ISA-S37.12-1982 (R1995)

Approved September 29, 1995

Standard

Specifications and Tests for Potentiometric Displacement Transducers

ISA-S37.12 — Specifications and Tests for Potentiometric Displacement Transducers

ISBN 0-87664-359-4

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Preface

This preface, as well as all footnotes and annexes, is included for informational purposes and is not a part of ISA-S37.12.

This standard has been prepared as a 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; Fax: (919) 549-8288; 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. Towards this end, this Department will endeavor to introduce SI and 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. 268-1992, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors. Certain metric units that are part of the SI system are in common accepted pressure measurement that is convertible to kilopascals by multiplying by 100.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA standards, recommended practices, and technical reports. 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 which ISA develops.

This standard is intended as a guide for technical personnel at user facilities as well as by manufacturers' technical and sales personnel whose duties include specifying, testing, or showing performance characteristics of strain-gage linear Potentiometric Displacement Transducers. By basing users' specifications as well as technical advertising and reference literature on this standard, or by referencing portions thereof, as applicable, a clear understanding of the users' needs or of the transducers' performance capabilities, and of the methods used for evaluating or proving performance, will be provided. Adhering to the specification outline, terminology and procedures shown will not only result in simple, but also complete specifications; it will also reduce design time, procurement lead time, and labor, as well as material costs. Of major importance will be the reduction of qualification tests resulting from use of a commonly accepted test procedure and uniform data presentation.

The development of this standard was initiated as the result of a survey conducted in December 1960. A total of 240 questionnaires was sent out to transducer users and manufacturers. A strong majority indicated in their replies a need for transducer standardization. As potentiometric displacement transducers were one of the types shown to be most in need of standardization, a project subcommittee, SP37.12, Potentiometric Displacement Transducers, was formed under the cognizance of SP37, Transducers for Aerospace Testing, and a standard was drafted and reviewed extensively, and revised in 1976. The reviewers were selected from a broad cross-section of all industries and sciences in which transducers are applied for measuring purposes.

The following individuals served as members of the 1977 SP37.12 Subcommittee:

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M. Brown	Bourns, Inc.
J. Kauker	Binary Controls
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This standard was reaffirmed by the ISA Standards and Practices Board on September 29, 1995.

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1 Scope

1.1 This Standard covers potentiometric displacement transducers, primarily those used in measuring systems.

NOTES

1. These specifications are not intended to cover transducers used in hazardous (classified) locations as specified in the National Electric Code.

2. Transducers for use in nuclear power plants must conform to additional U.S. Nuclear Regulatory Commission Requirements not specifically called out in this Standard.

1.2 Included among the specific versions of potentiometric displacement transducers to which this Standard is applicable are the following:

Angular Displacement Transducers
Linear Displacement Transducers

1.3 Terminology used in this document is defined in ISA-S37.1. Additional terms considered applicable to potentiometric displacement transducers are defined in 4.3 of this document. An asterisk appears after those terms defined in S37.1. A double asterik appears after those terms defined in 4.3 of this standard.

2 Purpose

This Standard establishes the following for potentiometric displacement transducers.

2.1 Uniform minimum specifications for design and performance characteristics

2.2 Uniform acceptance and qualification test methods, including calibration techniques

2.3 Uniform presentation of minimum test data

2.4 A drawing symbol for use in electrical schematics

3 Drawing symbol

3.1 The drawing symbol for a potentiometric displacement transducer is a square with an added equilateral triangle, the base of which is the left side of the square.

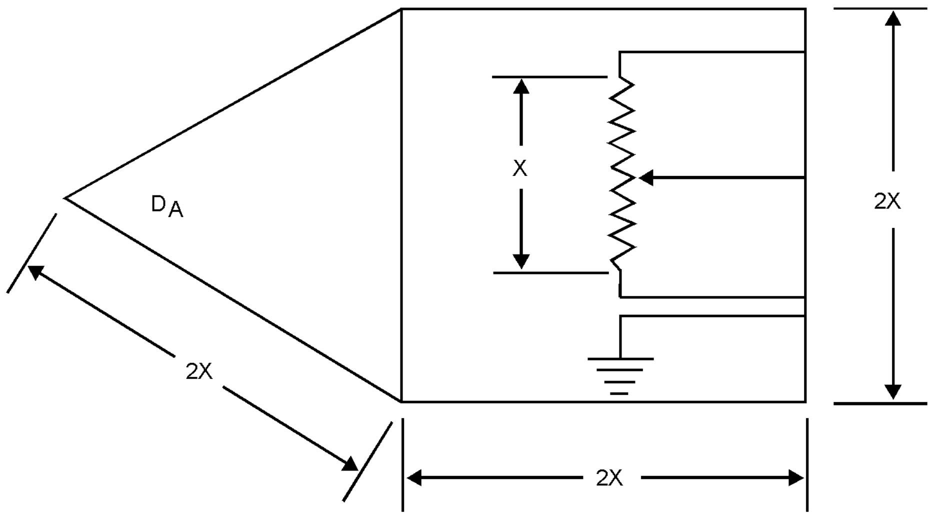

Figure 1 — Drawing Symbol

Subscripts

A = Angular
L = Linear

The letter "D" in the triangle designates "displacement," and the subscripts denote the second modifier. The illustration shows an angular displacement transducer, as symbolized by "DA."

3.2 The potentiometer is symbolized by a variable resistance of length x. The lines from it and to ground represent the electrical leads or terminations.

NOTES

1. 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.

2. For instrumentation systems use, refer to ISA-S5.1 *Instrumentation Symbols and Identification*.

4 Specification characteristics

4.1 Design characteristics

4.1.1 Required mechanical design characteristics

The following mechanical design characteristics shall be listed.

4.1.1.1 Type of displacement sensed

Angular displacement*
Linear displacement*

*Defined in ISA-S37.1

4.1.1.2 Configuration and dimensions

The outline drawing shall show the configuration with dimensions in millimetres (inches). Unless electrical connections are specified (reference 4.1.3.4), the outline shall include limiting maximum dimensions for these connections.

4.1.1.3 Mountings and mounting dimensions

The outline drawing shall indicate the method of mounting with hole size, centers, and other pertinent dimensions in millimetres (inches) including thread specifications for threaded holes or shafts if used.

4.1.1.4 Displacement connection

The displacement connection(s) shall be indicated on the outline drawing. For threaded fittings, specify applicable military or industry standard, or nominal diameter in millimetres (inches or ANSI size number), and the thread pitch in millimetres per one thread (threads per inch), and other details as necessary to define the shape of the threads.

4.1.1.5 Mounting effects

The maximum mounting force or torque shall be specified, if it will tend to affect transducer performance (reference 4.2).

4.1.1.6 Mass

The mass of the transducer shall be specified in grams (ounces).

4.1.1.7 Case sealing

If case sealing is necessary, the mechanism and materials used for sealing should be described. The same requirement applies to the electrical connector. The resistance of the sealing materials to cleaning solvents and commonly encountered fluids should be stated.

4.1.1.8 Dissimilar metals

Dissimilar metals, which could cause generation of significant electrical potential, migration of metal or corrosion, shall not be used in contact with each other.

4.1.1.9 Identification

The following characteristics shall be permanently in-scribed on the outside of the transducer case or on a suitable nameplate permanently attached to the case.

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

b) Name of Manufacturer, Part number (to reflect one controlled configuration), and Serial Number

c) Range* in radians/millimetres (degrees/inches) and designation of type of displacement (See 4.1.1.1.)

d) Maximum** excitation.*

e) Transduction Element resistance (Potentiometric Element).*

f) Identification of Electrical Connections.

