

INTERNATIONAL STANDARD

IEC 60721-3-3

Edition 2.2
2002-10

Edition 2:1994 consolidated with amendments 1:1995 and 2:1996

Classification of environmental conditions –

Part 3-3:

Classification of groups of environmental parameters and their severities – Stationary use at weatherprotected locations

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CONTENTS

FOREWORD	7
1 Scope	11
2 Normative references	11
3 Definitions	13
4 General	13
5 Classification of groups of environmental parameters and their severities	15
6 Sets of environmental condition class combinations	21
Annex A (informative) Survey of conditions affecting the choice of environmental parameters and their severities	35
Annex B (informative) Climatograms	65
Annex C (informative) Examples for practical application of the classification specified in this standard	87
Annex D (informative) Summary of conditions covered by sets of class combinations	93
Annex E (informative) Explanation of the environmental conditions in tropical areas as specified in classes 3K9 and 3K10	97
Figure 1 – Model shock response spectra (first order maximax shock response spectra)	33
Figure B.1 – Climatogram for class 3K1 (tolerance bands for temperature are marked by broken lines)	65
Figure B.2 – Climatogram for class 3K2	67
Figure B.3 – Climatogram for class 3K3	69
Figure B.4 – Climatogram for class 3K4	71
Figure B.5 – Climatogram for class 3K5	73
Figure B.6 – Climatogram for class 3K6	75
Figure B.7 – Climatogram for class 3K7	77
Figure B.8 – Climatogram for class 3K7L	79
Figure B.9 – Climatogram for class 3K8	81
Figure B.10 – Climatogram for class 3K8H	83
Figure B.11 – Climatogram for class 3K8L	85
Figure E.1 – Climatograms for tropical damp type of climate and tropical dry type of climate	101

Table 1 – Classification of climatic conditions.....	23
Table 2 – Classification of special climatic conditions.....	25
Table 3 – Classification of biological conditions.....	25
Table 4 – Classification of chemically active substances.....	27
Table 5 – Classification of mechanically active substances.....	29
Table 6 – Classification of mechanical conditions.....	29
Table 7 – Sets of environmental class combinations.....	29
Table 8 – Time to flashover.....	31
Table 9 – Thermal conditions prior to flashover.....	31
Table 10 – Thermal conditions following flashover.....	31
Table 11 – Conditions with respect to visibility through smoke.....	31
Table 12 – Conditions of chemically active substances.....	31

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CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 3-3: Classification of groups of environmental parameters and their severities – 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.
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International Standard IEC 60721-3-3 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test.¹⁾

This consolidated version of IEC 60721-3-3 consists of the second edition (1994) [documents 75(CO)102A and 75(CO)110], its amendment 1 (1995) [documents 75/224/FDIS and 75/246/RVD] and its amendment 2 (1996) [documents 75/279/FDIS and 75/289/RVD].

The technical content is therefore identical to the base edition and its amendments and has been prepared for user convenience.

It bears the edition number 2.2.

A vertical line in the margin shows where the base publication has been modified by amendments 1 and 2.

IEC 60721 consists of the following parts, under the general title: *Classification of environmental conditions*:

- Part 1, Environmental parameters and their severities
- Part 2, Environmental conditions appearing in nature
- Part 3, Classification of groups of environmental parameters and their severities

Annexes A to D are for information only.

¹⁾ IEC technical committee 75: "Classification of environmental conditions" has been transformed into technical committee 104.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until 2007. At this date, the publication will be

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

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CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 3-3: Classification of groups of environmental parameters and their severities – Stationary use at weatherprotected locations

1 Scope

This section of IEC 60721-3 classifies groups of environmental parameters and their severities to which products are subjected when mounted for stationary use at weather-protected locations under use conditions, including periods of erection work, down time, maintenance and repair.

Weatherprotected locations, where products may be mounted for stationary use permanently or temporarily, include land-based and offshore enclosed and sheltered locations. Use in and on vehicles is excepted.

Environmental conditions directly related to explosion hazards, fire extinction and ionizing radiation are excluded. Only environmental conditions as such are considered. No special description of the effects of these conditions on the products is given.

Environmental conditions directly related to explosion hazards, fire extinction and ionizing radiation are excluded. Any other unforeseen incidents are also excluded. The possibility of their occurrence should be taken into account in special cases.

Microclimate within a product is not included.

