



SURFACE VEHICLE RECOMMENDED PRACTICE

J2570™

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Superseding J2570 NOV2019

(R) Performance Specifications for Anthropomorphic Test Device Transducers

RATIONALE

This document was created to define the minimum requirements of transducers for use in locations within ATDs. It is revised to add or update ATD transducers required in current safety compliance and consumer information crash testing.

SAE J2570 has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

This SAE Recommended Practice defines the minimum performance specifications for sensors used within anthropomorphic test devices (ATDs) when performing impact tests per SAE J211. It is intended that any agency proposing to conduct tests in accordance with SAE J211 shall be able to demonstrate that the transducers they use would meet the performance requirements specified in this document.

1.1 Purpose

The purpose of this document is to provide guidelines for choosing sensors for use in ATDs in impact testing. The aim is to provide uniformity in transducer measurements, and provide a basis for meaningful comparisons of test results from different sources.

1.2 Field of Application

The transducer specifications defined in this document apply in particular to those transducers used within ATDs, and whose outputs are used to calculate various injury estimates. The transducer specifications also apply to sensors used for the calibration and positioning of ATDs.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J211-1 Instrumentation for Impact Test - Part 1 - Electronic Instrumentation

SAE J1733 Sign Convention for Vehicle Crash Testing

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For more information on this standard, visit https://www.sae.org/standards/content/J2570_202506/

Documents



Standard, visit Sharing Hub

2.1.2 National Highway Traffic Safety Administration (NHTSA) Publications

Available from NHTSA Headquarters, 1200 New Jersey Avenue, SE, West Building, Washington, D.C. 20590, Tel: 1-888-327-4236, <https://www.nhtsa.gov>.

Code of Federal Regulations, Title 49, part 572 (CFR part 572), <https://www.regulations.gov>

Appropriate NHTSA Dockets, Notice of Proposed Rule Making (Proposed Amendments to CFR part 572)

2.1.3 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO-10012:2003 Measurement Management Systems Requirements for Measurement Processes and Measuring Equipment

ISO/TS 21476:2018 Displacement Calibration Method of IR-TRACC Devices

ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories

2.1.4 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ANSI/NCSL Z540.3-2006 R13 Calibration Laboratories and Measuring and Test Equipment - General Requirements

2.1.5 MIL Specifications

Available from Defense Logistics Agency Land and Maritime applications.

Defense Logistics Agency, <https://www.dla.mil/>.

3. DEFINITIONS

3.1 Load Cell Definitions

3.1.1 CHANNEL FREQUENCY CLASS (CFC)

The channel frequency class is designated by a number indicating that the channel frequency response lies within limits specified by Figure 1 of SAE J211-1.

3.1.2 CROSSTALK

Effect on the reading of an unloaded axis when a load equal to the full-scale capacity of a secondary axis is applied to that secondary axis. Expressed as a percentage of full-scale capacity of the unloaded axis.

3.1.3 COMPENSATED TEMPERATURE RANGE

The range of temperature over which the load cell is compensated to maintain output and zero balance within specified limits.

3.1.4 DIMENSIONS AND MECHANICAL CONFIGURATION

ATD load cells are specifically designed for each ATD, and mechanical drawings define these configurations. If a testing lab uses, or a manufacturer builds, a device that requires an adapter to correctly position or mount the transducer (to comply with CFR part 572), all specifications must be met with the adapter attached to the transducer.

3.1.5 DEFLECTION AT FULL SCALE APPLIED LOAD

Maximum linear deflection of a load cell in the direction of the applied full scale load for that axis.

3.1.6 DEFLECTION AT FULL SCALE APPLIED MOMENT

Maximum angular deflection of a load cell in the direction of the applied full scale moment for that axis.

3.1.7 FREE AIR RESONANCE

The frequency at which a load cell resonates, when suspended freely in air by a single wire and impacted with a hard surfaced body. This test shall be done while monitoring the channel output to insure each channel's fundamental output frequency shall be equal to or greater than the specified frequency.

3.1.8 FULL SCALE CAPACITY

Full scale capacity refers to the capacity defined in CFR part 572. This must be defined for calculating other parameters in these specifications.

3.1.9 HYSTERESIS (PERCENT OF FULL SCALE CAPACITY)

The maximum deviation between ascending and descending output readings taken at the same load point, expressed as a percentage of full scale capacity. See Figure 1 for graphical representation.

3.1.10 NON-LINEARITY (PERCENT OF FULL SCALE CAPACITY)

The maximum deviation of a load cell output reading from the terminal line, expressed as a percentage of full scale capacity (the terminal line is defined as a straight line connecting a load cell zero load reading and its full scale reading). See Figure 1 for graphical representation.

3.1.11 TEMPERATURE EFFECTS ON OUTPUT

The change in output due to a change in load cell temperature, expressed as a percentage of reading per degree Celsius change. See Figure 1 for graphical representation.

3.1.12 TEMPERATURE EFFECTS ON ZERO BALANCE

The change in zero balance due to a change in load cell temperature, expressed as a percentage of full scale capacity per degree Celsius change. See Figure 1 for graphical representation.

3.1.13 TERMINAL LINE

A theoretical straight line connecting a load cell zero-load reading and its full-scale reading. See Figure 1 for graphical representation.

