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Operating conditions for industrial-process measurement and control equipment

Part 1. Specification for temperature, humidity and barometric pressure

Conditions de fonctionnement pour les matériels de mesure et commande dans les processus industriels

Partie 1. Spécification pour la température, l'humidité et la pression barométrique

Betriebsbedingungen für verfahrenstechnische Meß- und Steuereinrichtungen

Teil 1. Spezifikation für Temperatur, Luftfeuchtigkeit und barometrischer Druck

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National foreword

This Part of this British Standard has been prepared under the direction of the Industrial-process Measurement and Control Standards Committee and is identical with IEC Publication 654-1 : 1979 'Operating conditions for industrial-process measurement and control equipment Part 1 Temperature, humidity and barometric pressure', published by the International Electrotechnical Commission (IEC).

Terminology and conventions. The text of the international standard has been approved as suitable for publication, without deviation, as a British Standard. Some terminology and certain conventions are not identical with those used in British Standards.

NOTE. For convenience, the French text has been retained on the charts on pages 9 to 22.

Cross-reference

International standard	Corresponding British Standard
IEC 68-1 : 1978	BS 2011 Basic environmental testing procedures Part 1.1 : 1977 General (Identical)

British Standard

Operating conditions for industrial-process measurement and control equipment

Part 1. Specification for temperature, humidity and barometric pressure

1. Scope

Part 1 of the standard lists temperature and temperature gradient, humidity and barometric pressure conditions in specified locations to which land-based and off-shore industrial-process measurement and control systems or parts of 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.

Operating conditions directly related to fire and explosion hazards and conditions related to nuclear radiation are likewise not considered.

Standard atmospheric conditions for test purposes are given in IEC Publication 68-1, Basic Environmental Testing Procedures, Part 1: General (1978).

The influence quantities considered in this part are limited to those which may directly affect performance of process systems. Effects of the specific operating conditions on personnel are not within the scope of this part. Only operating conditions as such are considered; the effects of these conditions on instrumentation are specifically excluded.

This part establishes limit values, or sets of limit values, for the operating conditions listed. Other operating conditions, including those for which values are difficult both to define and to measure, and for which adequate standards are not known to exist will be covered in other parts of the standard. An example of an operating condition difficult to define is corrosive atmospheres, which are difficult to classify due to the wide variety and concentration of corrosive substances and combinations of substances which may be encountered.

Note. — Similar questions are at present being studied by Technical Committee No. 75, Classification of Environmental Conditions. Upon the issue of this committee's publication, the present publication should be reconsidered.

2. Object

The object of Part 1 of the standard is to provide users and suppliers of industrial-process measurement and control systems and parts of such systems with a uniform listing and classification of the listed operating conditions to which equipment may be exposed in specified locations.

This part is intended to serve as a basis for the preparation of comprehensive specifications for the listed operating 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 operating conditions affecting the performance of systems and of systems.

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

3. General

Part 1 of the standard considers the specific operating conditions of temperature, humidity, temperature gradient and barometric pressure. The conditions of temperature and humidity are classified according to severity depending on location. When appropriate, more than one set of limit values for a given condition in a particular location are listed. For barometric pressure conditions, two sets of limit values are listed.

While the above results in a large number of possible combinations of operating conditions, this appears to represent the "real world", where predictable relations between types of operating conditions do not exist.

The severity of the various operating conditions is shown by limit values rather than by means of average values. These values cover usual ranges of operating conditions. It is recognized that extreme or special operating conditions exist where values are greater and/or less than the stated values. To accommodate this situation, "special" categories for the operating conditions are provided. Specifications for equipment to operate under "special" or extreme conditions are a matter for negotiation between user and supplier but it is recommended to use values ending with 0 with steps of 10 K for temperature and values ending with 0 or 5 with steps of 5% for relative humidity.

4. Temperature and humidity classification of location

Sub-clauses 4.1 to 4.5 below establish types of air-conditioned, heated and/or cooled, enclosed, sheltered, and outdoor locations based on appropriate combinations of temperature and humidity limit values as specific in Charts A₁, A₂, B₁, B₂, B₃, C₁ and C₂ (first presentation or second presentation). The actual location classes are specified in the charts because a simple description of a realistic combination of high temperature and high humidity is difficult to make.

For Part 1, temperature shall be considered as location temperature measured at a representative point within the local environment, including adjacent heat-generating equipment, in which the measurement and control equipment will normally operate, be stored or transported. Similar considerations apply to humidity measurement.

When a number of instruments happen to be concentrated in one place, the actual air temperature and the corresponding relative humidity may locally differ from the air temperature and humidity at the representative point, due to the heat generated by the instruments.

The manufacturer should specify the amount of heat generated by his equipment, so that adequate measures can be taken to dissipate this heat.

In addition to the ambient temperature effects, the one-sided heating and/or cooling effects (e.g. solar radiation) should be considered for describing local environments.

Detailed specifications for the air quality and other conditions important for the proper operation and life of such equipment on locations, which are not otherwise covered in this part, are matters for 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.

4.1.1 *Temperature*

One set of limit values is listed.

4.1.1.1 Temperature not less than +18 °C, nor more than +27 °C, and controlled at ± 2 °C within this span.

4.1.1.2 Special. — Temperature limits do not conform to Sub-clause 4.1.1.1 above, but control is maintained at ± 2 °C within a specified span.