Conditions of stationary use at non-weatherprotected locations, portable and non-stationary use, use in vehicles and ships, conditions of storage and transportation, and microclimates inside products are given in other sections of IEC 60721-3.

A limited number of classes of environmental conditions is given, covering a broad field of application. The user of this standard should select the lowest classification necessary for covering the conditions of the intended use.

2 Normative references

The following referenced documents are indispensable for the application 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 60721-1:1990, *Classification of environmental conditions – Part 1: Environmental parameters and their severities*

IEC 60721-2-1:1982, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Section 1: Temperature and humidity*
Amendment 1 (1987)

IEC 60721-2-8:1994, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Section 8: Fire exposure*

IEC 60721-3-0:1984, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 0: Introduction*
Amendment 1 (1987)

ISO/IEC Guide 52: 1990, *Glossary of fire terms and definitions*

3 Definitions

In addition to the definitions in clause 3 of IEC 60721-1 and ISO/IEC Guide 52, the following definitions apply:

3.1

stationary use

the product is mounted firmly on the structure or on mounting devices or it is permanently placed at a certain site. It is not intended for portable or non-stationary use, but short periods of handling during erection work, down time, maintenance and repair at the location are included

3.2

weatherprotected location

a location at which the product is protected from weather influences:

- *totally weatherprotected location* (enclosed location): direct weather influences are totally excluded;
- *partially weatherprotected location* (sheltered location): direct weather influences are not totally excluded.

4 General

For further general guidance, see IEC 60721-3-0.

During periods of erection work, which are often connected with down time, the user should be aware that conditions might differ from those experienced during the period of operation. Therefore the selection of another class may be necessary for this period, unless special precautions have been taken.

The severities specified are those which will have a low probability of being exceeded. All specified values are maximum or limit values. These values may be reached, but do not occur permanently. Depending on the local situation there may be different frequencies of occurrence related to a certain period of time. Such frequencies of occurrence should be considered for any environmental parameter. They should additionally be specified if applicable. Information on duration and frequencies of occurrence is given in Amendment No. 1 to IEC 60721-3-0 as clause 6.

Attention is drawn to the fact that combinations of the environmental parameters given may increase the effect on a product. This applies especially to the presence of high relative humidity in addition to biological conditions or to conditions of chemically or mechanically active substances.

The environmental conditions present at a location may be affected by other influences, e.g. heat dissipation sources, special process conditions, etc.

Measurements of the environmental conditions present at a location should be made at a representative point in the vicinity of the product.

It is recognized that extreme or special environmental conditions may exist. Specifications for products to operate under such special conditions are a matter for negotiation between supplier and user.

5 Classification of groups of environmental parameters and their severities

A number of classes are specified in tables 1 to 6 and 8 to 12 for:

- climatic conditions (K);
- special climatic conditions (Z);
- biological conditions (B);
- conditions of chemically active substances (C);
- conditions of mechanically active substances (S);
- mechanical conditions (M);
- conditions during the initial phase of a fire (T, P, F, V, H).

This classification allows a number of possible combinations of environmental conditions, which bear upon products wherever used. It represents the real situation in respect of world-wide conditions of use, due to local influences of open-air climate, construction of buildings, mounting, process conditions, etc.

(See also clause 6.)

A class of conditions normally includes classes with lower severity digits.

For certain parameters it has not yet been possible to specify quantitative severities.

For a given location or product, reference should be made to the total set of classes, e.g.:

3K2/3Z1/3Z4/3B1/3C2/3S1/3M4 and 3T1/3P3/3F2/3V2/3H3.

(See also clause 6.)

Annex A explains the basis of the classes. It contains a summary of the conditions covered by each class and gives a survey of conditions affecting the choice of environmental parameters and their severities.

Annex B contains climatograms showing the interdependence of air temperature, relative humidity and absolute humidity for the climatic classes specified in table 1.

Annex C gives two examples for practical application of this classification.

5.1 Climatic conditions

The climatic conditions specified for classes 3K1 to 3K8 represent the conditions at weather-protected locations. They have been experienced world-wide over long periods of time, taking into account all the parameters that can influence them, e.g. external (open-air) climatic conditions, type of building construction, temperature/humidity controlling systems and internal conditions, e.g. heat dissipation from mounted equipment, presence of humans, etc. The conditions should cover all normal cases, but not exceptional events, e.g. failure of air-conditioning systems.

