

IEEE Standard Specification Format Guide and Test Procedure for Linear, Single-Axis, Pendulous, Analog Torque Balance Accelerometer

Sponsor
**Gyro and Accelerometer Panel
of the
IEEE Aerospace Electronics Systems Group**

Approved December 2, 1971
IEEE Standards Committee

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Foreword

(This Foreword is not a part of IEEE Std 337-1972, Specification Format Guide and Test Procedure for Linear, Single-Axis, Pendulous, Analog Torque Balance Accelerometer.)

This standard was prepared by the Gyro and Accelerometer Panel of the Aerospace Electronics Systems Group of the Institute of Electrical and Electronics Engineers. It consists of two parts.

Part I is a specification format guide for the preparation of an accelerometer specification. It provides a common meeting ground of terminology and practice for manufacturers and users. The user is cautioned not to overspecify; only those parameters that are required to guarantee proper instrument performance in the specific application should be controlled. In general, the specification should contain only those requirements that can be verified by test or inspection. Parameters in addition to those given in this standard are not precluded. Appendix A presents a discussion of the dynamic response of the instrument when operating in either the open or the closed loop mode. Figures 1, 2, A.1 and A2 are to be used as a guide for the preparation of specific figures or drawings.

Part II is a compilation of recommended procedures for testing an accelerometer. These procedures, including test conditions to be considered, are derived from those currently in use. For a specific application, the test procedure should reflect the requirements of the specifications; therefore, not all tests outlined in this document need be included, nor are additional tests precluded. In some cases, alternative methods for measuring performance characteristics have been included or indicated.

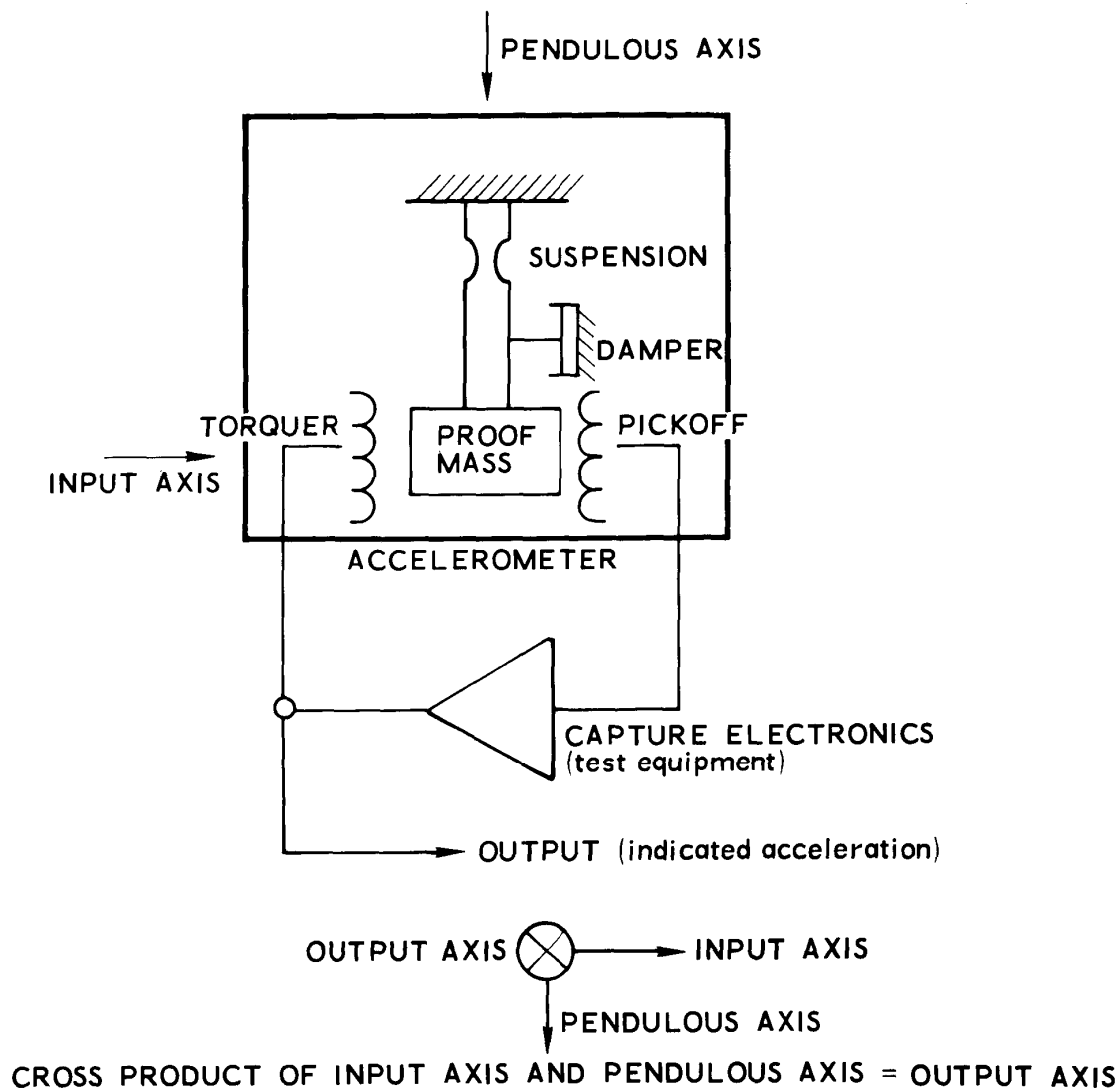
Blank spaces in the text of this document permit the insertion of specific parameter values and their tolerances. Brackets are used to enclose alternative choices of dimensional units, signs, axes, etc. Boxed statements are included for information only and are not part of the specification or test procedures.

