

Classification of environmental conditions —

**Part 4-3: Guidance for the correlation
and transformation of environmental
condition classes of IEC 60721-3 to the
environmental tests of IEC 60068 —
Stationary use at weatherprotected
locations**

ICS 19.040; 19.080

National foreword

This Published Document reproduces verbatim IEC TR 60721-4-3:2001, including amendment 1:2003.

The UK participation in its preparation was entrusted to Technical Committee GEL/104, Environmental conditions, classification and testing, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

This Published Document, having been prepared under the direction of the Electrotechnical Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 18 March 2002

Summary of pages

This document comprises a front cover, an inside front cover, the IEC TR title page, pages 2 to 59 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments
14605	30 September 2003	Addition of Annex A and Annex B

© BSI 30 September 2003

ISBN 0 580 39099 3

**RAPPORT
TECHNIQUE
TECHNICAL
REPORT**

**CEI
IEC**

TR 60721-4-3

Première édition
First edition
2001-03

AMENDMENT 1
2003-05

Classification des conditions d'environnement –

Partie 4-3:

**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 à poste fixe, protégé contre
les intempéries**

Classification of environmental conditions –

Part 4-3:

**Guidance for the correlation and transformation
of environmental condition classes of IEC 60721-3
to the environmental tests of IEC 60068 –**

Stationary use at weatherprotected locations



Numéro de référence
Reference number
CEI/IEC/TR 60721-4-3:2001

CONTENTS

FOREWORD	3
INTRODUCTION	5
1 Scope and object	6
2 Reference documents	6
3 Overview	7
3.1 General remarks concerning IEC 60721	7
3.2 General remarks concerning IEC 60068	7
3.3 Severities	7
3.4 Recommended tests	7
3.5 Environmental tests for in-use classes	8
3.6 Test durations	8
3.7 Ambient	8
4 Climatic conditions	9
5 Dynamic conditions	19
Annex A Stationary use at weather-protected locations – Climatic conditions	24
Annex B Stationary use at weather-protected locations – Dynamic conditions	54
Table 1 – Recommended tests for IEC 60721-3-3 – Class 3K2	9
Table 2 – Recommended tests for IEC 60721-3-3 – Class 3K3	11
Table 3 – Recommended tests for IEC 60721-3-3 – Class 3K4	13
Table 4 – Recommended tests for IEC 60721-3-3 – Class 3K5	15
Table 5 – Recommended tests for IEC 60721-3-3 – Class 3K6	17
Table 6 – Recommended tests for IEC 60721-3-3 – Class 3M1	19
Table 7 – Recommended tests for IEC 60721-3-3 – Class 3M2	20
Table 8 – Recommended tests for IEC 60721-3-3 – Class 3M3	21
Table 9 – Recommended tests for IEC 60721-3-3 – Class 3M4	22
Table 10 – Recommended tests for IEC 60721-3-3 – Class 3M6	23
Table A.1 – Recommended tests for IEC 60721-3-3 – Class 3K1	24
Table A.2 – Recommended tests for IEC 60721-3-3 – Class 3K7	26
Table A.3 – Recommended tests for IEC 60721-3-3 – Class 3K7L	30
Table A.4 – Recommended tests for IEC 60721-3-3 – Class 3K8	34
Table A.5 – Recommended tests for IEC 60721-3-3 – Class 3K8H	38
Table A.6 – Recommended tests for IEC 60721-3-3 – Class 3K8L	42
Table A.7 – Recommended tests for IEC 60721-3-3 – Class 3K9	46
Table A.8 – Recommended tests for IEC 60721-3-3 – Class 3K10	50
Table B.1 – Recommended tests for IEC 60721-3-3 – Class 3M5	54
Table B.2 – Recommended tests for IEC 60721-3-3 – Class 3M7	56
Table B.3 – Recommended tests for IEC 60721-3-3 – Class 3M8	58

INTERNATIONAL ELECTROTECHNICAL COMMISSION

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 4-3: Guidance for the correlation and transformation of environmental condition classes of IEC 60721-3 to the environmental tests of IEC 60068 – Stationary use at weatherprotected locations

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.
- 2) The formal decisions or agreements of the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this technical report may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 60721-4-3, 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
104/59/CDV	104/109/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 60721-3-3 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 60721-3-3 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 4-3: Guidance for the correlation and transformation of environmental condition classes of IEC 60721-3 to the environmental tests of IEC 60068 – Stationary use at weatherprotected locations

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 60721-3-3 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 60068-2-29:1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

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

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

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

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 weatherprotected locations*

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 – Introduction*¹⁾

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 60721-3-3 establishes classes of groups of environmental parameters with their associated environmental conditions to which the products may be exposed during use. 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.

