

# INTERNATIONAL STANDARD



**Classification of environmental conditions –  
Part 3-1: Classification of groups of environmental parameters and their  
severities – Storage**

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severities – Storage**

INTERNATIONAL  
ELECTROTECHNICAL  
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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

**Part 3-1: Classification of groups of environmental parameters and their severities – Storage**

## FOREWORD

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International Standard IEC 60721-3-1 has been prepared by IEC technical committee 104: Environmental conditions, classification, and methods of test.

This third edition cancels and replaces the second edition, published in 1997, and constitutes a technical revision.

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

- a) Clause 3: reworded and simplified.
- b) Clause 4: reworded and simplified.
- c) Clause 5: Annex C has been incorporated in Clause 5.
- d) 5.2: all existing climate classes have been replaced by completely new classes. The new classes are divided into 3 groups. The reason for the new classes is the latest revision of IEC 60721-2-1 which incorporated new climate types.
- e) 5.3: new classes for solar radiation and snow load.
- f) 5.6: all existing classes for mechanically active substances have been replaced by completely new classes.
- g) 5.7: all existing classes for mechanical conditions have been replaced by completely new classes.
- h) Table 1: new climatic classes with new severities.
- i) Table 2: new classes for solar radiation and snow load.
- j) Table 5 new mechanically active substances classes.
- k) Table 6: new mechanical conditions classes.

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

FDIS	Report on voting
104/772/FDIS	104/782/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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## CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

### Part 3-1: Classification of groups of environmental parameters and their severities – Storage

#### 1 Scope and object

This part of IEC 60721 classifies the groups of environmental parameters and their severities to which products together with their packaging, if any, are subjected when stored.

The environmental conditions specified in this document are limited to those which ~~may~~ can directly affect the products or their ultimate performance. Only environmental conditions as such are considered. No special description of the effects of these conditions on the products is given.

~~Transfer during storage is not included in the classification.~~

Environmental conditions directly related to fire or explosions ~~and conditions related to ionizing radiation are excluded~~ are not included. ~~Any other unforeseen incidents are also excluded. The possibility of their occurrence should be taken into account in special cases. Offshore locations are not included.~~

Conditions of stationary use, portable and non-stationary use, use in vehicles and ships, and conditions of transportation are given in other subparts of the IEC 60721-3 series.

The object of this document is to classify environmental parameters and their severities to which a product ~~may~~ can be exposed during storage. ~~Transfer and handling during storage and transport are addressed in IEC 60721-3-2.~~

~~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 intended storage.~~

#### 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 721-1: 1990, *Classification of environmental conditions – Part 1: Environmental parameters and their severities*  
Amendment 1 (1992)~~

~~IEC 721-2-1: 1982, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Temperature and humidity*  
Amendment 1 (1987)~~

~~IEC 721-3-0: 1984, Classification of environmental conditions—Part 3: Classification of groups of environmental parameters and their severities—Introduction  
Amendment 1 (1987)~~

~~IEC 60721-3-2: 1997, Classification of environmental conditions—Part 3: Classification of environmental parameters and their severities—Section 2: Transportation~~

~~IEC 721-3-3: 1994, Classification of environmental conditions—Part 3: Classification of environmental parameters and their severities—Section 3: Stationary use at weatherprotected locations~~

~~IEC 721-3-4: 1995, Classification of environmental conditions—Part 3: Classification of environmental parameters and their severities—Section 4: 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 terminological databases for use in standardization at the following addresses:

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

#### 3.1

##### **enclosed location**

location or structure that is covered on all sides in such a manner as to provide a degree of protection

#### 3.2

##### **non-weather-protected location**

location at which the product is not protected from direct ~~weather influences~~ meteorological conditions

#### 3.3

##### **open-air location**

location that is unenclosed that provides no protection from meteorological conditions

#### 3.4

##### **storage**

~~The product is placed at a certain site for long periods, but not intended for use during these periods~~

a product kept in a place when not being operated

#### 3.5

##### **sheltered location**

location or structure that provides limited protection from direct meteorological conditions such as rain and wind

#### 3.6

##### **weather-protected location**

location at which the product is protected from ~~weather influences~~ meteorological conditions

~~—totally weatherprotected location:—direct weather influences are totally excluded;  
(enclosed location)~~

~~partially weatherprotected location: direct weather influences are not completely (sheltered location) excluded.~~

## 4 General

~~For further general guidance, see IEC 721-3-0.~~

~~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 have not been included in this standard, but should be considered for any environmental parameter.~~

~~They should additionally be specified, if applicable. Information on the duration and frequency of occurrence is given, as clause 6, in amendment 1 to IEC 721-3-0.~~

~~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 the presence of chemically or mechanically active substances.~~

A product may be subjected to a range of environmental conditions during its lifetime. These conditions have been separated into classes described in IEC 60721-3-0. The classes given may be used for defining the maximum short-term environmental stresses of a product. However, they do not provide information regarding the long-term or total lifetime environmental stresses a product may experience. This means that no reliability or lifetime assessment is possible based on these classes alone. Refer to IEC 60721-2 (all parts) and applicable technical reports (IEC TR 62130 and IEC TR 62131-5) for further information on actual environmental conditions.

A product will be simultaneously exposed to a number of environmental parameters. For example, solar radiation and temperature, temperature and humidity, as well as vibration and temperature change. Combinations of the environmental parameters given may increase the effect on a product. Therefore, combined conditions should be considered in the design and evaluation of a product.

Products should be designed to survive and operate in different environments. Basically, they will be affected by the environmental influences in two ways:

- by the effects of short-term extreme environmental conditions which may directly cause malfunction or destroy the product;
- by the effect of long-term subjection to non-extreme environmental stresses which may slowly degrade the product and finally cause malfunction or destruction of the product.

Short-term extreme environmental conditions may occur at any time in the product's life. A product may be unaffected by an extreme condition when it is new but fail when it is subjected to the same condition after being used for a long period of time due to the effect of ageing. The order in which the environmental conditions are applied may affect the results of an evaluation.

It is important for the product specification, when referring to a certain class in IEC 60721-3 (all parts), to define whether the product is required to be capable of operating or only to survive without permanent damage when being exposed to the conditions described by the class.

The environmental classes may be used as a basis for the selection of design and test severities with respect to the consequence of failure. Information contained in IEC 60721-3 (all parts) may be used as a means to help establish expected requirements for use, storage, transportation, etc., and in the development of relevant specifications. The

selected severities used for testing should attempt to produce the effects of the actual environment.

EXAMPLE 1 A high temperature test on a heat dissipating product is designed to simulate the thermal effect of subjecting a product to conditions of high air temperature, solar radiation and other possible heat sources dependent on the application;

EXAMPLE 2 In a mechanical shock test, the product can be subjected to mechanical shocks of simple pulse shapes (e.g., half-sine), while the actual conditions cannot be described by such simple pulses.

It is recognized that extreme or special environmental conditions may exist which require consideration of severities that are not addressed by this document. ~~Specifications for products to be stored under such special conditions are a matter of negotiation between supplier and user.~~

## 5 Classification of groups of environmental parameters and their severities

### 5.1 General

A number of classes for climatic conditions (K), special climatic conditions (Z), biological conditions (B), chemically active substances (C), mechanically active substances (S), and mechanical conditions (M) are specified.

This classification allows a number of possible combinations of environmental conditions which bear upon products wherever stored. It represents the real situation concerning worldwide conditions of storage, for example, due to local influences of open-air climate, etc.

For certain environmental 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, for example:

~~1K2/1Z1/1B1/1C2/1S1/1M3~~

1K21/1Z1/1B1/1C2/1S10/1M10

~~See also clause 6.~~

~~Annex A contains a summary of the conditions covered by each class.~~

### 5.2 Climatic conditions (K)

NOTE All old classes have been replaced with new classes. The new classes were chosen to reflect 3 different storage condition: enclosed, sheltered and open-air locations.

The climatic conditions specified for classes ~~1K1 to 1K11~~ 1K20 to 1K29 refer to the conditions of storage of products. These conditions have been experienced worldwide over a long period of time taking into account all the parameters that can influence them such as ~~external (open-air)~~ climatic conditions, type of building construction, temperature/humidity controlling systems, and internal conditions, for example heat dissipation from other equipment and presence of humans, etc. The conditions should cover all normal cases, but not exceptional events.

