INTERNATIONAL STANDARD

ISO
6487

Second edition
1987-07-01

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Road vehicles — Measurement techniques in impact tests — Instrumentation

Véhicules routiers — Techniques de mesurage lors des essais de chocs — Instrumentation

Reference number
ISO 6487 : 1987 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6487 was prepared by Technical Committee ISO/TC 22, *Road vehicles.*

This second edition cancels and replaces the first edition (ISO 6487 : 1980), subclauses 3.9, 4.5, 4.6.2.2.1 and 4.8 of which have been technically revised. New clauses 0, Introduction, and 3, Reference, and new definition 4.10 have also been added.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Road vehicles — Measurement techniques in impact tests — Instrumentation

0 Introduction

This International Standard outlines a series of performance requirements which concerns the whole measurement sequence of impact shocks. These requirements may not be changed, and all of them are obligatory to any agency conducting tests to this International Standard. However the method of demonstrating compliance with the requirements is flexible and can be adapted to suit the needs of the particular equipment the agency is using.

This approach affects the interpretation of requirements. For example there is a requirement to calibrate within the working range of the channel (see 4.1), i.e. between F_L and $\frac{F_H}{2,5}$. This cannot be interpreted literally, as low frequency calibration of accelerometers requires large displacement inputs which are beyond the capacity of virtually any laboratory.

It is not intended that each requirement be taken too strictly, as necessitating proof by a single test. Rather it is intended that any agency, proposing to conduct tests to this International Standard, shall certify that if such a single test could be and were carried out then their equipment would meet the requirements. This certification would be based on reasonable deductions from existing data, such as the results of partial tests. The agency would normally be expected to make the basis of their certification available to users of their test results.

The basis of certification of some subjects can be very direct, in that a single test demonstrates compliance. On others, a less direct certification will be necessary. To continue the above example, the agency may have obtained similar calibrations with d.c. at a medium frequency and, from knowledge of the transducer, they may infer that calibrations at intermediate frequencies would have been the same.

Similar considerations apply to the practical need to divide the whole channel into subsystems, for calibration and checking purposes. The requirements are valid only for the whole channel, as this is the sole route by which subsystem performance affects the output quality. If it is difficult to measure the whole channel performance, which is often the case, the test agency may treat the channel as two or more convenient subsystems. The whole channel will be certified on the basis of subsystem results, together with a rationale for combining them.

To summarise, the International Standard allows users of impact test results to call up a set of relevant instrumentation requirements by merely specifying ISO 6487. Their test agency then has the primary responsibility for certifying that the ISO 6487 requirements are met by their instrumentation system. The evidence on which they have based this certification will be available to the user on request. In this way fixed requirements, guaranteeing the suitability of the instrumentation for impact testing, can be combined with flexible methods of demonstrating compliance with those requirements.

1 Scope

This International Standard specifies requirements and sets recommendations for measurement techniques used in impact tests. The requirements are to facilitate comparisons between results obtained by different laboratories and the recommendations given in the annex are to assist such laboratories in meeting the requirements.

NOTE — Optical methods are excluded from this International Standard, and form the subject of ISO 8721, *Road vehicles — Measurement techniques in impact tests — Optical instrumentation.*[1]

2 Field of application

The instrumentation as defined in this International Standard applies in particular to impact tests for road vehicles, including tests on their sub-assemblies.

3 Reference

ISO 2041, *Vibrational shock — Vocabulary.*

4 Definitions

For the purposes of this International Standard, the definitions in ISO 2041 and the following definitions apply.

4.1 data channel : All of the instrumentation from and including a single transducer (or multiple transducers the outputs of which are combined in some specified way) up to and including any analysis procedures that may alter the frequency content or the amplitude content of data.

4.2 transducer : 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.

1) At present at the stage of draft.

4.3 channel amplitude class, CAC : Designation for a data channel that meets certain amplitude characteristics as specified by this International Standard.

The CAC number is numerically equal to the upper limit of the measurement range.

4.4 characteristic frequencies, F_H, F_L, F_N : These frequencies are defined in the figure.

4.5 channel frequency class, CFC : Frequency class designated by a number indicating that the channel frequency response lies within limits specified by the figure.

This number and the value of the frequency F_H, in hertz, are numerically equal.

4.6 sensitivity coefficient : Slope of the straight line representing the best fit to the calibration values[1)] determined by the method of least squares within the channel amplitude class.

4.7 calibration factor of a data channel : Mean value of the sensitivity coefficients evaluated over frequencies which are evenly spaced on a logarithmic scale between F_L and $\frac{F_H}{2,5}$.

4.8 linearity error : Ratio, in percent, of the maximum difference between the calibration value and the corresponding value read on the straight line defined in 4.6 at the upper limit of the channel amplitude class.

4.9 transverse sensitivity (of a rectilinear transducer) **:** Sensitivity to excitation in a nominal direction perpendicular to its sensitive axis.

NOTE — The transverse sensitivity is usually a function of the nominal direction of the axis chosen.

4.10 transverse sensitivity ratio (of a rectilinear transducer) **:** Ratio of the transverse sensitivity to its sensitivity along its sensitive axis.

4.11 phase delay time (of a data channel) **:** Equal to the phase delay (in radians) of a sinusoidal signal, divided by the angular frequency of that signal (in radians per second).