Climatic conditions in tropical areas as specified in classes 3K9 and 3K10 are explained in annex E.

When selecting appropriate classes attention should be paid to the fact that the climatic conditions inside buildings depend on the outside (open-air) conditions, especially air temperature and solar radiation, and the type of building construction. Walls with good thermal insulation or high thermal capacity can consistently smooth the peaks of outside air temperature variations between day and night, or exceptionally for a longer period. Walls with poor thermal insulation or low thermal capacity cannot have that effect, and peaks can be magnified due to the effect of solar radiation during the day and the effect of building radiation at night. The effect of solar radiation can be increased by either heat-trap or greenhouse effects.

The actual interdependence of air temperature and humidity cannot be shown by stating severities only. Therefore climatograms are given in annex B.

5.2 Special climatic conditions

As the parameters heat radiation, movement of surrounding air, water from sources other than rain, high air temperature, and low air pressure may in practice occur with any of their severities in combination with any of the other climatic conditions, these special conditions are specified in table 2. In this case an assumption of the coincidence of events of increasing severity would lead to unnecessary overdesign.

5.3 Biological conditions

No quantitative severities have been specified for these conditions. The specified parameters of table 3 are typical, but may not be complete.

5.4 Chemically active substances

Contamination of natural atmosphere is mainly caused by chemical emissions from industrial activities, motor-driven vehicles and heating systems. A further chemical influence is caused by aerosols of sea salts. The contamination may affect the function and the materials of products.

The values given in this classification have been experienced in surveys for several years. Maximum values are given, because direct influence of higher concentrations over a short period normally causes more damage to material, which cannot regenerate. Mean values are given additionally, because their influence may be important for the long-term effect on the internal parts of the products.

In practice not all contaminants (parameters) classified in this standard are present simultaneously. Furthermore, the probability is low that the concentrations of those contaminants really present increase simultaneously and homogeneously. Depending on the local situation, there are often higher values of one contaminant only. The values specified for class 3C1 will normally be experienced in rural areas and areas with low industrial activities. The values specified for class 3C2 are experienced in urban areas. Therefore the severity of each of these two classes should be considered as the requirements for the combined effect of all parameters stated. The severities of classes 3C3 and 3C4, however, cannot be considered as the requirements for the combined effect of all parameters stated in order to avoid any uneconomical overdesign. For these classes it is possible to select only the severities of those single parameters, which might be relevant to the case of application. If single parameters of the classes 3C3 or 3C4 are selected for the description of the chemically active substances present at a location, for all other parameters which are not specially named, the severities of class 3C2 are valid.

NOTE Chemically active liquids and chemically active solids other than sea salts are not considered in this standard.

5.5 Mechanically active substances

Sand and dust are classified together, as the effects caused by these environmental conditions are similar.

5.6 Mechanical conditions

The conditions of vibrations (sinusoidal) are classified by severity levels of acceleration and displacement amplitude in high and low frequency ranges respectively.

Random vibration is not considered in this standard. It may be included when sufficient information is available.

Non-stationary vibration including shock is classified by using the first order undamped maximax shock response spectrum. See 6.1.3 of IEC 60721-1.

5.7 Conditions during the initial stage of a fire

The environmental fire conditions are described in IEC 60721-2-8. Their relation to the initial phase of a fire in a compartment has been the base for the selection of the parameters and their severities applied for the classes covering the pertinent conditions. The main parameters are:

a) *for pre-flashover fire conditions:*

- time to flashover (table 8);
- heat flux to various surfaces and items in the location;
- gas temperature of the upper gas layer in the location;
- rate of heat release (RHR), related to the rate of heat release causing flashover in the location (RHR_{fo}) and, accordingly, given by the ratio RHR/RHR_{fo} (table 9).

b) *for post-flashover fire conditions:*

- maximum gas temperature, combined with the duration of the heating phase of the location fire development (table 10).

c) *for conditions of smoke and chemically active substances:*

- optical density (table 11);
- concentration of hydrogen chloride (table 12).

