

Industrial-process measurement and control equipment — Operating conditions —

Part 1: Climatic conditions

The European Standard EN 60654-1:1993 has the status of a
British Standard

UDC 681.51:53.083:551.5

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI
Documents

AVA

Document Sharing Hub

Cooperating organizations

The European Committee for Electrotechnical Standardization (CENELEC), under whose supervision this European Standard was prepared, comprises the national committees of the following countries:

Austria	Italy
Belgium	Luxembourg
Denmark	Netherlands
Finland	Norway
France	Portugal
Germany	Spain
Greece	Sweden
Iceland	Switzerland
Ireland	United Kingdom

This British Standard, having been prepared under the direction of the Industrial-process Measurement and Control Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 September 1993

© BSI 05-1999

The following BSI references relate to the work on this standard:
Committee reference PCL/1
Draft for comment 90/25999 DC

ISBN 0 580 22242 X

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
Cooperating organizations	Inside front cover
National foreword	ii
Foreword	2
Text of EN 60654-1	3
National annex NA (informative) Committees responsible	26

National foreword

This British Standard has been prepared under the direction of the Industrial-process Measurement and Control Standards Policy Committee and is the English language version of EN 60654-1:1993 *Industrial-process measurement and control equipment — Operating conditions — Part 1: Climatic conditions*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 654-1:1993 published by the International Electrotechnical Commission (IEC).

This standard supersedes BS 5967-1:1980 which is withdrawn.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 26 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

English version

Industrial-process measurement and control equipment — Operating conditions Part 1: Climatic conditions

(IEC 654-1:1993)

Matériels de mesure et de commande dans les
processus industriels — Conditions de
fonctionnement
Partie 1: Conditions climatiques
(CEI 654-1:1993)

Leittechnische Einrichtungen für industrielle
Prozesse Umgebungsbedingungen
Teil 1: Klimatische Einflüsse
(IEC 654-1:1993)

This European Standard was approved by CENELEC on 1993-03-09. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of document 65A(CO)31, as prepared by Sub-committee 65A, System aspects, of IEC Technical Committee 65, Industrial-process measurement and control, was submitted to the IEC-CENELEC parallel vote in February 1992.

The reference document was approved by CENELEC as EN 60654-1 on 9 March 1993.

This European Standard replaces HD 413.1 S1:1981.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1994-02-01
- latest date of withdrawal of conflicting national standards (dow) 1994-02-01

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, Annex A is informative and Annex ZA is normative.

Contents

	Page		Page
Foreword	2	Figure A.3 — Location Class B1 Presentation 1	9
1 Scope	3	Figure A.4 — Location Class B1 Presentation 2	10
2 Normative references	3	Figure A.5 — Location Class B2 Presentation 1	11
3 General	3	Figure A.6 — Location Class B2 Presentation 2	12
4 Location classes with respect to climatic conditions	4	Figure A.7 — Location Class B3 Presentation 1	13
4.1 Air-conditioned locations (Class A)	4	Figure A.8 — Location Class B3 Presentation 2	14
4.2 Heated and/or cooled enclosed locations (Class B)	4	Figure A.9 — Location Class C1 Presentation 1	15
4.3 Sheltered locations (Class C)	5	Figure A.10 — Location Class C1 Presentation 2	16
4.4 Outdoor locations (Class D)	5	Figure A.11 — Location Class C2 Presentation 1	17
4.5 Climatic condition parameters	6	Figure A.12 — Location Class C2 Presentation 2	18
Annex A (informative) Climatograms for location classes	7	Figure A.13 — Location Class C3 Presentation 1	19
Annex ZA (normative) Other international publications quoted in this standard with the references of the relevant European publications	25	Figure A.14 — Location Class C3 Presentation 2	20
Figure A.1 — Location Class A1 Presentation 1	7	Figure A.15 — Location Class D1 Presentation 1	21
Figure A.2 — Location Class A1 Presentation 2	8	Figure A.16 — Location Class D1 Presentation 2	22
		Figure A.17 — Location Class D2 Presentation 1	23
		Figure A.18 — Location Class D2 Presentation 2	24
		Table 1 — Climatic condition parameters and severities for classes of location	6

1 Scope

The purpose of this part of IEC 654 is to provide users and suppliers of industrial-process measurement and control systems and parts of such systems with a uniform listing of the selected environmental conditions to which equipment may be exposed in specified locations.

This part lists environmental climatic conditions e.g. air temperature, humidity and air pressure in specified locations to which land-based and offshore industrial-process measurement and control systems may be exposed during operation, during periods when they are installed but inactive and during storage or transportation. Maintenance and repair conditions are not considered.

Environmental conditions directly related to fire and explosion hazards and conditions related to ionized radiation are likewise not considered. Effects of the specific environmental conditions on personnel are not within the scope of this part.

