INTERNATIONAL STANDARD

ISO 6487

Sixth edition
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Road vehicles — Measurement techniques in impact tests — Instrumentation

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

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 36, *Safety aspects and impact testing*.

This sixth edition cancels and replaces the fifth edition (ISO 6487:2012), which has been technically revised.

Introduction

This International Standard is the result of a willingness to harmonize the previous edition, ISO 6487:2012, and SAE International's Recommended Practice, SAE J211-1.

It presents a series of performance requirements concerning the whole measurement sequence of impact shocks.

These requirements may not be altered by the user and all are obligatory for any agency conducting tests to this International Standard. However, the method of demonstrating compliance with them is flexible and can be adapted to suit the needs of the particular equipment used by a testing agency.

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

It is not intended that each requirement be taken as necessitating proof by a single test. Rather, it is intended that any agency proposing to conduct tests to this International Standard guarantee that if a particular test could be and were to be carried out, then their equipment would meet the requirements. This proof would be based on reasonable deductions from existing data such as the results of partial tests.

On the basis of studies carried out by technical experts, no significant difference has been identified between the characteristics of the load transducer when using static as opposed to dynamic calibration methods. This new edition helps to define the dynamic calibration method for force and moment data channels in accordance with the current knowledge base and studies available.

The temperature of the anthropomorphic test device (ATD) used in a collision test needs to be monitored to confirm that it has been used within the acceptable temperature range prescribed for the whole ATD or body segment. The objective is to prevent temperature from being a variable that will influence the ATD response. The actual ATD temperature can be influenced by various factors including ambient air, high-speed photography lighting, sunshine, heat dissipation from transducers, and ATD in-board data acquisition systems. In order to respond to these objectives, the new edition specifies the performance requirements for the ATD temperature measurement.

This International Standard defines the requirements of an impact test for which the measurement uncertainties can only be partially calculated.

To summarize, this International Standard enables users of impact test results to call up a set of relevant instrumentation requirements by merely specifying this International Standard. Their test agency then has the primary responsibility for ensuring that the requirements of this International Standard are met by their instrumentation system. The evidence on which they have based this proof assessment will be available to the user upon 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.

Road vehicles — Measurement techniques in impact tests — Instrumentation

1 Scope

This International Standard gives requirements and recommendations for measurement techniques involving the instrumentation used in impact tests carried out on road vehicles. Its requirements are aimed at facilitating comparisons between results obtained by different testing laboratories, while its recommendations will assist such laboratories in meeting those requirements. It is applicable to instrumentation including that used in the impact testing of vehicle subassemblies. It does not include optical methods which are the subject of ISO 8721.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2041, *Mechanical vibration, shock and condition monitoring — Vocabulary*

ISO 3784, *Road vehicles — Measurement of impact velocity in collision tests*

ISO 4130, *Road vehicles — Three-dimensional reference system and fiducial marks — Definitions*

ISO/TR 27957, *Road vehicles — Temperature measurement in anthropomorphic test devices — Definition of the temperature sensor locations*

SAE J211-1, *Instrumentation for impact test — Part 1: Electronic instrumentation*

3 Terms and definitions

For the purposes of this document, the following terms and definitions given in ISO 2041 and the following apply.

3.1
data channel
all the instrumentation from, and including a single transducer (or multiple transducers, the outputs of which are combined in some specified way), to, and including any analysis procedures that may alter the frequency content or the amplitude content of data

3.2
transducer
first device in a *data channel* (3.1) 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

3.3
channel amplitude class
CAC
designation for a *data channel* (3.1) that meets certain amplitude characteristics as specified by this International Standard

Note 1 to entry: The CAC number is numerically equal to the upper limit of the measurement range which is equivalent to data channel full scale.

3.4
channel frequency class
CFC
frequency class designated by a number indicating that the channel frequency response lies within certain limits

Note 1 to entry: CFC XXX defines the frequency class with XXX = Frequency, F_H, in hertz.

3.5
calibration value
mean value measured and read during calibration of a *data channel* (3.1)

3.6
sensitivity
ratio of the output signal (in equivalent physical units) to the input signal (physical excitation) when an excitation is applied to the *transducer* (3.2)

EXAMPLE 10,24 mV/*g*/V for a strain gauge accelerometer.