3.3 Severities

IEC 60721-3-3 establishes classes of environmental conditions which have a low probability of being exceeded, covering the extreme short-term conditions to which the 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.

¹⁾ To be published.

3.5 Environmental tests for in-use classes

The in-use classes specify environmental conditions to which the product is exposed whilst being used, including assembly, non-operational state, maintenance and repair. Environmental conditions created by co-located equipment within an enclosure are not included in this class.

The relevant specification should detail 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.

3.6 Test durations

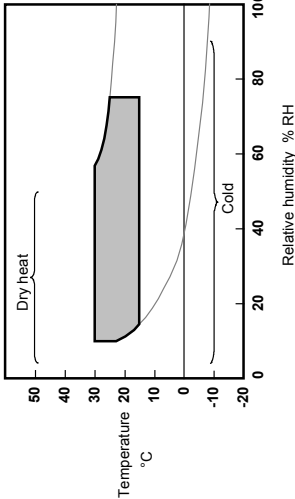
The durations recommended in tables 1 to 10 are selected on the basis that experience has shown them to be sufficient to demonstrate the effect of the condition on most products. However, the user may change these values if experience of specific applications warrants it. To assist the user, the notes associated with the tables in this report explain why the recommended duration was chosen.

3.7 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 60721-3-3 – Class 3K2
(continuously temperature-controlled enclosed locations, humidity not controlled)

IEC 60721-3-3 – Climatic conditions		IEC 60068-2 – Climatic tests				
Environmental parameter	Class 3K2	Nearest IEC 60068-2		Recommended test		Note No.
		Test method	Severity	Test method	Severity	
 Class 3K2 climatogram				x) Dry heat 60068-2-2: Bb/Bd y) Cold 60068-2-1: Ab/Ad z) Damp heat 60068-2-56: Cb	+30 °C, 16 h None None	1), 2) 3) 3)
a) Low air temperature	+15 °C	As recommended test			See above	
b) High air temperature	+30 °C	As recommended test			See above	
c) Low relative humidity	10 %	As recommended test			See above	
d) High relative humidity	75 %	As recommended test			See above	
e) Low absolute humidity	2 g/m ³	As recommended test			See above	
f) High absolute humidity	22 g/m ³	As recommended test			See above	
g) Rate of change of temperature	0,5 °C/min	60068-2-14: Nb	+5 °C to ambient two cycles 1 °C/min $t_1 = 3 \text{ h}$		Test normally not required – See note 4)	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) Solar radiation	700 W/m ²	60068-2-5: Sa Procedure C	1 120 W/m ² , 72 h, 40 °C		Add 10 °C to the dry-heat test; evaluate materials for photochemical reactions	7)
k) Heat radiation User selection from 3Z1, 3Z2 or 3Z3		No IEC 60068-2 test			Test normally not required – See note 8)	8)
l) Movement of surrounding air 1 m/s or user selection from 3Z4, 3Z5 or 3Z6		No IEC 60068-2 test			Test normally not required – See note 9)	9)
m) Condensation	No					