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*Defined in ISA-S37.1

**Defined in 4.3

g) Inscription of the following characteristics is optional:

h) Customer Specification or Part Number or both

Type of Electrical Connector and Mating Connector (if applicable)

i) Operating temperature range**

4.1.2 Supplemental mechanical design characteristics

Listing of the following mechanical design characteristics is optional.

4.1.2.1 Case material

Where applicable, state the surrounding environmental condition requirement or compatibility.

4.1.2.2 Number of Potentiometric Elements or Taps**

When more than one potentiometric transducer element or a tapped element is required, they shall be specified.

4.1.2.3 Maximum and minimum temperatures

The maximum and minimum temperature of environments, which can be applied to the transducer and which will not cause permanent calibration shift, shall be listed.

NOTE — Exposure time shall be specified, if relevant.

4.1.3 Required electrical design characteristics

The following electrical design characteristics shall be listed. All are applicable at Room Conditions.*

4.1.3.1 Excitation*

Expressed as "____volts (mA) dc" or "____volts (mA) ac rms at ____ Hz."

4.1.3.2 Maximum excitation**

Expressed as "____volts (mA) dc" or "____volts (mA) ac rms at ____ Hz," within the operating temperature range.

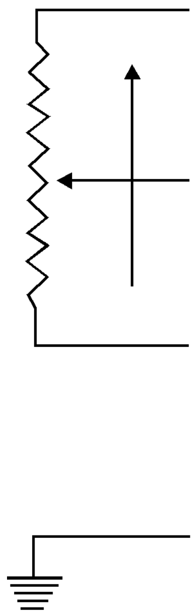
4.1.3.3 Resistance of transduction* element

Expressed as "____ ± ____ohms."

4.1.3.4 Electrical connections

Whether the electrical termination is by means of a connector or a cable, the pin designations or wire color code shall conform to the following transducer wiring standard.

*Defined in ISA-S37.1
**Defined in 4.3



Connector Pin	Wire Color	Mechanical Function	Electrical Function
1 or A	red	Maximum displacement	"Positive" excitation Terminal (if dc)
2 or B	green	Variable displacement	Wiper arm terminal output
3 or C	black	Minimum displacement	"Negative" excitation (if dc), or Common, output return
4 or D	Shield (optional)	(none)	Case ground

Figure 2 — Transducer Wiring Standard

NOTES

1. The Transduction element(s) shall be arranged to produce increasing "Positive" voltage output with increasing wiper displacement in direction (clockwise motion, viewed from shaft-end, for angular displacement transducers, and extending motion by linear displacement transducers shown by arrow).

2. For bidirectional range transducers, the arrow indicates increasingly positive displacement values.

3. Current flow shall be restricted to electrical elements and shall not be permitted in mechanical elements, such as shaft bushings.

4. **CAUTION — A short circuit on the output or an inadvertent connection of the excitation voltage to the wiper may pass excessive current through the wiper and the Transducer Element resistance, and cause a catastrophic failure of the transducer.**

5. Output Short-circuit protection (optional): In a specialized or dedicated transducer application, output short-circuit protection may be obtained by means of an optional output current limiting resistor. The resistor is placed in series with the potentiometer wiper, preferably integral to the transducer, between the wiper and the output terminal (connector pin "2" or "B" or wire color "green"). The resistance value is selected such that, with the output terminals shorted, the wiper current is limited to a proper maximum value. For example, if the excitation voltage will always be 5 volts dc and the wiper current should not exceed 10 milliamperes, then the resistance value should be 500 ohms. The same resistor also protects the transducer from damage due to inadvertent connection of the 5 volt excitation to the output terminals.

4.1.3.5 Insulation Resistance*

Expressed as "____megohms at ____volts dc between all transduction terminals in parallel and the transducer case at a temperature of ____°C and 90% relative humidity."

4.1.3.6 *Dieletric Withstand Voltage*

Expressed as "Capable of withstanding ____volts ac-rms at ____hertz, at a temperautre of ____°C and 90% relative humidity for ____minutes."

4.1.3.7 Load impedance*

Expressed as "____ohms" (see 4.2.19).

> **NOTE —** Although load impedance (the impedance presented to the output terminals of the transducer by the associated external circuitry) is not a transducer but a system characteristic, it affects the linearity defined in 4.2.4 and must be specified in order to define loading error. A single, close-tolerance value of load impedance shall be specified for use during all tests where not otherwise noted. To minimize loading error, the load impedance to transduction element resistance ratio should be as large as practicable.

4.2 Performance characteristics

The performance characteristics of the potentiometric displacement transducers should be tabulated in the order shown. Unless otherwise specified, they apply at Room Conditions as defined in ISA-S37.1. Characteristics are usually referred to the output and expressed as "% VR"; i.e., "percent Voltage Ratio*."

4.2.1 Range*

Expressed as "____to____radians/millimetres (degrees/inches)."

4.2.2 End points*

Expressed as "____% ± ____% and ____% ± ____% VR."

End Points shall be omitted where adequately defined using Error Band specifications.

4.2.3 Full scale output*

Expressed as "____% ± ____% VR."

> **NOTE —** Full scale output shall be omitted where adequately defined using End Points or Error Band specifications.

4.2.4 Linearity

Expressed as "____ linearity shall be within ± ____% VR with specified load impedance."

> **NOTE —** The linearity modifier shall be one of those defined in ISA-S37.1; namely end point, independent, least squares, terminal, or theoretical slope. Linearity values are dependent on load impedance.

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*Defined in ISA-S37.1

4.2.5 Hysteresis*

Expressed as "____% VR."

Alternately, the concepts of 4.2.4 and 4.2.5 may be replaced by 4.2.6.

4.2.6 Combined hysteresis* and linearity*

Expressed as "combined hysteresis and linearity within ± ____ % VR."

> **NOTE —** The linearity modifier shall be stated.

4.2.7 Repeatability*

Expressed as "within ____% VR over a period of ____hours."

Alternately, the concepts of 4.2.2, 4.2.3, 4.2.4, 4.2.5, and 4.2.7 may be replaced by 4.2.8.

4.2.8 Static error band*

Expressed as "± ____% VR as referred to ____(curve)____."

The curve shall be stated as follows:

NOTES

1. End Point Line — a straight line between end points
2. Best Straight Line — a line midway between the two parallel lines closest together and enclosing all output versus measured values
3. Least Square Line — a straight line for which the sum of the squares of the residuals is minimized
4. Terminal line — a straight line between 0 and 100 percent of both measurand and output
5. Theoretical Slope — a straight line between the theoretical end points
6. Other curves shall be defined if specified; e.g., mean-output curve

4.2.9 Resolution* (See also 4.3.1)

Expressed as "average resolution within ____% VR and maximum resolution within ____% VR."

4.2.10 Frequency response

Expressed as "within ± ____% from zero to ____ Hz at a peak-to-peak amplitude of ____% VR."

4.2.11 Operating temperature range**

Expressed as "from ____°C to ____°C."

4.2.12 Temperature error*

Expressed as "within ____% VR per ____°C." Or "within ____% VR over the operating temperature range."

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*Defined in ISA-S37.1
**Defined in 4.3

Alternately, 4.2.12 may be replaced by 4.2.13.

4.2.13 Temperature error band*

Expressed as "within ± ____% VR from the reference curve established for the Static Error Band and over the operating temperature range."

4.2.14 Acceleration error*

Expressed as "within ____% VR per g_n along ____axis at steady acceleration levels to ____ g_n."

> **NOTE —** The error shall be listed either for each of the three axes or for the axis with the largest error; i.e., most sensitive axis.

Alternately 4.2.14 may be replaced by 4.2.15.

