STANDARD

ISA–37.10–1982 (R1995)

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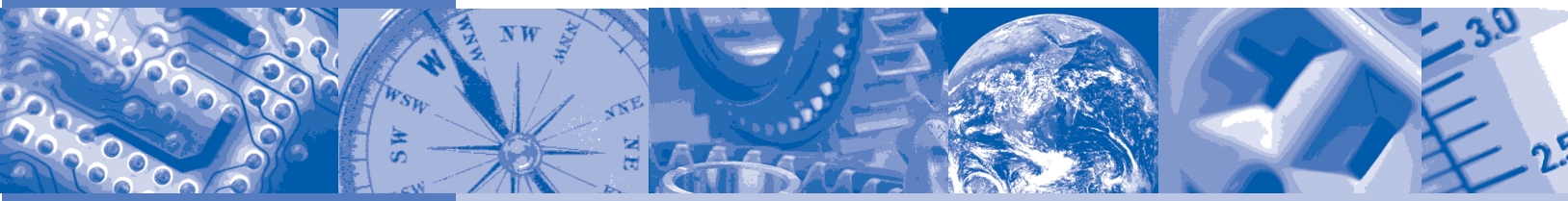

Specifications and Tests for Piezoelectric Pressure and Sound Pressure Transducers

Reaffirmed 29 September 1995

ISA–The Instrumentation, Systems, and Automation Society

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ISA-37.10-1982 (R1995), Specifications and Tests for Piezoelectric Pressure and Sound-Pressure Transducers

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Preface

This preface, as well as all footnotes and annexes, is included for informational purposes and is not part of ISA-37.10-1982 (R1995).

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1 Scope

1.1 This standard covers piezoelectric (including ferro-electric) pressure transducers and piezoelectric sound pressure transducers. Pressure and sound-pressure types could be the same instrument differing only in the method of calibration and manner of specifying performance. With the exception of certain impedance and charge measurements, this standard is also applicable to piezoelectric transducers with built-in amplifiers.

Sound pressure transducers sense and measure the pressure oscillations within an elastic fluid medium experiencing stress-strain waves. When installed near the sound source or in the wall of a test object, the transducer behavior relates to its pressure response. When installed in a sound field, considerable interaction occurs at higher frequencies during the measuring transaction, changing the quantity being measured and relating transducer behavior to its free-field or diffuse-field response. Both aspects of transducer behavior are covered in this standard.

1.2 Included among the specific types of piezoelectric pressure transducers to which this standard is applicable are the following:

a) Piezoelectric pressure transducers for transient pressure measurements

b) Piezoelectric pressure transducers that, in conjunction with associated electronic equipment, have quasi-dc response to gage pressures

c) Piezoelectric transducers for sound pressure levels in excess of 100 dB overall re 20 µ Pa associated with fluid-borne noise

1.3 Terminology used in this document is defined in ISA-S37.1, except that additional definitions particularly applicable to piezoelectric pressure and piezoelectric sound-pressure transducers are defined in 4.3 of this document.

2 Purpose

This Standard establishes the following for piezoelectric pressure and piezoelectric sound-pressure transducers.