The symbols used conform to IEEE Std 260-1967, Letter Symbols for Units Used in Electrical Science and Electrical Engineering. In this document, the symbol g is used to denote a unit of acceleration equal in magnitude to the local value of gravity at the test site or other specified value of gravity. This symbol is thus distinguished from g , which is the letter symbol for gram. The user should note that the forcing function for most of the tests described in this document is the local gravity vector. Since the magnitude of the gravity vector varies with location, it is necessary to normalize the measured coefficients to a selected standard value of g when comparing data obtained at different test locations. The attractive force of gravity acting on the proof mass of an earth-bound accelerometer is equivalent in effect to the inertia or reaction force due to an upward acceleration of one g .

The accelerometer considered in this document is a linear, single-axis, non-gyroscopic, analog torque balance, pendulous accelerometer with permanent magnet torquer. Refer to Accelerometer System Diagram on the next page. The analog electronics of the torque balance capture loop are considered to be part of the test equipment. The accelerometer is normally used as a sensing element to provide an electrical signal proportional to acceleration. An acceleration applied along the input axis causes the proof mass to deflect. The pickoff error signal caused by this motion is utilized in the capture loop to produce a restoring torque. When static equilibrium is reached, the reaction force of the proof mass to acceleration is exactly balanced by the restoring torque. The current required by the torquer to maintain this equilibrium condition is approximately proportional to the applied acceleration, and provides the accelerometer output.

The IEEE will maintain this document current with the state of the technology. Comments are invited on this document as are suggestions for additional material. These should be addressed to:

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Accelerometer System Diagram

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IEEE Standard Specification Format Guide and Test Procedure for Linear, Single-Axis, Pendulous, Analog Torque Balance Accelerometer

Part I — Standard Specification Format

1. Scope

This specification defines the requirements for a linear, single-axis, pendulous, analog torque balance accelerometer. The instrument is equipped with a permanent magnet torquer and is used as a sensing element to provide an electrical signal proportional to acceleration. The torque balance electronics are not considered to be part of the instrument.

2. Applicable Documents

The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of the specification to the extent specified herein. In the event of any conflict between the requirements of this document and the listed documents, the requirements of this document shall govern.

Give identification number, title, date of issue, and revision letter of each listed document.
--

2.1 Specifications

2.1.1 *Government*

2.1.2 *Industry/Technical*

2.1.3 *Company*

2.2 Standards

2.2.1 *Government*

2.2.2 *Industry/Technical*

2.2.2.1

Aerospace Industries Association, Standard Accelerometer Terminology, EETC Report 30, June 1965¹

2.2.2.2

IEEE Std 260-1967, Letter Symbols for Units Used in Electrical Science and Electrical Engineering

2.2.3 *Company*

2.3 Drawings

2.3.1 *Government*

2.3.2 *Industry/Technical*

2.3.3 *Company*

2.4 Bulletins

2.4.1 *Government*

2.4.2 *Industry/Technical*

2.4.3 *Company*

2.5 Other Publications

Other applicable documents should be listed in appropriate categories.
--

3. Requirements

3.1 Description

The accelerometer is a linear, single-axis, non-gyroscopic, analog torque balance, pendulous device with permanent magnet torquer. It is normally used as a sensing element to provide an electrical signal proportional to acceleration. The analog electronics used in the torque balance capture loop are considered to be part of the test equipment.