4.2.15 Acceleration error band*

Expressed as "within ± _____% VR from the reference curve established for the Static Error Band for steady accelerations up to ____ g_n along ____ axis."

> **NOTE —** The error band shall be listed either for each of the three axes or for the axis with the largest error; i.e., most sensitive axis.

4.2.16 Vibration error*

Expressed as "within ± ____% VR along ____axis over the specified vibration program." Signal "dropout" or discontinuities shall be noted.

> **NOTE —** The error shall be listed either for each of the three axes or for the axis with the largest error; i.e., most sensitive axis; and the program shall be detailed, preferably by a graph.

Alternately 4.2.16 may be replaced by 4.2.17.

4.2.17 Vibration error bands*

Expressed as "within ± ____% VR along ____axis from the reference curve established for the Static Error Band over the specified vibration program."

> **NOTE —** The error band shall be listed either for each of the three axes or for the axis with the largest error; i.e., most sensitive axis, and the program shall be detailed, preferably by a graph.

4.2.18 Mounting Error**

Expressed as "within ± ____% VR" or "within the Static Error Band."

4.2.19 Loading error*

Expressed as "within ± ____% VR" or "within the Static Error Band at a load impedance of ____ohms."

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*Defined in ISA-S37.1
**Defined in 4.3

4.2.20 Cycling life*

Expressed as "____cycles at one fourth of the designated maximum operating frequency of the transducers."

4.2.21 Other environmental conditions

Pertinent environmental conditions that shall not change transducer performance beyond certain limits shall be included along with the limits beyond which the transducer performance shall not change.

Examples are as follows:

a) Ambient Pressure*

b) Shock – Triaxial

c) High Level Acoustic Excitation

d) Humidity

e) Salt Atmosphere

f) Nuclear Radiation

g) Magnetic Fields

h) Sand and Dust

i) Total Immersion (and in what medium)

j) Solar (or other) Heat Radiation

k) Temperature Shock

l) Electromagnetic Interference, generation, or susceptibility

m) Vibration Acceleration – Triaxial

4.2.22 Storage life*

Expressed as "____ months (years) without changing performance characteristics beyond their specified tolerances."

> **NOTE —** Environmental storage conditions shall be described in detail. Where performance characteristics require additional tolerances over the storage life they shall be specified.

4.3 Additional terminology

4.3.1 average resolution: The reciprocal of the total number of output steps over the unit range multiplied by 100 and expressed in percent VR.

4.3.2 maximum excitation: The maximum allowable voltage (current) applied to the potentiometric element at Room Conditions while maintaining all other performance characteristics within their limits. (Note —The excitation value is particularly associated with temperature.)

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*Defined in ISA-S37.1

4.3.3 mounting effects: The effects (errors) introduced into transducer performance during installation caused by fastening of the unit or its mounting hardware or by irregularities of the surface on (or to) which the transducer is mounted.

4.3.4 operating temperature range: The range in extremes of ambient temperature within which the transducer must perform to the requirements of the "Temperature Error" or "Temperature Error Band." (See 4.2.12 and 4.2.13, respectively.)

4.3.5 potentiometric element: The resistive part of the transduction element upon which the wiper (movable contact) slides and across which excitation is applied. It may be constructed of a continuous resistance or of small diameter wire wound on a form (mandrel).

4.3.6 wiper (movable contact): That portion of the potentiometric assembly which slides on the resistance element. It is connected to a terminal and provides an electrical output as a function of the shaft position relative to the body.

4.3.7 dielectric withstand voltage: The ability of insulated portions of the transducer to withstand a specified overvoltage for a specified time without arcing or conduction above a specified current value across the insulation.

4.3.8 tap: A connection to a potentiometric element along its length, frequently at the element's center for use in providing bidirectional output.

4.3.9 worst resolution: The magnitude of the largest of all output steps over the unit range expressed as percentage voltage ratio (%VR).

4.3.10 shaft: The mechanical input element of the transducer.

4.3.11 shaft position: An indication of the position of the wiper relative to a reference point.

4.3.12 noise (refer to noise test circuit): Noise is any spurious variation in the electrical output, not present in the input. Noise is defined quantitatively in terms of an equivalent parasitic transient resistance appearing between the wiper and the resistance element while the input shaft is being moved.

The Equivalent Noise Resistance is established independently of the functional characteristics, in the Noise test circuit. The wiper is required to be excited by a specified dc constant current source. The Noise test circuit output measuring system is an oscilloscope with defined frequency bandwidth or time constant. The magnitude of the Equivalent Noise Resistance is measured as ohms variation while the input shaft is moved at a specified speed and observed as peak-to-peak deflection on the oscilloscope.

For example: if the constant current is one milliampere dc and the oscilloscope deflection is 100 millivolts peak-to-peak, then the Equivalent Noise Resistance is 100 ohms.

> **NOTE —** Noise may be characterized as generally reproducible, exhibited as a local nonlinearity, or it may be the classical sporadic type. Manufacturing cleanliness and improved quality control on processing may significantly reduce noise problems.

4.4 Supplemental performance characteristics

> **NOTE —** In critical applications these characteristics may be of potential use in the specifications of potentiometric displacement transducers. These characteristics are typically "Qualification Test" items; however, specific test procedures are not described in this standard.

4.4.1 End stops

The physical limits of motion provided by the transducer design which define the Total Travel of the Shaft.

> **NOTE —** In order to protect the transducer from overload, the End Stops will normally be placed beyond the maximum requirements for (desired) Mechanical Travel.

4.4.2 End point, *shaft position*

The shaft positions immediately before the first and after the last measurable change(s) in Output Ratio, after wiper continuity has been established, as the shaft moves in a specified direction.

4.4.3 End point, theoretical, *shaft position*

The shaft positions corresponding to the ends of the Theoretical Electrical Travel as determined from the Index Point.

The Index Point is a point of reference, fixing the relationship between a specified shaft position and the output percent VR. For example: In an ideal symmetrical range bidirectional potentiometric displacement transducer, zero position input should produce 50% VR output.

4.4.4 End resistance, *shaft position*

The resistance measured between the wiper terminal and end terminal with the shaft positioned at the corresponding End Point.

4.4.5 Extended position, linear potentiometer

The condition when the Shaft is moved out from the transducer to either the End Stop or end of Mechanical or Electrical Travel as specified.

4.4.6 Lateral runout, angular potentiometer

The perpendicularity of the mounting surface with respect to the rotational axis of the shaft, measured on the mounting surface at a specified distance from the outside edge of the mounting surface. The shaft is held fixed and the body of the potentiometer is rotated with specified loads applied radially and axially to the body of the transducer.

4.4.7 Operating force, non-springloaded designs, breakout force/torque

The maximum force required to initially move the shaft due to the effects of static friction of the parts, especially in "O-ring" sealed designs. The attitude of the line of action must be specified. Angular position transducer breakout torque is defined similarly.

4.4.8 Operating Force, Non-Spring Loaded Designs, Dynamic Force/Torque

The force/torque required to continuously move the shaft after the first motion has occurred. The attitude of the line of action must be specified.

4.4.9 Springloaded designs, initial force/torque

The force/torque required to move the shaft from its normal position of rest includes the force/torque to overcome the spring forces plus the Starting Force/Torque. The attitude of the line of action (direction of rotation) is specified.

4.4.10 Springloaded designs, final force/torque

The force/torque required to hold the shaft at the opposite end of the Stroke (extreme angular position of the shaft). This force/torque is measured and the attitude of the line of action (direction of rotation) must be specified.

