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American National Standard

Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity



ANSI/ISA-S71.01 — Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity

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Preface

This preface is included for informational purposes and is not part of ISA-S71.01.

This standard has been prepared as part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static, but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms, and asks that they be addressed to the Secretary, Standards and Practices Board, ISA, 67 Alexander Drive, P.O. Box 12277, Research Triangle Park, NC 27709, Telephone (919) 549-8411, e-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to U.S.A. users of ISA standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI-acceptable metric units in all new and revised standards to the greatest extent possible. *The Metric Practice Guide*, which has been published by the Institute of Electrical and Electronics Engineers as ANSI/IEEE Std. 268-1982, and future revisions will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA standards. Participation in the ISA standards-making process by an individual in no way constitutes endorsement by the employer of that individual, of ISA, or of any of the standards that ISA develops.

The information contained in the preface, footnotes, and appendices is included for information only and is not a part of the standard.

This document is one of several standards covering various environmental conditions affecting process measurement and control systems. In developing this standard, the committee goals included the following:

- 1) To provide a practical standard that can be applied with a minimum of research and technical effort by the user.
- 2) To provide a concise method of stating environmental classifications for convenient communication between all users of the standard.
- 3) To cover real-world ranges of each classified parameter.

In order to be compatible with international standards, the SP71 committee used the same limit values, wherever appropriate, as presented in Publication 654-1, First edition (1979), of the International Electrotechnical Commission: "Operating Conditions for Industrial-Process Measurement and Control Equipment, Part 1: Temperature, Humidity and Barometric Pressure."

For Classes B3 and B4 described in this standard, the committee specified limits of 5 to 90 percent relative humidity instead of 5 to 95 percent relative humidity as specified by the International Electrotechnical Commission. The committee concluded that for this class (Class B), relative humidity values above 90 percent should be covered in Severity Level X.

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Contents

1 Purpose	9
2 Scope	9
3 Introduction	9
4 Definitions	10
4.1 Normal operating conditions, operative limits, and transportation and storage conditions	10
4.2 Maintenance conditions	11
4.3 Maintenance	11
5 Location classifications	11
5.1 Air-conditioned locations (class A)	11
5.2 Enclosed temperature controlled locations (class B)	11
5.3 Sheltered locations (class C)	11
5.4 Outdoor locations (class D)	12
5.5 Special locations (class X)	12
Appendix A — Psychrometric charts	13

1 Purpose

The purpose of this standard is to establish uniform classifications of temperature and humidity conditions for industrial process measurement and control systems. This document is one of a series of standards on environmental conditions for process measurement and control systems.

2 Scope

2.1 This standard covers temperature and humidity environmental conditions for industrial process measurement and control equipment. Specifications for other environmental conditions are beyond the scope of this standard.

2.2 This standard establishes temperature and humidity classes for fixed (non-mobile) installations during normal operation (nonemergency conditions) or during transportation and storage.

2.3 The classes of temperature and humidity conditions stated in this standard are suitable for use in activities related to process instrumentation, including design, manufacturing, sales, installation, test, use, and maintenance. These classes may also be used as a guide when establishing requirements for environmental control of buildings or other protective housings for industrial process measurement and control systems.

2.4 These classifications pertain only to the environment external to the equipment which may affect the equipment externally or internally.

2.5 The effects of environmental conditions on safety, comfort, and performance of operating and maintenance personnel are not considered in this standard.

3 Introduction

3.1 Environmental classifications have been established according to the type of location. Within each classification, severity levels have also been established. Parameter limit values are tabulated for each classification and severity level of the location. These values are shown in Table 1 of this standard. The classification consists of a class location letter followed by a severity identification numeral.

EXAMPLE: Temperature and Humidity Classification A2 would represent Class A Location and Level 2 Severity.

3.2 The manufacturer and/or user should specify the equipment performance in a stated environmental Class and Severity Level. The following example shows how a manufacturer or user might specify several sets of environmental classes for operating or maintaining the same equipment.

Conditions	Temperature and humidity class
Normal operating conditions [*]	A2
Operative limit*	B2
Transportation & storage conditions*	C2
Maintenance condtions†	В3
Shutdown conditions [‡]	C1

EXAMPLE NO. 1

*These terms are defined in ISA-S51.1, "Process Instrumentation Terminology."