4.1.2 *Humidity*

Two sets of limit values are listed.

4.1.2.1 Relative humidity not less than 35% nor more than 75%.

4.1.2.2 Relative humidity not less than 20% nor more than 80%.

4.1.2.3 Special. — Relative humidity does not conform to Sub-clauses 4.1.2.1 or 4.1.2.2 above.

4.1.3 *Limit values of air-conditioned locations*

Table I is the compilation of temperature and humidity limit values of air-conditions locations.

TABLE I
Limit values of air-conditioned locations

Location class	Temperature (°C)	Relative humidity (%)	Chart reference ¹⁾
A ₁	+18 to +27	35 to 75	A ₁
A ₂	+18 to +27	20 to 80	A ₂
A _x	To be specified	To be specified	—

¹⁾ Charts are found at the end of this standard.

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.

Temperature control in accordance with Sub-clause 4.2.1.1 and humidity control according to Sub-clause 4.2.2.1 (as defined later) are recommended for work space with normal comfort for the operating personnel. Considerable operator discomfort can exist under continued exposure to the extremes of temperatures of Sub-clause 4.2.1.2.

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

4.2.1 Temperature

Two sets of limit values are listed.

4.2.1.1 Temperature not less than +15°C nor more than +30°C.

4.2.1.2 Temperature not less than +5°C nor more than +40°C.

4.2.1.3 Special. — Temperature does not conform to Sub-clauses 4.2.1.1 or 4.2.1.2 above.

4.2.2 Humidity

Two sets of limit values are listed.

4.2.2.1 Relative humidity not less than 10% nor more than 75% to the maximum moisture content of 0.020 kg/kg of dry air.

4.2.2.2 Relative humidity not less than 5% nor more than 95%, excluding condensation, to the maximum moisture content of 0.028 kg/kg of dry air.

4.2.2.3 Special. — Relative humidity does not conform to Sub-clauses 4.2.2.1 or 4.2.2.2 above. Occasional condensation, particularly at high relative humidity, but normally of short duration, may occur.

4.2.3 Limit values of heated and/or cooled enclosed locations

Table II is the compilation of temperature and humidity limit values of heated and/or cooled enclosed locations.

TABLE II
Limit values of heated and/or cooled enclosed locations

Location class	Temperature (°C)	Relative humidity (%)	Chart reference ¹⁾
B ₁	+15 to +30	10 to 75	B ₁
B ₂	+5 to +40	10 to 75	B ₂
B ₃	+5 to +40	5 to 95	B ₃
B _x	To be specified	To be specified	—

¹⁾ Charts are found at the end of this standard.

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 sunlight, fall of rain and other precipitation, and full wind pressure.

Note. — 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. Minimum temperatures may be as low as outdoor atmospheric conditions; maximum temperatures may be considerably greater than 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 for sheltered locations are “shacks” for operating instruments, unheated warehouses 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 a value which results 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.

4.3.1 *Temperature*

Two sets of limit values are listed.

4.3.1.1 Temperature not less than -25°C nor more than $+55^{\circ}\text{C}$.

4.3.1.2 Temperature not less than -40°C nor more than $+70^{\circ}\text{C}$.

4.3.1.3 Special. — Temperature does not conform to Sub-clauses 4.3.1.1 or 4.3.1.2.

4.3.2 *Humidity*

One set of limit values is listed.

4.3.2.1 Relative humidity 5% to 100% including occasional condensation. A limit value of absolute moisture content of air of 0.028 kg/kg of dry air is set on Charts C₁ and C₂.

4.3.3 *Wetness in sheltered locations*

4.3.3.1 In addition to occasional condensation due to rapid temperature changes, equipment located in these locations can be subjected to wind-driven precipitation, drip water, and water spray.

4.3.4 *Limit values of sheltered locations*

Table III is the compilation of temperature and humidity limit values of sheltered locations.

TABLE III
Limit values of sheltered locations

Location class	Temperature (°C)	Relative humidity (%)	Chart reference ¹⁾
C ₁	−25 to +55	5 to 100	C ₁
C ₂	−40 to +70	5 to 100	C ₂
C _x	To be specified	—	—

¹⁾ Charts are found at the end of this standard.

4.4 Outdoor locations (Class D)

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

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

Sufficient test data is not available at this time to define the extent to which solar or other radiation may cause equipment temperature to exceed “shaded” air temperature. 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, apparatus which has been exposed to direct sunlight may suddenly be subjected to rainfall).

4.4.1 Temperature

Upper temperatures in this class represent the surface temperature of the equipment resulting from air temperature measured in the shade, to which should be added the effect of solar radiation.

Two sets of limit values are listed.

4.4.1.1 Temperature not less than −25 °C nor more than +70 °C.

4.4.1.2 Temperature not less than −40 °C nor more than +85 °C.

4.4.1.3 Special. — Temperature does not conform to Sub-clauses 4.4.1.1 or 4.4.1.2 above.

4.4.2 Humidity

One set of limit values is listed.

4.4.2.1 Relative humidity not less than 5% and up to 100%, including condensation. A limit value of absolute moisture content of air of 0.050 kg/kg of dry air is assumed never to be exceeded in outdoor locations.

4.4.3 Wetness in outdoor locations

4.4.3.1 In addition to condensation due to rapid temperature changes, equipment located in these locations can be subjected to wetness as introduced by direct precipitation, water spray, water splash, leaks and spills; therefore, no charts are provided.