4.4.11 Output correlation

In a transducer which provides multiple outputs by the addition of independent resistance elements giving simultaneous reading with a common shaft motion, it is often necessary to relate the individual outputs to each other. This shall be expressed in ± percent output (full scale) at a specific output reading, or number of readings, or at any specified position of the shaft measured from a given datum.

4.4.12 Overload, shaft

The amount of force (torque) to which the Shaft may be subjected at the extremities of the Mechanical Travel (i.e., when reaching the End Stops) without damage to the transducer and without causing degradation of the specified performance characteristics.

4.4.13 Pilot diameter runout

The eccentricity of the pilot diameter with respect to the rotational axis of the shaft, measured on the pilot diameter. The shaft is held fixed and the body of the transducer is rotated with a specified load applied radially to the body of the transducer. This distance is measured from a specified datum.

4.4.14 Shaft misalignment, linear position potentiometer

The amount of freedom allowable or desirable of the Shaft in relation to the body of transducer when the body is held rigidly.

4.4.15 Misalignment, body

The amount the shaft is allowed or required to move at a specified retracted position in a conical motion. This shall be measured at a specified position on the shaft.

4.4.16 Misalignment, axial

The amount the shaft is allowed or required to deflect during all or any specified portion of the Total Travel and move in a line of parallel to the normal line of action.

4.4.17 Shaft rotation, linear position potentiometer

To be specified in rotational freedom in a direction normal to the axis of motion in radians (degrees). The definition of permissible output change, if any, in percent of Full Scale output should be included.

4.4.18 Shaft end play, angular position

The total axial excursion of the shaft, measured at the end of the shaft with a specified axial load supplied alternately in opposite directions.

4.4.19 Shaft radial play, angular position

The total radial excursion of the shaft, measured at a specified distance from the front surface of the unit. A specified radial load is applied alternately in opposite directions at a specified point.

4.4.20 Shaft runout

The eccentricity of the shaft diameter with respect to the rotational axis of the shaft, measured at a specified distance from the end of the shaft. The body of the potentiometer is held, and the shaft is rotated with a specified load applied radially to the shaft.

4.4.21 Side load

That force applied to any portion of the transducer, in any direction, which will result in bending loads and which will affect the Operating Force or Life Cycling requirements expressed in force units and direction of loading.

4.4.22 Static stop strength

The maximum static load that can be applied to the shaft at each mechanical stop for a specified period of time without permanent change of the stop positions greater than specified.

4.4.23 Dynamic stop strength

The inertial load, at a specified shaft velocity and a specified number of impacts, that can be applied to the shaft at each stop without a permanent change of the stop position greater than specified.

4.4.24 Total/mechanical travel, linear position transducer

The physical distance the shaft may be moved from one stop to the other. This distance, that includes the Electrical Travel and the Over-Travel, may apply to either one or both ends of the electrical travel. It may be located dimensionally from some convenient output datum; e.g., ± ____ mm (in.) from the _____________% VR output.

Table 1 — Tabulated characteristics versus test requirements

This table is intended for use as quick reference for design and performance characteristics and tests of their proper verification as contained in this Standard.

Characteristics	Paragraph	Required	Supplemental	Individual Acceptance Test	Qualification Test
Type of Displacement Sensed	4.1.1.1	X		No Test	
Configuration, Dimensions, Mounting Displacement Connection	4.1.1.2 through 4.1.1.4	X		5.2.1	
Mounting Effects	4.1.1.5	X			6.4
Mass	4.1.1.6	X			6.3
Case Sealing	4.1.1.7	X			5.2.1
Dissimilar Metals	4.1.1.8			5.2.1	
Identification	4.1.1.9	X		5.2.1	
Case Material	4.1.2.1		X		
Number of Potentiometric Elements or Taps	4.1.2.2		X	5.2.2 through 5.2.6	
Maximum and Minimum Temperatures	4.1.2.3		X		Special Test
Excitation	4.1.3.1	X		5.2.6	
Maximum Excitation	4.1.3.2	X			Special Test
Resistance of Transduction Element	4.1.3.3	X		5.2.2	
Electrical Connections	4.1.3.4	X		5.2.2	
Insulation Resistance	4.1.3.5	X		5.2.3	
Dielectric Withstand Voltage	4.1.3.6	X		5.2.4	
Load Impedance	4.1.3.7	X		5.2.5 (partially)	6.5
Range	4.2.1	X		5.2.6	
End Points	4.2.2	X		5.2.6	
Full Scale Output	4.2.3	X		5.2.6	
Linearity	4.2.4	X		5.2.5	
Hysteresis	4.2.5	X		5.2.6	
Combined Hysteresis and Linearity	4.2.6	X		5.2.6	
Repeatability	4.2.7	X		5.2.6	
Static Error Band	4.2.8	X		5.2.6	
Resolution	4.2.9	X			6.2
Frequency Response	4.2.10				6.7
Operating Temperature Range	4.2.11	X			6.8
Temperature Error	4.2.12	X			6.8
Temperature Error Band	4.2.13	X			6.8
Acceleration Error	4.2.14	X			6.9
Acceleration Error Band	4.2.15	X			6.9
Vibration Error	4.2.16	X			6.10
Vibration Error Bands	4.2.17	X			6.10
Mounting Error	4.2.18				6.4
Loading Error	4.2.19				6.5
Cycling Life	4.2.20	X			6.12
Other Environmental Conditions	4.2.21	X			6.11
Noise	4.3.12				6.6
Storage Life	4.2.22				Special Test (accelerated)

4.4.25 Total/mechanical travel, angular position transducer

The physical angle shaft may be rotated, from one stop to the other. This arc includes the Electrical Travel and the Over-Travel. It may be located dimensionally from some convenient output datum; e.g., ± ____radians (degrees) from the ____%VR output.

> **NOTE —** Certain angular position transducers may be designed for continuous rotation.

4.4.26 Electrical travel

That portion of the Mechanical Travel during which an output change occurs.

4.4.27 Overtravel

The differences between the required Electrical Travel and Mechanical Travel which the shaft may be moved (or rotated) beyond either or both ends of the Electrical Travel and during which no electrical-output change occurs.

4.4.28 Wiper bounce

The phenomenon of intermittent separation between the wiper and the resistive element may be caused by foreign matter, vibration, or the speed of the wiper motion. It may be measured by the value of the ratio of contact-off to contact-on time, when (a) the transducer is subjected to vibration over a specified range of frequencies and amplitudes, in the direction most likely to promote contact separation; or (b) the wiper is moved at all speeds to a specified maximum value. A convenient way to achieve this is to move the input shaft sinusoidally at specified low frequencies, with the peak-to-peak displacement approaching the range of the transducer. Steady state angular rotation may be used for Angular Displacement Transducers that do not include mechanical stops.

5 Individual acceptance test and calibrations

5.1 Basic equipment necessary to perform individual acceptance tests and calibrations of potentiometric displacement transducers

The basic equipment for acceptance tests and calibrations consists of a source of displacement, a source of electrical excitation for the potentiometer, and a device which measures the electrical output ratio of the transducer directly or as a ratio to excitation input (VR). The combined errors or uncertainties of the calibration system consisting of these three components should be less than one-fifth of the characteristic under evaluations. The traceability to national standards for this measuring system shall be well known.

5.1.1 Displacement

The displacement source may be either continuously variable over the range of the instrument or may give discrete steps as long as the steps can be programmed in such a manner that the transition from one position to the next during calibration is accomplished without eliminating an existing hysteresis (or friction) error of the transducer by overshoot or fluctuation.

5.1.2 Stable excitation source of accurately known amplitude (unless VR is being measured)

Commonly used sources are chemical batteries such as dry cells and storage batteries or line-powered, electronically regulated, power supplies. (A current limiting device shall be inserted in series with the transducer to preclude accidental damage of the potentiometric element.)