¹Available from: National Standards Association, Inc 1321 Fourteenth Street, NW Washington, DC 20005

3.2 General Requirements

3.2.1 Precedence

In the event of conflict among the purchase agreement, this specification, and other documents referred to herein, the order of precedence shall be as follows:

- 1) Purchase agreement
- 2) This specification and its applicable drawings
- 3) Other applicable documents

List other applicable documents in order of precedence; see Section 2.

3.2.2 Definitions

The following document defines terminology used in this specification:

Aerospace Industries Association, *Standard Accelerometer Terminology*, EETC Report 30, June 1965.

3.3 Performance

3.3.1 Operating Temperature

The operating temperature, as indicated by the temperature sensor [on, within] the accelerometer, shall be _____
± _____ °C.

Section 3.3.1 is applicable only to an accelerometer with its own temperature control.

3.3.2 Pickoff Characteristics

3.3.2.1 Scale Factor

The pickoff scale factor shall be _____ ± _____ V/rad.

In some cases it may be desirable to specify the pickoff linearity.

3.3.2.2 Phase

When the angular displacement of the proof mass about the output axis is positive, the output voltage measured from terminal _____ (high) to terminal _____ (low) shall [lead, lag] the pickoff excitation by _____ ± _____ °. Similarly, when the angular displacement of the proof mass about the output axis is negative, the output voltage (high to low) shall [lag, lead] the pickoff excitation by _____ ± _____ °. The pickoff excitation shall be applied to terminals _____ (high) and _____ (low). These requirements shall be met for all output voltages greater than _____ V.

3.3.2.3 Electrical Null

The minimum electrical output shall not exceed _____ V rms.

In some cases, it may be desirable to specify the fundamental, its harmonics, and quadrature.

3.3.2.4 Maximum Output

The maximum output voltage for proof mass rotation in each direction shall be _____ $\pm$ _____ V rms.

The output limits need not be symmetrical about the null.

3.3.3 Reference Constants

Nominal values of these constants are listed for reference only. They are not specified as they may vary within the framework of the specification and because they are difficult or impossible to measure independently in a complete accelerometer.

- 1) Moment of inertia of pendulum about the output axis _____ $\text{g} \cdot \text{cm}^2$
- 2) Pendulosity _____ $\text{g} \cdot \text{cm}$
- 3) Damping coefficient _____ $\text{dyn} \cdot \text{cm} \cdot \text{s}$
- 4) Damping ratio _____
- 5) Torquer scale factor _____ $\text{dyn} \cdot \text{cm}/\text{mA}$
- 6) Proof mass _____ g

3.3.4 Pendulum Elastic Restraint

The pendulum elastic restraint K_r shall be _____ $\pm$ _____ g/rad for pendulum displacements within the range of $0 \pm$ _____" (seconds — plane angle).

Pendulum elastic restraint includes all restraints such as flex lead spring restraint, pivot spring restraint, and pickoff reaction torque restraint but it does not include the principal restraint (rebalance torque supplied by the servo loop). K_r is related to K_e of Appendix A by the following relationship: $K_r = K_e/(980 \times \text{pendulosity})$.

3.3.5 Input Limits

The input limits shall be $\pm$ _____ g .

The input limits need not be symmetrical about the null.

3.3.6 Overload Capacity

The accelerometer shall perform within specification requirements after an acceleration of _____ g has been applied along the _____ [axis, axes] for _____ seconds a total of _____ times.

3.3.7 Capture Electronics

The capture electronics, which is a part of the test equipment, shall have characteristics as follows.

3.3.7.1 Input Characteristics

- 1) Source impedance _____ $\pm$ _____ $[+, -] j$ _____ $\pm$ _____ Ω
- 2) Input frequency _____ $\pm$ _____ Hz
- 3) Input impedance _____ $\pm$ _____ $[+, -] j$ _____ $\pm$ _____ Ω
- 4) Input voltage, maximum _____ V [ac, dc]
- 5) Input voltage, quadrature _____ V [rms, peak to peak]
- 6) Input voltage, harmonics _____ V [rms, peak to peak]
- 7) Input phase angle (relative to reference voltage) _____ $\pm$ _____ $^\circ$

3.3.7.2 Output Characteristics

- 1) Load impedance _____ $\pm$ _____ $[+, -] j$ _____ $\pm$ _____ Ω
- 2) Output impedance _____ $\pm$ _____ $[+, -] j$ _____ $\pm$ _____ Ω
- 3) Polarity positive with [in-phase, out-of-phase] input
- 4) Voltage range + _____ $\pm$ _____ V to - _____ $\pm$ _____ V
- 5) Current range + _____ $\pm$ _____ mA to - _____ $\pm$ _____ mA
- 6) With grounded input, the output shall be within $\pm$ _____ V dc and _____ V rms maximum
- 7) Quadrature rejection shall be greater than _____ dB
- 8) Noise shall be less than _____ mV rms 0 to _____ Hz for all input conditions of Section 3.3.7.1
- 9) Gain K_A _____ $\pm$ _____ V dc/V rms with the above specified output load impedance
- 10) Frequency response

Describe the transfer function or the gain and phase characteristics, or both. Specify tolerances compatible with the application.