Explanatory notes for table 1 – Class 3K2

- 1) To test 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. The cold and humidity conditions in this class are within the standard atmosphere conditions as defined in IEC 60068-1 and are therefore considered benign for most products and consequently no test is recommended. The other boundary conditions of the climatogram are not normally tested since there are no suitable IEC 60068-2 tests available.
- 2) The test temperature is equivalent to the environmental parameter of IEC 60721-3-3 for this class. The choice of the duration of 16 h is considered to be sufficient for most products to demonstrate that its design is adequately toleranced to function at this temperature.
- 3) These low temperature and humidity conditions are within the standard atmospheric conditions described in IEC 60068-1, and so no test is recommended.
- 4) The temperature range in this class is considered to be within the standard atmospheric conditions described in IEC 60068-1, and so no change in temperature test need be recommended.
- 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) There is no IEC 60068-2 test method for this condition, which is within the standard range of atmospheric conditions as defined in IEC 60068-1 and is therefore considered benign for most products. No test is recommended.
- 7) The IEC 60068-2-5 procedure C test for simulating the effects of solar radiation at ground level is chosen since it produces continuous irradiation thus allowing assessment of photo-degradation effects. Although the severity of this class is 700 W/m², the only Sa test condition contained in 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, refer to IEC 60721-4-0.
- 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.
- 8) No test is recommended. No value is available in IEC 60721-3-3 for heat radiation, and the effect is normally included in the dry heat test. For products mounted near sources of high heat radiation, special precautions such as heat shields or insulation may be necessary or an additional elevated temperature test may be required, the degree of elevation being dependant on the severity of the heat source.
- 9) No test is recommended. No suitable IEC 60068-2 test exists and the condition is considered as benign for most products. Precautions should be taken, especially for large products if a special condition (3Z4, 3Z5 or 3Z6) is chosen, and the users may have to develop their own methodology if the condition is to be evaluated.

NOTE "No" in the class column means that no IEC 60721-3-3 condition is specified.

Explanatory notes for table 2 – Class 3K3

- 1) To test 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. The other boundary conditions of the climatogram are not normally tested since there are no suitable IEC 60068-2 tests available.
- 2) The test temperature is equivalent to the environmental parameter of IEC 60721-3-3 for this class. The choice of the duration of 16 h is considered to be sufficient for most products to demonstrate that its design is adequately tolerated to function at this temperature.
- 3) These severities are the nearest preferred values in IEC 60068-2, and the minor differences in both temperature and humidity from the environmental parameter of IEC 60721-3-3 are considered to be insignificant and are within normal measurement tolerances. The duration of 96 h is considered to be sufficient for most products to demonstrate that its 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. However, in this class, the temperature range is small and condensation is unlikely to occur so it is recommended that, with the possible exception of hermetically sealed products, this test should be omitted.
- 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. There is no IEC 60068-2 test method for this condition, which is within the standard range of atmospheric conditions as defined in IEC 60068-1 and is therefore considered benign for most products. No test is recommended.

- 6) The IEC 60068-2-5 procedure C test for simulating the effects of solar radiation at ground level is chosen since it produces continuous irradiation thus allowing assessment of photodegradation effects. Although the severity of this class is 700 W/m², the only Sa test condition contained in 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, refer to IEC 60721-4-0.

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.
- 7) No test is recommended. No value is available in IEC 60721-3-3 for heat radiation and the effect is normally included in the dry heat test. For products mounted near sources of high heat radiation, special precautions such as heat shields or insulation may be necessary or an additional elevated temperature test may be required, the degree of elevation being dependant on the severity of the heat source.
- 8) No test is recommended. No suitable IEC 60068-2 test exists and the condition is considered as benign for most products. Precautions should be taken, especially for large products if a special condition (3Z4, 3Z5 or 3Z6) is chosen, and the users may have to develop their own methodology if the condition is to be evaluated.

(temperature-controlled enclosed locations with a wide range of relative humidity, humidity not controlled)

