

Classification of environmental conditions —

**Part 4-7: Guidance for the correlation
and transformation of environmental
condition classes of IEC 60721-3 to the
environmental tests of IEC 60068 —
Portable and non-stationary use**

ICS 19.040

National foreword

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Classification des conditions d'environnement –

Partie 4-7:

**Guide pour la corrélation et la transformation
des classes de conditions d'environnement
de la CEI 60721-3 en essais d'environnement
de la CEI 60068 –
Utilisation en déplacement**

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to the environmental tests of IEC 60068 –
Portable and non-stationary use**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

**Part 4-7: Guidance for the correlation and transformation
of environmental condition classes of IEC 60721-3
to the environmental tests of IEC 60068 –
Portable and non-stationary use**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60721-4-7, which is a technical report, has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
104/63/CDV	104/113/RVC

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until 2002.
At this date, the publication will be

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- withdrawn;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

This document which is purely informative is not to be regarded as an International Standard.

INTRODUCTION

It is essential to emphasise the guidance nature of this report since it is virtually impossible to specify mandatory requirements for worldwide use. However, for those cases which require different tests from those recommended in this report, the guidance given should establish principles and methodology to determine alternative tests.

Transformation guidance is provided where the parameters used to define conditions in IEC 60721-3-7 are different from those used to define the tests and/or the severities in IEC 60068-2.

The reasons for correlation are provided to enable specification writers to modify a test if their application warrants it. Where differences in values of parameters exist between IEC 60721-3-7 and IEC 60068-2, the nearest severities of the IEC 60068-2 test procedures are used. If it is necessary to deviate from an IEC 60068-2 severity, the reasons are detailed in the report and an alternative test is recommended in the tables.

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 4-7: Guidance for the correlation and transformation of environmental condition classes of IEC 60721-3 to the environmental tests of IEC 60068 – Portable and non-stationary use

1 Scope and object

This part of IEC 60721 is a technical report dealing with the correlation and transformation of the conditions given in IEC 60721-3-7 to the environmental tests defined in IEC 60068-2.

An environment may consist of a number of environmental conditions such as dynamic, climatic and biological and other effects due to chemically and mechanically active substances. In this report, only dynamic and climatic conditions have been considered.

The purpose of this technical report is to provide the specification writer with guidance, together with a set of easy-to-use tables which correlate and transform these conditions.

2 Reference documents

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Tests A: Cold*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*

IEC 60068-2-5:1975, *Environmental testing – Part 2: Tests – Test Sa: Simulated solar radiation at ground level*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*

IEC 60068-2-18:1989, *Environmental testing – Part 2: Tests – Test R and guidance: Water*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)*

IEC 60068-2-31:1969, *Environmental testing – Part 2: Tests – Test Ec: Drop and topple, primarily for equipment-type specimens*

IEC 60068-2-32:1975, *Environmental testing – Part 2: Tests – Test Ed: Free fall (Procedure 1)*

IEC 60068-2-55:1987, *Environmental testing – Part 2: Tests – Test Ee and guidance: Bounce*

IEC 60068-2-56:1988, *Environmental testing – Part 2: Tests – Test Cb: Damp heat, steady state, primarily for equipment*

IEC 60068-2-64:1993, *Environmental testing – Part 2: Test methods – Test Fh: Vibration, broad-band, random (digital control) and guidance*

IEC 60721-2-3:1987, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Air pressure*

IEC 60721-2-4:1987, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Solar radiation and temperature*

IEC 60721-3-3:1994, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weather-protected locations*

IEC 60721-3-7:1995, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 7: Portable and non-stationary use*

IEC 60721-4-0, *Classification of environmental conditions – Part 4-0: Guidance for the correlation and transformation of the environmental condition classes of IEC 60721-3 to the environmental tests of IEC 60068 – Introduction¹⁾*

ISO 554:1976, *Standard atmospheres for conditioning and/or testing – Specifications*

ISO 2533:1975, *Standard atmosphere – Addendum 1 (1985), Addendum 2 (1997)*

3 Overview

3.1 General remarks concerning IEC 60721

IEC 60721-3-7 establishes classes of groups of environmental parameters with their associated environmental conditions to which products may be exposed during transportation. Parameters in these classes are given individually, but the product may be exposed to them simultaneously. Some of the parameters are independent whilst others may be strongly correlated, for example, solar radiation and temperature.

3.2 General remarks concerning IEC 60068

IEC 60068-2 establishes a series of environmental test procedures and appropriate test severities. Selection of test severities depends upon the failure consequences of the product. Two types of product may be placed at locations covered by the same environmental class. However, one type of product may be tested under significantly more severe conditions than the other because of its different failure consequences. This report only addresses normal failure consequences; for higher failure consequences, the test severity may need to be increased on the basis of specialist knowledge of the product.

