IEC 60721-3-9

Edition 2.0 2024-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Classification of environmental conditions – Part 3-9: Classification of groups of environmental parameters and their severities – Microclimates inside products

Classification des conditions d'environnement – Partie 3-9: Classification des groupements des agents d'environnement et de leurs sévérités – Microclimats à l'intérieur des produits

IEC 60721-3-9:2024-04(en-fr)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 3-9: Classification of groups of environmental parameters and their severities – Microclimates inside products

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 60721-3-9 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test. It is an International Standard.

This second edition cancels and replaces the first edition published in 1993, Amendment 1:1994 and Corrigendum 1:1995. This edition constitutes a technical revision.

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

a) Clause 2 has been updated;
b) Clause 4 has been re-edited and simplified;
c) Annex A has been revised and updated;

d) a new Annex B has been added and gives the origin of the constitutional diagram for humid air, which is the basis of drawing the climatogram for a microclimate.

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

Draft	Report on voting
104/1041/FDIS	104/1050/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60721 series, published under the general title *Classification of environmental conditions*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn, or
- revised.

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CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 3-9: Classification of groups of environmental parameters and their severities – Microclimates inside products

1 Scope

This part of IEC 60721 classifies groups of microclimatic conditions, to which components (basic parts, assemblies, built-in units) can be subjected inside products, which are used under the climatic conditions as classified in IEC 60721-3-3 and IEC 60721-3-4.

Characteristic parameters for the microclimates are high air temperature and high relative air humidity. Further parameters of the climatic classes, for example low temperature, can affect the components additionally, but have not been considered here.

A limited number of microclimatic classes is specified taking into consideration typical limiting high air temperatures of components.

NOTE The term "microclimate" can, for example in meteorology or buildings, have a different meaning than those discussed in this document.

2 Normative references

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

IEC 60721-1, *Classification of environmental conditions − Part 1: Environmental parameters and their severities*

IEC 60721-3-0:2020, *Classification of environmental conditions – Part 3-0: Classification of groups of environmental parameters and their severities – Introduction*

IEC 60721-3-3:2019, *Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities – Stationary use at weatherprotected locations*

IEC 60721-3-4:2019, *Classification of environmental conditions – Part 3-4: Classification of groups of environmental parameters and their severities – Stationary use at non-weatherprotected locations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60721-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
microclimate
climatic condition at the place where a component is installed in the product

Note 1 to entry: Only air temperature and air humidity are taken into account.

3.2
microclimatic class
classified microclimate designated by:

a) the climatic class as specified in IEC 60721-3-3:2019 or IEC 60721-3-4:2019;

b) the class of high air temperature;

c) the optional class of limited relative air humidity, in relation to the climatic class severity

Note 1 to entry: For items b) and c), see Table 1.

4 General

Microclimates at the place where the components are installed in a product can differ significantly from the climatic conditions to which the product is subjected.

The microclimates describe the climatic conditions at the place where the component is installed in a product, for example inside an enclosure. These are essentially the climatic classes specified in IEC 60721-3-3:2019 or IEC 60721-3-4:2019 but with the addition of severities of high air temperature and limited relative air humidity to account for external or appreciable self-generated heating during operation. Microclimates can also be used to designate the operational conditions for components.

When temperatures in excess of those of the environment itself occur inside a product, the relative air humidity and, therefore, also the humidity stress on the components is reduced. Even in an environment with a relative air humidity as high as 100 %, the relative air humidity inside the product is reduced below 60 % by an excess temperature of 10 K. Below this humidity level, the corrosion effect of chemically active substances is low.

The microclimates described concern the case of placing of components in enclosures with comparatively free access to the surrounding atmosphere. Difficult access of air (e.g. presence of non-tight seal of the enclosure) can produce more severe conditions as a result of suction of moisture into the enclosure and subsequent accumulation of water. This can result from frequent switching on and off of the product or rapid changes of temperature inside the product due to external climatic conditions, for example rain, irradiation.

Components in products without external heating or self-generated heating or in the non-operational state for a significant period of time are affected directly by the conditions of the climatic class appropriate for a location.

When there is a change in the climatic conditions, with and without external heating or self-generated heating, the time for which the component is subjected to the climatic conditions shall be taken into consideration. Details on duration and frequency of occurrence shall be referred to IEC 60721-3-0:2020, and details on change of climatic conditions, such as the rate of change of temperature, shall be referred to IEC 60721-3-3:2019 and IEC 60721-3-4:2019.

Further guidance shall be referred to IEC 60721-3-0:2020.