It also may be desirable to specify short-circuit protection, overload protection, and removal of load protection in this section if required.

3.3.8 Accelerometer Bias

3.3.8.1 Absolute Value

The absolute value of the bias K_0 shall not exceed _____ g .

3.3.8.2 Short-Term Stability

The standard deviation of the bias from its mean value as determined over a period of _____ [hours, days] of continuous operation shall be less than _____ g . Bias measurements shall be made _____ times per day and at least _____ [minutes, hours] apart.

3.3.8.3 Long-Term Stability

The best fit slope of the bias determined over a period of _____ days of continuous operation shall be less than _____ g/day . The standard deviation of the bias data points from the best fit line shall be less than _____ g . Bias measurements shall be made _____ times per day and at least _____ [minutes, hours] apart.

The unbiased estimate of the standard deviation may be substituted for the standard deviation. Alternate ways of specifying short-term or long-term stability or both may be used, for example, peak-to-peak deviation.

3.3.8.4 Repeatability

The rms deviation of the bias from the mean of _____ measurements shall be less than _____ g . Between successive measurements, the accelerometer shall be cooled to _____ $^{\circ}C$ for at least _____ hours.

The cool-down time should be sufficient to attain thermal equilibrium. Other conditions for repeatability may be specified, such as turn-off with the accelerometer maintained at operating temperature.

3.3.8.5 Sensitivity

The absolute value of the sensitivity coefficients of the bias to variations from the standard test conditions of Section 4.5 shall not exceed the limits listed below:

- 1) Pickoff excitation voltage _____ g/V
- 2) Pickoff excitation frequency _____ g/Hz
- 3) Operating temperature _____ g/°C
- 4) External magnetic fields _____ g/T
- 5) Pressure _____ g/(N/m²)
- 6) Ambient temperature _____ g/°C

3.3.9 Accelerometer Scale Factor

3.3.9.1 Scale Factor and Tolerance

The scale factor K_1 shall be _____ $\pm$ _____ output units/g.

The desired form of the output should be specified, for example, V or mA.

3.3.9.2 Short-Term Stability

The standard deviation of the scale factor from its mean value as determined over a period of _____ [hours, days] of continuous operation shall be less than _____ output units/g. Scale factor measurements shall be made _____ times per day and at least _____ [minutes, hours] apart.

3.3.9.3 Long-Term Stability

The best fit slope of the scale factor determined over a period of _____ days of continuous operation shall be less than _____ (output units/g) per day. The standard deviation of the scale factor data points from the best fit line shall be less than _____ output units/g. Scale factor measurements shall be made _____ times per day and at least _____ [minutes, hours] apart.

The unbiased estimate of the standard deviation may be substituted for the standard deviation. Alternate ways of specifying short-term or long term stability, or both, may be used, for example, peak-to-peak deviation.

3.3.9.4 Repeatability

The rms deviation of the scale factor from the mean of _____ measurements shall be less than _____ output units/g. Between successive measurements, the accelerometer shall be cooled to _____ °C for at least _____ hours.

The cool-down time should be sufficient to attain thermal equilibrium. Other conditions for repeatability may be specified, such as turn-off with the accelerometer maintained at operating temperature.

3.3.9.5 Sensitivity

The absolute value of the sensitivity coefficient of the scale factor to variations from the standard test conditions of Section 4.5 shall not exceed the limits listed below:

- 1) Pickoff excitation voltage _____ percent/V
- 2) Pickoff excitation frequency _____ percent/Hz
- 3) Operating temperature _____ percent/°C
- 4) External magnetic fields _____ percent/T
- 5) Pressure _____ percent/(N/m²)
- 6) Ambient temperature _____ percent/°C

3.3.10 Nonlinearity

The absolute values of the second-order nonlinearity coefficient K_2 and the third-order nonlinearity coefficient K_3 shall be less than _____ g/g^2 and _____ g/g^3 , respectively.

3.3.11 Torquer Polarity

With a voltage applied between terminal _____ (high) and terminal _____ (low), the pickoff output voltage shall be [in-phase, out-of-phase] with respect to the pickoff excitation voltage.

3.3.12 Self-Test Torquer Characteristics

3.3.12.1 Self-Test Torquer Scale Factor

The self-test torquer scale factor shall be _____ $\pm$ _____ mA/g.