~~Climatic conditions in tropical areas, as specified in classes 1K10 and 1K11, are explained in annex C.~~

When selecting appropriate classes, attention should be paid to the fact that the climatic conditions inside buildings may 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, those produced over a longer period of time. Walls with poor thermal insulation or low thermal capacity cannot have this effect, and peaks can be magnified due to the effect of solar radiation during the day, and to the effect of building radiation at night. The effect of solar radiation can be increased by either heat-trap or greenhouse effects.

At non-weather-protected locations, the influence from special climatic conditions constitutes a more significant share of the effects bearing upon a product ~~and its functional parts~~ than at weatherprotected locations. The effects of temperature change, solar radiation, precipitation, air velocity and wind-chill should be particularly considered ~~in this respect~~.

The severity of these effects may be influenced, for example by constructional details (type and thickness of material, colour of surfaces, sealing or breathing of casings, etc.), and by storage details (selection of storage site, consideration of degrees of exposure to prevailing wind and weather, etc.).

#### Enclosed storage

- 1K20 applies to fully air conditioned enclosed storage locations. Air temperature and humidity control is used continuously to maintain the required conditions.
- 1K21 applies to enclosed storage locations with limited temperature control and no humidity control.
- 1K22 applies to enclosed storage locations having no temperature or humidity control.

#### Sheltered storage

- 1K23 applies to sheltered storage locations in tropical, arid, temperate, and cold climatic classification with the thermal effects from solar radiation encompassed in the temperature.
- 1K24 applies to sheltered storage locations in the polar climate type with the thermal effects from solar radiation encompassed in the temperature.

#### Open-air storage

- 1K25 applies to open-air storage in the tropical climatic classification.
- 1K26 applies to open-air storage in the arid and temperate climatic classifications.
- 1K27 applies to open-air storage in the cold and polar climatic classifications.

These conditions are specified in Table 1.

**Table 1 – Classification of climatic conditions**

Environmental parameter	Unit	Class <sup>-10)</sup>										
		1K1	1K2	1K3	1K4	1K5	1K6	1K7	1K8	1K9	1K10 <sup>11)</sup>	1K11 <sup>11)</sup>
a) Low air temperature	°C	+20 <sup>6)</sup>	+5	-5	-25	-40	-55	-20	-33	-65	+5	-20
b) High air temperature	°C	+25 <sup>6)</sup>	+40	+45	+55	+70	+70	+35	+40	+55	+40	+55
c) Low relative humidity <sup>-1)</sup>	%	20	5	5	10	10	10	20	15	4	30	4
d) High relative humidity <sup>-1)</sup>	%	75	85	95	100	100	100	100	100	100	100	100
e) Low absolute humidity <sup>-1)</sup>	g/m <sup>3</sup>	4	1	1	0,5	0,1	0,02	0,9	0,26	0,003	6	0,9
f) High absolute humidity <sup>-1)</sup>	g/m <sup>3</sup>	15	25	29	29	35	35	22	25	36	36	27
g) Rate of change of temperature <sup>-2)</sup>	°C/min	0,1	0,5	0,5	0,5	1,0	1,0	0,5	0,5	0,5	0,5	0,5
h) Low air pressure <sup>-3)</sup>	kPa	70	70	70	70	70	70	70	70	70	70	70
i) High air pressure <sup>-3)</sup>	kPa	106	106	106	106	106	106	106	106	106	106	106
j) Solar radiation	W/m <sup>2</sup>	500	700	700	1120	1120	1120	1120	1120	1120	1120	1120
k) Heat radiation	None	No	?)	?)	?)	?)	?)	?)	?)	?)	?)	?)
l) Movement of surrounding air <sup>-4)</sup>	m/s	0,5	1,0 <sup>8)</sup>	1,0 <sup>8)</sup>	1,0 <sup>8)</sup>	5,0 <sup>8)</sup>	5,0 <sup>8)</sup>	8)	8)	8)	50 <sup>8)</sup>	50
m) Condensation	None	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
n) Precipitation (rain, snow, hail, etc.)	None	No	No	No	Yes <sup>9)</sup>	Yes <sup>9)</sup>	Yes <sup>9)</sup>	Yes	Yes	Yes	Yes	Yes
o) Rain intensity	mm/min	None	None	None	None <sup>9)</sup>	None <sup>9)</sup>	None <sup>9)</sup>	6	6	15	15	15
p) Low rain temperature <sup>-5)</sup>	°C	None	None	None	None <sup>9)</sup>	None <sup>9)</sup>	None <sup>9)</sup>	+5	+5	+5	+5	+5
q) Water from sources other than rain	None	No	No	?)	?)	?)	?)	?)	?)	?)	?)	?)
r) Formation of ice and frost	None	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

Environmental Parameter	Unit	Enclosed			Sheltered		Open-air		
		1K20	1K21	1K22	1K23	1K24	1K25	1K26	1K27
a) Low air temperature	°C	+20 <sup>6)</sup>	+5	-25	-45	-50	+5	-20	-50
b) High air temperature	°C	+25 <sup>6)</sup>	+40	+55	+70	+70	+45 <sup>11)</sup>	+50 <sup>11)</sup>	+45 <sup>11)</sup>
c) Low relative humidity <sup>1)</sup>	%	20	5	10	4	4	30	4	10
d) High relative humidity <sup>1)</sup>	%	75	85	100	100	100	100	100	100
e) Low absolute humidity <sup>1)</sup>	g/m <sup>3</sup>	4	1	0,5	0,2	0,003	6	0,1	0,003
f) High absolute humidity <sup>1)</sup>	g/m <sup>3</sup>	15	25	29	35	20	35	30	25
g) Rate of change of temperature <sup>2)</sup>	°C/min	0,1	0,5	0,5	1,0	1,0	1,0	1,0	1,0
h) Low air pressure <sup>3)</sup>	kPa	70	70	70	70	70	70	70	70
i) High air pressure <sup>3)</sup>	kPa	106	106	106	106	106	106	106	106
j) Solar radiation	W/m <sup>2</sup>	7)	7)	10)	10)	10)	1090	1090	1090
k) Heat radiation	Not specified	No	7)	7)	7)	7)	No	No	No
l) Movement of surrounding air <sup>4)</sup>	m/s	0,5	1,0	1,0	5,0 <sup>8)</sup>	5,0 <sup>8)</sup>	8)	8)	8)
m) Condensation	Not specified	No	No	Yes	Yes	Yes	Yes	Yes	Yes
n) Precipitation (rain, snow, hail, etc.)	Not specified	No	No	No	Yes <sup>9)</sup>	Yes <sup>9)</sup>	Yes	Yes	Yes
o) Rain intensity	mm/min	None	None	None	None <sup>9)</sup>	None <sup>9)</sup>	15	15	15
p) Driving rain	m/s	None	None	None	None	None	18	18	18
q) Snow load	kg/m <sup>2</sup>	None	None	None	None	None	None	8)	8)
r) Low rain temperature <sup>5)</sup>	°C	None	None	None	None <sup>9)</sup>	None <sup>9)</sup>	+5	+5	+5
s) Water from sources other than rain	L/m <sup>2</sup> /min	No	No	Dripping Water	Dripping Water	Dripping Water	12)	12)	12)
t) Formation of ice and frost (including freeze-thaw)	Not specified	No	No	Yes	Yes	Yes	No	Yes	Yes

Notes to Table 1

- 1) The low and high relative ~~humidities~~ humidity levels are limited by the low and high absolute humidities, so that, for example, for environmental parameters a) and c), or b) and d), the severities given in Table 1 do not occur simultaneously.
- 2) Averaged over a period of time of 5 min.
- 3) The value of 70 kPa represents a limit for open-air conditions, normally at an altitude of 3 000 m. In some geographical areas, open-air conditions may occur at higher altitudes. Conditions in mines are not considered.
- 4) A cooling system based on non-assisted convection may be disturbed by adverse movement of surrounding air.
- 5) This rain temperature should be considered together with high air temperature b) and solar radiation j). The cooling effect of the rain has to be considered in connection with the surface temperature of the product.
- 6) These are air-conditioned locations with a tolerance of  $\pm 2$  °C on stated temperature value.
- 7) Conditions occurring at the location concerned to be selected from Table 2.
- 8) If applicable, a special value may be selected from Table 2.
- 9) Applies **only** to wind-driven precipitation at ~~partially weather protected~~ sheltered locations.
- 10) ~~The classes of climatic conditions of this standard include the classes of IEC 721-3-3 and IEC 721-3-4 as follows:~~  
~~1K1 covers 3K1 1K3 covers 3K5 1K5 covers 3K7 1K7 covers 4K1 1K9 covers 4K4 1K11 covers 4K6~~  
~~1K2 covers 3K3 1K4 covers 3K6 1K6 covers 3K8 1K8 covers 4K2 1K10 covers 4K5~~
- 10) Thermal effect of solar radiation is included in the temperature.
- 11) Thermal effect of solar radiation is not included in the temperature.
- 12) Sources of water other than rain are encompassed by driving rain.

