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Okoljski preskusi - 3-11. del: Spremljajoča dokumentacija in vodila - Izračunavanje nezanesljivosti pogojev v komorah za klimatsko preskušanje

Environmental testing - Part 3-11: Supporting documentation and guidance - Calculation of uncertainty of conditions in climatic test chambers

Umgebungseinflüsse - Teil 3-11: Unterstützende Dokumentation und Leitfaden - Berechnung der Messunsicherheit von Umgebungsbedingungen in Klimaprüfkammern

Essais d'environnement - Partie 3-11: Documentation d'accompagnement et guide - Calcul de l'incertitude des conditions en chambres d'essais climatiques

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OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: <input type="checkbox"/> Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
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TITLE:
Environmental testing - Part 3-11: Supporting documentation and guidance - Calculation of uncertainty of conditions in climatic test chambers

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTAL TESTING –

Part 3-11: Supporting documentation and guidance — Developing a climatic sequential test

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International Standard IEC 60068-3-14 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test.

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

FDIS	Report on voting
XX/XX/FDIS	XX/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

- 92 • reconfirmed,
93 • withdrawn,
94 • replaced by a revised edition, or
95 • amended.
96

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INTRODUCTION

98 The IEC 60068-2 series includes a variety of single and combined climatic condition tests. Some
99 of these tests can give cumulative effects or hysteretic effects, causing the unit-under-test
100 deteriorates, making it more vulnerable to the follow-up tests. Thus, the determination of test
101 sequence can have significant influence to the conclusion of a test.

102 This part of IEC 60068 provides guidance for developing a climatic sequential test for a certain
103 type of product (electrical, electromechanical or electronic equipment and devices, as well as
104 their subassemblies, constituent parts and components). It is written for technicians, engineers
105 and managers in environment testing, and for those who need to understand the results of
106 sequential climatic environment tests.

107 With the increasing importance of the IEC Quality Assessment System for Electronic
108 Components (IECQ), it has become necessary to define the test sequence more precisely than
109 could be done in clause 7 of IEC 60068-1, in order to provide a satisfactory reproducibility of
110 the test. This International Standard describes in detail a composite test specifying a “climatic
111 sequence” for specimens of products, and it includes guidance in informative annexes for
112 specification writers and those performing the test.

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ENVIRONMENTAL TESTING –

Part 3-14: Supporting documentation and guidance — Developing a climatic sequential test

119 1 Scope

120 This part of IEC 60068-3 describes a generic process for developing a climatic sequential test
121 programme by sequencing the test methods selected from IEC 60068-2 series. The generic
122 process comprises a systematic approach to the development of a sequential environmental
123 test programme. The process is applicable to electrical product, and can be customized
124 according to specific product requirements and applications. The process is designed for use
125 by both product suppliers and purchasers. The full process is particularly relevant to electrical
126 products, which would include products containing any components or material that have the
127 potential to degrade, as a consequence of environmental exposure.

128 2 Normative references

129 There are no normative references in this document.

130 3 Terms and definitions

131 For the purposes of this document, the following terms and definitions apply.

132 ISO and IEC maintain terminological databases for use in standardization at the following
133 addresses:

- 134 • IEC Electropedia: available at <http://www.electropedia.org/>
- 135 • ISO Online browsing platform: available at <http://www.iso.org/obp>

136 3.1 137 cumulative effects

138 permanently remained consequences of environmental conditions imposed on a product after
139 the environmental exposures are removed

140 3.2 141 hysteretic effects

142 gradually attenuated consequences of an environmental condition after the environmental
143 exposure are removed

144 3.3 145 Life Cycle Environmental Profile 146 LCEP

147 design and test decision baseline document outlining real-world environmental conditions that
148 a product or component will experience during usage-related events (e.g., transportation,
149 storage, operational usage, maintenance) from its release/ manufacturing to the end of its
150 useful life

151 4 Background

152 4.1 Environmental exposure sequence in life cycle

153 When exposed to environmental conditions, products will be influenced by the surrounding
154 environment. The influence is related to the environmental severity, the mechanism of
155 environment effect to the product and the initial state. To provide confidence that a product is
156 capable of surviving and operating in the environmental conditions which will encounter during
157 its life cycle, it is necessary to evaluate the product against those conditions. As far as
158 practicable, such evaluations need to consider all environmental conditions and their sequence
159 the product can experience during its life cycle. An environmental test programme should, as
160 far as practicable, replicate the usage environment and expose the product to the environmental
161 conditions so that the product would experience from the point of manufacture to the end of its
162 life. The environmental conditions that exist during storage, transportation, handling and
163 operation should be contained.

164 See IEC 60721-1, IEC 60721-2 and IEC 60721-3 for the classification of environmental
165 conditions.

166 **4.2 Failure mechanism under a sequential test**

167 The environmental worthiness assessment of products is generally conducted by serial
168 laboratory environmental tests according to a specified environmental test programme. See IEC
169 60721-4 for guidance for the correlation and transformation of environmental condition classes
170 to the environmental tests. While a specimen is exposed to one environmental test, its state
171 changes somehow. The changes can be some permanent damages due to the previous
172 environment exposed onto the specimen, or some remaining effects by the previous
173 environmental exposure, which will disappear gradually in a long duration.