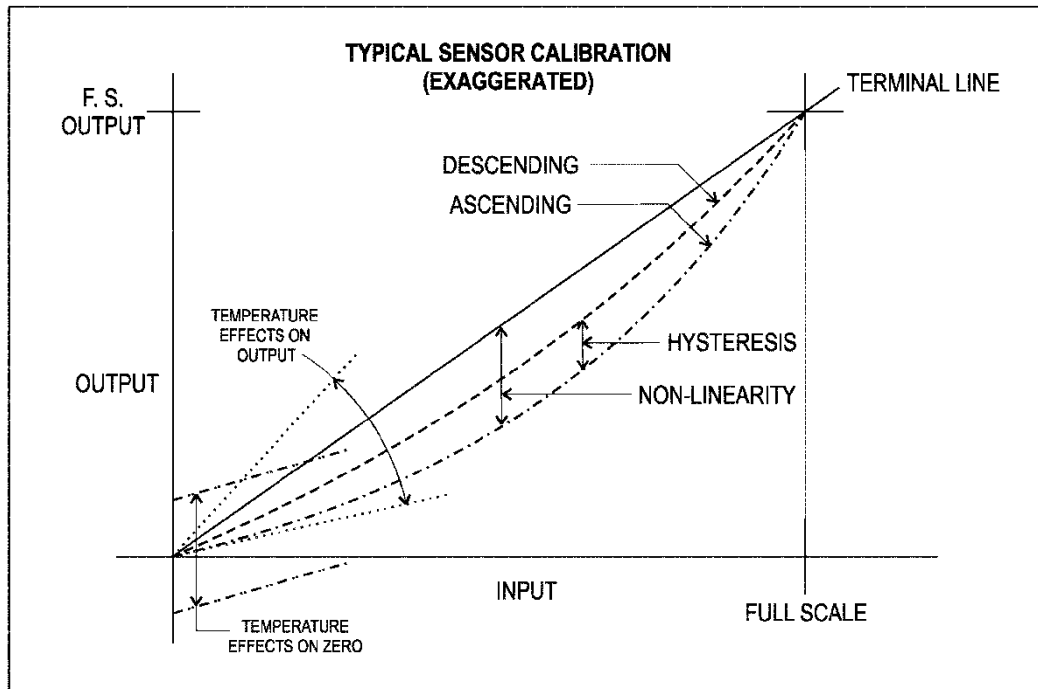


Figure 1 - Typical sensor calibration curves

3.2 Accelerometer Definitions

3.2.1 DAMPING RATIO

The ratio of an accelerometer output versus input when excited by a sinusoidal input near the point of resonance.

Damped and undamped accelerometers have different characteristics and cannot be considered equivalent. However, each can be considered as one component of a total system which must meet the requirements of SAE J211-1 (which includes the anti-aliasing filter, transducer response, post-test filtering, and phase delay). A section discussing the usage of damped accelerometers has been developed as Appendix A of this document.

3.2.2 FREQUENCY RESPONSE OR BANDWIDTH

The range of frequencies over which the accelerometer output voltage will follow the sinusoidally varying mechanical input within specified limits. The difference in sensitivity at any frequency relative to the reference sensitivity, measured typically at 100 Hz, is specified as a percentage of the sensitivity measured at the reference frequency.

3.2.3 FULL SCALE RANGE

The maximum operating range or amplitude of the accelerometer while staying within other specification limits. This must be defined for calculating other parameters in these specifications.

3.2.4 RESONANCE FREQUENCY

The resonance frequency is the frequency at which the voltage output of an accelerometer lags the mechanical input by a phase angle of 90 degrees. For undamped accelerometers, it may alternately be defined as the frequency at which the response (sensitivity) of an accelerometer is at its maximum output.

3.2.5 SENSITIVITY OR SCALE FACTOR

The ratio of the accelerometer signal output in electrical units (e.g., millivolts) to the physical excitation of the accelerometer in engineering units (e.g., m/s^2). This may be determined from a single point or a regression of evenly spaced points, as specified for the transducer.

3.2.6 TEMPERATURE EFFECTS ON OUTPUT

The change in output due to a change in transducer temperature, expressed as a percentage of reading per degree Celsius change. See Figure 1 for graphical representation.

3.2.7 TEMPERATURE EFFECTS ON ZERO BALANCE

The change in zero balance due to a change in transducer temperature, expressed as a percentage of full scale range per degree Celsius change.

3.2.8 COMPENSATED TEMPERATURE RANGE

The range of temperature over which the accelerometer is compensated to maintain sensitivity and zero balance within specified limits.

3.2.9 TRANSVERSE SENSITIVITY

The output of the sensitive axis due to any acceleration applied orthogonally to that axis, specified as a percentage of applied acceleration.

3.2.10 ZERO REPEATABILITY

When any shock pulse is applied in the primary direction and within the specified range of an accelerometer, the zero output shall return to its initial value.

3.3 Angular Displacement Transducer Definitions

This section applies to direct output rotary potentiometers. Angular displacement can also be measured by integrating the output of an angular rate sensor.

3.3.1 COMPENSATED TEMPERATURE RANGE

The range of temperature over which the transducer is compensated to maintain rated output and zero balance within specified limits.

3.3.2 DIMENSIONS AND MECHANICAL CONFIGURATION

Sensor size and bracketry is designed per ATD application.

3.3.3 MINIMUM ELECTRICAL ANGLE

The specified shaft travel over which the functional characteristic extends between defined output ratio limits, as determined from the index point.

3.3.4 MINIMUM ROTATIONAL SPEED

The minimum rotational speed at which the transducer must operate while maintaining its specified performance.

3.3.5 NON-LINEARITY

The maximum deviation, expressed in degrees, of the actual functional characteristic from a fully defined straight reference line.

3.3.6 OUTPUT SMOOTHNESS

A measurement of any spurious variation in the electrical output that is not present in the input, expressed in degrees.