**5.3 Special climatic conditions (Z)**

~~As, in practice,~~ Parameters such as heat radiation, movement of the surrounding air, solar radiation, snow load, and water from sources other than rain may occur with any severity in combination with any of the other climatic conditions. These ~~special~~ conditions are specified in Table 2. ~~In those cases, an assumption of the coincidence of events of increasing severity would lead to unnecessary overdesign.~~

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**Table 2 – Classification of special climatic conditions**

Environmental parameter	Class <sup>3)</sup>	Unit	Special condition Z
k) Heat radiation	1Z1	None	Negligible
	1Z2	None	Conditions of heat radiation, e.g. in the vicinity of room heating systems
l) Movement of surrounding air <sup>4)</sup>	1Z3	m/s	30
	1Z4	m/s	50
q <sub>s</sub> ) Water from sources other than rain <sup>2)</sup>	1Z5	None	Dripping water
	<del>1Z6</del>	<del>None</del>	<del>Water jets</del>
	<del>1Z7</del>	<del>None</del>	<del>Water waves</del>
j) Solar radiation	1Z8	W/m <sup>2</sup>	500
	1Z9	W/m <sup>2</sup>	700
q) Snow load	1Z10	kg/m <sup>2</sup>	100 (single snow storm)
	1Z11	kg/m <sup>2</sup>	240 (whole season)
<sup>1)</sup> <del>A cooling system based on non-assisted convection may be disturbed by adverse movement of surrounding air.</del> <sup>2)</sup> <del>Underwater conditions are not considered.</del> <sup>3)</sup> <del>The classes of special climatic conditions of this standard include the classes of IEC 721-3-3 and IEC 721-3-4 as follows:</del> <del>1Z1 covers 3Z1                      1Z3 covers 3Z6 and 4Z4                      1Z5 covers 3Z7                      1Z7 covers 4Z9</del> <del>1Z2 covers 3Z2                      1Z4 covers 4Z5                      1Z6 covers 3Z10 and 4Z8</del>			

#### 5.4 Biological conditions (B)

No quantitative severity has been specified for these conditions. The specified parameters of Table 3 are typical, but may not be complete.

- 1B1 applies to storage locations with environmental controls in place to prevent the growth of mould and physical controls to prevent attack by animals.
- 1B2 applies to storage locations without environmental or physical controls in place to prevent mould growth or attacks by animals, except termites.
- 1B3 applies to locations where attacks by termites may occur.

**Table 3 – Classification of biological conditions**

Environmental parameter	Unit	Class <sup>1)</sup>		
		1B1	1B2	1B3
a) <i>Flora</i>	None	Negligible	Presence of mould, fungus, etc.	
b) <i>Fauna</i>	None	Negligible	Presence of rodents and other animals harmful to products excluding termites	including termites
<sup>1)</sup> The classes of biological conditions of this standard include the classes of IEC 721-3-3 and IEC 721-3-4 as follows: 1B1 covers 3B1 ————— 1B2 covers 3B2 and 4B1 — 1B3 covers 3B3 and 4B2				

Units	Class		
	1B1	1B2	1B3
None	Negligible	Presence of mould, fungus, etc. Presence of rodents and other animals harmful to products excluding termites	including termites

**5.5 Chemically active substances (C)**

The contamination of the 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 and road salts. Contamination may affect the function and materials of products. **These conditions are specified in Table 4.**

~~The values given in this classification have been taken from surveys over several years. Maximum values are given, because direct influence of higher concentrations over a short period of time 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 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 actually present increase simultaneously and homogeneously. Depending on the local situation, there are often higher values of one contaminant only. The values specified for class 1C1 will normally be experienced in rural areas and areas with low industrial activity. The values specified for class 1C2 are experienced in urban areas. Therefore the severity of each of these two classes shall be considered as the requirements for the combined effect of all parameters stated. The severities of class 1C3, however, cannot be combined as the requirement for the combined effect of all parameters stated in order to avoid any uneconomical overdesign. For that class, it is possible to select only the severities of those single parameters which might be relevant in the case of application. If single parameters of class 1C3 are selected for the description of the chemically active substances present at a location, the severities of class 1C2 are valid for all other parameters which are not specially named.~~

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

See Annex A for additional information.

**1C1** applies to locations in rural and some urban areas, with low industrial activity and moderate traffic. In winter, heating methods in concentrated urban areas may cause increased contamination.

- 1C2 applies to locations with normal levels of contaminants as experienced in urban areas with industrial activity scattered over the whole area, or with heavy traffic. Salt mist is present in coastal areas.
- 1C3 applies to locations in the immediate vicinity of industrial sources, with chemical emissions. Salt mist is present in coastal areas.

Table 4 – Classification of chemically active substances

Environmental parameter	Unit <sup>1)</sup>	Class <sup>5)</sup>					
		1C1L	1C1	1C2		1C3 <sup>3)</sup>	
		Maximum value	Maximum value	Mean value	Maximum value <sup>2)</sup>	Mean value	Maximum value <sup>2)</sup>
a) Salt mist to include Sea and road salts	None	No	No <sup>4)</sup>	Salt mist Yes		Salt mist Yes	
b) Sulphur dioxide	mg/m <sup>3</sup>	0,1	0,1	0,3	1,0	5,0	10
	cm <sup>3</sup> /m <sup>3</sup>	0,037	0,037	0,11	0,37	1,85	3,7
c) Hydrogen sulphide	mg/m <sup>3</sup>	0,01	0,01	0,1	0,5	3,0	10
	cm <sup>3</sup> /m <sup>3</sup>	0,0071	0,0071	0,071	0,36	2,1	7,1
d) Chlorine	mg/m <sup>3</sup>	0,01	0,1	0,1	0,3	0,3	1
	cm <sup>3</sup> /m <sup>3</sup>	0,0034	0,034	0,034	0,1	0,1	0,34
e) Hydrogen chloride	mg/m <sup>3</sup>	0,01	0,1	0,1	0,5	1,0	5,0
	cm <sup>3</sup> /m <sup>3</sup>	0,0066	0,066	0,066	0,33	0,66	3,3
f) Hydrogen fluoride	mg/m <sup>3</sup>	0,003	0,003	0,01	0,03	0,1	2,0
	cm <sup>3</sup> /m <sup>3</sup>	0,0036	0,0036	0,012	0,036	0,12	2,4
g) Ammonia	mg/m <sup>3</sup>	0,3	0,3	1,0	3,0	10	35
	cm <sup>3</sup> /m <sup>3</sup>	0,42	0,42	1,4	4,2	14	49
h) Ozone	mg/m <sup>3</sup>	0,01	0,01	0,05	0,1	0,1	0,3
	cm <sup>3</sup> /m <sup>3</sup>	0,005	0,005	0,025	0,05	0,05	0,15
i) Nitrogen oxides (expressed in equivalent values of nitrogen dioxide)	mg/m <sup>3</sup>	0,1	0,1	0,5	1,0	3,0	9,0
	cm <sup>3</sup> /m <sup>3</sup>	0,052	0,052	0,26	0,52	1,56	4,68

1) The values given in cm<sup>3</sup>/m<sup>3</sup> have been calculated from the values given in mg/m<sup>3</sup>, and refer to a temperature of 20 °C and a pressure of 101,3 kPa. The table uses round values.