¹⁾ To be published.

3.3 Severities

IEC 60721-3-7 establishes classes of environmental conditions, having a low probability of being exceeded, which cover the extreme short-term conditions to which products may be exposed. The suggested test severities given in the tables of this report take this into account. For further information, refer to IEC 60721-4-0, which serves as an introduction to the IEC 60721-4 series.

3.4 Recommended tests

In the following tables two types of test are shown. The first details the equivalent IEC 60068-2 test using the nearest recommended severities. The second is the recommended test method and severities, which are considered to be more suitable for testing most electrotechnical products.

3.5 Dynamic considerations

The product is frequently moved from place to place. During transfer, there is no special packaging for the product. The total transfer time may amount to a significant portion of the product's lifetime. The product is not permanently mounted on any structure or placed at a fixed site. The product may be operated while being either in a stationary or in a transfer state.

Vibration levels and frequency ranges stated in table 6 of IEC 60721-3-7 refer to the structural parts of the location. Products for portable and non-stationary use are not normally rigidly connected to these, and the nature of the specific equipment and location shall be considered if these data are used for the design of a test specification.

The effects of these classes therefore require the absence of tethers or other means of fixing the equipment to the testing table. Vertical vibration accelerations greater than approximately 10 m/s^2 will result in effects akin to "bounce", the methodology of which is described in IEC 60068-2-55, method A, with a peak acceleration of $1,1 g_n$ to $1,2 g_n$. This implies the lack of specified fixing points for the product. IEC 60068-2-6 and IEC 60068-2-64 require that fixing points are determined for the specimen under test; the user shall therefore define these points prior to vibration testing.

3.6 Environmental tests for portable and non-stationary use

The classes of portable and non-stationary use specify the environmental conditions to which portable products are subjected whilst being used, including periods of transfer, down time, maintenance and repair. Environmental conditions created by co-located products within an enclosure are not included in these classes.

The relevant specification should specify when, during the environmental test programme, the product is in its operational state, and which performance requirements should be measured before, during and after the test, together with the failure criteria.

3.7 Test durations

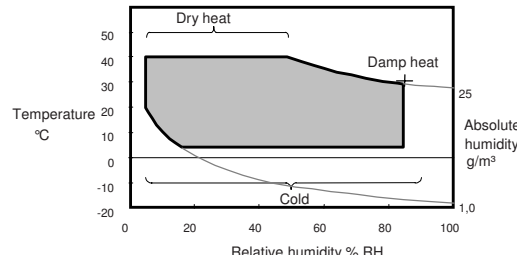
The durations recommended in tables 1 to 7 are selected on the basis that experience has shown them to be sufficient to demonstrate the effect of the condition on most products. However, the user may change these values if experience of a specific application warrants it. To assist the user, the notes associated with the tables in this report explain why the recommended duration was chosen.

3.8 Ambient

The term "ambient" which is used for some recommended tests refers to the standard atmospheric conditions described in 5.3.1 of IEC 60068-1, that is, between 15 °C and 35 °C and from 25 % to 75 % RH with a maximum absolute humidity of 22 g/m³ and at air pressure between 86 kPa and 106 kPa. Details of the standard atmospheric conditions are provided in ISO 2533 and its addenda, whilst a summary is provided in IEC 60721-2-3. A "reference condition" for testing is described in ISO 554.

4 Climatic conditions

Table 1 – Recommended tests for IEC 60721-3-7 – Class 7K1
(use at enclosed, temperature-controlled location, humidity is not controlled)