5.1.3 Electronic indicating instrument

Examples of suitable devices are

Manually Balanced Ratiometer
Achievable Accuracy
1 part in 10,000

Self-Balancing Ratiometer
Achievable Accuracy
1 part in 10,000

Digital Electronic Voltmeter/Ratiometer
Achievable Accuracy

± (0.01% of Reading + 1 digit) (4 digit display)
± (0.005% of Reading + 1 digit) (5 digit display)

NOTE — Please refer to 4.1.3.7.

5.2 Calibration and test procedures

Results obtained during the calibration and testing shall be recorded on a data sheet similar to the sample data sheet in Section 7, Figure 4 of this standard. Calibration and testing shall be performed under Room Conditions as defined in ISA-S37.1 unless otherwise specified.

NOTES

1. The definitive paragraph under Performance Characteristics (Section 4) of this document is listed beside each of the parameters for which the test results are compared.

2. If more than one potentiometric element is used in the transducer, the performance of every element shall be recorded on its own form.

3. Automatic or semi-automatic testing may be used and should be encouraged as a means to minimize human error. The technique used should be established as satisfactory relative to the manual method.

5.2.1 The transducer shall be inspected visually for mechanical defects, poor finish, and other applicable mechanical characteristics of 4.1.1.

Configuration and Dimensions	4.1.1.2
Mounting and Mounting Dimensions	4.1.1.3
Displacement Connection	4.1.1.4
Identification	4.1.1.9

By use of special equipment, or by formal verification of production methods and materials used, the following can be additionally determined:

Case Sealing	4.1.1.7
Dissimilar Metals	4.1.1.8
Case Material	4.1.2.1

5.2.2 A precision resistance measuring device shall be used to measure

Resistance of Transduction Element	4.1.3.3

and can be used to verify

Number of Potentiometric Elements or Taps	4.1.2.2
Electrical Connections	4.1.3.4

NOTE — A resistance measuring device using constant current excitation and the four-wire technique is preferred.

CAUTION — Care must be observed when using any resistance measurement device that the measurement current does not exceed the current rating of the transducer element. To preclude possible inadvertent damage to the transducer, the measurement current should be less than the maximum permissible transducer wiper current.

5.2.3 Measure the insulation resistance between all transduction element terminals (or leads) connected in parallel and the case (and ground pin) of the transducer with a megohmmeter device, using a potential of 50 volts unless otherwise specified.

Insulation Resistance	4.1.3.5

5.2.4 Verify the Dielectric Withstand Voltage** using sinusoidal ac voltage test with all transduction element terminals (or leads) paralleled and tested to case and ground pin.

Dielectric Withstand Voltage**	4.1.3.6

5.2.5 The transducer shall be connected to the displacement source and secured as recommended for its use. The appropriate excitation source and indicating instruments shall be properly connected to the transducer and turned "on." Adequate warm-up time for indicating instruments shall be allowed before tests are conducted. Electrical connections shall be checked for correctness of hook-up including the appropriate load impedance (see 4.1.3.7).

Three complete calibration cycles shall be run consecutively. Excitation amplitude shall be monitored as wired unless VR is measured.

Tapping, vibrating, or dithering the unit in any manner is not permitted unless specifically noted. Approach the points gradually; do not overshoot. Do not exceed mechanical travel limits of the unit.

Unless specified individual instructions are given dictating a unidirectional range transducer requirement, all calibrations shall be accomplished as for bidirectional range transducers. The calibration shall commence at the electrical center, 50.00 percent voltage ratio, representing zero position for plus/minus equal range units. For biased plus/minus range units, the calculated ideal electrical output voltage ratio, other than 50.00 percent voltage ratio above, shall be used as the reference zero starting point.

**Defined in 4.3

Set the static calibration displacement fixture to a desirable reference "zero" position. Adjust the transducer's shaft position in the fixture so that specified zero position output is obtained (this may be done with aid of "Fine Adjustment" on the transducer if it is provided). Lock the transducer shaft in the fixture.

Calibration displacement input increments will nominally be ten percent of the transducer's full span, or ten percent of each available arc or segment for tapped potentiometers. A minimum total of 11 input points (21 individual data points: 50, 60, 70, 80, 90, 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, 0, 10, 20, 30, 40, 50 % VR) must be used for each calibration run on each available arc or segment. For measurement units use "Radians" ("Degrees") for angular transducers, "Millimeters" ("Inches") for linear transducers. Do not use fractions or mixed units (e.g., degrees and minutes); use only simple decimal multiples of the above units.

Record e_o/e_i in terms of % VR.

Fill in the "Theoretical % VR" Column by calculating the e_o/e_i values in accordance with the transducer specification.

Perform three full range, increasing and decreasing calibration cycles, using selected measurand levels. Record e_o/e_i in percent VR units under the "Run 1," "Run 2," and "Run 3," respectively.

Record the largest plus and minus deviations observed from the theoretical/calculated/predicted values. Record these deviations under "maximum error." Show polarity of error for each entry.

Examine the "Maximum Error" column. Show the largest "plus" and largest "minus" error as "Error Band" in the appropriate spaces on the form. Show error band allowed by the applicable specification.

Or, in lieu of the error band concept, use the Best Straight Line.

5.2.6 In order to verify performance between the discrete levels and to assure absence of noise, a full-scale X-Y plot shall be obtained, preferably inscribed diagonally across the test record form, by applying increasing, then decreasing, displacement to the transducer, and simultaneously to a reference transducer having continuous resolution and suitable linearity, each connected to one axis input of the plotter.

From the data obtained during these tests, the following characteristics should be determined:

End Points	4.2.2
Full Scale Output	4.2.3
Linearity	4.2.4
Hysteresis	4.2.5
(or Hysteresis and Linearity)	4.2.6
Repeatability	4.2.7

6 Qualification test procedures

Qualification Tests shall be performed as applicable using the test forms of Section 7 as required. Upon completion of all testing, the form of Figure 9 shall be used to summarize all testing.

6.1 Initial performance tests (Figure 5)

The tests and procedures of Section 5 shall be run to establish reference performance during increasing (and decreasing) steps of 50, 60, 80, 100, 80, 60, 50, 40, 20, 0, 20, 40, 50 percent VR minimum.

6.2 Resolution test (Figure 9)

An X-Y plotter shall be connected so that the transducer output is connected to the X-Axis and a continuous-resolution reference transducer to the Y-Axis input of the plotter. As the displacement to both transducers is slowly increased (simultaneously on both transducers), the number of steps shall be recorded from 0 to 100 percent of the test transducer's range. The following shall be determined:

Resolution (Average and Worst)**	4.2.9

6.3 Mass test (Figure 9)

The transducer mass shall be determined on an appropriate balance scale. The following shall be established:

Mass	4.1.1.6

6.4 Mounting test (Figure 9)

The mounting of the actual installation shall be duplicated as closely as possible following specific instructions and one calibration run performed. The following shall be established:

Mounting Error	4.2.18
Mounting Effect	4.1.1.5

6.5 Loading test (Figure 9)

Approximately 67 percent of full range (span) displacement shall be applied to the transducer, the resultant output shall be measured open-circuited, then the specified load impedance (4.1.3.7) shall be connected across the output terminals and the output measured again. The following shall be verified:

Loading Error	4.2.19

**Defined in 4.3

NOTE — The resistance of the ratiometer or other indicating instrument must be taken into account. If the transducer is to be used with other values of load impedance, the corresponding loading error can be verified in the same manner.