2.1 Uniform minimum general specifications for describing design and performance characteristics

2.2 Selected uniform acceptance and qualification test methods, including calibration techniques

2.3 Uniform procedures for the presentation of transducer test data

2.4 A drawing symbol for use on measurement system electrical schematics (See Note in Section 3.)

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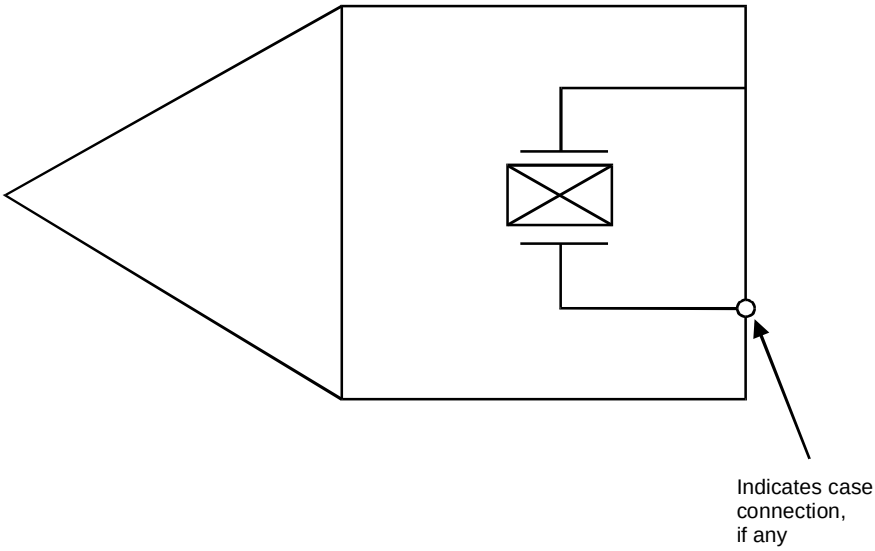
3 Drawing Symbol

The drawing symbol for a transducer is a square with an added equilateral triangle, the base of which is one side of the square. The triangle symbolizes the sensing element.

The piezoelectric element is symbolized by a small rectangle encompassing two diagonally crossing lines. Surrounding this rectangle is the electrical symbol for a capacitor. Lines from the symbolic capacitor to the right side of the large square represent the electrical leads.

> **NOTE —** This symbol is not ANSI-approved at this time. It has been submitted to the ANSI Y32 Committee on Graphic Symbols for their consideration and approval.



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4 Characteristics

	Summary		Individual Acceptance Tests		Qualification
	Basic	Supplemental	go/no-go	measured	Tests
Cable Characteristics (state whether integral or nonintegral)					
Type	4.1.1		5.1		
Length	4.1.1		5.8.1		
Connector(s) used	4.1.1		5.1		
Temperature range	4.1.1				
Capacitance at Room Temperature	4.1.3			5.8.1	
Noise Characteristics		4.1.4			6.2
Case Connector Sealing (if applicable)	4.1.1		6.1		
Dimensions, configurations, and markings	4.1.1		5.1		
Connector Type	4.1.1		5.1		
Exposed Materials	4.1.1				
Transduction Element Material					
Type	4.1.1				
Sensing Mode	4.1.1				
Mounting Method	4.1.1		5.1		
Transducer Temperature Range (excluding cable if nonintegral)					
Operating	4.2.1.9				6.6
Storage		4.1.4			
Dead Volume		4.1.2			
Equivalent Volume		4.1.2			
Diaphragm Material and Thickness		4.1.2			
Vibration Isolation or Cancellation Descriptions					
Mechanical		4.1.2			6.4
Electrical		4.1.4			6.4
Capacitance					
Room Temperature	4.1.3			5.5	
Over Temperature Range		4.1.4			6.6
Grounding	4.1.3		5.7		
Insulation Resistance (if applicable)					
Room Temperature	4.1.3		5.5		
Over Temperature Range		4.1.4			
Shunting Resistance					
Room Temperature	4.1.3		5.5		
Over Temperature Range		4.1.4			6.6
Range	4.2.1.1			5.2	
Sensitivity					
At Room Temperature (nominal+tolerance)					
Over Temperature Range	4.2.1.7				6.6
Over Ambient Pressure Range (sound-pressure transducers only)	4.2.1.13				6.3
Stability					6.8
Frequency Response					
Pressure Transducers	4.2.1.3				5.4.1
Sound-Pressure Transducers	4.2.1.3			5.4.2	
Linearity	4.2.1.4			5.2	
Pressure-Excited Resonance					
At lowest resonant frequency	4.2.1.14			5.4.1	
At additional frequencies		4.2.2.1			5.4.1
Proof Pressure Pressure Transducers	4.2.1.5		5.3		
Burst Pressure Rating Pressure Transducers	4.2.1.6				6.9
Spurious Output from Temperature Gradient	4.2.1.8				6.7
Vibration Error	4.2.1.10		6.4		
Directivity	4.2.1.15				5.4.2
Susceptibility to Environments					
Mechanical Shock	4.2.1.11				
Humidity	4.2.1.11				
Salt Spray	4.2.1.11				
Nuclear Radiation	4.2.1.11				
Electromagnetic Interference	4.2.1.11				6.8
Steady-state Acceleration	4.2.1.11				6.5