The influence quantities considered in this part are limited to those which may directly affect the performance of process measurement and control systems. Only environmental conditions as such are considered.

This part establishes location classes with severity levels or sets of severity levels for the environmental conditions listed. Other environmental conditions are covered in other parts of the standard.

The limit values of this part are defined and specified in IEC 721-3-3 and IEC 721-3-4.

It is intended to serve as a basis for the preparation of comprehensive specifications for environmental conditions by the user and by the supplier.

One of the purposes of this part is to avoid problems which might result from neglecting considerations of specific environmental conditions affecting the performance of systems and parts of systems.

An additional purpose of this part is to aid in the choice of severity levels for use in the development of evaluation specifications of industrial-process measurement and control equipment.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 654. At the time of publication of this standard, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 654 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 721-3-1:1987, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Storage*.

Amendment 1 (1991)

IEC 721-3-2:1985, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Transportation*.

Amendment 1 (1991)

IEC 721-3-3:1987, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Stationary use at weather-protected location*.

Amendment 1 (1991)

IEC 721-3-4:1987, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Stationary use at non-weatherprotected locations*.

Amendment 1 (1991)

3 General

A limited number of location classes with respect to climatic conditions is given in clause 4.

The established classes may be applied also for storage and/or transportation (e.g. Class B2 for operation may be combined with Class C2 for transportation). Otherwise, it is recommended to refer to the appropriate classes of IEC 721-3-1 and IEC 721-3-2.

Parameter severity values of the various operating conditions are shown by limit values rather than by means of average values. These values cover usual ranges of environmental conditions and are considered as having a low probability of being exceeded. It is recognized that extreme or special environmental conditions may exist where values are greater and/or less than the stated values. To accommodate this situation, "special" categories for environmental conditions are provided. Specifications for equipment to operate under "special" conditions are a matter for negotiation between user and supplier but it is recommended to use values taken from IEC 721-3-1, IEC 721-3-2, IEC 721-3-3 and IEC 721-3-4.

4 Location classes with respect to climatic conditions

Subclauses 4.1 to 4.5 establish types of locations such as:

- a) *Weatherprotected locations*:
 - Class A: air-conditioned locations;
 - Class B: heated and/or cooled enclosed locations;
 - Class C: sheltered and/or unheated enclosed locations;
- b) *Non-weatherprotected locations*:
 - Class D: outdoor locations.

These types of locations are based on appropriate combinations of climatic condition parameters and their limit values, corresponding to the climatic classes of IEC 721-3-3 and IEC 721-3-4 as listed in Table 1. Climatograms for the location classes are illustrated in the charts given in Annex A, since a simple description of a realistic combination of, for example, high temperature and high humidity is difficult to make.

Temperature shall be considered as location temperature measured at a representative point within the local environment, including adjacent heat-generating equipment. It shall be taken into account that solar radiation may increase the temperature on the surface of equipment. Similar considerations apply to the humidity measurement. When a number of instruments are concentrated in one place, the actual air temperature and the corresponding relative humidity may differ locally from the air temperature and humidity at the representative point, due to the heat generated by the instruments. The manufacturer shall specify the amount of heat generated by his equipment, so that adequate measures can be taken to dissipate this heat.

Temperature gradients are specified for all locations. When the rate of change is significant, it should be considered.

Solar radiation is specified for all locations. Classes A and B should include solar radiation if equipment is located near windows.

Temperature gradients in the space of local environments caused by such phenomena as one-sided radiation or cold wind can produce thermal stress in equipment. Preferred values of gradients are not specified because they are dependent on the physical and material characteristics of the equipment which will occupy the local environment.

The occurrence of condensation, wind-driven precipitation and formation of ice is also specified. Detailed specifications for the air quality and other conditions important for the proper operation and life of equipment on locations which are not otherwise covered in this part are matters for negotiation between user and supplier.

Some variations of air pressure are due to weather conditions; major variations are, in general, the result of altitude. Artificial pressurization may increase environmental pressure in certain locations. Air pressures other than those specified are matters of negotiation between user and supplier.

4.1 Air-conditioned locations (Class A)

For air-conditioned locations (Class A), both air temperature and humidity are controlled within specified limits. These locations are frequently provided for process-control computers and other electronic equipment requiring a controlled air environment. Major central control rooms with equipment for critical levels of process control are normally in this category.

4.2 Heated and/or cooled enclosed locations (Class B)

For heated and/or cooled enclosed locations (Class B), only air temperature is controlled within specified limits.

