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Standard

Environmental Conditions for Process Measurement and Control Systems: Power

ISA-S71.02 — Environmental Conditions for Process Measurement and Control Systems: Power

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Preface

This preface is included for informational purposes and is not part of the standard.

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 USA 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 employers of the 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 that cover various environmental conditions affecting process measurement and control systems. In developing this standard the committee goals include the following:

1) To provide a practical standard that can be applied with minimum research and technical effort by the user.

2) To provide a concise method of stating environmental classifications for convenient communications between users of the standard.

3) To cover real-world ranges of each classified parameter.

This standard is limited to power considerations only, covering power considerations that affect industrial process measurement and control systems.

In order to make S71.02 compatible with international standards, the SP71 committee used the same limit values, except as noted below, as presented in Publication 654-2, first edition (1979), of the International Electrotechnical Commission: Operating Conditions for Industrial Process Measurement and Control Equipment, Part 2: Power. The following exceptions were made:

AC voltage unbalanced for polyphase systems was added to bring this standard into compliance with an existing ANSI standard.

DC voltage tolerance, range 2, was adjusted to reflect tighter tolerance limits introduced since 1979.

The number of pneumatic power supply levels has been reorganized for instruments and control elements.

The assistance of those who aided in the preparation of this standard, by their review of the draft and by offering suggestions toward its improvement, is gratefully acknowledged.

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1 Purpose

The purpose of this standard is to establish uniform classifications of power supplied to process measurement and control equipment.

The classification system provides users and manufacturers of instruments with a means of specifying the electrical or pneumatic parameters of a power system to which a specified measurement or control system may be connected.

This document is one of a series of standards on environmental conditions for process measurement and control systems.

> **CAUTION:** THIS DOCUMENT IS NOT INTENDED TO SERVE AS A SAFE WIRING PRACTICES MANUAL

2 Scope

2.1 This standard classifies power parameters that affect industrial process measurement and control equipment. Specifications for other environmental conditions are beyond the scope of this standard.

2.2 The classes of environmental conditions stated in this standard are suitable for use in activities related to process instrumentation, including design, manufacture, sales, installation, test, use, and maintenance.

2.3 These classifications pertain only to power as received by the equipment.

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

2.5 Certain types of pressure regulators derive their operating power from the pressure of the controlled fluid. Similarly, certain types of temperature regulators derive pressure for valve operation from thermal expansion of the fluid in the temperature-sensing element. These self-operated and process-powered devices are not considered within the scope of this publication.

3 Introduction

3.1 Electrical classifications have been established in Section 5 according to the type of power variable received by the system or parts of the system.

Pneumatic classifications have been established in Section 6 according to the power level received by the system or parts of the system. A parameter range has been included for all variables in both sections.

3.2 The manufacturer and/or user should specify the equipment performance in a stated class and parameter range. The following example shows how a manufacturer or user might specify power using the tables.

Example 1

AC Power Source	Parameter Range	Class
Voltage tolerance	<±10%	A2
Frequency deviation	<±1.0%	B2
Harmonic content	<5%	C2

4 Definitions

4.1 Electrical power definitions

For purposes of this standard the following definitions of terms relating to electrical energy supply are used.

4.1.1 power source: The primary source from which the system's power is derived.

4.1.2 power: The electrical energy supplied to a system, or elements of a system, for process measurement and control.

4.1.3 power supply device: An external electrical device that converts, regulates, rectifies, or otherwise modifies the supply from the primary power source to provide electrical energy suitable for operation of an electrical system, or elements of an electrical system, for measurement and control.

4.1.4 steady-state power: Conditions persisting for more than 200 milliseconds.

4.1.5 transient power supply effects: Disturbances with a duration of 200 milliseconds or less. Some of these effects are specified in ISA electromagnetic compatibility standards.

4.2 Pneumatic power definitions

For purposes of this standard the following definitions of terms relating to pneumatic energy supply are used.

4.2.1 pneumatic power source: The primary source from which system power is derived. The source is usually compressed air, supplied from a compressor through a piping system. Other gases under pressure may be used.

4.2.2 pneumatic power supply: The pneumatic energy supplied to a system or elements of a system for industrial process measurement and control.

4.2.3 pneumatic power supply device: An external unit that regulates or otherwise modifies the pneumatic supply from the primary source to provide energy suitable for a system or elements of a system for industrial process measurement and control.

4.2.4 dew point temperature: The temperature, referred to a specific pressure, at which water vapors condense.

5 Electrical power classification

5.1 General

This section applies to both AC and DC electrical power sources. Electrical energy for the operation of process measurement and control systems may be provided by several methods. These methods include direct connection to a single power source or connection to a power supply device. Alternate methods for providing electrical energy include the use of auxiliary standby, backup, or parallel power sources that provide for the operation of the electrical system in case of failure of the main power source.