2) Mean values are expected long-term values. Maximum values are limit or peak values, occurring over a period of time of not more than 30 min per day.

3) It is not mandatory to consider class 1C3 as a requirement for the combined effect of all parameters stated. If applicable, the values of single parameters may be selected from this class. In that case, the severities of class 1C2 are valid for all parameters not especially named.

4) Salt mist may be present in sheltered locations of coastal areas.

5) The classes of chemically active substances of this standard include the classes of IEC 721-3-3 and IEC 721-3-4 as follows:  
 1C1L covers 3C1L — 1C1 covers 3C1 and 4C1 — 1C2 covers 3C2 and 4C2 — 1C3 covers 3C3 and 4C3 —

## 5.6 Mechanically active substances (S)

NOTE All old classes have been replaced with new classes. The new classes were chosen to reflect 3 different storage conditions; enclosed, sheltered and open-air locations.

Dust and sand are classified together, as the effects caused by these environmental conditions are similar.

- 1S10 applies to enclosed storage locations where precautions have been taken to minimize the presence of dust and sand.
- 1S11 applies to enclosed storage locations not situated in proximity to dust or sand sources and with no precautions to minimize the ingress of dust or sand. Such enclosed storage locations could include shipping containers.
- 1S12 applies to enclosed storage locations in close proximity to sand or dust sources, including urban area and with no precautions to minimize the ingress of dust or sand. It also applies to exposed storage locations situated in areas not subject to natural dust storms or significant industrial activity.
- 1S13 applies to exposed storage locations which may be exposed to wind-driven dust and sand either due to natural conditions or due to industrial activity producing blown sand or dust.

These conditions are specified in Table 5.

**Table 5 – Classification of mechanically active substances**

Environmental parameter	Unit	Class			
		1S1	1S2	1S3	1S4
a) Sand	mg/m <sup>3</sup>	None	30	300	1000
b) Dust (suspension)	mg/m <sup>3</sup>	0,01	0,2	5,0	15
c) Dust (sedimentation)	mg/(m <sup>2</sup> .h)	0,4	1,5	20	40
1) The classes of mechanically active substances of this standard include the classes of IEC 721-3-3 and IEC 721-3-4 as follows: 1S1 covers 3S1                      1S1 covers 3S2                      1S3 covers 4S2                      1S4 covers 4S3					

Environmental parameter	Unit	Class			
		1S10	1S11	1S12	1S13
Setting (sedimentary) dust	mg/(m <sup>2</sup> .d)	None	6	Note 1	Note 2
Turbulent (suspended) dust	mg/(m <sup>2</sup> .h)	None	None	600	Note 2
Windblown dust	mg/m <sup>3</sup>	None	None	None	18
	m/s				13
NOTE 1 Encompassed within turbulent (suspended) dust.					
NOTE 2 Encompassed within windblown dust.					

**5.7 Mechanical conditions (M)**

~~The conditions of vibration (sinusoidal) are classified by severity levels of acceleration, and displacement amplitudes in high and low frequency range, 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 figure 1).~~

NOTE All old classes have been replaced with new classes. The new classes based on IEC TR 62131-5.

Mechanical conditions relate to the levels of vibration and shock that may exist at a storage location, for example as a result of normal operations, nearby vehicular movement, etc. These conditions are specified in Table 6.

- 1M10 applies to storage locations experiencing insignificant levels of vibration and shock.
- 1M11 applies to storage locations experiencing low levels of vibration and shock, such as those transmitted from air conditioning, machines or passing vehicles in the vicinity, etc.
- 1M12 applies to storage locations experiencing significant levels vibration and shock, such as those close to heavy machines and conveyor belts.

**Table 6 – Classification of mechanical conditions**

Environmental parameter	Unit	Class <sup>2)</sup>							
		1M1		1M2		1M3		1M4	
a) <i>Stationary vibration, sinusoidal:</i> displacement amplitude acceleration amplitude frequency range	mm m/s <sup>2</sup> Hz	0,3 2-9	1 9-200	1,5 2-9	5 9-200	3,0 2-9	10 9-200	7,0 2-9	20 9-200
b) <i>Non-stationary vibration, including shock:</i> shock response spectrum type L peak acceleration $\hat{a}^{(1)}$ shock response spectrum type I peak acceleration $\hat{a}^{(1)}$ shock response spectrum type II peak acceleration $\hat{a}^{(1)}$	m/s <sup>2</sup> m/s <sup>2</sup> m/s <sup>2</sup>	40		40		None		None	
		None		None		100		None	
		None		None		None		250	
c) <i>Static load</i>	kPa	5		5		5		5	

1) See figure 1.

2) The classes of mechanical conditions of this standard (except static load) include the classes of IEC 721-3-3 and IEC 721-3-4 as follows:

1M1 covers 3M1                      1M2 covers 3M2                      1M3 covers 3M4                      1M4 covers 3M6 and 4M6.

Environmental parameter	Unit	Class		
		1M10	1M11	1M12
Stationary vibration, random: acceleration spectral density	(m/s <sup>2</sup> ) <sup>2</sup> /Hz	None	0,01	0,1
	Hz		5 to 200 Hz	5 to 200 Hz

## 6 Sets of environmental condition class combinations

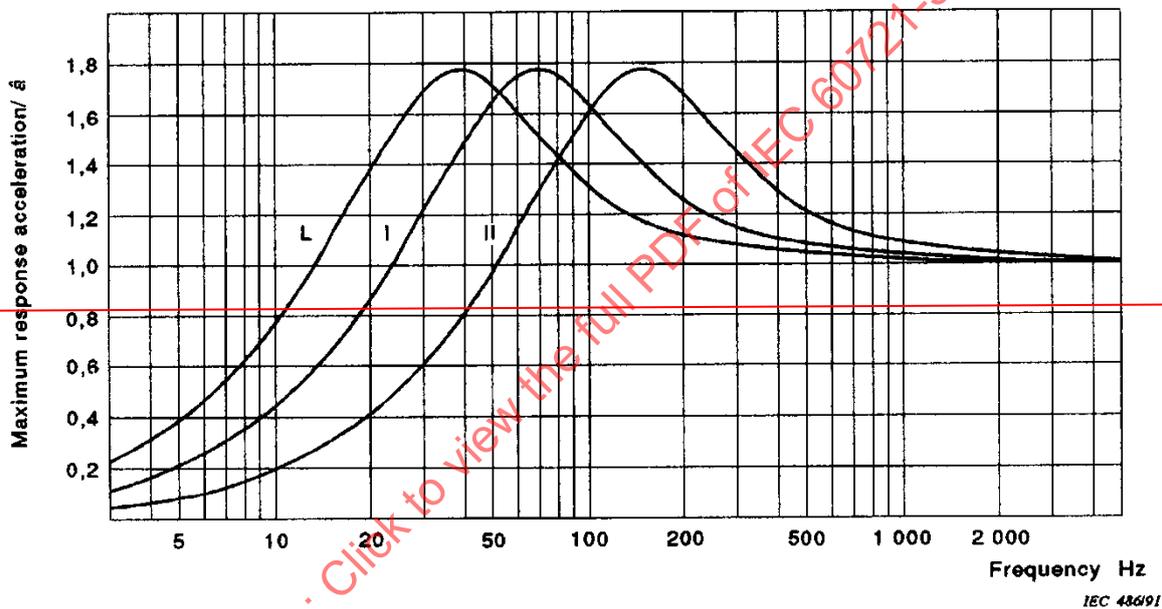
As indicated in clause 5, the classification allows a number of possible combinations of environmental conditions bearing on products wherever used. The number of possibilities, and thus the flexibility, is therefore very great. In practice, however, this flexibility is not always an advantage when,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

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 then may be made to this standard, for example IE12. 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 IE12 but sand 300 mg/m<sup>3</sup>.

