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Vodenje zanesljivosti - 3-10. del: Navodilo za uporabo - Vzdrževalnost in vzdrževanje

Dependability management - Part 3-10: Application guide - Maintainability and maintenance

Gestion de la sûreté de fonctionnement - Partie 3-10: Guide d'application - Maintenabilité et maintenance

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<https://standards.iteh.ai/catalog/standards/sist/191565c5-a6e1-4bcf-87f2-a60dd80b6b9e/osist-pr-en-iec-60300-3-10-2024>

ICS:

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21.020	Značilnosti in načrtovanje strojev, aparatov, opreme	Characteristics and design of machines, apparatus, equipment

oSIST prEN IEC 60300-3-10:2024 **en**



56/2007/CDV

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<input checked="" type="checkbox"/> SUBMITTED FOR CENELEC PARALLEL VOTING Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	<input type="checkbox"/> NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE: Dependability management – Part 3-10: Application guide – Maintainability and maintenance
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PROPOSED STABILITY DATE: 2024

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

DEPENDABILITY MANAGEMENT –

**Part 3-10: Application guide –
Maintainability and maintenance**

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International Standard IEC 60300-3-10 has been prepared by IEC technical committee 56:Dependability.

This second edition cancels and replaces the first edition published in 2001. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) **More guidance is included on establishing a maintenance programme**
- b) **Some guidance on support and supportability has been removed and is covered in IEC 60300-3-14**

The text of this International Standard is based on the following documents:

FDIS	Report on voting
56/XX/FDIS	56/XX/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

The National Committees are requested to note that for this document the stability date is **20XX**.

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Document Preview

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1 INTRODUCTION

2 This document provides guidance on how to identify and apply appropriate analysis and
3 assurance techniques for maintainability (and maintenance).

4 Maintainability relates to the ease and speed with which an item can be retained in, or restored
5 to, a state to perform as required. Maintainability is concerned with the time and resources to
6 undertake maintenance actions in a defined context.

7 For software, maintainability is the ease with which the software can be modified without major
8 reverse engineering or redesign to address faults and changing needs. The purpose of software
9 maintenance is to retain the value of software over time.

10 Maintenance actions are those necessary to retain or restore an item to a state to perform as
11 required. The relative ease and economy of maintenance actions relates to the total economic
12 impact resulting from the actions' frequency, timing, and duration.

13 An important part of the cost of an item over its life is the total resources spent on the tasks
14 necessary to maintain it in a satisfactory condition. This is related to the number of tasks needed
15 and their complexity and duration. An item that can be maintained easily and is supported by a
16 competent and efficient maintenance organization has a greater availability and a reduced life
17 cycle cost compared to one that does not have these attributes.

18 This standard provides managers and technical professionals involved in specification, design,
19 development, manufacture, acceptance and use of products and services with guidance on how
20 to achieve, analyse and assure maintainability and maintenance effectiveness.

21 Guidance in this standard can be used at any time during the life cycle of an item or project for
22 the planning and implementation of a maintainability or maintenance programme.

23 The activities described within this standard can form part of an organization's asset
24 management or quality management strategy and can therefore be aligned to, and consistent
25 with, the organizational objectives.

26 The maintainability and maintenance programme content described in this document can be
27 tailored to suit the needs of the application. Maintainability and maintenance programmes can
28 be conducted independently or as one integrated programme.

29 This document is one of the 'top level' interrelated dependability standards that provides
30 managers and technical personnel with guidance on how to effectively plan and implement
31 dependability activities. Other documents in the suite are:

- 32 – IEC 60300-1 which highlights the importance and benefits of managing dependability. It
33 gives guidance on dependability activities and how to integrate them into an existing
34 management system and life cycle processes.
- 35 – IEC 60300-3-4 which provides guidance for writing dependability requirements in
36 specifications together with a means of assuring the achievement of those requirements.
- 37 – IEC 60300-3-14 which provide guidance on how to identify and apply appropriate analysis
38 and assurance techniques for supportability (and support).
- 39 – Standards to cover reliability and availability, which are planned.

