

# TECHNICAL REPORT

**Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) –  
Part 2: Environmental conditions**

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**Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS) –  
Part 2: Environmental conditions**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## HOME AND BUILDING ELECTRONIC SYSTEMS (HBES) AND BUILDING AUTOMATION AND CONTROL SYSTEMS (BACS) –

### Part 2: Environmental conditions

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The text of this Technical Report is based on the following documents:

Draft	Report on voting
23/983/DTR	23/999/RVDTR

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

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

A list of all parts in the IEC 63044 series, published under the general title *Home and Building Electronic Systems (HBES) and Building Automation and Control Systems (BACS)*, can be found on the IEC website.

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

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## INTRODUCTION

The IEC 63044 series deals with developing and testing home and building electronic systems (HBES) and building automation and control systems (BACS).

The expression HBES/BACS covers any combination of HBES and/or BACS devices including their separate connected/detachable devices linked together via one or more networks.

This document applies to HBES/BACS devices and defines the environmental conditions in which these devices are to be used when so declared by the manufacturer.

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# HOME AND BUILDING ELECTRONIC SYSTEMS (HBES) AND BUILDING AUTOMATION AND CONTROL SYSTEMS (BACS) –

## Part 2: Environmental conditions

### 1 Scope

This part of IEC 63044 provides the environmental conditions for HBES/BACS devices, when declared in the manufacturer's documentation for use in one or more of the environment classes as defined in Clause 6 of this document.

This document focuses on the following environmental conditions:

- climatic environmental conditions,
- chemical environmental conditions,
- mechanical environmental conditions,
- biological environmental conditions.

This document does not supersede the relevant product standard, if any, and applies only in addition to the relevant products standard when it is referred to in the manufacturer's documentation. It is intended to support the particular manufacturer's declaration or any agreement on environmental conditions between customer and manufacturer.

This document is not intended to give guidance on requirements and tests for the drafting of product standards.

The document provides an overview of environmental conditions for devices operating in weather-protected and non-weather-protected locations, ship environments, portable use and also for storage and transport.

### 2 Normative references

There are no normative references in this document.

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions 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

##### product documentation

set of documents that may contain any of the following:

- the manufacturer's installation and operations literature which accompanies the product;
- the product information contained in the manufacturer's catalogue and other product marketing material/information;

- the description, definitions, product literature and usage as presented in electronic format on the manufacturer's (or supplier's) website on the World Wide Web/Internet

### 3.2

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

location that is enclosed, and where direct weather influences are totally excluded

Note 1 to entry: In addition, temperature is controlled by heating or cooling to maintain the required conditions, especially where these are very different from those of the open-air climate. Humidity is not controlled. Vibration and shock are insignificant. These locations may be in rural and some urban areas with low industrial activities and moderate traffic. There is no particular risk of biological attack due to mould growth, animals, etc.

EXAMPLES:

- normal living or working areas, for example living rooms, and rooms for general use such as theatres, restaurants, offices, shops, workshops for electronic assembly and products;
- telecommunication centres;
- storage rooms for valuable and sensitive products.

### 3.3

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

location that is enclosed, but where direct weather influences are not completely excluded

Note 1 to entry: In addition, neither temperature nor humidity is controlled, although heating may be used to raise low temperatures where there is a large difference between the conditions of this location and those of the open-air climate. Vibration is of low significance.

EXAMPLES:

- entrances and staircases of buildings, garages, cellars, and certain workshops;
- buildings in factories and industrial process plants;
- unattended equipment stations, certain telecommunication buildings, ordinary storage;
- rooms for frost-resistant products, farm buildings, etc.

## 4 General explanation for all tests

The variety and the diversity of the devices within the scope of this document make it difficult to define precise criteria for the evaluation of the immunity test results.

If, as a result of the application of the tests defined in this document, the device becomes dangerous or unsafe, the device is deemed to have failed the test.

## 5 Environmental conditions

### 5.1 General test conditions

The HBES/BACS devices are designed for use in one or more of the environment classes according to the classification in the IEC 60721-3 series as indicated in Table 1 to Table 4.

All test procedures are described in the IEC 60068 series.