[†]See Section 4, this standard, for definiton.

[‡]Specified separately only when Shutdown Conditions differ from Transportation and Storage Conditions. See also Section 4.1, this standard.

The above example may also be specified as follows:

EXAMPLE NO. 2								
Parameters								
Temperature range (°C)	Control tolerance (°C)	Max. rate of change (°C/ Hour)	Humidity range (% R.H.)*	Control tolerance (% R.H.)	Max. moisture content (Kg/Kg Dry Air)			
18 to 27	±2	±5	20 to 80	±10	N.A.†			
5 to 40	±3	±10	10 to 75	N.A.	0.020			
-40 to 85	N.A.	±10	5 to 100	N.A.	0.028			
5 to 40	±10	±20	5 to 90	N.A.	0.028			
-25 to 55	N.A.	±5	5 to 100	N.A.	0.028			
	Temperature range (°C) 18 to 27 5 to 40 -40 to 85 5 to 40 -25 to 55	Temperature range (°C) Control tolerance (°C) 18 to 27 ±2 5 to 40 ±3 -40 to 85 N.A. 5 to 40 ±10 -25 to 55 N.A.	Temperature range (°C) Control tolerance (°C) Max. rate of change (°C/Hour) 18 to 27 ±2 ±5 5 to 40 ±3 ±10 -40 to 85 N.A. ±10 5 to 40 ±10 ±20 -25 to 55 N.A. ±5	Temperature range (°C) Control tolerance (°C) Max. rate of change (°C/Hour) Humidity range (°C/Hour) 18 to 27 ±2 ±5 20 to 80 5 to 40 ±3 ±10 10 to 75 -40 to 85 N.A. ±10 5 to 100 5 to 40 ±10 ±20 5 to 90 -25 to 55 N.A. ±5 5 to 100	EXAMPLE NO. 2ParametersTemperature range (°C)Control tolerance (°C)Max. rate of change (°C/Hour)Humidity range (% R.H.)*Control tolerance (% R.H.)18 to 27±2±520 to 80±1018 to 27±2±520 to 80±105 to 40±3±1010 to 75N.A40 to 85N.A.±105 to 100N.A.5 to 40±10±205 to 90N.A25 to 55N.A.±55 to 100N.A.			

EXAMPLE NO. 2

NOTES: *R.H. = Relative Humidity

[†]N.A. = Not Applicable

4 Definitions

4.1 Normal operating conditions, operative limits, and transportation and storage conditions

These terms are defined in the ISA-S51.1 Standard "Process Instrumentation Terminology." The ISA-S51.1 definition of "Transportation and Storage Conditions" includes "Shutdown." If the shutdown conditions are different from transportation and storage conditions, the shutdown environment shall be specified separately.

4.2 Maintenance conditions

Conditions under which maintenance is performed.

4.3 Maintenance

Any activity intended to keep equipment in satisfactory working condition, including tests, measurements, replacements, adjustments, and repairs. (Refer to the Scientific Apparatus Manufacturers Association Standard PMC 32.1, "Process Instrumentation Reliability Terminology.")

5 Location classifications

5.1 Air-conditioned locations (class A)

Class A locations are locations where both air temperature and relative humidity are controlled. These locations are usually provided for computers and other electronic equipment requiring a controlled air environment.

Special consideration should be given where hygroscopic materials, such as punched cards and chart paper, will be used. These materials, depending on the manufacturer's recommendation, may require a relative humidity less than the maximum given in Table 1. The special requirements shall be described by use of Severity Level "X" of Table 1.

5.2 Enclosed temperature controlled locations (class B)

Class B locations are locations where air temperature is controlled but relative humidity is not controlled. These locations are usually provided where continuous operator surveillance is required. This class may also represent storage and occasionally transportation conditions.

5.3 Sheltered locations (class C)

Class C locations are locations protected from direct exposure to the climatic elements, such as sunlight, rain and other precipitation, and full wind pressure.