DEPENDABILITY MANAGEMENT –

Part 3-10: Application guide – Maintainability and maintenance

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1 Scope

47 This part of IEC 60300 gives guidance to managers and technical and financial personnel on
48 the basic principles of maintainability and maintenance activities that are applicable to any
49 organization..

50 This document describes:

- 51 – the value and nature of maintainability and maintenance characteristics;
- 52 – the interfaces between maintainability and related dependability attributes of reliability and
53 supportability, as well as potential trade-offs that can be made through the interfaces during
54 the life cycle of an item;
- 55 – the elements of maintainability and maintenance programmes;
- 56 – the application of maintainability and maintenance programmes throughout the life cycle;
- 57 – assurance of meeting maintainability and maintenance requirements;
- 58 – maintainability and maintenance data and information management.

59 This document is applicable to equipment, software, services, or structures, and gives guidance
60 on matters of common interest to any business supplying, purchasing or sustaining products,
61 services, or structures.

2 Normative references

63 The following documents are referred to in the text in such a way that some or all of their content
64 constitutes requirements of this document. For dated references, only the edition cited applies.
65 For undated references, the latest edition of the referenced document (including any
66 amendments) applies.

67 IEC 60050-192:2015, *International Electrotechnical Vocabulary (IEV) – Part 192: Dependability*

3 Terms, definitions and abbreviations

69 For the purposes of this document, the terms and definitions given in IEC 60050-192 and the
70 following apply.

71 ISO and IEC maintain terminological databases for use in standardization at the following
72 addresses:

- 73 – IEC Electropedia: available at <http://www.electropedia.org/>
- 74 – ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Terms and definitions

3.1.1 item

78 subject being considered

79 Note 1 to entry: The item may be an individual part, component, device, functional unit, equipment, subsystem, or
80 system.

81 Note 2 to entry: The item may consist of hardware, software, people or any combination thereof.

82 Note 3 to entry: The item is often comprised of elements that may each be individually considered.

83 [SOURCE: IEC 60050-192:2015, 192-01-01, modified – Notes 4 and 5 to entry have been
84 omitted]

85 3.1.2

86 off-the-shelf

87 OTS

88 item commercially available for purchase and use without the need to conduct development
89 activities

90 Note 1 to entry: Sometimes referred to as COTS (commercial off-the-shelf) or MOTS (modified off-the-shelf).

91 3.1.3

92 indenture level

93 level of sub-division within a system hierarchy

94 EXAMPLE System, subsystem, assembly and component.

95 Note 1 to entry: From the maintenance perspective, the indenture level depends upon various factors, including the
96 complexity of the item's construction, the accessibility of sub items, skill level of maintenance personnel, test
97 equipment facilities, and safety considerations.

98 [SOURCE: IEC 60050-192:2015, 192-01-05]

99 3.1.4

100 maintenance support

101 provision of resources to maintain an item

102 Note 1 to entry: Resources include human resources, support equipment, materials and spare parts, maintenance
103 facilities, documentation and information, and maintenance information systems.

104 3.1.5

105 line of maintenance

106 position in an organization where specified levels of maintenance are to be carried out

107 EXAMPLE 1st line - field; 2nd line – repair shop; 3rd line - manufacturer's facility.

108 Note 1 to entry: Maintenance echelon is characterized by the level of skill of the personnel, the facilities available,
109 the location, etc.

110 [SOURCE: IEC 60050-192:2015, 192-06-03]

111 3.1.6

112 maintenance concept

113 definition of the maintenance objectives, line of maintenance, indenture levels, maintenance
114 levels, maintenance support, and their interrelationships

115 Note 1 to entry: The maintenance concept of an item provides the basis for maintenance planning, determining
116 supportability requirements, and developing logistic support.