The loading error of a potentiometric transducer is variable with wiper position, ranging from zero at both extremes to a maximum value at approximately 67 percent VR. As a first approximation the percentage error is equal to fifteen times the ratio of the transduction element resistance to the loading resistance. Unless otherwise stated, assembly adjustments of the transducer apply to the open circuit conditions at the output terminals.

6.6 Noise test (refer to noise test circuit)

Using an oscilloscope and a ____ milliampere dc constant current source, the output of the Noise Test Circuit shall be less than ____ millivolts peak-to-peak, representing less than ____ ohms equivalent resistance variation in the wiper. This test shall be conducted at representative high and low input shaft speeds, which shall be specified.

NOTE — The input shaft of a potentiometric angular displacement transducer, which does not include mechanical stops, may be rotated continuously and hence easily subjected to a constant angular speed for dynamic considerations.

Most other potentiometric angular or linear displacement transducers may conveniently be driven dynamically, using a sinusoidal motion for the input stimulus.

CAUTION — Limiting values of frequency, velocity, and acceleration may apply to the transducer shaft (or to the motion source) for a given dynamic input displacement.

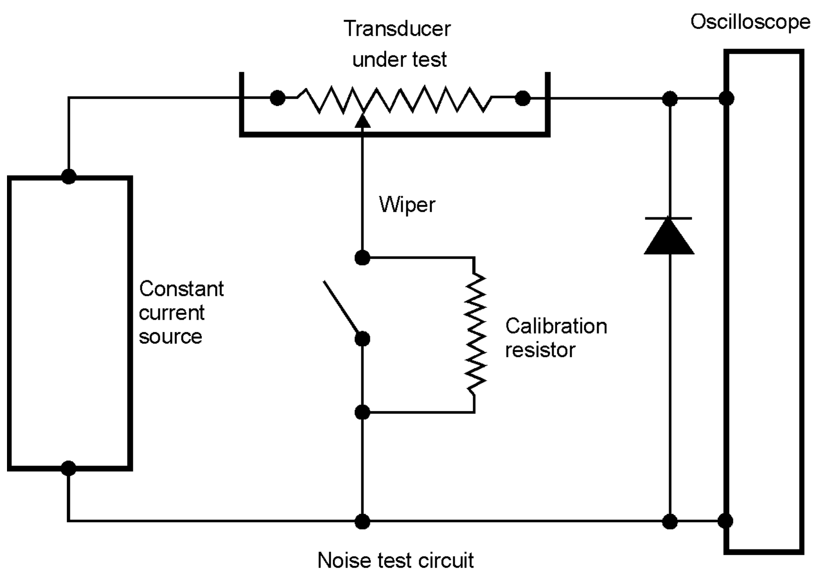


Figure 3 — Noise Test Circuit

6.7 Dynamic response test (Figure 7b as applicable)

The dynamic response characteristics of displacement transducers may be established either with transient-excitation devices, or with sinusoidal displacement generators.

6.7.1 Transient excitation method

A step function of displacement may be generated with a solenoid or a spring-loaded trigger mechanism.

By applying step functions of displacement at Room Conditions within the full scale range of the transducers, and analyzing the electronic or electro-optical recording of the transducer output, the following can be determined:

Frequency Response	4.2.10

6.7.2 Sinusoidal excitation method

For frequencies below about 30 Hz, an oscillating mechanical table may be used.

A sinusoidal displacement waveform of constant amplitude and varying frequency, over a specified frequency range shall be applied. The following shall be determined:

Frequency Response	4.2.10

6.8 Temperature tests

6.8.1 Low temperature test (Figure 6)

The transducer shall be placed in a suitable temperature chamber. The temperature of the transducer shall be stabilized for one hour at the lower specified operating temperature and three calibration cycles performed. The insulation resistance shall be measured and recorded as in 5.2.3.

These tests shall establish the following:

Temperature Error (at low temperature) or	4.2.12
Temperature Error Band (at low temperature)	4.2.13

6.8.2 Post low temperature test (at room conditions) (Figure 6)

The transducer shall be removed from the temperature chamber and permitted to stabilize for one hour at room conditions. The tests of 6.7.1 shall be repeated except that the operating temperature shall be room temperature.

6.8.3 High temperature test (Figure 6)

The tests of 6.7.1 shall be repeated except that the transducer temperature shall be stabilized for one hour at the highest specified operating temperature.

These tests shall establish the following:

Temperature Error (at high temperature) or	4.2.12
Temperature Error Band (at high temperature)	4.2.13

6.8.4 Post high temperature test (at room conditions) (Figure 6)

The tests of 6.7.2 shall be repeated after stabilization of the transducer at room temperature for one hour.

> **NOTE —** If required, thermal and post-thermal zero shift and sensitivity shift also may be calculated from the results of these tests.

6.9 Acceleration test (Figure 8)

Acceleration shall be imposed on the transducer in three orthogonal directions by tilting it in the earth's gravitational field or by placing it on a centrifuge. A specific acceleration level shall be applied on specified axes, and the output measured. The following shall be established:

Acceleration Error	4.2.14
or	
Acceleration Error Band	4.2.15

6.10 Vibration test (Figure 8)

With specified measurand levels applied, the transducer shall be vibrated along specified axes at specified acceleration amplitudes over the specified frequency range within an electro-magnetic or hydraulic shaker. The transducer output shall be recorded with a high-speed recorder. The following shall be established:

Vibration Error	4.2.16
or	
Vibration Error Band	4.2.17

> **NOTE —** If so specified, the vibration error band can be established as the algebraic sum of maximum vibration errors and the last previously obtained static error band.

6.11 Tests for other environmental conditions (Figure 6)

The transducer shall be exposed to other specified environmental conditions. As specified for each condition, one complete calibration cycle shall be performed during or after the test to establish the ability of the transducer to perform satisfactorily.

See 4.2.21.

6.12 Life test (Figure 6)

After applying the specified number of full range excursions of measurand, or after completion of each of several specified portions of the total number of cycles, at least one complete calibration cycle shall be performed to establish minimum value of

Cycling Life	4.2.20

7 Test report forms

7.1 The test report forms listed are recommended for use during the testing of Potentiometric Displacement Transducers.

7.2 When using the forms, all pertinent information shall be inserted in its proper place. On some forms, blank space has been provided for additional tests. Where the test is prolonged; e.g., Cycling Life, more than one form may be required.

7.3 Individual Acceptance Tests and Calibrations (Figure 4). Used during acceptance testing of Section 5.

Initial Performance Tests and Calibrations (Figure 5). Used for establishing the reference performance for comparison to other test results.

Environmental Test Record (Figure 6). Used for Temperature, Maximum Temperature, Life and other environmental tests.

Dynamic Response Tests (Figure 7). Used for recording test results of Frequency Response. (Note — Use 7a or 7b as applicable.)

Acceleration/Vibration Tests (Figure 8). Used to record Acceleration and Vibration Test results.

Test Summary (Figure 9). Used to compile the results of all testing.