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

**Table 7 — Sets of environmental class combinations**

Condition	Set of class combinations			
	1E11	1E12	1E13	1E14
Climatic	1K2	1K3	1K4	1K8
Special climatic	1Z2	1Z2	1Z1	1Z1
	-	-	1Z3	1Z4
	-	1Z5	1Z5	1Z6
Biological	1B1	1B1	1B2	1B2
Chemically active substances	1C2	1C2	1C2	1C2
Mechanically active substances	1S2	1S2	1S3	1S3
Mechanical	1M2	1M2	1M2	1M3



*Example of durations for half-sine pulse:*

Spectrum type L: duration 22 ms

Spectrum type I: duration 11 ms

Spectrum type II: duration 6 ms

**Figure 1 — Model shock response spectra (first order maximax shock response spectra)**  
 For explanations see note 6 relating to table 1 of IEC 721-1

## **Annex A** **(informative)**

### **Summary of conditions covered by the classes**

#### **A.1 General**

This annex contains a summary of the conditions covered by each class.

A survey of conditions affecting the choice of environmental parameters and their severities may be found in the clauses A.2 of annex A of IEC 721-3-3 and IEC 721-3-4.

Climatograms describing the interdependence of air temperature, relative humidity and absolute humidity may be found in annexes B of the aforementioned standards.

#### **A.2 Summary of conditions**

##### **A.2.1 Climatic conditions**

These are covered by eleven class notations as follows. For the types and groups of climates, see IEC 721-2-1:

**1K1** This class applies to fully air-conditioned, enclosed locations. Air temperature and humidity control is used continuously to maintain the required conditions.

Stored products may be exposed to attenuated solar radiation and to movements of surrounding air due to draughts from the air-conditioning system. They are not subjected to heat radiation, condensed water, precipitation, water from sources other than rain, or formation of ice.

**1K2** In addition to the conditions covered by class 1K1, this class applies to temperature-controlled enclosed locations. Humidity is not controlled.

Heating or cooling is used to maintain the required conditions, especially where there is a large difference between them and the open-air climate.

Stored products may be exposed to solar radiation and heat radiation. They may also be exposed to movements of surrounding air due to draughts in buildings, caused by open windows, special process conditions, etc.

**1K3** In addition to the conditions covered by class 1K2, this class applies to enclosed locations having neither temperature nor humidity control.

Heating may be used to raise low temperatures, especially where there is a large difference between the conditions of this class and the open-air climate.

Stored products may be subjected to condensed water, to water from sources other than rain, and to formation of ice.

**1K4** In addition to the conditions covered by class 1K3, these classes apply to locations  
**1K5** which may have openings directly to the open air, that is they may be only partially  
**1K6** weatherprotected.

Class climatic conditions may be affected to a varying extent by the type of building

~~construction and conditions of the open air climate (see 5.1).~~

~~Stored products may be subjected to limited wind-driven precipitation.~~

~~1K7 In addition to the conditions covered by classes 1K4, 1K5 and 1K6, these classes apply to locations which are non-weatherprotected, and which are directly exposed to open-air climates.~~

~~Class 1K7 represents the conditions covered by the restricted group of open-air climates.~~

~~Class 1K8 represents the conditions covered by the moderate group of open-air climates.~~

~~Class 1K9 represents the conditions covered by the world-wide group of open-air climates.~~

~~1K10 Class 1K10 represents the conditions covered by the Warm Damp and Warm Damp Equable types of open-air climate (tropical damp type of climate, in areas with tropical rainforests).~~

~~1K11 Class 1K11 represents the conditions covered by the Warm Dry, Mild Warm Dry and Extremely Warm Dry types of open-air climate (tropical dry type of climate, in areas near the tropics, such as deserts).~~

~~Additionally to those parameters where severities have been specified for each climatic class in table 1, stored products may be subjected to heat radiation, to movements of surrounding air, and to water from sources other than rain. If applicable, severities may be taken from table 2.~~

#### ~~A.2.2 B Biological conditions~~

~~These are covered by three class notations as follows:~~

~~1B1 This class applies to locations without particular risks of biological attacks. This includes protective measures, such as special product design, or storage in locations of such construction that mould growth, attacks by animals, etc. are not probable.~~

~~1B2 In addition to the conditions covered by class 1B1, this class applies to locations where mould growth or attacks by animals, except termites, may occur.~~

~~1B3 In addition to the conditions covered by class 1B2, this class applies to locations where attacks by termites may occur.~~

#### ~~A.2.3 C Chemically active substances~~

~~These are covered by four class notations as follows:~~

~~1C1L This class applies to locations where the atmosphere is continuously controlled.~~

~~1C1 In addition to the conditions covered by class 1C1L, this class applies to locations in rural and some urban areas, with low industrial activity and moderate traffic. In winter, heating methods in concentrated urban areas may cause increased contamination. Salt mist may be present in sheltered locations in coastal areas.~~

~~1C2 — In addition to the conditions covered by class 1C1, this class applies to locations with normal levels of contaminants as experienced in urban areas with industrial activity scattered over the whole area, or with heavy traffic.~~

~~1C3 — In addition to the conditions covered by class 1C2, this class applies to locations in the immediate neighbourhood of industrial sources, with chemical emissions.~~

#### ~~A.2.4 — S — Mechanically active substances~~

~~These are covered by four class notations as follows:~~

~~1S1 — This class applies to locations where precautions have been taken to minimize the presence of dust. Ingress of sand is prevented.~~

~~1S2 — In addition to the conditions covered by class 1S1, this class applies to locations without special precautions to minimize the presence of dust or sand, but not situated in proximity to dust or sand sources.~~

~~1S3 — In addition to the conditions covered by class 1S2, this class applies to locations in close proximity to sand or dust sources, including urban areas.~~

~~1S4 — In addition to the conditions covered by class 1S3, this class applies to areas with a high proportion of wind-driven sand or dust in the air, and to locations with processes producing sand or dust.~~

#### ~~A.2.5 — M — Mechanical conditions~~

~~These are covered by four class notations as follows:~~

~~1M1 — This class applies to locations with insignificant vibration and shock.~~

~~1M2 — In addition to the conditions covered by 1M1, this class applies to locations with vibration of low significance.~~

~~1M3 — In addition to the conditions covered by 1M2, this class applies to locations with significant vibration and shock, such as those transmitted from machines or passing vehicles in the vicinity, etc.~~

~~1M4 — In addition to the conditions covered by 1M3, this class applies to locations where the levels of vibration and shock are high, such as those close to heavy machines and conveyor belts.~~

**Annex B**  
(informative)

**Summary of conditions covered by the sets of class combinations**

~~This annex contains a condensed description of the complete classification for four standardized environmental condition cases.~~

~~For a more detailed description, see annex A.~~

~~The general environmental conditions are covered by four set notations as follows:~~

- ~~IE11 This set covers continuously temperature-controlled locations; heating, cooling or humidification being used where necessary to maintain required conditions; exposure to some solar and heat radiation; movement of surrounding air, such as through open windows; without particular risk of biological attacks; with normal levels of contaminants experienced in urban areas with industrial activities scattered over the whole area, or with heavy traffic; without special precautions to minimize presence of dust or sand, but not situated in proximity to dust and sand sources; experiencing vibration of low significance.~~
- ~~IE12 In addition to the conditions covered by IE11, IE12 applies to locations having neither temperature nor humidity control; heating may be used to raise low temperatures; with buildings constructed to avoid extremely high temperatures; with risk of condensation, dripping water, formation of ice.~~
- ~~IE13 In addition to the conditions covered by IE12, IE13 applies to locations in buildings provided with minimal protection from daily variations of outside climate; exposure to solar radiation, wind-driven precipitation; with risk of mould growth and attacks by animals except termites; in close proximity to sand and dust sources, including those of urban areas.~~
- ~~IE14 In addition to the conditions covered by IE13, IE14 applies to non-weatherprotected locations; negligible heat radiation; fair movement of surrounding air; experiencing significant shock, for example that transmitted from machines or passing vehicles in the vicinity.~~

## **Annex C** (informative)

### **Explanation of the environmental conditions in tropical areas as specified in classes 1K10 and 1K11**

#### **C.1 General**

~~The tropics are the areas within the Northern and Southern tropics (between 23°27' south and 23°27' north).~~

In tropical areas, the following types of open air climate, as specified in IEC 721-2-1, apply:

- ~~Warm Dry (WDr)~~
- ~~Mild Warm Dry (MWDr)~~
- ~~Extremely Warm Dry (EWDr)~~
- ~~Warm Damp (WDa)~~
- ~~Warm Damp Equable (WDaE)~~

~~The tropics are the zones of the earth in which, during daytime, high temperatures, frequently combined with high precipitation, prevail. In these areas, seasonal changes are scarcely pronounced.~~

~~The tropical climate extends from warm damp climatic conditions in tropical rainforests at the equator to the warm dry climate in the deserts near the tropics. Consequently, two types of tropical climate should be distinguished:~~

- ~~— tropical dry as a combination of the Warm Dry, Mild Warm Dry and Extremely Warm Dry types of climate; and~~
- ~~— tropical damp as a combination of the Warm Damp and Warm Damp Equable types of climate.~~

~~There are also regions where the climate, owing to the particular altitude, deviates considerably from the usual conditions of those latitudes, for example solar radiation and air pressure or ice and snow on mountain summits. In many areas in the tropics, environmental conditions are identified by uniform conditions, and in other regions by very extreme climatic conditions:~~

~~Balanced conditions:~~

- ~~— minimum daily temperature fluctuations of less than 1 °C and annual temperature fluctuations of maximum 6 °C;~~
- ~~— balanced duration of daylight periods between 10,5 h and 13,5 h;~~
- ~~— uniform intensity of solar radiation;~~
- ~~— balanced conditions for an abundant fauna.~~

~~Extreme conditions:~~

- ~~— precipitation: rainfall the whole year round near the equator, heavy rainfall during certain periods of the year near the tropics;~~
- ~~— tropical cyclones in sea areas: wind velocities of 30 m/s with peaks attaining more than 60 m/s, for example in typhoons in the Western Pacific and in hurricanes in the Caribbean Sea;~~

- ~~— unfavourable soil conditions: erosion of humus and minerals in areas with heavy rainfalls;~~
- ~~— rapid drying of soil in the desert as a result of high temperatures and strong winds;~~
- ~~— lush vegetation in tropical rainforests, less dense vegetation in mountain forests;~~
- ~~— grass areas of savannahs and steppes, absence of vegetation in the desert.~~

## **~~C.2 Climatograms~~**

~~Climatograms for the two classes describing climatic conditions in tropical areas are given in figure C.1. They are based on the mean value of annual extreme values of air temperature and humidity for the types of climate specified in C.1 above.~~

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## Annex A (informative)

### Chemically active substances

The values given in this classification have been taken from surveys over several years. Maximum values are given, because direct influence of higher concentrations over a short period of time 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 internal parts of the products.

In practice, not all contaminants (parameters) classified in this document are present simultaneously. Furthermore, the probability is low that the concentrations of those contaminants actually present increase simultaneously and homogeneously. Depending on the local situation, there are often higher values of one contaminant only. The values specified for class 1C1 will normally be experienced in rural areas and areas with low industrial activity. The values specified for class 1C2 are experienced in urban areas. Therefore the severity of each of these two classes shall be considered as the requirements for the combined effect of all parameters stated. The severities of class 1C3, however, cannot be combined as the requirement for the combined effect of all parameters stated in order to avoid any uneconomical overdesign. For that class, it is possible to select only the severities of those single parameters which might be relevant in the case of application. If single parameters of class 1C3 are selected for the description of the chemically active substances present at a location, the severities of class 1C2 are valid for all other parameters which are not specially named.

Chemically active liquids and chemically active solids other than sea salts or road salts are not considered in this document.

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# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Classification of environmental conditions –  
Part 3-1: Classification of groups of environmental parameters and their  
severities – Storage**

**Classification des conditions d'environnement –  
Partie 3-1: Classification des groupements des agents d'environnement et de  
leurs sévérités – Stockage**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –****Part 3-1: Classification of groups of environmental parameters and their severities – Storage**

## FOREWORD

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International Standard IEC 60721-3-1 has been prepared by IEC technical committee 104: Environmental conditions, classification, and methods of test.

This third edition cancels and replaces the second edition, published in 1997, and constitutes a technical revision.

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

- a) Clause 3: reworded and simplified.
- b) Clause 4: reworded and simplified.
- c) Clause 5: Annex C has been incorporated in Clause 5.

- d) 5.2: all existing climate classes have been replaced by completely new classes. The new classes are divided into 3 groups. The reason for the new classes is the latest revision of IEC 60721-2-1 which incorporated new climate types.
- e) 5.3: new classes for solar radiation and snow load.
- f) 5.6: all existing classes for mechanically active substances have been replaced by completely new classes.
- g) 5.7: all existing classes for mechanical conditions have been replaced by completely new classes.
- h) Table 1: new climatic classes with new severities.
- i) Table 2: new classes for solar radiation and snow load.
- j) Table 5 new mechanically active substances classes.
- k) Table 6: new mechanical conditions classes.

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

FDIS	Report on voting
104/772/FDIS	104/782/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

## CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

### Part 3-1: Classification of groups of environmental parameters and their severities – Storage

#### 1 Scope and object

This part of IEC 60721 classifies the groups of environmental parameters and their severities to which products together with their packaging, if any, are subjected when stored.

The environmental conditions specified in this document are limited to those which can directly affect the products or their ultimate performance. 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 fire or explosions are not included.

Conditions of stationary use, portable and non-stationary use, use in vehicles and ships, and conditions of transportation are given in other subparts of the IEC 60721-3 series.

The object of this document is to classify environmental parameters and their severities to which a product can be exposed during storage. Transfer and handling during storage and transport are addressed in IEC 60721-3-2.

#### 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*

#### 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 terminological databases for use in standardization at the following addresses:

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

##### 3.1

##### **enclosed location**

location or structure that is covered on all sides in such a manner as to provide a degree of protection

### 3.2

#### **non-weather-protected location**

location at which the product is not protected from direct meteorological conditions

### 3.3

#### **open-air location**

location that is unenclosed that provides no protection from meteorological conditions

### 3.4

#### **storage**

a product kept in a place when not being operated

### 3.5

#### **sheltered location**

location or structure that provides limited protection from direct meteorological conditions such as rain and wind

### 3.6

#### **weather-protected location**

location at which the product is protected from meteorological conditions

## 4 General

A product may be subjected to a range of environmental conditions during its lifetime. These conditions have been separated into classes described in IEC 60721-3-0. The classes given may be used for defining the maximum short-term environmental stresses of a product. However, they do not provide information regarding the long-term or total lifetime environmental stresses a product may experience. This means that no reliability or lifetime assessment is possible based on these classes alone. Refer to IEC 60721-2 (all parts) and applicable technical reports (IEC TR 62130 and IEC TR 62131-5) for further information on actual environmental conditions.

A product will be simultaneously exposed to a number of environmental parameters. For example, solar radiation and temperature, temperature and humidity, as well as vibration and temperature change. Combinations of the environmental parameters given may increase the effect on a product. Therefore, combined conditions should be considered in the design and evaluation of a product.

Products should be designed to survive and operate in different environments. Basically, they will be affected by the environmental influences in two ways:

- by the effects of short-term extreme environmental conditions which may directly cause malfunction or destroy the product;
- by the effect of long-term subjection to non-extreme environmental stresses which may slowly degrade the product and finally cause malfunction or destruction of the product.

Short-term extreme environmental conditions may occur at any time in the product's life. A product may be unaffected by an extreme condition when it is new but fail when it is subjected to the same condition after being used for a long period of time due to the effect of ageing. The order in which the environmental conditions are applied may affect the results of an evaluation.

It is important for the product specification, when referring to a certain class in IEC 60721-3 (all parts), to define whether the product is required to be capable of operating or only to survive without permanent damage when being exposed to the conditions described by the class.

The environmental classes may be used as a basis for the selection of design and test severities with respect to the consequence of failure. Information contained in IEC 60721-3 (all parts) may be used as a means to help establish expected requirements for use, storage, transportation, etc., and in the development of relevant specifications. The selected severities used for testing should attempt to produce the effects of the actual environment.

