set of general failure modes 29

Table 2 – Illustrative example of a severity classification for end effects 35

Table 3 – Risk/criticality matrix 49

Table 4 – Failure mode severity 51

Table 5 – Failure mode occurrence related to frequency and probability of occurrence 51

Table 6 – Failure mode detection evaluation criteria 53

Table 7 – Example of a set of failure effects (for a motor vehicle starter) 57

Table 8 – Example of a failure effects probability 57

Table B.1 – Definition and classification of the severity of the effects of failures on the complete M-G system 83

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ANALYSIS TECHNIQUES FOR SYSTEM RELIABILITY –
PROCEDURE FOR FAILURE MODE
AND EFFECTS ANALYSIS (FMEA)**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60812 has been prepared by IEC technical committee 56: Dependability.

This second edition cancels and replaces the first edition published in 1985 and constitutes a technical revision.

The main changes from the previous edition are as follows:

- introduction of the failure modes effects and criticality concepts;
- inclusion of the methods used widely in the automotive industry;
- added references and relationships to other failure modes analysis methods;
- added examples;
- provided guidance of advantages and disadvantages of different FMEA methods.



SAI GLOBAL

This is a free 6 page sample. Access the full version online.

The remainder of this document
is available for purchase online at

www.saiglobal.com/shop

SAI Global also carries a wide range of publications from a wide variety of Standards Publishers:



SAI GLOBAL



Click on the logos to search the database online.