3.3.12.2 Self-Test Torquer Polarity

With a voltage applied between terminal _____ (high) and terminal _____ (low), the pickoff output voltage shall be [in-phase, out-of-phase] with respect to the pickoff excitation voltage.

3.3.13 Input-Axis Misalignment

The absolute value of the input-axis misalignment δ_p about the pendulous axis shall be less than _____ [rad, g/cross g].

The absolute value of the input-axis misalignment δ_o about the output axis shall be less than _____ [rad, g/cross g].

In some applications it may be desirable to specify the input-axis misalignment stability or sensitivity, or both.

3.3.14 Cross Coupling

The absolute value of the cross-coupling coefficients K_{ip} , K_{io} shall be less than _____ (g/g)/cross g.

3.3.15 Frequency Response

The open-loop frequency response shall conform to the following requirements:

- 1) The input frequency corresponding to a phase lag of 45° shall be less than _____ Hz
- 2) The input frequency corresponding to a phase lag of 135° shall be between _____ and _____ Hz

In some cases it may be desirable to specify the phase versus frequency characteristics.

3.3.16 Warmup Time

The output of the accelerometer shall be within _____ output units of its steady-state value in no more than _____ minutes after starting up from _____ $^\circ\text{C}$.

3.3.17 Threshold

The threshold shall be less than _____ g.

3.3.18 Resolution

The resolution shall be less than _____ *g*.

3.3.19 Turn-On Hysteresis

The absolute value of the turn-on hysteresis shall be less than _____ *g*.

3.3.20 Life

3.3.20.1 Operating Life

Under the operating environment conditions specified in Section 3.6.2, the unit shall be capable of operating and performing within the requirements of this specification for a period of at least _____ hours.

3.3.20.2 Storage Life

Under the nonoperating environment conditions specified in Section 3.6.1, the life of the instrument shall be greater than _____ years.

3.4 Mechanical Requirements

3.4.1 Exterior Surfaces

All exterior surfaces must withstand the environment herein specified and the handling expected in the normal course of operation, testing, and maintenance without deterioration which causes nonconformance to this specification.

Additional requirements controlling surface finish, protective treatment, metals, dissimilar metals, workmanship, etc, may be designated by the procuring organization.

3.4.2 Dimensions

The outline, mounting dimensions and location of the center of gravity shall conform to Fig 1.