VENDOR'S PART NO.	TEST FACILITY	USER'S PART NO.
VENDOR	**POTENTIOMETRIC DISPLACEMENT TRANSDUCER**	SERIAL NO.
LINEAR ☐ ANGULAR ☐	**INDIVIDUAL ACCEPTANCE TESTS AND CALIBRATIONS**	RANGE _____ TO _____ _____
Visual Inspection: Dimensions ☐ Workmanship ☐ Finish ☐ Nameplate ☐ El. Conn. ☐	Electrical Inspection: Element Resistance _____ ohms Insulation Resistance _____ Megohms at _____ Vdc Dielectric Withstand Voltage @ _____ Vac, _____ Hz ☐ Z_L used _____ MΩ	

Calibration @ _____ V _____ Excitation Ambient Temperature _____ °C (I = Inital, F= Final)

		Run 1		Run 2		Run 3			Max. Error (%VR)	
Input Dis- place ment	Theor. Output (%VR)	%VR		%VR		%VR			+	–
		Increase	Decrease	Increase	Decrease	Increase	Decrease			
	100		X		X		X			
	90									
	80									
	70									
	60									
	50	(I) (F)		(I) (F)		(I) (F)				
	40									
	30									
	20									
	10									
	0	X		X		X				

* _____ Linearity : ± _____ , – _____ %VR (Allowed: ± _____ %VR); *Hysteresis: _____ %VR (All'd _____ %VR)

* Hysteresis and _____ Linearity (Combined): + _____ ,– _____ %VR (Allowed: _____ ± _____ %VR)

Error Band: + _____ , – _____ %VR (Allowed: ± _____ %VR);

Repeatability: _____ %VR (All'd: _____ %VR); *End Points: _____ and _____ %VR (All'd: _____ and _____ %VR)

*Full-Scale Output: _____ %VR (Allowed: _____ ± _____ %VR) NOTE: *Values Determined From _____ Calib. Cycle

Full-Scale X-Y Plot _____	Static Error Band: + _____ , – _____ %VR (Allowed: ± _____ %VR) Error Bands Ref. To _____

Equipment Used:	Tested By: _____ Date: _____ Approved By: _____

Figure 4 — Potentiometric Displacement Transducer Individual Acceptance Tests and Calibrations

VENDOR'S PART NO.	TEST FACILITY	USER'S PART NO.
VENDOR	**POTENTIOMETRIC DISPLACEMENT TRANSDUCER**	SERIAL NO.
LINEAR ☐ ANGULAR ☐ TYPE OF TEST	☐ INITIAL PERFORMANCE TEST ☐ ____________________ TEST	CUSTOMER RANGE _____ TO _________ _______

Visual Inspection: Dimensions ☐ Workmanship ☐ Finish ☐ Nameplate ☐ El. Conn. ☐	Electrical Inspection: Element Resistance ____________ ohms Insulation Resistance ____________ Megohms at _______ Vdc Dielectric Withstand Voltage @ _______ Vac, _________ Hz ☐ Z_L used ________ MΩ

Calibration @ ____________ V ____________ Excitation Ambient Temperature ______________ °C (I = Initial, F= Final)

Input Dis-place-ment	Theor.	%VR (Run 1)		%VR(Run 2)			%VR (Run 3)		Maximum Error %VR	
	%VR	Increase	Decrease	Increase	Decrease		Increase	Decrease	+	–
	100		X		X			X		
	80									
	60									
	50	(I) (F)		(I) (F)			(I) (F)			
	40									
	20									
	0	X		X			X			

* ________________ Linearity : + ________ , – ________ %VR (Allowed: ± _____ %VR); *Hysteresis: ________ %VR (All'd ________ %VR)

* Hysteresis and ________________ Linearity (Combined): + ________ ,– ________ %VR (Allowed: ______ ± __________ %VR)

Error Band: + ________ , – ________ %VR (Allowed: ± ________ %VR);

Repeatability: __________ %VR (All'd: _______ %VR); *End Points: ________ and ________ %VR (All'd: ________ and ________ %VR)

*Full-Scale Output: ________ %VR Allowed: ________ ± ______ %VR NOTE: *Values Determined From ______________ Calib. Cycle

Full-Scale X-Y Plot: ______ Static Error Band: + __________ , – ________ %VR (Allowed: ± ____________ %VR)

Error Bands Ref. To ______________________________________

Equipment Used:	Defects Noted Or Comments:

Tested By: ____________________________ Date: _________________________ Approved By: ______________________________

Figure 5 — Potentiometric Displacement Transducer Initial Performance Test

VENDOR'S PART NO.	TEST FACILITY	USER'S PART NO.
VENDOR	**POTENTIOMETRIC DISPLACEMENT TRANSDUCER**	SERIAL NO.
	ENVIRONMENTAL TEST RECORD	CUSTOMER
TYPE OF TEST		RANGE _____ TO _________ _________

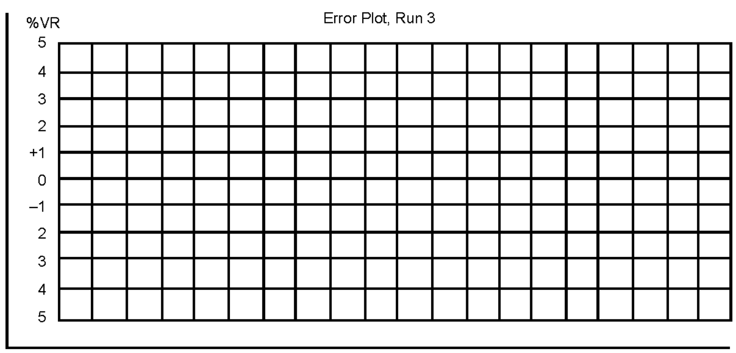
	Type of Environment	Level
Linear ☐ Angular ☐	☐ Before ☐ During ☐ After	_______ (I = Initial) (F = Final)

Input Displacement	Theoretical	%VR (Run 1)		%VR (Run 2)			%VR (Run 3)		Maximum Error %VR	
	%VR	Increase	Decrease	Increase	Decrease		Increase	Decrease	+	–
	100									
	90									
	80									
	70									
	60									
	50	____ (I) (F)	____ (I) (F)	____ (I) (F)			____ (I) (F)			
	40									
	30									
	20									
	10									
	0									

Error Band: + _____ % – _______ %VR (Referred To ______________________) Allowed: ± _______ %VR

Ins. Resistance: __________ Megohms at _____ Vdc

Comments: ______________________



Tested By. ______________ Date Test Started: __________ Date Test Finished: __________

Approved By: ______________ Approved By: ______________
Title: Title:

Figure 6 — Potentiometric Displacement Transducer Environmental Test Record

VENDOR'S PART NO.	TEST FACILITY	USER'S PART NO.
VENDOR	**POTENTIOMETRIC DISPLACEMENT TRANSDUCER**	SERIAL NO.
LINEAR ☐ ANGULAR ☐	**INDIVIDUAL ACCEPTANCE TESTS AND CALIBRATIONS**	RANGE ______ TO ______ ______

Visual Inspection: Dimensions ☐ Workmanship ☐ Finish ☐ Nameplate ☐ El. Conn. ☐	Electrical Inspection: Element Resistance ______ ohms Insulation Resistance ______ Megohms at ______ Vdc Dielectric Withstand Voltage @ ______ Vac, ______ Hz ☐ Z_L used ______ MΩ

Calibration @ ______ V ______ Excitation Ambient Temperature ______ °C (I = Inital, F= Final)

		Run 1		Run 2		Run 3			Max. Error (%VR)	
Input Dis-place ment	Theor. Output (%VR)	%VR		%VR		%VR			+	–
		Increase	Decrease	Increase	Decrease	Increase	Decrease			
	100		X		X		X			
	90									
	80									
	70									
	60									
	50	(I) (F)		(I) (F)		(I) (F)				
	40									
	30									
	20									
	10									
	0	X		X		X				

* ______ Linearity : ± ______ , – ______ %VR (Allowed: ± ______ %VR); *Hysteresis: ______ %VR (All'd ______ %VR)

* Hysteresis and ______ Linearity (Combined): + ______ ,– ______ %VR (Allowed: ______ ± ______ %VR)

Error Band: + ______ , – ______ %VR (Allowed: ± ______ %VR);

Repeatability: ______ %VR (All'd: ______ %VR); *End Points: ______ and ______ %VR (All'd: ______ and ______ %VR)