IEC 60721-3-3 – Climatic conditions		IEC 60688-2 – Climatic tests						
Environmental parameter	Class 3K4	Nearest IEC 60688-2		Recommended test		Note No.		
		Test method	Severity	Test method	Severity			
Class 3K4 climatogram	a) Low air temperature	+5 °C		As recommended test	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, 93 % RH, 16 h	1), 2) 1), 2) 1), 3)	
	b) High air temperature	+40 °C						See above
	c) Low relative humidity	5 %						See above
	d) High relative humidity	95 %						See above
	e) Low absolute humidity	1 g/m ³						See above
	f) High absolute humidity	29 g/m ³						See above
	g) Rate of change of temperature	0.5 °C/min	+5 °C to ambient two cycles 1 °C/min $t_1 = 3 \text{ h}$	Test normally not required – See note 4)	4)			
	h) Low air pressure	70 kPa	60068-2-13: M	Test normally not required – See note 5)	5)			
	i) High air pressure	106 kPa	No IEC 60688-2 test	Test normally not required – See note 6)	6)			
	j) Solar radiation	700 W/m ²	60068-2-5: Sa Procedure C	Add 10 °C to the dry heat test; evaluate materials for photochemical reactions	7)			
	k) Heat radiation	User selection from 3Z1, 3Z2 or 3Z3	No IEC 60688-2 test	Test normally not required – See note 8)	8)			
	l) Movement of surrounding air	1 m/s or user selection from 3Z4, 3Z5 or 3Z6	No IEC 60688-2 test	Test normally not required – See note 9)	9)			
	m) Condensation	Yes	60068-2-30: Db Variant 2	60068-2-30: Db Variant 2	+30 °C, 90 - 100 % RH Two cycles	10)		
	n) Wind driven precipitation (rain, snow, hail, etc.)	No						
	o) Water from sources other than rain User selection from 3Z7, 3Z8, 3Z9 or 3Z10		No IEC 60688-2 test	60068-2-18: Ra, Rb	See note 11)	11)		
	p) Formation of ice	No						
NOTE "No" in the class column means that no IEC 60721-3-3 condition is specified.								

NOTE "No" in the class column means that no IEC 60721-3-3 condition is specified.

Explanatory notes for table 3 – Class 3K4

- 1) To test products against the conditions of the climatology, 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 climatology. The other boundary conditions of the climatology are not normally tested since there are no suitable IEC 60068-2 tests available.
 - 2) The test temperature is equivalent to the environmental parameter of IEC 60721-3-3 for this class. The choice of the duration of 16 h is considered to be sufficient for most products to demonstrate that its design is adequately tolerated to function at this temperature. IEC 60721-3-3 includes a special condition of +55 °C, which can be applied to the conditions in this class. If this special condition is applicable to the product, an alternative test of +55 °C for 16 h is recommended.
 - 3) These severities are the nearest preferred values in IEC 60068-2 and the minor changes in both temperature and humidity are considered to be insignificant and are within normal measurement tolerances. The duration of 96 h is considered to be sufficient for most products to demonstrate that its 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. However, in this class, the temperature range is small and condensation is unlikely to occur, so it is recommended that, with the possible exception of hermetically sealed products, this test should be omitted.
 - 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) There is no IEC 60068-2 test method for this condition, which is within the standard range of atmospheric conditions defined in IEC 60068-1 and is therefore considered benign for most products. No test is recommended.
 - 7) The IEC 60068-2-5 procedure C test for simulating the effects of solar radiation at ground level is chosen since it produces continuous irradiation thus allowing assessment of photo-degradation effects. Although the severity of this class is 700 W/m², the only Sa test condition contained in 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, refer to IEC 60721-4-0.
- 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.
- 8) No test is recommended. No value is available in IEC 60721-3-3 for heat radiation, and the effect is normally included in the dry heat test. For products mounted near sources of high heat radiation, special precautions such as heat shields or insulation may be necessary or an additional elevated temperature test may be required, the degree of elevation being dependant on the severity of the heat source.
 - 9) No test is recommended. No suitable IEC 60068-2 test exists and the condition is considered as benign for most products. Precautions should be taken, especially for large products if a special condition (3Z4, 3Z5 or 3Z6) is chosen, and the users may have to develop their own methodology if the condition is to be evaluated.
 - 10) The test temperature does not correspond to the characteristic severity of the climatology, as it is the next highest preferred value in IEC 60068-2. It is, however, strongly recommended that this temperature be lowered to 30 °C in order to test within the prescribed limits of the climatology. The duration of two cycles (48 h) is considered adequate for most products. For products with high heat dissipation, omit this test since the self-heating effect will prevent condensation from occurring and the effect of high humidity is covered by test Cb (test z). Variant 2 of test Db is chosen since it adequately tests the condition and is simpler to perform than variant 1.
 - 11) No value is available in IEC 60721-3-3 other than the description of the four types of source (table 2, 3Z7 to 3Z10):
 - a) Dripping water: If the product is normally protected from rain but may be exposed to falling drops from condensation or leakage from upper surfaces, IEC 60068-2-18: Ra 2 – drip box with a 2 m drop height, a tilt angle of 0°, and a 1 h duration is the preferred method.
 - b) Spraying water: If the product is likely to be exposed to water from sprinkler systems or spray from wheels, IEC 60068-2-18 tests Rb 2.1 – oscillating tube – or Rb 2.2 – hand-held shower, 1 min/m², 30 min max. – are the preferred methods.
 - c) Splashing water: If the product is likely to be exposed to flushing or sluicing water, IEC 60068-2-18: Rb 3 – hosing – is the preferred method.
 - d) Water jets: If jets of water are likely to strike the product, choose from either IEC 60068-2-18: Ra or Rb tests to demonstrate that the product is designed to function under these conditions.