Neither heating nor cooling is normally provided. Ventilation, if any, may be either natural or forced. Minimum air temperature inside the enclosure may be as low as the outdoor air temperature. Maximum air temperature inside the enclosure may be considerably greater than the outdoor air temperature due to solar radiation heating of the shelter surfaces. The air inside the shelter is the environment for the equipment. Condensation may occur on surfaces within the shelter or within the equipment enclosure due to temporary excursions below the local dew point.

Sheltered locations are provided where minimum protection is required for operators, maintenance personnel, or equipment. Examples of equipment shelters range from box enclosures to equipment "shacks."

5.4 Outdoor locations (class D)

Class D locations are locations where there is no specific protection from the environment.

Equipment in these locations may be subjected to sudden and severe changes of environment due to weather or other factors. Minimum temperature of the equipment may be as low as the outdoor air temperature. Maximum temperature of the equipment may be considerably greater than the outdoor air temperature due to solar radiation heating. Differential temperature conditions may also exist in the equipment when part of the equipment is exposed to direct heat radiation with the remaining surface shaded, or by other circumstances of this type. Condensation may occur due to temporary excursions below the local dew point. In addition to the effect of ambient air temperature, the effect of radiated heat from the sun or other sources should be considered for selecting severity levels in Table 1.

5.5 Special locations (class X)

It is recognized that extreme or special service conditions exist in which the excursions of temperature or humidity differ from the previously mentioned classes. To accommodate this situation, a special Class "X" is included in Table 1. Specifications for equipment in Class X are a matter of negotiation between user and supplier.

Location	Class	Severity level	Temperature limits (°C)	Control point tolerance (°C)	Maximum rate of change (°C/ Hour)	Humidity limits (% Relative Humidity)	Control point tolerance (% Relative Humidity)	Maximum moisture content (Kg/Kg dry air)
Air Conditioned		1	18 to 27 ^d	±2 ^e	±5 ^f	35 to 75 ^d	±5 ^e	N.A.
	A	2	18 to 27 ^d	±2 ^e	±5 ^f	20 to 80 ^d	±10 ^e	N.A.
		Х	T.B.S. ^d	T.B.S. ^e	T.B.S. ^f	T.B.S. ^d	T.B.S. ^e	T.B.S.
Enclosed Temperature E Controlled		1	15 to 30 ^d	±2 ^e	±5 ^f	10 to 75 ^d	N.A.	N.A.
	В	2	5 to 40 ^d	±3 ^e	±10 ^f	10 to 75 ^d	N.A.	0.020
		3	5 to 40 ^d	±10 ^e	±20 ^f	5 to 90 ^d	N.A.	0.028
		4	5 to 50 ^d	±10 ^e	±20 ^f	5 to 90 ^d	N.A.	0.028
		Х	T.B.S. ^d	T.B.S. ^e	T.B.S. ^f	T.B.S. ^d	N.A.	T.B.S.
Sheltered C		1	-25 to 55	N.A.	±5	5 to 100	N.A.	0.028
	С	2	-40 to 85	N.A.	±10	5 to 100	N.A.	0.028
		Х	T.B.S.	N.A.	T.B.S.	5 to 100	N.A.	T.B.S.
Outdoor	D	1	-25 to 70	N.A.	±10	5 to 100	N.A.	N.A.
		2	-40 to 85	N.A.	±20	5 to 100	N.A.	N.A.
		3	-55 to 65	N.A.	±20	5 to 100	N.A.	N.A.
		Х	T.B.S.	N.A.	T.B.S.	T.B.S.	N.A.	N.A.

Table 1^{a,b,c} — Location, class, and severity levels

NOTES: ^a This table applies for atmospheric pressures between 86 kPa and 108 kPa

^b N.A. = Not Applicable

^c T.B.S. = To Be Specified

^d Operating temperature/humidity to be selected from within temperature/humidity limits

^e Allowable variation from the selected operating temperature/humidity control point

^f Maximum rate of change within the control tolerance

Figure 1 — Air-conditioned locations, class A1























Figure 7 — Sheltered locations, class C1



Dry Bulb Temperature (°C)



Dry Bulb Temperature (°C)

Developing and promulgating technically sound consensus standards, recommended practices, and technical reports is one of ISA's primary goals. To achieve this goal the Standards and Practices Department relies on the technical expertise and efforts of volunteer committee members, chairmen, and reviewers.

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