3.7
sensitivity coefficient
slope of the straight line representing the best fit to the *calibration values* (3.5) determined by the method of least squares within the *channel amplitude class (CAC)* (3.3)

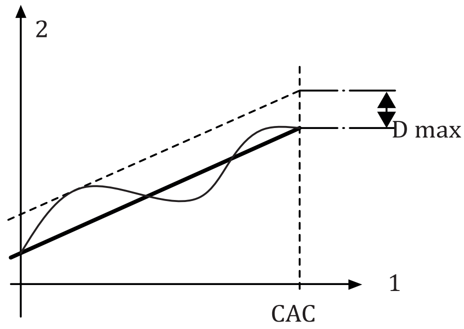
Note 1 to entry: Specific sensors such as seat belt sensors, torque sensors, and multi-axial force sensors may require a specific calibration procedure.

3.8
calibration factor of a data channel
arithmetic mean of the *sensitivity coefficients* (3.7) evaluated over frequencies evenly spaced on a logarithmic scale between F_L and $F_H/2,5$

Note 1 to entry: See Figure 2 and Figure 3.

3.9
non-linearity
ratio of the maximum difference (D_{max}) between the *calibration value* (3.5) and the value read from the best approximation of *calibration values* (3.5) expressed as a percentage of the *channel amplitude class (CAC)* (3.3)

Note 1 to entry: See Figure 1 and 4.5.4.



Key

1 input signal

2 output signal

NOTE Non-linearity = D_{max}/CAC * 100.

Figure 1 — Non-linearity

3.10
transverse sensitivity of a rectilinear transducer
sensitivity (3.6) to excitation in a nominal direction perpendicular to its sensitive axis

Note 1 to entry: The transverse sensitivity of a rectilinear transducer is usually a function of the nominal direction of the axis chosen.

Note 2 to entry: The cross sensitivity of force and bending moment transducers is complicated by the complexity of loading cases. At time of publication, this situation had yet to be resolved.

3.11
transverse sensitivity ratio of a rectilinear transducer
ratio of the *transverse sensitivity of a rectilinear transducer* (3.10) to its sensitivity along its sensitive axis

Note 1 to entry: The cross-sensitivity of force and bending moment transducers is complicated by the complexity of loading cases. At time of publication, this situation had yet to be resolved.

3.12
phase delay time of a data channel
time equal to the phase delay, expressed in radians, of a sinusoidal signal divided by the angular frequency of that signal and expressed in radians per second

3.13
environment
aggregate at a given moment of all external conditions and influences to which the *data channel* (3.1) is subject

4 Performance requirements

4.1 CFC specifications and performance requirements

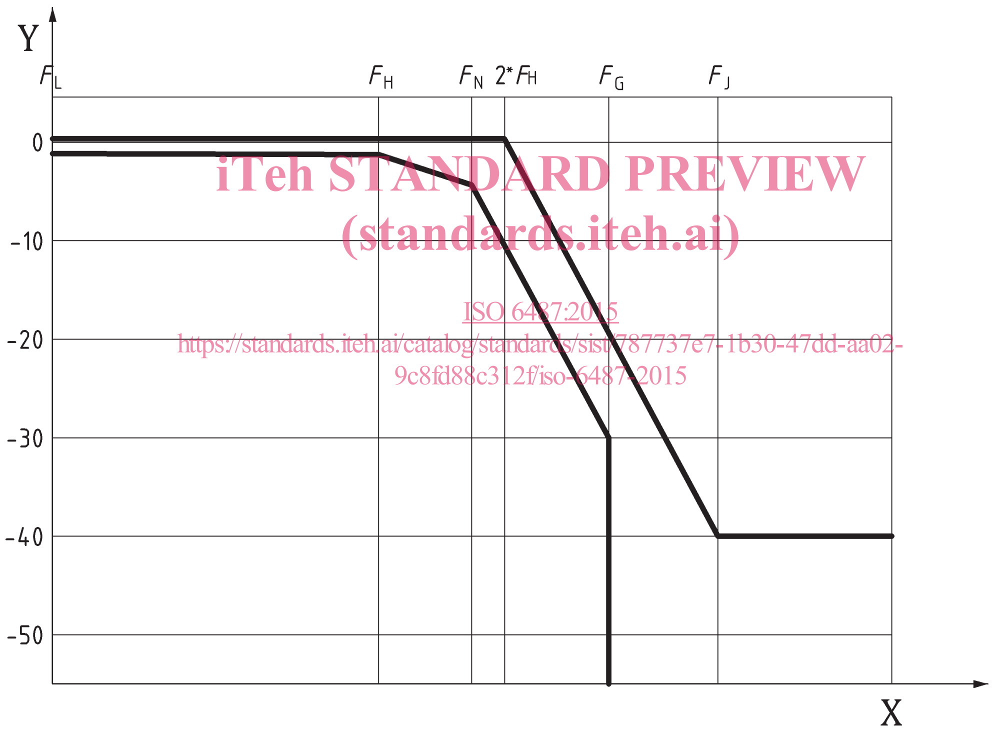
The absolute value of the non-linearity of a data channel at any frequency (except if data channel is calibrated against only one point) in the channel frequency class (CFC) shall be less than or equal to 2,5 % of the value of the CAC over the whole measurement range.