Environmental tests are applied in accordance with the test method in the relevant basic standard of the IEC 60068 series. In addition the following applies:

- the device is in operation during all tests except those for storage and transportation;
- the tests are carried out in the least favourable operating mode;
- it is not always possible to test every function of the devices, and in such cases the most onerous mode of operation is selected;
- the tests are carried out as single tests in sequence. The sequence of testing is optional;

- the description of the test, the test method and the test set-up are given in basic standards (IEC 60068-x-x) which are referred to in Table 1 to Table 4;
- the content of these basic standards is not repeated here. However, details of modifications and other information needed for the practical application of the tests are given in this document.

Annex A provides a description of the environmental classes and a summary of sets of environmental classes.

## 5.2 General performance criteria

A functional description and a definition of performance criteria, during or as a consequence of environmental testing, are provided by the manufacturer and noted in the test report, based on the following criteria:

- changes in stored data, such as communication error logs, and which are not directly related to the intended function of the equipment may be ignored;
- in addition, the device continues to operate according to its product documentation as intended during and after the test. No unintended change of state, unintended loss of stored data, unintended function or loss of function is allowed;
- during (except for storage and transportation) and after all tests the device is not blocking the transmission media or sending unintended telegrams.

## 6 Environmental conditions

### 6.1 Climatic

Classification of climatic environmental conditions and tests are shown in Table 1.

**Table 1 – Details of climatic tests**

Location	Storage <sup>a</sup>	Transport <sup>a</sup>	Weather protected		Non-weather protected <sup>f</sup>	Ship	Portable and non-stationary
			Controlled <sup>d</sup>	Uncontrolled			
Environment class	IEC 60721-3-1 1K3	IEC 60721-3-2 2K3	IEC 60721-3-3 3K4	IEC 60721-3-3 3K5 Or 3K6	IEC 60721-3-4 4K2 Or 4K1	IEC 60721-3-6 6K3	IEC 60721-3-7 7K2
Tests	Units						
Change of temperature IEC 60068-2-14 <sup>g</sup>							
min. temperature	-5	-25	5	-5 or -25	-33 or -20	-25	-5
max. temperature	45	70	40	45	40	55	45
Damp heat steady state	None	None	30 / 16 95	40 / 2 days 95	40 / 2 days 95 Or 35 / 2 days 95	30 / 10 days 93	None
Damp heat cyclic	25 / 40 1	25 / 55 2	None	25 / 30 2	25 / 40 2 (both)	None	25 / 40 2
IP rating <sup>e</sup>	IPXX	IPXX	IPXX	IPXX <sup>b</sup>	IPX4	IPX6 <sup>c</sup>	IPX3

<sup>a</sup> Tests on storage and transport conditions aim to verify the resistance of the packaging. The tests are carried out once per package (which may be used for more than one product). During these tests the device is not in operation. For all other tests the device is in operation.

<sup>b</sup> See HD 60364.7.701, HD 384.7.702 for installation requirements in bathrooms, swimming pools and similar environments.

<sup>c</sup> IP rating IP56 is for open deck.

<sup>d</sup> Covers also weather-protected controlled locations in vehicles, e.g., ships.

<sup>e</sup> X means that the IP rating is not set by the environmental requirements but may be specified by other requirements such as safety.

<sup>f</sup> The manufacturer chooses the climatic test according to the environment in which the products are installed.

<sup>g</sup> Temperature change rate: 1 °C/min, duration of constant temperature ( $t_1$  of Figure 2 in IEC 60068-2-14:2009): 10 min, number of cycles: 2.

## 6.2 Chemical

Classification of chemical environmental conditions and tests are shown in Table 2.

**Table 2 – Details of chemical tests**

Location	Storage	Transport	Weather protected		Non-weather protected	Ship	Portable and non-stationary
			Controlled	Uncontrolled			
Environment class	IEC 60721-3-1	IEC 60721-3-2	IEC 60721-3-3	IEC 60721-3-3	IEC 60721-3-4	IEC 60721-3-6	IEC 60721-3-7
Tests	1C1	2C1	3C1	3C1	4C1	6C2	7C2
Salt mist	IEC 60068-2-11	None	None	None	None	NaCl	NaCl
	Units					2	2
	days					10 to 15	10 to 15
Hydrogen sulphide	IEC 60068-2-43	None	None	None	None	4	4
	parts per million						
	days						

For devices that are especially susceptible to chemically active substances (for example sensors mounted in chicken farms, swimming pools, cheese, and fruit stores, etc.) use 3C2 (Salt mist: NaCl for 2 days and Hydrogen sulphide 10 ppm to 15 ppm for 4 days).