Heated and/or cooled enclosed locations are commonly provided for operation of parts of a control system where operator surveillance on a continuous basis is required (i.e. when the location is not an air-conditioned location). Storage of equipment is frequently (preferably) in a heated and/or cooled enclosed location. Heating and cooling are not generally available during transportation. Enclosed means of transportation are normally considered "sheltered locations" (Class C).

For Class B3, occasional condensation may occur, particularly at high relative humidity, but is normally of short duration.

4.3 Sheltered locations (Class C)

For sheltered locations (Class C), neither air temperature nor humidity is controlled and equipment is protected against direct exposure to such climatic elements as direct solar radiation, rainfall, other precipitation, and full wind pressure, etc. Enclosed locations which are neither heated nor cooled are considered sheltered locations.

Neither heating nor cooling is normally provided. Ventilation, if any, is usually by natural means. Low temperatures may be as low as those of outdoor atmospheric conditions; high temperatures may be considerably greater than those of outdoor atmospheric conditions (due to solar radiation action on the shelter).

Since the shelter may not be completely tight, these locations may be subject to some (limited) wind-driven precipitation.

Typical of sheltered locations are “shacks” for operating instruments, unheated ware-houses for storage and enclosed-bodied trucks for transportation. It may be noted that in some types of warehouses (and occasionally in other sheltered locations), humidity may rise to values which result in condensation on stored equipment.

Transmitters, final control elements and some indicators separate from controllers are often located in sheltered locations. Controllers, recorders and other equipment may operate in sheltered locations when frequent operator attention is not important.

Condensation may occur. In addition to occasional condensation due to rapid temperature changes, equipment located in these locations may be subjected to wind-driven precipitation, dripping water and water spray.

4.4 Outdoor locations (Class D)

For outdoor locations (Class D), neither air temperature nor humidity are controlled and the equipment is exposed to atmospheric conditions such as direct solar radiation, wind, rain, hail, sleet, snow and icing.

Sensors, transmitters, final control elements and actuators as well as some indicators separate from controllers are often located in outdoor locations.

It should be noted that rapid changes of atmospheric temperature can occur in outdoor locations. Of particular importance is the temperature gradient between sunny and shaded areas of exposed equipment. The temperature of equipment may change rapidly (for instance, an apparatus which has been exposed to direct sunlight may suddenly be subjected to rainfall).

Occasional condensation may occur. In addition to condensation due to rapid temperature changes, equipment located in these locations may be subjected to wetness as introduced by direct precipitation, water spray, water splash, leaks and spills.

4.5 Climatic condition parameters

Table 1 — Climatic condition parameters and severities for classes of location

Environmental parameter	Unit	Class of location (Notations in brackets are climatic classes of IEC 721-3-1, IEC 721-3-3 and IEC 721-3-4)												
		A1 ¹⁾ (3K1) /	Ax ²⁾ / /	B1 (3K2) /	B2 (3K3) (1K2)	B3 (3K4) /	Bx ²⁾ / /	C1 (3K5) (1K3)	C2 (3K6) /	C3 (3K7) (1K5)	Cx ²⁾ / /	D1 (4K2) (1K8)	D2 (4K3) /	Dx ²⁾ / /
Low air temperature	°C	+20		+15	+5	+5		-5	-25	-40		-33	-50	
High air temperature	°C	+25		+30	+40	+40		+45	+55	+70		+40	+40	
Low relative humidity	%	20		10	5	5		5	10	10		15	15	
High relative humidity	%	75		75	85	95		95	100	100		100	100	
Low absolute humidity	g/m³	4		2	1	1		1	0,5	0,1		0,26	0,03	
High absolute humidity	g/m³	15		22	25	29		29	29	35		25	36	
Solar radiation	W/m²	500		700	700	700		700	1 120	1 120		1 120	1 120	
Rate of change of temperature ³⁾	°C/min	0,1		0,5	0,5	0,5		0,5	0,5	0,1		0,5	0,5	
Condensation		No		No	No	Yes		Yes	Yes	Yes		Yes	Yes	
Wind-driven precipitation, (rain, snow, hail, etc.)		No		No	No	No		No	Yes	Yes		Yes	Yes	
Formation of ice		No		No	No	No		Yes	Yes	Yes		Yes	Yes	
Low air pressure	kPa	86 ⁴⁾		86 ⁴⁾	86 ⁴⁾	86 ⁴⁾		86 ⁴⁾	86 ⁴⁾	86 ⁴⁾		86 ⁴⁾	86 ⁴⁾	
High air pressure		106		106	106	106		106	106	106		106	106	

1) Tolerance of ± 2 °C on stated temperature values.

2) For "special" Classes Ax, Bx, Cx and Dx, values should be selected from IEC 721-3-1, IEC 721-3-2, IEC 721-3-3 and IEC 721-3-4.

3) To be considered when significant.

4) 70 kPa for high altitude and/or transportation.