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4.1 Design characteristics

4.1.1 Basic mechanical design characteristics

The following mechanical design characteristics are required to be listed:

a) **Cable, non-integral**

If a non-integral cable is supplied with the transducer, the type, length, connector types, and maximum operating temperature of this cable shall be specified. (Requirements for the specification of electrical cable characteristics are given in 4.1.3).

b) **Case sealing**

If case sealing is employed, the mechanism and materials for sealing shall be described. The same requirement applies to the electrical connector. The resistance of the sealing materials to common and corrosive fluids shall be stated.

c) **Connection, pressure**

The pressure connection shall be indicated on the outline drawing [see (e) Dimensions]. For threaded cases of fittings, indicate the nominal size, thread pitch, thread series, and thread class. For a flush-mounted transducer, indicate whether flange mounting, cemented installation, or other specified means is employed.

d) **Connector, electrical**

The connector on the transducer shall be described. If the transducer is supplied with an integral cable, the connector at the end of the cable shall be described. The mating connector for the above connector shall also be described or designated.

e) **Dimensions**

An outline drawing of the transducer shall show its complete configuration with dimensions given in millimeters (or inches).

f) **Identification**

The following characteristics shall be permanently inscribed on the outside of the transducer case or (for very small transducers) supplied with the transducer:

1) Nomenclature of transducer (According to ISA-S37.1, Section 3)

2) Name or trademark of manufacturer. Model (Part) Number, and Serial Number

3) Range (if applicable)

g) **Materials, housing**

The case materials exposed to the environment shall be identified.

h) **Material, transduction element**

The type of piezoelectric material employed as the transduction element shall be identified. (A proprietary name is acceptable.) The sensing mode of this element shall also be specified.

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i) **Fluid limitations**

If specific corrosive fluids are associated with a particular transducer application, the compatibility of the transducer and its accessories with such specified fluids shall be stated.

j) **Mounting and mounting dimensions**

Unless the pressure connection serves as the transducer mounting, the outline drawing shall indicate the method of mounting with dimensions in millimeters or inches.

k) **Mounting force or torque**

Mounting force or torque shall be specified. When pressure connection is not integral with mount, pressure-connection torque shall also be specified.

l) **Weight**

The weight of the transducer shall be specified in grams (or ounces). If the transducer includes an integral cable, its weight also shall be stated.

4.1.2 Supplemental mechanical design characteristics

Listing the following mechanical design characteristics is optional.

a) **Dead volume**

For non-flush-mounted transducers, the dead volume may be given in cubic millimeters (or cubic inches). For piezoelectric sound-pressure transducers, the Equivalent Volume due to the compliance of the diaphragm may be specified to assist in transducer calibrations.

b) **Identification**

The following supplemental information may be inscribed on the transducer case:

1) Sensitivity

2) Customer Specification, Part Number, or both

3) Type of Electrical Connector

4) Maximum Operating Pressure

5) Maximum Operating Temperature

c) **Material, pressure sensing**

The diaphragm material and thickness may be specified, if a diaphragm is employed.

d) **Vibration isolation**

If the transduction element is mechanically isolated in some way from the transducer mounting points (to reduce vibration sensitivity) this may be described.

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