5.1.1 Power source capacity should be specified in volt-amperes to include the effects of reactive loads on a power source. Inrush currents, created when equipment is turned on, should also be taken into account.

5.1.2 Operating conditions that relate to electric power sources and power received are classified only for steady-state conditions. Classification of operating conditions related to transient power disturbances are not included.

5.2 AC power classification

Nominal AC power specifications should include rms voltage, frequency in hertz, and the number of phases. The following classes, shown in Table 1, should be used to specify an AC power source.

5.2.1 Class A voltage tolerance is specified as the percent deviation of rms voltage from nominal.

5.2.2 Class B frequency deviation is specified as the percent deviation of frequency from nominal.

5.2.3 Class C harmonic content is specified as present rms voltage not occurring at the primary frequency.

5.2.4 Class D phase angle is specified as the departure from nominal phase angle in degrees. This class is specified for polyphase systems only.

5.2.5 Class E voltage unbalance is specified for polyphase systems as percent maximum voltage deviation from the average of the phase voltage measured at the equipment terminal divided by the same average voltage. Example: With voltages of 230, 238, and 225, the average is 231; the maximum deviation from the average is 7 volts, and the average unbalance = 100 x (7/231) = 3.03 percent.

Table 1 — AC power classifications

Parameter	Class	Range				
		1	2	3	4	5
Voltage tolerance	A	≤±1%	≤±10%	–15% to 10%	–20% to +15%	T.B.S.
Frequency deviation	B	≤±0.2%	≤±1.0%	≤±5.0%	T.B.S.	N.A.
Harmonic content	C	≤2%	≤5%	≤10%	≤20%	T.B.S.
Phase angle departure	D	≤1°	≤2°	≤5°	T.B.S.	N.A.
Voltage unbalance	E	≤1%	≤2%	≤5%	T.B.S.	N.A.

Notes: All parameters must be measured at the process measurement and control equipment input terminals.
T.B.S. = To Be Specified
N.A. = Not Applicable
≤ is defined as “less than or equal to”

5.3 DC power classifications

The following classes, as shown in Table 2 and 5.3.3, should be used to specify a DC power source.

5.3.1 Class F voltage tolerance is specified as the percent deviation from nominal voltage.

5.3.2 Class G ripple is specified in percent as the ratio of the peak-to-peak value of the AC component to the nominal voltage.

Table 2 — DC power classifications

Parameter	Class	Range				
		1	2	3	4	5
Voltage tolerance	F	≤±1%	≤±10%	–15%	≤±25%	T.B.S.
Ripple	G	≤±0.2%	≤±1.0%	≤±5.0%	≤±15%	T.B.S.

5.3.3 Class H ground reference is specified as polarity of the terminal of a DC power source, if any, that is connected to a ground reference.

H1. Positive if the positive terminal is connected to a ground reference.

H2. Negative if the negative terminal is connected to a ground reference.

H3. Floating if neither terminal is connected to a ground reference.

6 Pneumatic power classification

6.1 General

Pneumatic power is required for pneumatic elements of process control systems. These elements include transmitters, controllers, displays, final control elements, and auxiliary functions.

6.2 Pneumatic energy sources

Pneumatic energy for operation of systems may be provided by direct connection to a single power source or connection to a power supply device. Other energy sources include auxiliary, standby, or backup pneumatic power sources that provide for operation of the pneumatic system in case of failure of the primary pneumatic power source.

6.3 Instrument air quality

Instrument air must be supplied in accordance with quality air standards specified in ISA-S7.3-1981, Quality Standard for Instrument Air.

6.3.1 Instrument air contaminants shall be specified in accordance with ISA-S71.04-1985, Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants.

6.4 Pneumatic power supply classification

The following classifications, as shown in Table 3, should be used to specify a pneumatic power source.

6.4.1 Class J instrument pressure is specified as the operating pressure range used by transmitters and controllers.

6.4.2 Class K control element pressure is specified as the operating pressure range used by pneumatic actuators and positioner-actuators.

6.4.3 Class L pneumatic power supply dew point is specified as the dew point temperature of the gas supplied at the lowest ambient temperature and maximum operating pressure of the pneumatic system.

Table 3 — Pneumatic power source classifications

Parameter	Class	Range		
		1	2	3
Instrument pressure, kP ($lb/in.^2$)	J	130 to 150 (18.9 to 21.8)	217 to 265 (31.5 to 38.4)	T.B.S.
Control element pressure, kP ($lb/in.^2$)	K	130 to 300 (18.9 to 43.5)	550 to 1050 (79.8 to 152.3)	T.B.S.
Dew point	L	10°C less than minimum ambient temperature	T.B.S.	N.A.

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