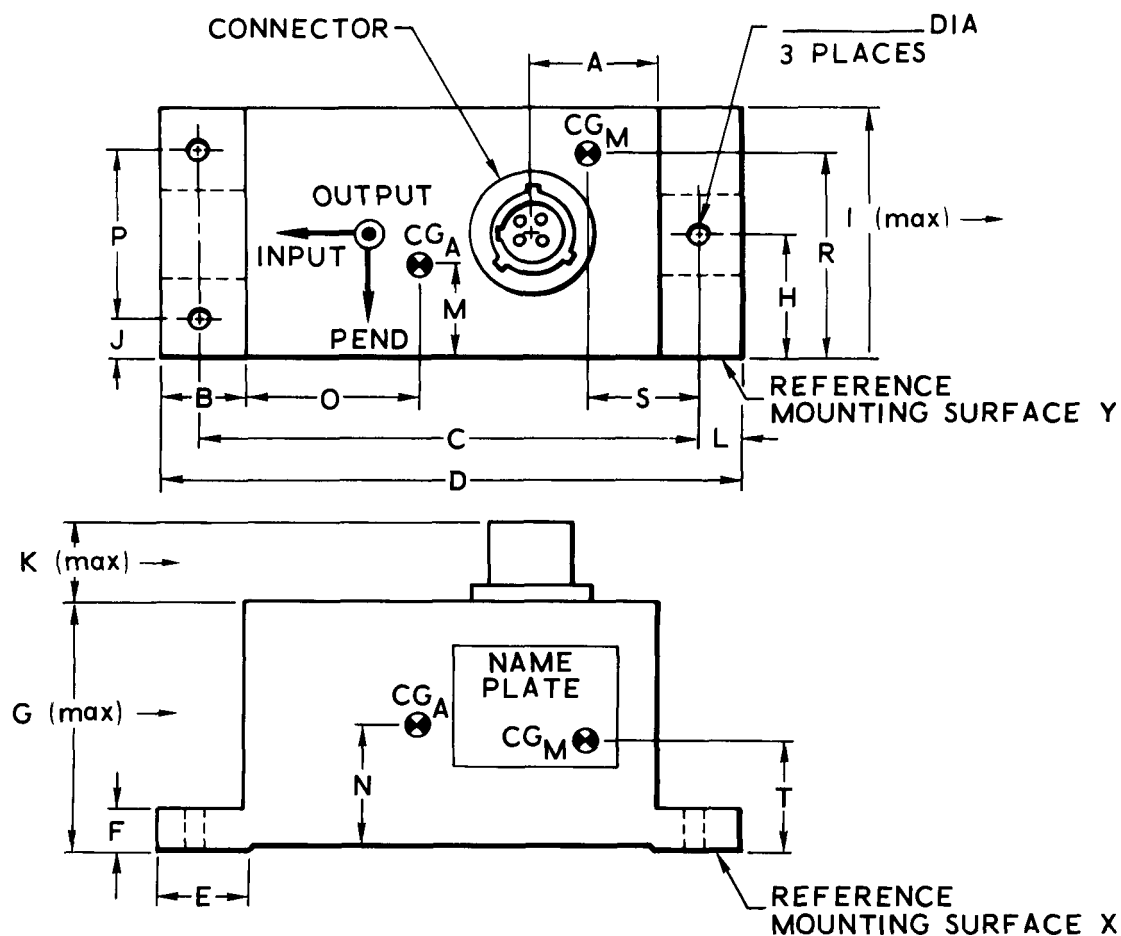
3.4.3 Accelerometer Axes

The input, pendulous, and output reference axes and their positive directions shall be defined by external markings and by reference mounting [surface, surfaces] as indicated in Fig 1. The location of the center of gravity of the accelerometer (CG_A) and the location of the center of gravity of the proof mass (CG_M) are also given. The positive directions of the axes shall be such that the cross product of input axis and pendulous axis shall be along the output axis.

3.4.4 Weight

The weight shall be _____ $\pm$ _____ [g, kg, oz, lb].

If appropriate, maximum weight only need be specified. When accessories such as cable or connector are to be included in the weight, the specification shall so state.



PIN	DESCRIPTION
A	
B	
C	
etc	

CG_A = CENTER OF GRAVITY OF THE ACCELEROMETER

CG_M = CENTER OF GRAVITY OF THE PROOF MASS

THE REFERENCE MOUNTING SURFACES X AND Y ARE USED FOR LOCATING THE INPUT REFERENCE AXIS

Give nominal dimensions and tolerances. It is not intended that this sample drawing offer specific information, but it is to be used as a guide. The accelerometer may be cylindrical, square, etc.

Figure 1—Dimensions

3.4.5 Seal

In general, only one of the two methods given below would be specified.

- 1) *Fluid Filled.* The accelerometer shall be sealed such that no fluid leakage is detected under _____ power magnification after being subjected to an external vacuum at _____ $\pm$ _____ torr, and an accelerometer temperature of _____ $\pm$ _____ °C for a minimum period of _____ minutes.

In some cases, other procedures may be more appropriate, such as the use of fluorescent tracers in the fluid to facilitate leak detection, or weight loss may be measured to indicate leakage.

- 2) *Gas Filled.* The accelerometer shall be sealed such that the maximum gas leakage shall not exceed _____ cm³ of helium per second or equivalent, measured at standard conditions, during a minimum period of _____ minutes that the accelerometer is being subjected to a vacuum of _____ $\pm$ _____ torr at a temperature of _____ $\pm$ _____ °C.

Or

The accelerometer shall be sealed such that there shall be no flow of bubbles during a period of _____ minutes when the accelerometer is placed in a bath of _____ having a viscosity of _____ centistokes at _____ °C.

Tracer gases may be added to the fill gas in order to facilitate leak detection.

In the bubble test, care must be taken to distinguish bubbles due to leakage from those due to absorbed gases on the outer surface.

3.4.6 Identification of Product

The accelerometer shall be marked on the surface with the following information:

- 1) Name of component
- 2) Model number
- 3) Stock number
- 4) Part number
- 5) Contract number
- 6) Unit serial number
- 7) Manufacturer's name or symbol

The purchase agreement may require other or additional identification.

3.5 Electrical Requirements

3.5.1 Electrical Schematic

The accelerometer electrical circuits shall be as shown in Fig 2.