EXAMPLE 1 A high temperature test on a heat dissipating product is designed to simulate the thermal effect of subjecting a product to conditions of high air temperature, solar radiation and other possible heat sources dependent on the application;

EXAMPLE 2 In a mechanical shock test, the product can be subjected to mechanical shocks of simple pulse shapes (e.g., half-sine), while the actual conditions cannot be described by such simple pulses.

It is recognized that extreme or special environmental conditions may exist which require consideration of severities that are not addressed by this document.

## 5 Classification of groups of environmental parameters and their severities

### 5.1 General

A number of classes for climatic conditions (K), special climatic conditions (Z), biological conditions (B), chemically active substances (C), mechanically active substances (S), and mechanical conditions (M) are specified.

This classification allows a number of possible combinations of environmental conditions which bear upon products wherever stored. It represents the real situation concerning worldwide conditions of storage, for example, due to local influences of open-air climate.

For certain environmental 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, for example:

1K21/1Z1/1B1/1C2/1S10/1M10

### 5.2 Climatic conditions (K)

NOTE All old classes have been replaced with new classes. The new classes were chosen to reflect 3 different storage condition: enclosed, sheltered and open-air locations.

The climatic conditions specified for classes 1K20 to 1K29 refer to the conditions of storage of products. These conditions have been experienced worldwide over a long period of time taking into account all the parameters that can influence them such as open-air climatic conditions, type of building construction, temperature/humidity controlling systems, and internal conditions, for example heat dissipation from other equipment and presence of humans. The conditions should cover all normal cases, but not exceptional events.

When selecting appropriate classes, attention should be paid to the fact that the climatic conditions inside buildings may 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, those produced over a longer period of time. Walls with poor thermal insulation or low thermal capacity cannot have this effect, and peaks can be magnified due to the effect of solar radiation during the day, and to the effect of building radiation at night. The effect of solar radiation can be increased by either heat-trap or greenhouse effects.

At non-weather-protected locations, the influence from special climatic conditions constitutes a more significant share of the effects bearing upon a product than at weather-protected locations. The effects of temperature change, solar radiation, precipitation, air velocity and wind-chill should be particularly considered.

The severity of these effects may be influenced, for example by constructional details (type and thickness of material, colour of surfaces, sealing or breathing of casings, etc.), and by storage details (selection of storage site, consideration of degrees of exposure to prevailing wind and weather, etc.).

#### Enclosed storage

- 1K20 applies to fully air conditioned enclosed storage locations. Air temperature and humidity control is used continuously to maintain the required conditions.
- 1K21 applies to enclosed storage locations with limited temperature control and no humidity control.
- 1K22 applies to enclosed storage locations having no temperature or humidity control.

#### Sheltered storage

- 1K23 applies to sheltered storage locations in tropical, arid, temperate, and cold climatic classification with the thermal effects from solar radiation encompassed in the temperature.
- 1K24 applies to sheltered storage locations in the polar climate type with the thermal effects from solar radiation encompassed in the temperature.

#### Open-air storage

- 1K25 applies to open-air storage in the tropical climatic classification.
- 1K26 applies to open-air storage in the arid and temperate climatic classifications.
- 1K27 applies to open-air storage in the cold and polar climatic classifications.

These conditions are specified in Table 1.

Table 1 – Classification of climatic conditions

Environmental Parameter	Unit	Enclosed			Sheltered		Open-air		
		1K20	1K21	1K22	1K23	1K24	1K25	1K26	1K27
a) Low air temperature	°C	+20 <sup>6)</sup>	+5	-25	-45	-50	+5	-20	-50
b) High air temperature	°C	+25 <sup>6)</sup>	+40	+55	+70	+70	+45 <sup>11)</sup>	+50 <sup>11)</sup>	+45 <sup>11)</sup>
c) Low relative humidity <sup>1)</sup>	%	20	5	10	4	4	30	4	10
d) High relative humidity <sup>1)</sup>	%	75	85	100	100	100	100	100	100
e) Low absolute humidity <sup>1)</sup>	g/m <sup>3</sup>	4	1	0,5	0,2	0,003	6	0,1	0,003
f) High absolute humidity <sup>1)</sup>	g/m <sup>3</sup>	15	25	29	35	20	35	30	25
g) Rate of change of temperature <sup>2)</sup>	°C/min	0,1	0,5	0,5	1,0	1,0	1,0	1,0	1,0
h) Low air pressure <sup>3)</sup>	kPa	70	70	70	70	70	70	70	70
i) High air pressure <sup>3)</sup>	kPa	106	106	106	106	106	106	106	106
j) Solar radiation	W/m <sup>2</sup>	7)	7)	10)	10)	10)	1090	1090	1090
k) Heat radiation	Not specified	No	7)	7)	7)	7)	No	No	No
l) Movement of surrounding air <sup>4)</sup>	m/s	0,5	1,0	1,0	5,0 <sup>8)</sup>	5,0 <sup>8)</sup>	8)	8)	8)
m) Condensation	Not specified	No	No	Yes	Yes	Yes	Yes	Yes	Yes
n) Precipitation (rain, snow, hail, etc.)	Not specified	No	No	No	Yes <sup>9)</sup>	Yes <sup>9)</sup>	Yes	Yes	Yes
o) Rain intensity	mm/min	None	None	None	None <sup>9)</sup>	None <sup>9)</sup>	15	15	15
p) Driving rain	m/s	None	None	None	None	None	18	18	18
q) Snow load	kg/m <sup>2</sup>	None	None	None	None	None	None	8)	8)
r) Low rain temperature <sup>5)</sup>	°C	None	None	None	None <sup>9)</sup>	None <sup>9)</sup>	+5	+5	+5
s) Water from sources other than rain	L/m <sup>2</sup> /min	No	No	Dripping Water	Dripping Water	Dripping Water	12)	12)	12)
t) Formation of ice and frost (including freeze-thaw)	Not specified	No	No	Yes	Yes	Yes	No	Yes	Yes

Notes to Table 1

- 1) The low and high relative humidity levels are limited by the low and high absolute humidities, so that, for example, for environmental parameters a) and c), or b) and d), the severities given in Table 1 do not occur simultaneously.
- 2) Averaged over a period of time of 5 min.
- 3) The value of 70 kPa represents a limit for open-air conditions, normally at an altitude of 3 000 m. In some geographical areas, open-air conditions may occur at higher altitudes. Conditions in mines are not considered.
- 4) A cooling system based on non-assisted convection may be disturbed by adverse movement of surrounding air.
- 5) This rain temperature should be considered together with high air temperature b) and solar radiation j). The cooling effect of the rain has to be considered in connection with the surface temperature of the product.
- 6) These are air-conditioned locations with a tolerance of  $\pm 2$  °C on stated temperature value.
- 7) Conditions occurring at the location concerned to be selected from Table 2.
- 8) If applicable, a special value may be selected from Table 2.
- 9) Applies only to wind-driven precipitation at sheltered locations.
- 10) Thermal effect of solar radiation is included in the temperature.
- 11) Thermal effect of solar radiation is not included in the temperature.
- 12) Sources of water other than rain are encompassed by driving rain.

### 5.3 Special climatic conditions (Z)

Parameters such as heat radiation, movement of the surrounding air, solar radiation, snow load, and water from sources other than rain may occur with any severity in combination with any of the other climatic conditions. These conditions are specified in Table 2.

**Table 2 – Classification of special climatic conditions**

Environmental parameter	Class	Unit	Special condition Z
k) Heat radiation	1Z1	None	Negligible
	1Z2	None	Conditions of heat radiation, e.g. in the vicinity of room heating systems
l) Movement of surrounding air	1Z3	m/s	30
	1Z4	m/s	50
s) Water from sources other than rain	1Z5	None	Dripping water
j) Solar radiation	1Z8	W/m <sup>2</sup>	500
	1Z9	W/m <sup>2</sup>	700
q) Snow load	1Z10	kg/m <sup>2</sup>	100 (single snow storm)
	1Z11	kg/m <sup>2</sup>	240 (whole season)

### 5.4 Biological conditions (B)

No quantitative severity has been specified for these conditions. The specified parameters of Table 3 are typical, but may not be complete.

- 1B1 applies to storage locations with environmental controls in place to prevent the growth of mould and physical controls to prevent attack by animals.
- 1B2 applies to storage locations without environmental or physical controls in place to prevent mould growth or attacks by animals, except termites.
- 1B3 applies to locations where attacks by termites may occur.