<sup>a</sup> Covers also weather-protected controlled locations in vehicles, e.g., ships.

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### 6.3 Mechanical

Classification of mechanical environmental conditions and tests are shown in Table 3.

**Table 3 – Details of mechanical tests**

Location	Storage <sup>a</sup>	Transport <sup>a</sup>	Weather protected		Non-weather protected	Ship	Portable and non-stationary
			Controlled <sup>e</sup>	Uncontrolled			
Environment class	IEC 60721-3-1	IEC 60721-3-2	IEC 60721-3-3	IEC 60721-3-3	IEC 60721-3-4	IEC 60721-3-6	IEC 60721-3-7
Tests	1M2	2M2	3M1	3M2	4M2	6M2	7M2
Vibration sinusoidal	None	3,5	None	( $\leq 58,1$ Hz): 0,075 ( $> 58,1$ Hz): 10	( $\leq 58,1$ Hz): 0,075 ( $> 58,1$ Hz): 10	( $\leq 13,2$ Hz): 1 ( $> 13,2$ Hz): 6,88	None
displacement <sup>d</sup>		2 to 9		10 to 150	10 to 150	5 to 100	
acceleration		3		3	3	3	
frequency range		10		10	10	5	
number of axes							
sweep cycles <sup>c</sup>							
Vibration random	None	None	None	None	None	None	See <sup>b</sup>
acceleration spectral density (ASD)							1
slope							0,5
frequent range							-3
							10 to 100, 100 to 200, 200 to 2 000
Shock	None	150	None	None	None	300	400
Peak acceleration		11				6	6
Duration		3				100	4 000
Number of events (for each direction)							
Free fall	None	< 15 > 15 > 75	None	None	None	None	< 1 < 10 < 50
Mass	None	1,0 0,5 0,10					1,0 0,5 0,1
Fall height							

- a Tests on storage and transport conditions aim to verify the resistance of the packaging. The tests are carried once per package (which may be used for more than one product). During these tests the device is not in operation and is within transport packing. For all other tests, the device is in operation and unpackaged.
- b ASD 1 m<sup>2</sup>/s<sup>3</sup> at (10 to 100) Hz, decreasing by 3 dB/oct to 0,5 m<sup>2</sup>/s<sup>3</sup> at 200 Hz, then 0,5 m<sup>2</sup>/s<sup>3</sup> at (200 to 2 000) Hz.
- c As an alternative to the sweep, the critical frequency of each axis can be tested for at least 60 min.
- d Displacement of 35 mm is recommended to simulate more severe conditions in transport.
- e Covers also weather-protected controlled locations in vehicles, e.g., ships.

#### 6.4 Biological

Classification of biological environmental conditions and tests are shown in Table 4.

**Table 4 – Details of biological tests**

Location	Storage	Transport	Weather protected		Non-weather protected	Ship	Portable and non-stationary
			Controlled <sup>b</sup>	Uncontrolled			
Environment class	IEC 60721-3-1 1B1	IEC 60721-3-2 2B1	IEC 60721-3-3 3B1	IEC 60721-3-3 3B1 <sup>a</sup>	IEC 60721-3-4 4B1	IEC 60721-3-6 6B2	IEC 60721-3-7 7B1
Tests	Units	None	None	None <sup>a</sup>	Variant 2 28	Variant 2 28	None
Mould growth	IEC 60068-2-10	None	None	None <sup>a</sup>	Variant 2 28	Variant 2 28	None

- a For devices that are especially susceptible to mould growth (for example sensors which are covered or poorly ventilated) use class 3B2 (Test: mould growth variant 2 for 28 days). Otherwise class 3B1 is also valid for uncontrolled conditions and no test is required.
- b Covers also weather-protected controlled locations in vehicles, e.g., ships.

