SAE INTERNATIONAL

SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) Instrumentation for Impact Test - Part 1 - Electronic Instrumentation

RATIONALE

Revisions to SAE J211 are a continuing process and are considered at each five year review. Changes were made as part of an ongoing effort of harmonization with ISO 6487 and include additional definitions, tightening of the filter corridors, procedures for verifying system performance, changes and additions to CFC recommendations, specification of transducer equivalency, and changes to data format recommendations.

1. SCOPE

This recommended practice outlines a series of performance recommendations, which concern the whole data channel. These recommendations are not subject to any variation and all of them shall be adhered to by any agency conducting tests to this practice. However, the method of demonstrating compliance with the recommendations is flexible and can be adapted to suit the needs of the particular equipment the agency is using.

It is not intended that each recommendation be taken in a literal sense, as necessitating a single test to demonstrate that the recommendation is met. Rather, it is intended that any agency proposing to conduct tests to this practice shall be able to demonstrate that if such a single test could be and were carried out, then their equipment would meet the recommendations. This demonstration shall be undertaken on the basis of reasonable deductions from evidence in their possession, such as the results of partial tests.

In some systems it may be necessary to divide the whole channel into subsystems, for calibration and checking purposes. The recommendations have been written only for the whole channel, as this is the sole route by which subsystem performances affect the quality of the output. If it is difficult to measure the whole channel performance, which is usually the case, the test agency may treat the channel as two or more convenient subsystems. The whole channel performance could then be demonstrated on the basis of subsystem results, together with a rationale for combining the subsystem results together.

Part 1 of this recommended practice covers electronic instrumentation and Part 2 covers photographic instrumentation.

PART 1 - ELECTRONIC INSTRUMENTATION

1.1 Purpose

The purpose of this SAE Recommended practice is to provide guidelines and recommendations for the techniques of measurement used in impact tests. The aim is to achieve uniformity in instrumentation practice and in reporting test results. Use of this recommended practice will provide a basis for meaningful comparisons of test results from different sources.

1.2 Field of Application

The instrumentation as defined in this recommended practice applies in particular to impact tests for road vehicles, including tests of their sub-assemblies, and occupant surrogates.

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 724-776-4970 (outside USA), www.sae.org.

SAE J670 Vehicle Dynamics Terminology

SAE J1727 Injury Calculations Guidelines

SAE J1733 Sign Convention for Vehicle Crash Testing

SAE J2570 Performance Specifications for Anthropomorphic Test Device Transducers

SAE Paper 930100 An Evaluation of Various Viscous Criterion Computational Algorithms

2.1.2 NHTSA Publication

Available from Department of Transportation, The Office of Crashworthiness Research, 408 7th Street SW, Washington, DC 20590.

NHTSA Version 5 Test Reference Guide: Volume 1 – Vehicle Tests, Volume 2 – Biomechanics, Volume 3 – Components, and Volume 4 – Signal Waveform Generator

3. DEFINITIONS

The definitions in paragraphs 3.5 to 3.14 apply to the whole data channel, as defined in paragraph 3.1.

3.1 DATA CHANNEL

All of the instrumentation from and including a single transducer (or multiple transducers whose outputs are combined in some specified way) up to and including any analysis procedures that may alter the frequency content or the amplitude content or the timing of data. It also includes all cabling and interconnections.

3.2 TRANSDUCER

The first device in a data channel, used to convert a physical quantity to be measured into a second quantity (such as an electrical voltage) which can be processed by the remainder of the channel. For transducer equivalency, see Appendix B.

3.3 FULL SCALE

The maximum usable linear range of a data channel. For ATD transducers, see SAE J2570.

3.4 DATA CHANNEL FULL SCALE

That value of a data channel determined by the component of the channel with the lowest full scale level. This is expressed in terms of the measured variable (input). For example, F.S. = 50 G, 1000 N, 1 m/s, etc.

3.5 CHANNEL AMPLITUDE CLASS, CAC

The designation for a data channel that meets certain amplitude characteristics as specified by this recommended practice. The CAC number is numerically equal to the upper limit of the measurement range (that is, equivalent to the data channel full scale).

3.6 CHARACTERISTIC FREQUENCIES, F_H, F_L, F_N

These frequencies are defined in Figures 1 and 2.

3.7 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 for CFCs of 1000 and 600, and by Figure 2 for CFCs of 60 and 180.

NOTE: Figure 1 has not changed in reference to J211 March 1995 except to specify nodal points instead of slopes. This number and the value of the frequency F_H in hertz are numerically equal.

3.8 CALIBRATION VALUE

The value measured and read during the calibration of a data channel (see paragraph 4.6).

3.9 SENSITIVITY COEFFICIENT

The slope of the straight line representing the best fit to the calibration values determined by the method of least squares within the channel amplitude class.

3.10 CALIBRATION FACTOR OF A DATA CHANNEL

The arithmetic mean of the sensitivity coefficients evaluated over frequencies which are evenly spaced on a logarithmic scale between F_L and $F_H/2.5$.

3.11 LINEARITY ERROR

The ratio, in percent, of the maximum difference between the calibration value and the corresponding value read on the straight line defined in paragraph 3.9 at the upper limit of the channel amplitude class (data channel full scale).

3.12 SENSITIVITY

The ratio of the output signal (in equivalent physical units) to the input signal (physical excitation), when an excitation is applied to the transducer. (Example: 10.24 mV/G/V for a strain gage accelerometer.) For ATD transducers, see SAE J2570.

3.13 PHASE DELAY TIME

The phase delay time of a data channel is equal to the phase delay (in radians) of a sinusoidal signal, divided by the angular frequency of that signal (in radians per second).

3.14 ENVIRONMENT

The aggregate, at a given moment, of all external conditions and influences to which the data channel is subjected.