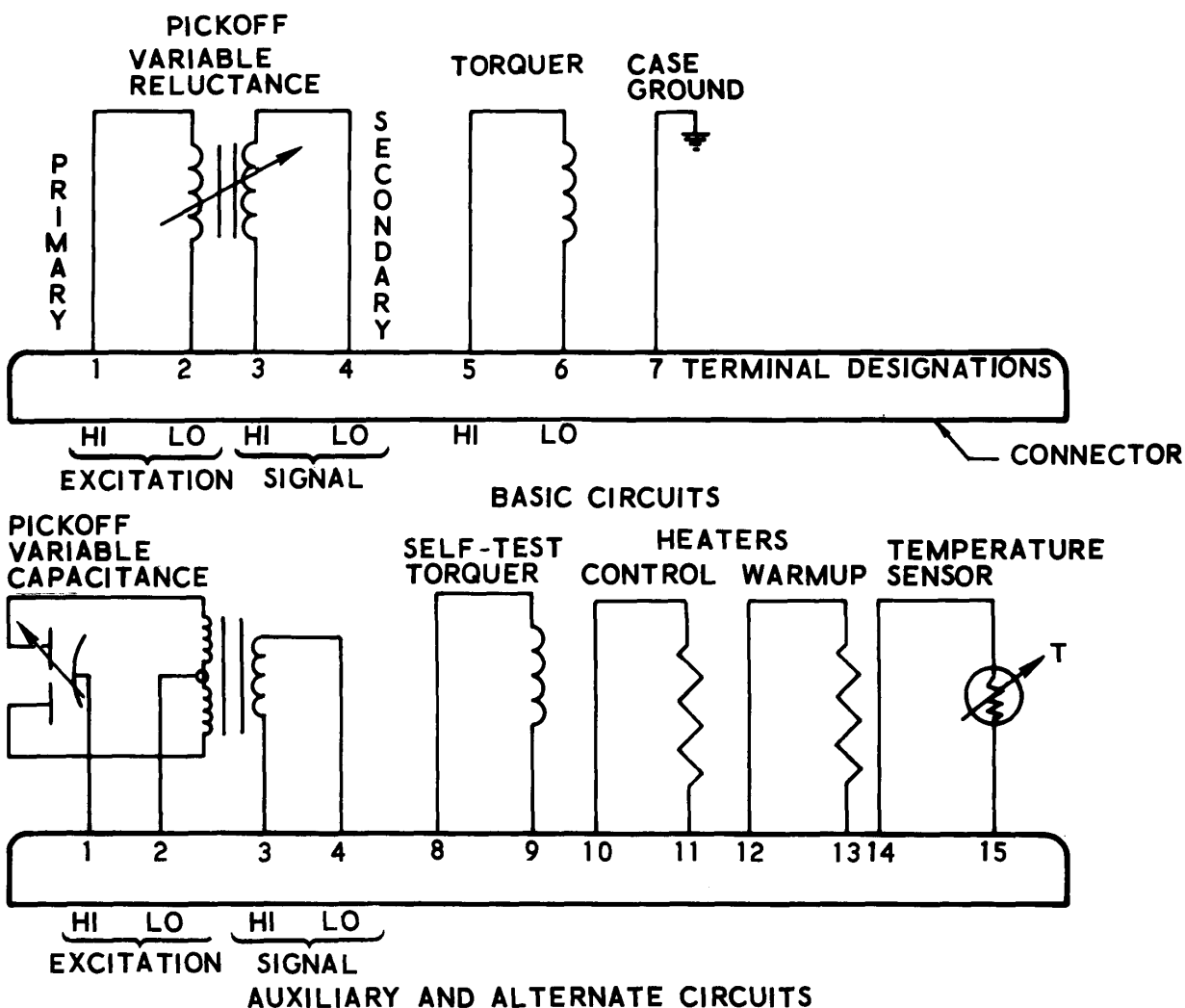


Figure 2—Electrical Schematic

3.5.2 Excitation

3.5.2.1 Pickoff

The pickoff excitation shall be

- 1) Frequency _____ $\pm$ _____ Hz
- 2) [Voltage, Current] _____ $\pm$ _____ [V, mA]
- 3) Maximum [voltage, current] waveform distortion _____ percent
- 4) Source impedance _____ $\pm$ _____ Ω

Specify wave shape if other than sinusoidal.

3.5.2.2 Heaters

The heater excitations shall be as follows:

- 1) *Warmup Heater*
 Frequency _____ $\pm$ _____ Hz
 Voltage _____ $\pm$ _____ V
 Current _____ A maximum
 Type of control is _____
- 2) *Control Heater*
 Frequency _____ $\pm$ _____ Hz
 Voltage _____ $\pm$ _____ V
 Current _____ A maximum
 Type of control is _____

3.5.2.3 Temperature Sensor

The temperature sensor excitation shall be

- 1) Frequency _____ $\pm$ _____ Hz
- 2) Voltage _____ $\pm$ _____ V

3.5.2.4 Self-Test Torquer

The self-test torquer excitation shall be:

- 1) Maximum input [voltage, current] _____ [V, mA]
- 2) Electrical noise shall not exceed _____ mV
- 3) Source impedance _____ $\pm$ _____ Ω

3.5.3 Impedances

The impedances shall conform to the following specifications when the unit is at the operating temperature.