117 [SOURCE: IEC 60050-192:2015, 192-06-02, modified – Term “maintenance policy” has been
118 omitted and term “maintenance concept” used instead in Note 1 to entry”]

119 3.1.7

120 maintenance policy

121 maintenance philosophy

122 intentions and direction of an organization as formally expressed by its top management (as
123 related to maintenance)[SOURCE: ISO 55000:2014, 3.1.18, modified]

124

125

126 **3.1.8**
127 **testability**

128 degree to which an item can be tested

129 [SOURCE: IEC 60050-192:2015, 192-09-20]

130 **3.2 Abbreviations**

131 BIT built-in test

132 BITE built-in test equipment

133 OTS off-the-shelf

134 FMEA failure modes and effects analysis

135 FMECA failure modes, effects and criticality analysis

136 ILS integrated logistic support

137 ILSA integrated logistic support analysis

138 ILSP integrated logistic support plan

139 IPS integrated project support

140 LCC life cycle cost

141 LORA level of repair analysis

142 LRU line replaceable unit

143 MLDT mean logistic delay time

144 MTTM mean time to maintain (preventive tasks)

145 MTTR mean time to restoration (or repair or recovery)

146 MaxTTR maximum time to repair

147 OEM original equipment manufacturer

148 RAM random access memory

149 RCM reliability centred maintenance

150 ROM read-only memory

151 TA task analysis

152 **4 Maintainability and maintenance overview**

153 **4.1 Description of maintainability**

154 Maintainability relates to the ease and speed with which an item can be retained in, or restored
155 to, a state to perform as required. It is a characteristic of the item design, construction,
156 installation, and commissioning. Maintainability is designed into an item for defined user
157 requirements, including the use environment. Improved maintainability can reduce lifecycle cost
158 and support preservation of the item's inherent reliability.

159 Maintainability can be measured as the probability that a given maintenance action, performed
160 under stated conditions, using specified procedures and with defined support, can be completed
161 within a specific time period. This defined support may include personnel with defined
162 competencies, spares, tools, information, facilities, and logistics applied within a defined
163 organizational context.

164 Software differs from hardware in that it does not wear out and faults originate in the
165 specification, design logic or coding process and they can lie hidden until specific input
166 conditions occur. For software, maintainability relates to the ease and speed with which
167 software can be modified to change or add capabilities to correct faults, improve performance
168 or other attributes, or to adapt it to a different environment. From a system perspective, the
169 time to restore a system following a software crash can be an important parameter as this has
170 an immediate impact on operations and customer experience.

171 4.2 Description of maintenance

172 Maintenance is described as the combination of all technical and administrative actions,
173 including supervisory actions, intended to retain an item in, or restore it to, a state in which it
174 can perform as required when required. Maintenance covers preventive and corrective
175 maintenance. Preventive maintenance is the maintenance carried out to mitigate degradation
176 and reduce the probability of failure and corrective maintenance is the maintenance carried out
177 after fault detection to effect restoration.

178 The maintenance tasks necessary to achieve the required availability of an item need to be
179 identified before that maintainability can be fully defined. Not all items are maintained. Some
180 are designed to run to failure, perhaps because maintenance is not cost effective or
181 maintenance is ineffective in reducing the probability of failure modes.

182 Maintenance does not include maintenance support. Maintenance is the action required to
183 maintain, where as maintenance support is all the resources required to maintain the item (see
184 IEC 60300-3-14).

185 Clause 6 through 8 details the specifications and the programmes for maintenance.

186 4.3 Principles

187 Evaluation and control of maintainability and maintenance is founded on a set of principles.
188 These principles should directly influence the intent of, design for, and delivery of an
189 organization's maintenance activity.

190 These principles are as follows. [oSIST prEN IEC 60300-3-10:2024](https://standards.iteh.ai/catalog/standards/sist/191565c5-a6e1-4bcf-87f2-a60dd80b6b9e/osist-pren-iec-60300-3-10-2024)

191 1) Maintenance exists to provide value.