## Annex A (informative)

### Sets of environmental class combinations

#### A.1 General

Table A.1 gives a summary of sets of environmental classes.

**Table A.1 – Summary of classes**

Conditions	Storage	Transport	Weather protected		Non-weather protected	Ship	Portable and non-stationary
			Controlled	Uncontrolled			
Climatic conditions	1K3	2K3	3K3	3K5	4K2	6K3	7K2
Chemical conditions	1C1	2C1	3C1	3C1	4C1	6C2	7C2
Mechanical conditions	1M2	2M2	3M1	3M2	4M2	6M2	7M2
Biological conditions	1B1	2B1	3B1	3B1	4B1	6B2	7B1

#### A.2 Description of the classes

##### A.2.1 General

All of the following descriptions are extracted from the IEC 60721 series and listed here for information only.

##### A.2.2 Storage

**1K3** 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.

**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. Salt mist may be present in sheltered locations in coastal areas.

**1M2** Applies to locations with vibration of low significance.

**1B1** 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.

##### A.2.3 Transportation

**2K3** Transportation in unventilated enclosures and in non-weather-protected conditions with restrictions to the general open-air climates, excluding cold and cold temperate climates. Transportation by air only in heated, pressurized holds is included. The product may be moved between cold outdoor and warm indoor conditions. It may be exposed to direct solar radiation, precipitation and splashing water. The product may be placed on a wet floor and inside an enclosure, which is subjected to sunshine, rain, etc. Outdoor exposure does not include subjection to sea waves. The product may be placed close to heating elements.

- 2C1** All cases of transportation where the product is placed indoors in such a way that it is protected from salt mist. Transportation only takes place in areas with moderate industrial activities and traffic.
- 2M2** Transportation in all kinds of lorries and trailers in areas with well-developed road systems. It also includes transportation by trains with specially designed shock reducing buffers and by ships.
- 2B1** Transportation in areas without particular risks of biological attacks (from flora or fauna). This includes transportation in compartments of such construction that mould growth, attacks of animals, etc., are not probable.

**A.2.4 Use in weather-protected controlled locations**

- 3K3** 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. The conditions of this class may be found in normal living or working areas, for example living rooms, rooms for general use (theatres, restaurants, etc.), offices, shops, workshops for electronic assemblies and other electrotechnical products, telecommunication centres, storage rooms for valuable and sensitive products.
- 3C1** Applies to locations in rural and some urban areas with low industrial activities and moderate traffic. In winter, heating methods in concentrated urban areas may cause increased contamination. Salt mist may be present in sheltered locations of coastal areas and in offshore sites.
- 3M1** Applies to locations with insignificant vibration and shock.
- 3B1** This class applies to locations without particular risks of biological attacks. It includes protective measures, for example, special product design, or installations in locations of such construction that mould growth, attacks of animals, etc., are not probable.

**A.2.5 Use in weather-protected uncontrolled locations**

- 3K5** 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. Installed products may be subjected to formation of ice. The conditions of this class may be found in some entrances and staircases of buildings, in garages, cellars, certain workshops, buildings in factories and industrial process plants, unattended equipment stations, certain telecommunication buildings, ordinary storage rooms for frost-resistant products, farm buildings, etc.
- 3C1** See description above in weather-protected controlled locations.
- 3M2** Applies to locations with vibration of low significance, for example for products fastened to light supporting structures subjected to negligible vibrations.
- 3B1** See description above in weather-protected controlled locations.

**A.2.6 Use in non-weather-protected locations**

- 4K2** Applies to locations which are non-weather-protected and which are directly exposed to the moderate group of open-air climates including cold temperate, warm dry and mild warm dry types of climate.
- 4C1** Applies to conditions of locations in rural and urban areas with low industrial activity and moderate traffic. Coastal areas are not covered by this class.
- 4M2** Applies to locations which are protected from significant vibration and shock.
- 4B1** Applies to conditions of locations where mould growth or attacks from animals, excluding termites, may occur.

**A.2.7 Use in locations on ships**

- 6K3** Covers products placed in machinery spaces as well as in close proximity to equipment dissipating considerable heat. 6K3 covers also products placed close to gates, ramps, etc., which are opened temporarily for loading and unloading.