NOTE "No" in the class column means that no IEC 60721-3-3 condition is specified.

Explanatory notes for table 4 – Class 3K5

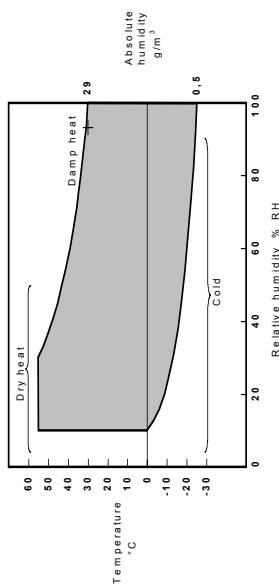
- 1) To test products against the conditions of the climatogram, only three tests are normally used:
 - dry heat test, where the relative humidity shall not exceed 50 % but is not specifically controlled;
 - cold test, where humidity is not controlled;
 - damp heat test, steady state, where both temperature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

These are shown as tests x, y and z in the climatogram. The other boundary conditions of the climatogram are not normally tested since there are no suitable IEC 60068-2 tests available.
- 2) The test temperature is equivalent to the environmental parameter of IEC 60721-3-3 for this class. Because there are rarely chemical or physical changes in material once low-temperature stabilization has been achieved, the recommended duration of 16 h is considered to be more than adequate for low-temperature testing, and this may be reduced to 2 h for small products with low thermal mass. The selection of the duration of 16 h for the dry heat test is the most acceptable of those recommended in IEC 60068-2-2 as it is considered to be sufficient for most heat-dissipating products in order to demonstrate that its design is adequately tolerated to function at this temperature. IEC 60721-3-3 includes a special condition of +55 °C, which can be applied to the conditions in this class. If this special condition is applicable to the product, an alternative test of +55 °C for 16 h is recommended.
- 3) These severities are the nearest preferred values in IEC 60068-2 and the minor changes in both temperature and humidity are considered to be insignificant and are within normal measurement tolerances. The duration of 96 h is considered to be sufficient for most products 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. However, in this class, condensation may occur so a range is proposed which crosses the 0 °C boundary in order to allow condensation to occur for low-heat-dissipating products. The specified IEC 60721-3-3 value of rate of change is 0,5 °C/min; however, the lowest preferred value in test N of IEC 60068-2-14 is 1 °C/min. It is recommended that the test value of 0,5 °C/min be used, especially for large, heat-producing products.
- 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) There is no IEC 60068-2 test method for this condition, which is within the standard range of atmospheric conditions defined in IEC 60068-1 and is therefore considered benign for most products. No test is recommended.
- 7) The IEC 60068-2-5 procedure C test for simulating the effects of solar radiation at ground level is chosen since it produces continuous irradiation thus allowing assessment of photo-degradation effects. Although the severity of this class is 700 W/m², the only Sa test condition contained in 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, refer to IEC 60721-4-0.

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.