192 Maintenance tasks, and the associated maintainability characteristics of an item, exist to
193 provide value to stakeholders. Value is what is important to the business, reflected in
194 organizational objectives. Value can be tangible, such as increased volume of product, or
195 intangible, such as improved consumer confidence. It can be financial, such as reduced
196 cost to repair an item, or non-financial, such as improved safety.

197 2) Maintainability and maintenance tasks are inherent to a design solution.

198 Maintainability is an inherent characteristic of a design solution. This means that it is a
199 permanent attribute of that design which cannot be improved without a change to the design
200 solution. Maintainability levels and maintenance tasks are inextricably linked such that
201 maintenance tasks become a consequence of the design solution.

202 3) Maintainability can be balanced against other dependability attributes and stakeholder
203 requirements to achieve organizational objectives.

204 Maintainability, reliability, and supportability can be balanced and traded-off to achieve
205 availability, a measure commonly aligned with business success. Dependability attributes
206 can also be balanced and traded-off with other organizational considerations such as cost
207 and assurance level required.

208 4) Maintainability and maintenance activities continue during use to continuously improve and
209 assure that the item continues to meet stakeholder requirements.

210 During the use of an item, the environment, stakeholder requirements and other factors can
 211 change and, thus, continued achievement of maintainability and maintenance effectiveness
 212 will need to be re-evaluated.

213 When applying these principles to develop a maintainability or maintenance programme,
 214 activities should be tailored considering market conditions, item complexity and stakeholder
 215 definition and requirements together with the size and experience of the organization.

216 4.4 Benefits

217 Benefits of controlling maintainability and maintenance include:

- 218 – establishing an appropriate and cost-effective maintenance schedule;
- 219 – providing justified confidence that the maintainability of items will be as required, when
 220 required;
- 221 – understanding and managing the risks of failure or degraded performance in an effective
 222 way to achieve a balance of cost, risk, and performance;
- 223 – enabling maintainability design weaknesses to be identified and improved with consideration
 224 for performance, risk and life cycle cost;
- 225 – providing information and data that enable continual improvement;
- 226 – preserving inherent levels of reliability and safety designed into the item;
- 227 – reduced item down time resulting in improved availability;
- 228 – reduced maintenance effort and related support resources resulting in reduced life cycle
 229 cost;
- 230 – improved timeliness of maintenance delivery;
- 231 – improved quality of maintenance resulting in higher realized levels of reliability;
- 232 – improved safety of maintenance personnel through improved access and ergonomics;
- 233 – improved sustainability by preserving the inherent characteristics of the item and increasing
 234 the life and possibility of re-use.

235 4.5 Interfaces

236 4.5.1 General

237 Dependability is the ability to perform as and when required. Dependability has many attributes
 238 but is usually characterized in terms of reliability, maintainability, supportability, and the
 239 resulting availability. In some cases, other characteristics such as durability and integrity are
 240 also included under the umbrella of dependability. Managing maintainability can improve
 241 dependability by reducing downtime and the level of resource necessary to ensure the item can
 242 perform as required, when required.

243 4.5.2 Effect of maintainability on reliability

244 Reliability is the probability that an item will provide a required function, without failure, for a
 245 given interval (time, operating cycles, distance etc.).

246 In theory, the ease and speed of maintenance of an item has no effect on its reliability. In
 247 practice however, it can affect the quality of maintenance and, in turn, poor quality of
 248 maintenance can reduce reliability below its inherent value. For example, a difficult-to-perform
 249 maintenance task with an unrealistic maintainability target may force hasty maintenance which
 250 can reduce reliability.

251 It is possible that additional maintenance could improve reliability. However, this could increase
 252 maintenance time thus changing the optimal balance of maintenance downtime and availability
 253 intended by the original design.