*Full-Scale Output: ______ %VR (Allowed: ______ ± ______ %VR) NOTE: *Values Determined From ______ Calib. Cycle

Full-Scale X-Y Plot ______	Static Error Band: + ______ , – ______ %VR (Allowed: ± ______ %VR) Error Bands Ref. To ______

Equipment Used:	Tested By: ______ Date: ______ Approved By: ______

Figure 7a — Potentiometric Displacement Transducer Dynamic Response Tests

VENDOR'S PART NO.	TEST FACILITY	USER'S PART NO.
VENDOR	**POTENTIOMETRIC DISPLACEMENT TRANSDUCER**	SERIAL NO.
REPORT NO.	**DYNAMIC RESPONSE TESTS**	CUSTOMER
TYPE OF TEST	**(SINUSOIDAL METHOD)**	RANGE ______ TO __________ _________

Ambient Conditions: Temperature:________ °C; Pressure: __________ Pa; ____________ Humidity ____________________________ %

Dynamic Response:

Excitation (Volts or ma) ________________________________ ; Transducer Load ______________________________________ ohms

Sinusoidal Generator ___________________________________ ; ____

Mounting Configuration ____

Test Temperature ________ °C

Sinusoidal

Frequency, Hz __________

Peak to Peak, %VR ________

ATTACH OSCILLOSCOPE PHOTOGRAPH OF TRANSDUCER RESPONSE

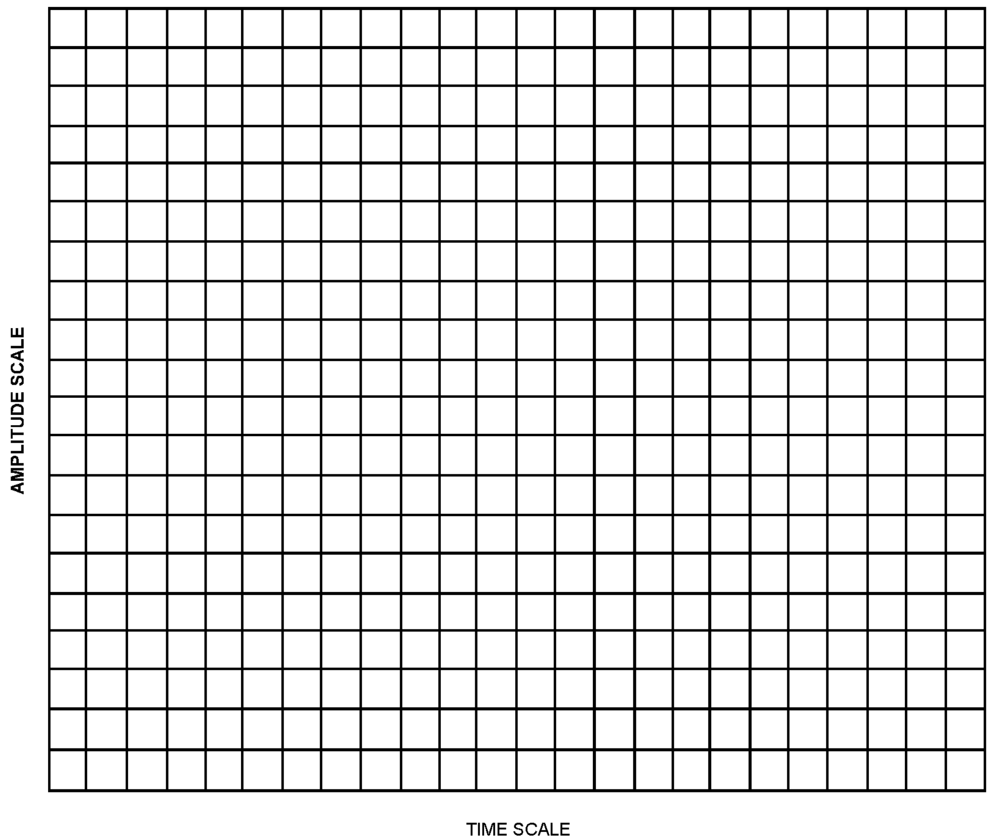


Figure 7b — Potentiometric Displacement Transducer Dynamic Response Tests (Sinusoidal Method)

VENDOR'S PART NO.	TEST FACILITY	USER'S PART NO.
VENDOR	**POTENTIOMETRIC DISPLACEMENT TRANSDUCER**	SERIAL NO.
REPORT NO.	ACCELERATION/VIBRATION TEST RECORD	CUSTOMER
TYPE OF TEST		RANGE ______ TO ___________ _________

SKETCH OF TRANSDUCER SHOWING AXIS ORIENTATION:

ACCELERATION TEST

AXIS	+X	–X	+Y	–Y	+Z	–Z
Output Before Accel. (%VR)						
Applied Accel. (G)						
Output During Accel. (%VR)						
Accel. Error (%VR)						

COMMENTS

Input Displacement Used ________________ ______________

Max. Accel. Error: + ________________ ,– ______________ %VR

Pre-Accel. Static Error Band: + ________________ ,– ______________ %VR

Accel. Error Band: + ________________ ,– ______________ %VR

(Allowed Accel. Error Band ± ________________ %VR)

Tested By: ________________________________ (Technician)

________________________________ (Test Engineer)

Date: ______________ Approved By: ______________________

Witnessed By: ______________________ (______________)

Witnessed By: ______________________ (______________)

VIBRATION TEST

AXIS	X			Y			Z		
Output Before Vib.	%VR			%VR			%VR		
Vibration Error	Freq. (Hz)	Error		Freq. (Hz)	Error		Freq. (Hz)	Error	
		Pol.	%VR		Pol.	%VR		Pol.	%VR

Max. Vib. Error: + ________________ ,– ______________ %VR

Pre-Vibl. Static Error Band: + ________________ ,– ______________ %VR

Vib. Error Band: + ________________ ,– ______________ %VR

(Allowed Vib. Error Band: ± ________________ %VR)

Tested By: ________________________________ (Technician)

________________________________ (Test Engineer)

Date: ______________ Approved By: ______________________

Witnessed By: ______________________ (______________)

Witnessed By: ______________________ (______________)

COMMENTS

Figure 8 — Acceleration/Vibration Test Report

VENDOR'S PART NO.	TEST FACILITY	USER'S PART NO.
VENDOR		SERIAL NO.
REPORT NO.	**TRANSDUCER TEST REPORT**	CUSTOMER
TYPE OF TEST	**POTENTIOMETRIC DISPLACEMENT TRANSDUCER**	RANGE ______ TO ___________ _________

SUMMARY OF RESULTS:								☐ Error ☐ Error Band	
Test	Tested Per Proced. No. or Test Waived Per	Par.No.	Pass	Fail					
				Error	Electr.	Mechan.	See Cmmnts.	+%VR	–% VR
Initial P.T. (Performance Test)									
Resolution								Avg: ___%VR	Max: ___ %VR
Mass								___________	________
								___________	________
Noise								___________	________
Mounting									
Loading Max. Z_L / Min. Z_L									
Frequency Response								Flat (+__%): _____To____Hz	
								_______ms.,	_____%Ovs.
Low Temp. ____________________ °C									
After Low Temp.									
High Temp. +________________ °C									
Add'l. Temp. ___________________ °C									
After High Temp.									
_______________ g_n Vibration									
After___________ g_n Vibration									
Acceleration									
After Accel.									
Life									

Tested By: ______________________________ Date Test Started: ______________ Date Test Finished: __________

Approved By: ______________________________ Approved By: ______________________________

Title: Title:

Figure 9 — Transducer Test Report

Annex A — References

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ISBN: 0-87664-359-4