5 Classification of microclimatic conditions

The severities of high air temperature and of limited relative air humidity for a number of microclimatic classes are specified in Table 1.

Table 1 – Classification of microclimatic conditions

Environmental parameter	Class	Unit	Severity
a) High air temperature	X1	°C	55
	X2		70
	X3		85
	X4		100
	X5		125
	X6		155
	X7		200
b) Limited relative air humidity	Y1	%	65
	Y2		75
	Y3		85
	Y4		95

Examples for the designation and marking of microclimatic classes are given in Clause 6. Exceptional conditions may call for severities different from those of the classes; these should be selected from the values specified in IEC 60721-1.

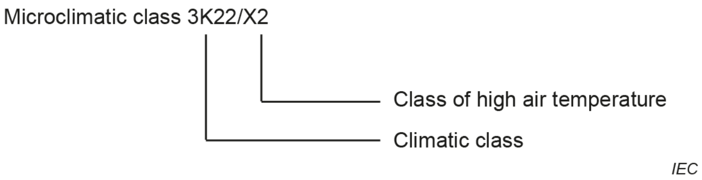
The graphical representation of a microclimatic class is given in Clause A.1 from which six characteristic corner points can be determined. For a selection of preferred microclimatic classes, paired values of air temperature and relative air humidity are stated in Table A.1 and Table A.2.

The method described in Annex A applies to the period of time when microclimatic conditions have reached a steady state.

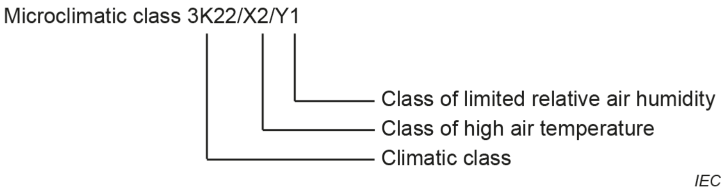
6 Types and marking of microclimatic classes

A microclimatic class is marked with the appropriate class designation of the climatic class of the product and the appropriate class designation of Table 1.

EXAMPLE 1 – Increased air temperature only



EXAMPLE 2 – Increased air temperature and limited relative air humidity



Annex A
(informative)

Graphical representation and preferred microclimatic classes

A.1 Graphical representation of the microclimatic classes

Figure A.1 is an example of the climatogram of microclimatic class 3K22/X2/Y1.

The characteristic points and lines of the climatogram are obtained in the following manner:

– Draw the climatogram of climatic class 3K22.
– Mark the corner points by A, B, C, D, E and F:
  • A is the high air temperature at high absolute air humidity;
  • B is the high relative air humidity at high absolute air humidity;
  • C is the low air temperature at high relative air humidity;
  • D is the low air temperature at low absolute air humidity;
  • E is the low relative air humidity at low absolute air humidity;
  • F is the high air temperature at low relative air humidity.
– Determine the difference between the air temperature of the microclimate (70 °C) and the high air temperature of the climatic class (40 °C) i.e. 30 °C.
– Shift the corner points A to F by the value of this difference between the high air temperatures of the microclimate and the climatic class on the lines of constant absolute air humidity.
– Mark the obtained corner points by A’ to F’.
– Draw the boundary line for the limitation of the relative air humidity at 65 % with high/low absolute air humidity, marking the intersection with B_{65} and C_{65}.
– Draw the resulting climatogram A’, B_{65}, C_{65}, D, E’ and F’.

NOTE This method of transformation on lines of constant absolute air humidity is physically correct only for closed systems. For open systems, the transformation on the lines of constant partial water vapour pressure can be used. Since the error in the given temperature range is not significant, for the transformation, the lines of constant absolute air humidity as specified in Annex B were used also for open systems.

The climatogram of the microclimatic class 3K22/X2/Y1 is the envelope line A’, B_{65}, C_{65}, D, E’ and F’.

The microclimate during permanent external or self-generated heating complies with the area within the line A’, B’, C’, D’, E’ and F’. The two corner points A’ and B’ of a climatogram such as Figure A.1 represent:

– A' is the high air temperature and related high absolute air humidity of the microclimate with external heating or self-generated heating;
– B' is the high relative air humidity and related high air temperature of the microclimate with external heating or self-generated heating;

  These corner points indicate the range of maximum stress on components by relative air humidity during external heating or self-generated heating. They can be suitably described by pairing values of air temperature and relative air humidity for the points in question from climatograms. The paired values for the remaining corner points of a climatogram are generally of minor importance.