The frequency response of a data channel shall lie within the limiting curves given in Table 1 and Figure 2 for CFC 1 000 and CFC 600. For CFC 60 and CFC 180, the frequency response of a data channel shall lie within the limiting curves given in Table 2 and Figure 3. The zero decibels line is defined by the calibration factor.

NOTE For CFC 180 and CFC 60, the filtering algorithm given in Annex A addresses this requirement.

Table 1 — Logarithmic scales for CFC 1 000 and CFC 600

	Attenuations (dB)		Frequency (Hz)	
F_Z	Upper	Lower	CFC 600	CFC 1000
F_L	+0,5	−0,5	0,1	0,1
F_H	+0,5	−1,0	600	1 000
F_N	+0,5	−4,0	1 000	1 650
2*F_H	+0,5		1 200	2 000
F_G		−30,0	2 119	3 496
F_J	−40,0	-∞	3 865	6 442



Key

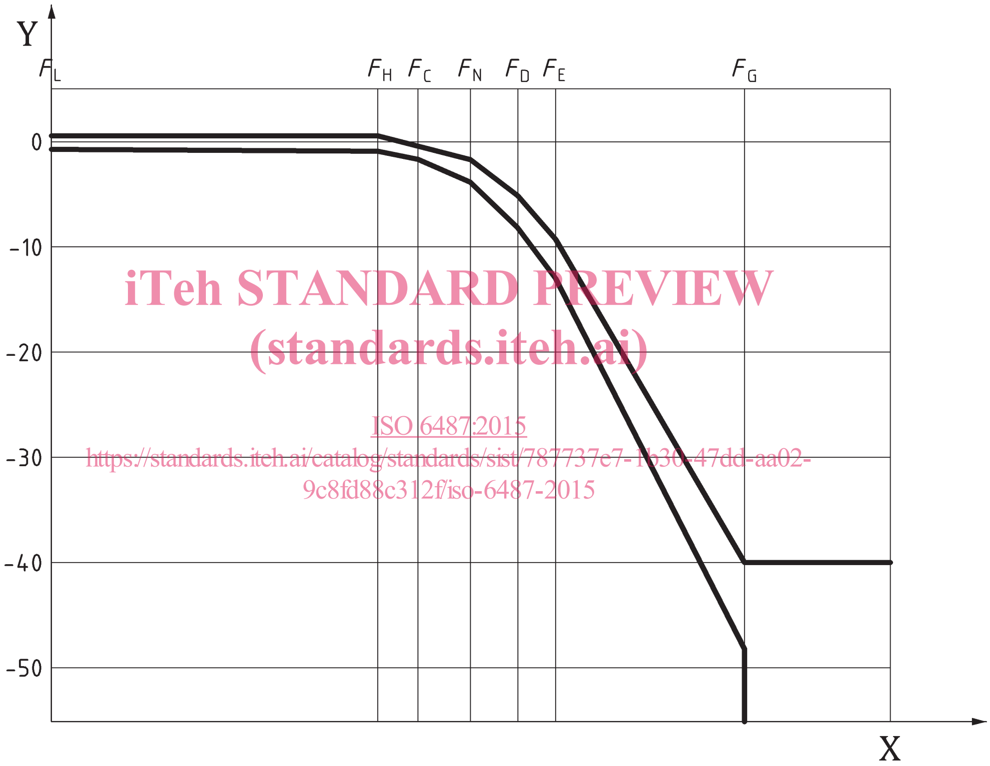
X in Hertz

Y in dB

Figure 2 — Frequency response limits — CFC 1 000 and CFC 600

Table 2 — Logarithmic scales for CFC 60 and CFC 180

	Attenuations (dB)		Frequency (Hz)	
F_Z	Upper	Lower	CFC 60	CFC 180
F_L	+0,5	−0,5	0,1	0,1
F_H	+0,5	−1,0	60	180
F_C	−0,3	−1,8	75	225
F_N	−1,8	−3,8	100	300
F_D	−5,2	−8,2	130	390
F_E	−9,2	−13,2	160	480
F_G	−40	−48,3	452	1 310



Key

X in Hertz

Y in dB

Figure 3 — Frequency response limits — CFC 60 and CFC 180

4.2 Phase delay time of a data channel

The phase delay time of a data channel between its input and output shall be determined. It shall not vary by more than 1/(10 F_H) s between 0,03 F_H and F_H.