174 When an environmental test programme is to be specified for a particular product, the sequence
175 in which tests are carried out is important. That is because damage or effect, initiated by the
176 previous environmental test, will not probably become apparent or significant, until another is
177 applied. Specifically, a product can survive from an environmental test programme if the test is
178 carried out in one particular order, but fail if carry out the test in another order. Therefore, the
179 order in which environmental tests are undertaken, should ideally reflect the order in which they
180 appear in the life cycle. In practice, it is usually not possible to exactly reproduce every aspect
181 of a product life cycle, as environmental exposure can vary, especially during operational
182 conditions.

183 **5 Introduction to the Process**

184 **5.1 General**

185 The process to develop a climatic environmental test sequence, as set out in this document, is
186 considered in three stages:

- 187 a) Stage 1: review environmental requirements of products and compile a provisional
188 sequence;
- 189 b) Stage 2: establish critical environments, based upon knowledge and refine sequence;
- 190 c) Stage 3: prepare a technically reliable, cost-effective sequential test programme.

191 **5.2 Stage 1: review environmental requirements and compile a provisional test 192 sequence**

193 Stage 1 of the process, considers the product usage requirements to establish a provisional
194 environmental sequence. Generally, the requirements of specific concerns are; the product life
195 cycle, usually contained within the technical requirement, as well as the product environmental
196 requirements. Together these can be used to generate a provisional list of environmental
197 requirements and sequence. At this stage, the environmental sequence will comprise a list of
198 environmental conditions arising from each phase of the product life cycle. This provisional
199 environmental sequence will be extensive, with many similar environmental conditions
200 appearing within a number of different phases, of the life cycle.

201 **5.3 Stage 2: establish critical environments and refine sequence**

202 Stage 2 of the process, refines the provisional environmental sequence to eliminate
203 unnecessary repetition of environmental conditions, as well as consider the effects of the
204 sequence and of potential product failure modes. The elimination of unnecessary repetition of
205 environmental conditions is achieved by consideration of the operational state. For example,
206 the environmental conditions occurring when the product is packaged and non-operational,
207 have the potential to be merged.

208 It is possible for coincident environmental conditions to have an effect on the product, which is
209 greater than the case if they are applied separately. **In such cases, the coincident environmental
210 conditions sometimes have a synergistic effect. If the synergistic effect is likely to be significant
211 for a particular product, consideration should be given to undertaking combined environmental
212 testing.**

213 In parallel, consideration of the potential failure modes of the product, should allow a sequential
214 order of the environmental conditions to be established. For example, if temperature variation
215 testing degrades seals and joints, allowing moisture around to pass through these seals and

216 joints when the product is exposed to a damp heat condition, the temperature variation test
 217 should be done before the humidity test. Conversely, when moisture penetrates into electrical
 218 box during the humidity test, a following low temperature test can cause the test sample to
 219 condense or freeze inside. It is for this reason that recursive and iterative philosophy (so called
 220 “shake it, bake it and shake it again”) to refine test sequence is generally the keyword
 221 throughout the whole process to develop a test programme. Stage 2 of the process, also
 222 considers the environmental conditions which need to be considered as part of a sequential
 223 programme and those than can be considered separately, as non-sequential tests.

224 **5.4 Stage 3: prepare sequential test programme**

225 Stage 3 of the process considers the environmental sequence generated by the preceding
 226 stages and then generates a technically reliable, cost-effective test programme. Having
 227 identified the appropriate sequences of environments these can be converted into a test
 228 programme. This should also consider the need to include appropriate functional testing of the
 229 product during and after the testing as well as the need for any post-test destructive or non-
 230 destructive inspection. In certain cases, greater technical credibility and cost effectiveness can
 231 be achieved by modifying the sequence, to allow more effective use and time. Although, such
 232 modifications should not override the order identified in Stage 2, some adjustments can still be
 233 achieved.

234 **5.5 Overall process**

235 The overall process is illustrated in Table 1 and is discussed in detail hereinafter.

236 **Table 1 – The process to develop an environmental test sequence**

Stage	Task	Sub-Task
1	review requirements and compile a provisional test sequence	evaluate life cycle
		evaluate environmental requirements
		compile provisional lists of critical environments
2	establish critical environments, based upon knowledge of product and refine test sequence	consideration of the operational state of the product
		identification of potential failure modes
		review sensitivity of the product to sequential environmental conditions
		identify need for combined testing, and refine test programme
3	prepare a sequential test programme	consideration of sequential and non-sequential testing
		review programme for technical credibility and cost effectiveness

237 **6 Stage 1: review requirements and compile provisional test sequence**

238 **6.1 Evaluate product life cycle**

239 Consideration of the product life cycle should have occurred as part of the exercise to generate
 240 the environmental requirements document. The environmental requirements document should
 241 reflect the predominant phases of the life cycle. However, a product life cycle can contain
 242 multiple iterations of some events, such as the product has the potential to be transported
 243 several times in its entire life. As a consequence, even a well-constructed environmental
 244 requirements document should be considered alongside the life cycle, when identifying all the
 245 sequential conditions the particular equipment experiences.

246 The product life cycle can also be used to identify whether changes in logistics and operational
 247 usage will occur in the future. For example, one type of transport vehicle can be replaced by
 248 another. Even when information of future potential environmental conditions is not known,
 249 identifying the possibility permits the management of potential consequences. It is also
 250 necessary to consider a worst-case usage to future proof against unknown usage requirements.

251 **6.2 Evaluate environmental requirements**

252 **6.2.1 Identify major phases**

253 The information in the environmental requirements document can be presented in several ways.
 254 Whichever approach is used, the logistical and operational requirements should be broken down