All the parameters listed contribute towards a description of the environmental fire conditions. Some of the parameters specify fire exposure characteristics. This applies to the classes of table 9 concerning the reaction to fire of materials and products during the pre-flashover fire condition, and to the parameters connected to the classes of table 10 with respect to the fire behaviour and resistance of, for instance, load-supporting and separating structures, doors, ventilation systems during the post-flashover fire condition. Without being direct fire exposure characteristics, parameters such as the heat release ratio of the classes in table 9 and the times in table 8 are decisive for the risk of flashover and, if flashover occurs, for the safe escape of people from the fire. The gas temperatures of the classes of table 9 and the parameters of tables 11 and 12 are all fire exposure characteristics of importance for the functioning of optical detectors and for the probability of people to survive during evacuation or to remain within safe areas of refuge during the fire. The concentration of hydrogen chloride resulting from a fire is important for evaluating the risk of contamination of electric products by subsequent corrosion

6 Sets of environmental condition class combinations

As indicated in clause 5 the classification allows a number of possible combinations of environmental conditions bearing on products wherever used. The number of possibilities, and thus the flexibility, is therefore very great. In practice, however, this flexibility is not always an advantage when, for instance, environmental condition specifications for a certain location are drawn up by different parties, invariably producing small but disturbing divergencies.

In order to limit the possibilities to general cases, standard sets of class combinations may be selected from table 7. For a given location or product, reference may then be made to this standard, for example IE32. Only when conditions are not considered to be covered by this specification, is reference made to each class as indicated in clause 5. Alternatively, if some severities of parameters deviate from that or those of the class combination, this should be expressed by the addition to the set designation of the following phrase: "but ... (parameter) ... (severity and unit)", for example IE32 but sand 30 mg/m³.

Annex D gives a summary of conditions covered by the sets of class combinations.

Table 1 – Classification of climatic conditions

Environmental parameter	Unit	Class												
		3K1	3K2	3K3	3K4	3K5	3K6	3K7	3K7L	3K8	3K8H	3K8L	3K9 ⁸⁾	3K10 ⁸⁾
a) Low air temperature	°C	+20 ³⁾	+15	+5	+5	-5	-25	-40	-40	-55	-25	-55	+5	-20
b) High air temperature ⁵⁾	°C	+25 ³⁾	+30	+40	+40 ⁵⁾	+45 ⁵⁾	+55	+70	+40	+70	+70	+55	+40	+55
c) Low relative humidity	%	20	10	5	5	5	10	10	10	10	10	10	30	4
d) High relative humidity	%	75	75	85	95	95	100	100	100	100	100	100	100	100
e) Low absolute humidity	g/m ³	4	2	1	1	1	0,5	0,1	0,1	0,02	0,5	0,02	6	0,9
f) High absolute humidity	g/m ³	15	22	25	29	29	29	35	35	35	35	29	36	27
g) Rate of change of temperature ¹⁾	°C/min	0,1	0,5	0,5	0,5	0,5	0,5	1,0	1,0	1,0	1,0	1,0	1,0	1,0
h) Low air pressure ⁷⁾	kPa	70	70	70	70	70	70	70	70	70	70	70	70	70
i) High air pressure ²⁾	kPa	106	106	106	106	106	106	106	106	106	106	106	106	106
j) Solar radiation	W/m ²	500	700	700	700	700	1120	1120	None	1120	1120	1120	1120	1120
k) Heat radiation	None	No	6)	6)	6)	6)	6)	6)	6)	6)	6)	6)	6)	6)
l) Movement of surrounding air ⁴⁾	m/s	0,5	1,0 ⁵⁾	1,0 ⁵⁾	1,0 ⁵⁾	1,0 ⁵⁾	1,0 ⁵⁾	5,0 ⁵⁾	5,0 ⁵⁾	5,0 ⁵⁾	5,0 ⁵⁾	5,0 ⁵⁾	5,0 ⁵⁾	5,0 ⁵⁾
m) Condensation	None	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
n) Wind-driven precipitation (rain, snow, hail, etc.)	None	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
o) Water from sources other than rain	None	No	No	No	6)	6)	6)	6)	6)	6)	6)	6)	6)	6)
p) Formation of ice	None	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

1) Averaged over a period of time of 5 min.

2) Conditions in mines are not considered.

3) These are air-conditioned locations with a tolerance of ± 2 °C on stated temperature values.

4) A cooling system based on non-assisted convection may be disturbed by adverse movement of surrounding air.

5) If applicable, a special value may be selected from table 2.

6) Conditions occurring at the locations concerned to be selected from table 2.

7) Severity value of 70 kPa covers worldwide application (altitudes up to 3 000 m). For some restricted applications, a value may be selected from table 2.

8) Further information on classes 3K9 (tropical damp) and 3K10 (tropical dry) is given in annex E.