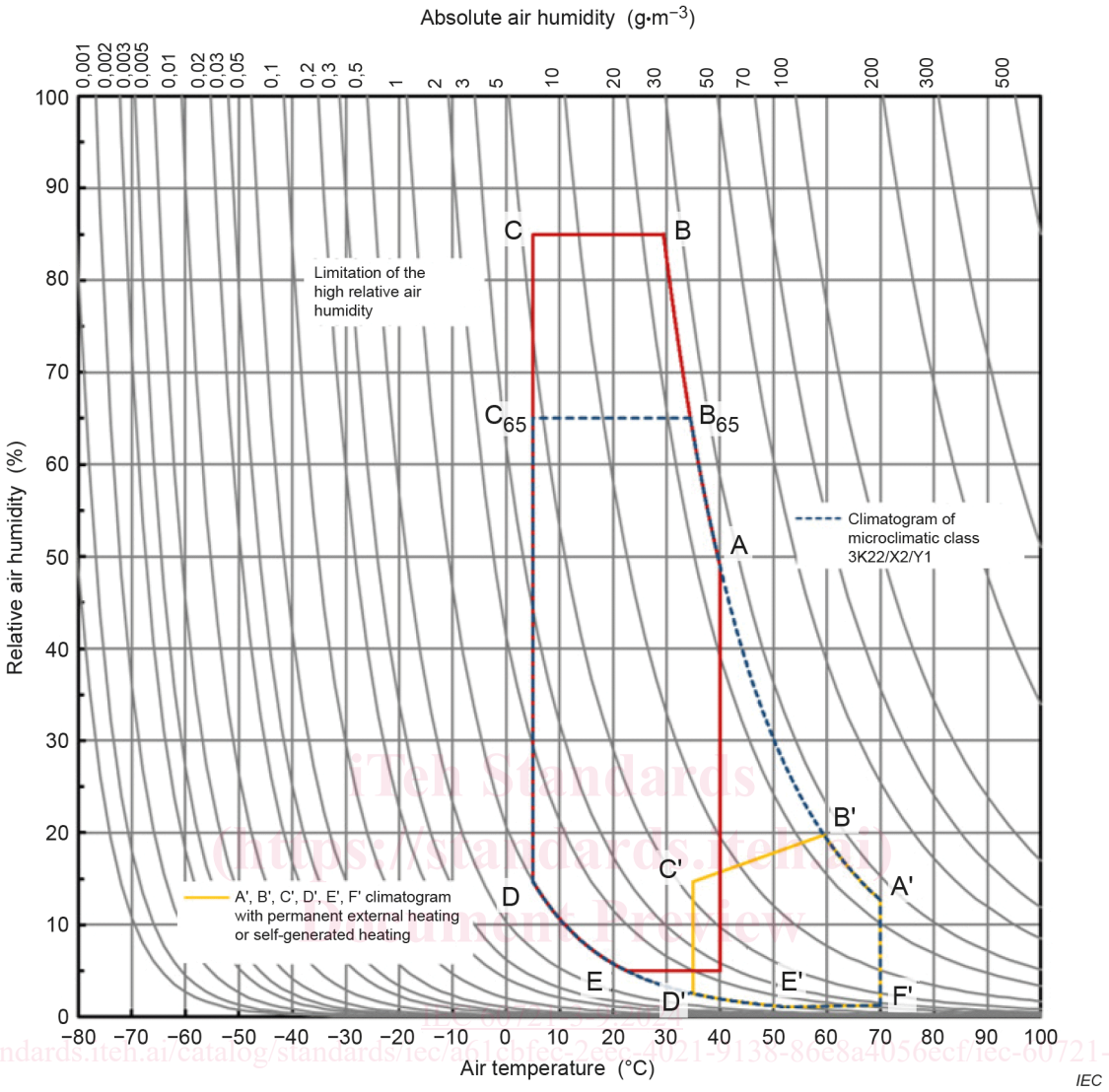


Figure A.1 – Example of a climatogram for a microclimate: Microclimatic class 3K22/X2/Y1

A.2 Tables of preferred microclimatic classes

Table A.1 and Table A.2 give paired values for air temperature/relative air humidity at the corner points of the climatograms (such as Figure A.1) of the most usual microclimatic classes with weatherprotected locations. Table A.1 gives the value of corner points A', B', C', D', E' and F', and Table A.2 gives the value of corner points B_{Y1} to B_{Y4} and C_{Y1} to C_{Y4}.

NOTE The corner points A', B', C', D', E' and F' are not affected by the change of limited relative air humidity; they are determined by the high air temperature and the climatic class. The corner points B_{Y1} to B_{Y4} and C_{Y1} to C_{Y4} are not affected by the change of high air temperature; they are determined by the limited relative air humidity and the climatic class.