4.12 environment : Aggregate, at a given moment, of all external conditions and influences to which the data channel is subject.

5 Performance requirements

5.1 Linearity error

The absolute value of the linearity error of a data channel at any frequency in the CFC shall be less than or equal to 2,5 % of the value of the CAC over the whole measurement range.

5.2 Amplitude against frequency[2)]

The frequency response of a data channel shall lie within the limiting curves given in the figure. The zero dB line is defined by the calibration factor.

5.3 Phase delay time

The phase delay time between the input and the output of a data channel shall be determined, and shall not vary more than $\frac{1}{10\,F_H}$ s between 0,03 F_H and F_H.

5.4 Time

5.4.1 Time base

A time base shall be recorded and shall give at least 1/100 s with an accuracy of 1 %.

5.4.2 Relative time delay

The relative time delay between the signals of two or more data channels regardless of their frequency class shall not exceed 1 ms excluding phase delay caused by phase shift. Two or more data channels of which the signals are combined shall have the same frequency class and shall not have a relative time delay greater than $\frac{1}{10\,F_H}$ s.

This requirement applies to analogue signals, synchronization pulses and digital signals.

5.5 Transducer transverse sensitivity ratio

The transducer transverse sensitivity ratio shall be less than 5 % in any direction.

5.6 Calibration

5.6.1 General

A data channel shall be calibrated at least once a year against reference equipment traceable to known standards. The

1) "Calibration value" is the mean value measured and read during calibration.

2) No method for the evaluation of the dynamic response during calibration of data channels for forces and displacements is included in this International Standard since no satisfactory method is known at present. The problem will be reconsidered later.

methods used to carry out a comparison with reference equipment shall not cause an error greater than 1 % of the CAC. The use of reference equipment is limited to the range of frequencies for which they have been calibrated.

Subsystems of a data channel may be evaluated individually and the results factored into the accuracy of the total data channel. This can be made for example by an electrical signal of known amplitude simulating the output signal of the transducer which allows a check to be made on the gain of the data channel, excluding the transducer.

5.6.2 Accuracy of reference equipment for calibration

The accuracy of the reference equipment shall be certified or endorsed by an approved metrology service.

5.6.2.1 Static calibration

5.6.2.1.1 Accelerations

The error shall be less than 1,5 % of the channel amplitude class.

5.6.2.1.2 Forces

The error shall be less than 1 % of the channel amplitude class.

5.6.2.1.3 Displacements

The error shall be less than 1 % of the channel amplitude class.

5.6.2.2 Dynamic calibration

5.6.2.2.1 Accelerations

The error in the reference accelerations expressed as a percentage of the channel amplitude class shall be less than 1,5 % below 400 Hz, less than 2 % between 400 and 900 Hz, and less than 2,5 % between 900 Hz and the maximum frequency at which the reference acceleration is used (see 5.6.4).

5.6.2.2.2 Forces and displacements

[See footnote 2) on page 2.]

5.6.2.3 Time

The relative error in the reference time shall be less than 10^{-5}.

5.6.3 Sensitivity coefficient and linearity error

The sensitivity coefficient and the linearity error shall be determined by measuring the output signal of the data channel against a known input signal, for various values of this signal.

The calibration of the data channel shall cover the whole range of the amplitude class.

For bi-directional channels, both the positive and negative values shall be used.

If the calibration equipment cannot produce the required input, due to excessively high values of the quantity to be measured, calibrations shall be carried out within the limits of these calibration standards and these limits shall be recorded in the report.

A total data channel shall be calibrated at a frequency or at a spectrum of frequencies with its significant value comprised between F_L and $\frac{F_H}{2,5}$.

5.6.4 Calibration of frequency response

The response curves of phase and amplitude against frequency shall be determined by measuring the output signals of the data channel in terms of phase and amplitude against a known input signal, for various values of this signal varying between F_L and 10 times the CFC or 3 000 Hz, whichever is lower.

5.7 Environmental effects

The existence or otherwise of an influence of environmental effects shall be checked regularly (i.e. electric or magnetic flux, cable velocity, etc.). This can be done for instance by recording the output of spare channels equipped with dummy transducers.

If significant output signals are obtained, corrective action shall be taken, for instance re-allocation or replacement of cables.

5.8 Choice and designation of data channel

The CAC and CFC define a data channel.[1)]

The CAC shall be 1, 2 or 5 multiplied by a power of ten.

A data channel consistent with the specifications of this International Standard shall be designated according to the following codes :

ISO 6487 (number of this International Standard)
CAC . . . (channel amplitude class)
CFC . . . (channel frequency class)

If the calibration of the amplitude or frequency response does not cover the complete CAC or CFC owing to limited properties of the calibration equipment, then the CAC or CFC shall be marked with an asterisk.

1) Their values are chosen for a given application by the party requiring this application.

Example

ISO 6487 - CAC* 200 m/s² - CFC 1 000 Hz

means that :

— this measurement has been carried out according to this International Standard;

— the channel amplitude class was 200 m/s²;

— the channel frequency class was 1 000 Hz;

— the calibration of the amplitude response did not cover the complete CAC.

The test report shall indicate the calibration limits.