3.5.3.1 Pickoff

- 1) The pickoff input impedance shall be _____ $\pm$ _____ $[+, -] j$ _____ $\pm$ _____ Ω at the specified excitation and output load
- 2) The output load impedance shall be _____ $\pm$ _____ Ω
- 3) The output impedance shall be $\pm$ _____ $[+, -] j$ _____ $\pm$ _____ Ω with the specified pickoff excitation

3.5.3.2 Heaters

The warmup heater resistance shall be _____ $\pm$ _____ Ω and the inductance shall be less than _____ H.

The control heater resistance shall be _____ $\pm$ _____ Ω and the inductance shall be less than _____ H.

3.5.3.3 Temperature Sensor

The temperature sensor resistance shall be _____ $\pm$ _____ Ω and the temperature coefficient shall be $[+, -] j$ _____ $\pm$ _____ $\Omega/^{\circ}\text{C}$ at _____ $^{\circ}\text{C}$.

3.5.3.4 Torquer

The torquer impedance shall be _____ $\pm$ _____ $[+, -] j$ _____ $\pm$ _____ Ω when measured at a frequency of _____ Hz.

In some cases, it may be desirable to specify the dc resistance or the impedance at several frequencies.

3.5.3.5 Self-Test Torquer

The self-test torquer resistance shall be _____ $\pm$ _____ Ω .

3.5.4 Insulation Resistance

The insulation resistance between isolated circuits and between the accelerometer case and circuits isolated from the case shall not be less than _____ M Ω measured at _____ $\pm$ _____ V dc applied for _____ $\pm$ _____ seconds.

Lower voltages may be specified for certain elements, such as the pickoff input to output. The time specified should allow for time constants of RFI filters, if any.

3.5.5 Dielectric Strength

The leakage current shall not exceed _____ mA when _____ $\pm$ _____ V rms, _____ Hz are applied between isolated circuits and between the accelerometer case and circuits isolated from the case for _____ $\pm$ _____ seconds.

Lower voltages may be specified for certain elements, such as the pickoff input to output. For some cases lower voltages may be specified for subsequent tests.

3.5.6 Electromagnetic Interference

The electromagnetic interference shall be in accordance with _____.

In the United States, a common standard is MIL-STD-461.

3.5.7 Magnetic Flux Leakage

The magnetic flux leakage shall not exceed _____ T at a distance of _____ cm from the accelerometer in any direction.

3.6 Environmental Requirements

The environmental conditions listed in this section are those to which the instrument may be subjected during storage, transportation, and handling or operation, or both. The equipment shall be designed to survive these environments and to successfully complete the environmental tests specified in Section 4.

3.6.1 *Nonoperative Environment*

The following conditions, occurring separately or in combination, may be encountered during transportation and handling, or storage, or both. The accelerometer shall conform to all the requirements of Section 3.3 after exposure to any reasonable combinations of the specified service conditions.

Where appropriate, the environment specified must be adjusted for the protection afforded by packaging.

3.6.1.1 *Temperature and Thermal Radiation*

Ambient temperature may vary from a minimum of _____ °C to a maximum of _____ °C under unsheltered ground conditions. Areas exposed to direct sunlight shall be considered as unsheltered conditions.

3.6.1.2 *Vibration*

Describe the vibration environment. For sinusoidal vibration, include the specific vibration amplitude versus frequency, duration, or sweep rate and axes of application. For random vibration, specify power spectral density (provide figure if complex), tolerance, bandwidth, peak acceleration level, total rms acceleration, duration, and axes of application.

3.6.1.3 *Mechanical Shock*

Specify the shock wave shape, duration of the pulse, tolerances, number of shocks, and axes of application.

3.6.1.4 *Thermal Shock*

_____ °C to _____ °C. The heating and cooling rates of the ambient environment shall be approximately _____ °C/s.

For cyclic conditions, specify temperature limits for each level, dwell times, and sequence.

3.6.1.5 *Pressure*

_____ [N/m², lbf/in²] to _____ [N/m², lbf/in²]. The rate of change of pressure shall be nominally _____ [(N/m²)/s, (lbf/in²)/s].

If appropriate, pressure may be expressed in terms of altitude and rate of climb.

3.6.1.6 *Fungus*

Specify fungus organisms, length of exposure, and temperature and humidity conditions during exposure.

3.6.1.7 *Humidity*

Relative humidity from 0 to 100 percent with conditions such that condensation may take place in the form of water or frost.

3.6.1.8 *Salt Spray*

_____ percent salt solution for _____ hours.