- 8) No test is recommended. No value is available in IEC 60721-3-3 for heat radiation, and the effect is normally included in the dry heat test. For products mounted near sources of high heat radiation, special precautions such as heat shields or insulation may be necessary or an additional elevated temperature test may be required, the degree of elevation being dependant on the severity of the heat source.
- 9) No test is recommended. No suitable IEC 60068-2 test exists, and the condition is considered as benign for most products. Precautions should be taken, especially for large products, if a special condition (3Z4, 3Z5 or 3Z6) is chosen and the users may have to develop their own methodology if the condition is to be evaluated.
- 10) The test temperature does not correspond to the characteristic severity of the climatogram as it is the next highest preferred value in IEC 60068-2. It is, however, strongly recommended that this temperature be lowered to 30 °C in order to test within the prescribed limits of the climatogram. The duration of two cycles (48 h) is considered adequate for most products. For products with high heat dissipation, omit this test since the self-heating effect will prevent condensation from occurring, and the effect of high humidity is covered by test Cb (test z). Variant 2 of test Db is chosen since it adequately tests the condition and is simpler to perform than variant 1
- 11) No value is available in IEC 60721-3-3 other than the description of the four types of source (table 2, 3Z7 to 3Z10).
 - a) Dripping water: If the product is normally protected from rain, but likely to be exposed to falling drops from condensation or leakage from upper surfaces, IEC 60068-2-18: Ra 2 – drip box with a 2 m drop height, a tilt angle of 0°, and a 1 h duration – is the preferred method.
 - b) Spraying water: If the product is likely to be exposed to water from sprinkler systems or spray from wheels, IEC 60068-2-18, tests Rb 2.1 – oscillating tube – or Rb 2.2 – hand held shower, 1 min/m², 30 min max. – are the preferred methods.
 - c) Splashing water: If the product is likely to be exposed to flushing or sluicing water, IEC 60068-2-18: Rb 3 – hosing – is the preferred method.
 - d) Water jets: If jets of water are likely to strike the product, choose from either IEC 60068-2-18: Ra or Rb test to demonstrate that the product is designed to function under these conditions.
- 12) No suitable test exists in IEC 60068-2 other than the cold test (test y); however, special precautions should be taken if the product contains moving parts.

Table 5 – Recommended tests for IEC 60721-3-3 – Class 3K6
(locations with no temperature or humidity control, which may have openings direct to the open-air – partially weatherprotected)

IEC 60721-3-3 -Climatic conditions		IEC 60068-2 – Climatic tests					
Environmental parameter		Class 3K6	Nearest IEC 60068-2		Recommended test		Note No.
			Test method	Severity	Test method	Severity	
 Class 3K6 climatogram		a) Low air temperature		As recommended test		+55 °C, 16 h	1), 2)
		b) High air temperature		As recommended test		-25 °C, 16 h	1), 2)
		c) Low relative humidity		As recommended test		+30 °C, 93 % HR, 96 h	1), 3)
		d) High relative humidity		As recommended test			
		e) Low absolute humidity		As recommended test			
		f) High absolute humidity		As recommended test			
		g) Rate of change of temperature		-25 °C to ambient two cycles 1 °C/min t ₁ = 3 h	60068-2-14: Nb	-25 °C to ambient two cycles 0,5 °C/min t ₁ = 3 h	4)
		h) Low air pressure		60068-2-13: M	70 kPa, 30 min	Test normally not required – See note 5)	5)
		i) High air pressure		No IEC 60068-2 test		Test normally not required – See note 6)	6)
		j) Solar radiation		60068-2-5: Sa Procedure C	1 120 W/m ² 72 h, 40 °C	Add 15 °C to the dry heat test; evaluate materials for photochemical reactions	7)
k) Heat radiation User selection from 3Z1, 3Z2 or 3Z3		No IEC 60068-2 test		Test normally not required – See note 8)	8)		
l) Movement of surrounding air 1 m/s or user selection from 3Z4, 3Z5 or 3Z6		No IEC 60068-2 test		Test normally not required – See note 9)	9)		
m) Condensation	Yes	60068-2-30: Db Variant 2	+40 °C, 90 - 100 % RH Two cycles	60068-2-30: Db Variant 2	+30 °C, 90 - 100 % RH Two cycles	10)	
n) Wind-driven precipitation (rain, snow, hail, etc.)	Yes	No IEC 60721-3-3 value		Test normally not required – See note 11)	11)		
o) Water from sources other than rain User selection from 3Z7, 3Z8, 3Z9 or 3Z10		No IEC 60068-2 test		60068-2-18: Ra, Rb See note 12)	12)		
p) Formation of ice	Yes	No IEC 60068-2 test		Test normally not required – See note 13)	13)		