IEC 60721-3-7 – Climatic conditions		IEC 60068-2 – Climatic tests				
Environmental parameter	Class 7K1	Nearest IEC 60068-2		Recommended test		Note No.
		Test method	Severity	Test method	Severity	
 Class 7K1 climatogram				x) Dry heat 60068-2-2: Bb/Bd y) Cold 60068-2-1: Ab/Ad z) Damp heat 60068-2-56: Cb	+40 °C, 16 h +5 °C, 16 h +30 °C, 85 % RH, 96 h	1), 2) 1), 2) 1), 3)
a) Low air temperature	+5 °C	As recommended test		See above		
b) High air temperature	+40 °C	As recommended test		See above		
c) Low relative humidity	5 %	As recommended test		See above		
d) High relative humidity	85 %	As recommended test		See above		
e) Low absolute humidity	1 g/m³	As recommended test		See above		
f) High absolute humidity	25 g/m³	As recommended test		See above		
g) Rapid change of temperature	+5 °C/ +25 °C	As recommended test		60068-2-14: Na	+5 °C to ambient, five cycles <i>t</i> ₁ = 3 h, <i>t</i> ₂ = <3 min	4)
h) Low air pressure	70 kPa	60068-2-13: M	70 kPa, 30 min	Test normally not required – See note 5)		5)
i) High air pressure	106 kPa	No IEC 60068-2 test		Test normally not required – See note 6)		6)
j) Rate of change of pressure	Negligible	No IEC 60068-2 test		Test normally not required – See note 7)		7)
k) Solar radiation	700 W/m²	60068-2-5: Sa Procedure C	1 120 W/m², 72 h, +40 °C	Add 10 °C to the dry heat test and evaluate materials for photochemical reactions		8)
l) Heat radiation User selection from 7Z1,7Z2 or 7Z3		No IEC 60068-2 test		Test normally not required – See note 9)		9)
m) Movement of surrounding air User selection from 7Z4, 7Z5, 7Z6 or 7Z7		No IEC 60068-2 test		Test normally not required – See note 10)		10)
n) Condensation	Yes	No IEC 60068-2 test		60068-2-30: Db Variant 2	+40 °C, 90 % to 100 % RH Two cycles	11)

o) Precipitation (rain, snow, hail, etc.)	No					
p) Rain intensity	No					
q) Low rain temperature	No					
r) Water from sources other than rain User selection from 7Z8, 7Z9, 7Z10, 7Z11, 7Z12 or 7Z13		No IEC 60068-2 test		60068-2-18: Ra or Rb	See note 12)	12)
s) Formation of ice and frost	No					
NOTE "No" in the class column means that no IEC 60721-3-7 condition is specified.						

Explanatory notes for table 1 – Class 7K1

Remark – As described in IEC 60721-3-7, products in this class will also meet the requirements of classes 2K1 and 3K3.

- 1) For testing products against the conditions of the climatogram, only three tests are normally used:
 - dry heat test, where the relative humidity shall not exceed 50 % but is not specifically controlled;
 - cold test, where humidity is not controlled;
 - damp heat test, steady state, where both temperature and humidity are controlled.

These are shown as tests x, y and z in the climatogram. Other boundary conditions of the climatogram are not required to be tested and there are no IEC 60068-2 tests available.

- 2) The test temperature is equivalent to the environmental parameter of IEC 60721-3-7 for this class. The choice of the duration of 16 h is considered to be sufficient for most heat-dissipating specimens to demonstrate that their design is adequately tolerated to function at this temperature. IEC 60721-3-3 includes a special condition of +55 °C. If this special condition is applicable to the product, an alternative test of +55 °C for 16 h is recommended.
- 3) These severities are equivalent to the environmental parameter of IEC 60721-3-7 for this class. The duration of 96 h is considered to be sufficient for most heat-dissipating specimens to demonstrate that their design is adequately tolerated to function at this humidity.
- 4) The change of temperature test is normally used to check design tolerancing and the range is not important. Ambient conditions, as described in 3.8, are proposed as the upper temperature to allow the single-chamber method to be used, thus making the test economical to perform. The duration t_1 and number of cycles is specified in test Na of IEC 60068-2-14.

- 5) For sealed products or for products containing/processing liquids, test M of IEC 60068-2-13 is recommended. For normal applications where the effect of air pressure is evaluated at the component level, no test is recommended.
- 6) No test is recommended. There is no IEC 60068-2 test method for this condition, which is considered benign for most products.
- 7) No test is recommended. There is no IEC 60721-3-7 severity value or IEC 60068-2 test method for this condition which is considered benign for most products.
- 8) The IEC 60068-2-5 procedure C test for simulating the effects of solar radiation at ground level has been chosen since it produces continuous irradiation thus allowing photo-degradation effects to be assessed. Although the severity of this class is 700 W/m², the only Sa test condition of IEC 60068-2-5 is for a solar radiation value of 1 120 W/m².

Solar tests are not considered satisfactory, since it is difficult to replicate the actual radiation experienced in practice. It is recommended that this condition should be evaluated by increasing the temperature of the dry heat test by 10 °C and evaluating materials and components for photochemical reactions. For more information, see IEC 60721-4-0.

With this level of solar radiation, surface temperatures may be as high as 25 °C above ambient. Surface temperature can also fall at night due to heat irradiation (see IEC 60721-2-4). These effects should be taken into account when selecting materials and a reduced temperature test should be considered for the low temperature test (test Ab/Ad).

Products may be protected against the effect of solar radiation, for example, by the fitting of efficient heat shields, in which case the elevated temperature for the dry heat test can be omitted, or reduced in severity, depending on the effectiveness of the precautions. It should be normal practice to model such precautions in order to give confidence in the ability of the product to resist the effect of solar radiation.