**Table 3 – Classification of biological conditions**

Units	Class		
	1B1	1B2	1B3
None	Negligible	Presence of mould, fungus, etc. Presence of rodents and other animals harmful to products excluding termites	including termites

**5.5 Chemically active substances (C)**

The contamination of the 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 and road salts. Contamination may affect the function and materials of products. These conditions are specified in Table 4.

See Annex A for additional information.

- 1C1 applies to locations in rural and some urban areas, with low industrial activity and moderate traffic. In winter, heating methods in concentrated urban areas may cause increased contamination.
- 1C2 applies to locations with normal levels of contaminants as experienced in urban areas with industrial activity scattered over the whole area, or with heavy traffic. Salt mist is present in coastal areas.
- 1C3 applies to locations in the immediate vicinity of industrial sources, with chemical emissions. Salt mist is present in coastal areas.

**Table 4 – Classification of chemically active substances**

Environmental parameter	Unit	Classification				
		1C1	1C2		1C3	
		Maximum value	Mean value	Maximum value	Mean value	Maximum value
a) Salt mist to include sea and road salts	None	No	Yes		Yes	
b) Sulphur dioxide	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,1 0,037	0,3 0,11	1,0 0,37	5,0 1,85	10 3,7
c) Hydrogen sulphide	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,01 0,0071	0,1 0,071	0,5 0,36	3,0 2,1	10 7,1
d) Chlorine	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,1 0,034	0,1 0,034	0,3 0,1	0,3 0,1	1 0,34
e) Hydrogen chloride	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,1 0,066	0,1 0,066	0,5 0,33	1,0 0,66	5,0 3,3
f) Hydrogen fluoride	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,003 0,0036	0,01 0,012	0,03 0,036	0,1 0,12	2,0 2,4
g) Ammonia	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,3 0,42	1,0 1,4	3,0 4,2	10 14	35 49
h) Ozone	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,01 0,005	0,05 0,025	0,1 0,05	0,1 0,05	0,3 0,15
i) Nitrogen oxides (expressed in equivalent values of nitrogen dioxide)	mg/m <sup>3</sup> cm <sup>3</sup> /m <sup>3</sup>	0,1 0,052	0,5 0,26	1,0 0,52	3,0 1,56	9,0 4,68

### 5.6 Mechanically active substances (S)

NOTE All old classes have been replaced with new classes. The new classes were chosen to reflect 3 different storage conditions; enclosed, sheltered and open-air locations.

Dust and sand are classified together, as the effects caused by these environmental conditions are similar.

- 1S10 applies to enclosed storage locations where precautions have been taken to minimize the presence of dust and sand.
- 1S11 applies to enclosed storage locations not situated in proximity to dust or sand sources and with no precautions to minimize the ingress of dust or sand. Such enclosed storage locations could include shipping containers.
- 1S12 applies to enclosed storage locations in close proximity to sand or dust sources, including urban area and with no precautions to minimize the ingress of dust or sand. It also applies to exposed storage locations situated in areas not subject to natural dust storms or significant industrial activity.
- 1S13 applies to exposed storage locations which may be exposed to wind-driven dust and sand either due to natural conditions or due to industrial activity producing blown sand or dust.

These conditions are specified in Table 5.

**Table 5 – Classification of mechanically active substances**

Environmental parameter	Unit	Class			
		1S10	1S11	1S12	1S13
Setting (sedimentary) dust	mg/(m <sup>2</sup> ·d)	None	6	Note 1	Note 2
Turbulent (suspended) dust	mg/(m <sup>2</sup> ·h)	None	None	600	Note 2
Windblown dust	mg/m <sup>3</sup>	None	None	None	18
	m/s				13
NOTE 1 Encompassed within turbulent (suspended) dust.					
NOTE 2 Encompassed within windblown dust.					

### 5.7 Mechanical conditions (M)

NOTE All old classes have been replaced with new classes. The new classes based on IEC TR 62131-5.

Mechanical conditions relate to the levels of vibration and shock that may exist at a storage location, for example as a result of normal operations, nearby vehicular movement, etc. These conditions are specified in Table 6.

- 1M10 applies to storage locations experiencing insignificant levels of vibration and shock.
- 1M11 applies to storage locations experiencing low levels of vibration and shock, such as those transmitted from air conditioning, machines or passing vehicles in the vicinity, etc.
- 1M12 applies to storage locations experiencing significant levels vibration and shock, such as those close to heavy machines and conveyor belts.

**Table 6 – Classification of mechanical conditions**

Environmental parameter	Unit	Class		
		1M10	1M11	1M12
Stationary vibration, random: acceleration spectral density	(m/s <sup>2</sup> ) <sup>2</sup> /Hz	None	0,01	0,1
	Hz		5 to 200 Hz	5 to 200 Hz

## **Annex A** (informative)

### **Chemically active substances**

The values given in this classification have been taken from surveys over several years. Maximum values are given, because direct influence of higher concentrations over a short period of time 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 internal parts of the products.

In practice, not all contaminants (parameters) classified in this document are present simultaneously. Furthermore, the probability is low that the concentrations of those contaminants actually present increase simultaneously and homogeneously. Depending on the local situation, there are often higher values of one contaminant only. The values specified for class 1C1 will normally be experienced in rural areas and areas with low industrial activity. The values specified for class 1C2 are experienced in urban areas. Therefore the severity of each of these two classes shall be considered as the requirements for the combined effect of all parameters stated. The severities of class 1C3, however, cannot be combined as the requirement for the combined effect of all parameters stated in order to avoid any uneconomical overdesign. For that class, it is possible to select only the severities of those single parameters which might be relevant in the case of application. If single parameters of class 1C3 are selected for the description of the chemically active substances present at a location, the severities of class 1C2 are valid for all other parameters which are not specially named.

Chemically active liquids and chemically active solids other than sea salts or road salts are not considered in this document.

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## Bibliography

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IEC 60721-2-1, *Classification of environmental conditions – Part 2-1: Environmental conditions appearing in nature – Temperature and humidity*

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

IEC 60721-2-5, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Section 5: Dust, sand, salt mist*

IEC 60721-3 (all parts), *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities*

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

IEC 60721-3-2, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 2: Transportation*

IEC TR 62130, *Climatic field data including validation*

IEC TR 62131-5, *Environmental conditions – Vibration and shock of electrotechnical equipment – Part 5: Equipment during storage and handling*

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## COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

## CLASSIFICATION DES CONDITIONS D'ENVIRONNEMENT –

**Partie 3-1: Classification des groupements des agents  
d'environnement et de leurs sévérités – Stockage**

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La Norme internationale IEC 60721-3-1 a été établie par le comité d'études 104 de l'IEC: Conditions, classification et essais d'environnement.

Cette troisième édition annule et remplace la deuxième édition, parue en 1997. Elle constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) Article 3: reformulé et simplifié.
- b) Article 4: reformulé et simplifié.
- c) Article 5: l'Annexe C a été intégrée dans l'Article 5.

- d) 5.2: toutes les catégories climatiques existantes ont été remplacées par des catégories complètement nouvelles. Les nouvelles catégories ont été divisées en 3 groupes. Ces catégories nouvelles ont été créées en raison de l'intégration de nouveaux types de climats dans la dernière révision de l'IEC 60721-2-1,
- e) 5.3: nouvelles catégories pour le rayonnement solaire et la charge de neige.
- f) 5.6: toutes les catégories existantes de substances mécaniquement actives ont été remplacées par des catégories complètement nouvelles.
- g) 5.7: toutes les catégories de conditions mécaniques existantes ont été remplacées par des catégories complètement nouvelles.
- h) Tableau 1: nouvelles catégories climatiques avec de nouvelles sévérités.
- i) Tableau 2: nouvelles catégories pour le rayonnement solaire et la charge de neige.
- j) Tableau 5: nouvelles catégories de substances mécaniquement actives.
- k) Tableau 6: nouvelles catégories de conditions mécaniques.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
104/772/FDIS	104/782/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60721, publiées sous le titre général *Classification des conditions d'environnement*, peut être consultée sur le site web de l'IEC.

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