INTERNATIONAL

RECOMMENDATION

OIML R 103

Edition 1992 (E)

Measuring instrumentation for human response to vibration

(with reference to International Standards 8041 and 5347 of the International Organization for Standardization)

Appareillage de mesure pour la réponse des individus aux vibrations

(en référence aux Normes Internationales 8041 et 5347 de l'Organisation Internationale de Normalisation)

OIML R 103 Edition 1992 (E)

ORGANISATION INTERNATIONALE
DE MÉTROLOGIE LÉGALE

INTERNATIONAL ORGANIZATION
OF LEGAL METROLOGY

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Foreword

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This publication – reference OIML R 103 (E), edition 1992 – which is under the responsibility of TC 13 *Measuring instruments for acoustics and vibration*, was approved for final publication by the International Committee of Legal Metrology in 1991 and sanctionned by the International Conference of Legal Metrology in 1992.

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MEASURING INSTRUMENTATION
for HUMAN RESPONSE to VIBRATION

1 General

1.1 Scope

This Recommendation deals with instruments (hereafter referred to as vibration-measuring instruments) designed for the measurement of time- and frequency-weighted accelerations of sinusoidal and stochastic vibrations, for assessing vibrations as perceived by human beings. The Recommendation specifies the metrological and technical requirements for vibration-measuring instruments that are submitted to the control of Legal Metrology Services, the requirements relating to the technical documents accompanying vibration-measuring instruments, and the methods to be used for pattern evaluation and verification.

The Recommendation is consistent with the requirements of ISO 8041 *Human response to vibration - Measuring instrumentation*, First edition 1990, and the relevant requirements of ISO 5347-0 *Methods for the calibration of vibration and shock pick-ups*, Part 0 *Basic concepts*, First edition 1987 with Technical Corrigendum 1:1990, and ISO/DIS 5347-3 *Methods for the calibration of vibration and shock pick-ups*, Part 3 *Secondary vibration calibration*, 1987.

The Recommendation follows the principle of direct reference: it can be used only by reference to the ISO Standards mentioned.

1.2 Terminology

The terms used in this Recommendation are defined in ISO 2041 *Vibration and shock - Vocabulary*, Second edition 1990, and in ISO 8041.

2 Metrological requirements

2.1 Vibration-measuring instruments of accuracy classes 1 and 2, referred to as types 1 and 2 in ISO 8041, shall comply with the requirements of ISO 8041 of which the relevant sub-clauses are grouped and listed in column 2 of the table of Annex A of this Recommendation.

The vibration-measuring instruments shall meet the tolerances stated in ISO 8041, which are considered as the maximum permissible errors on initial and subsequent verification. A multi-function instrument (exponential time weighting, linear integration, peak indication) shall be marked as being of only one accuracy class; all functions related to ISO 8041 shall satisfy at least the requirements for that accuracy class.

2.2 When different values for the in-service and verification errors are prescribed by national regulation, the values of the maximum permissible errors in service shall be 1.25 times those specified for verification.

2.3 The requirements stated in subclauses 2.1 and 2.2 of this Recommendation shall also be adhered to when the vibration-measuring instrument is being used in accordance with the manufacturer's instructions for normal use.

3 Technical requirements

3.1 The material and components used and the construction of vibration-measuring instruments shall be such as to ensure sufficient stability to enable the instrument to comply with the metrological requirements.

3.2 The vibration-measuring instruments shall bear, clearly and indelibly, at least the following markings:

a) manufacturer's trade-mark,
b) pattern designation,
c) accuracy class,
d) serial number,
e) pattern approval sign in conformity with national regulations.

3.3 Each vibration-measuring instrument shall be accompanied by an instruction manual which shall include all information listed in subclause 9.2 of ISO 8041.

3.4 Accessories that are part of the main instrument shall be unambiguously identifiable by a list affixed to the instrument, or in an attached document or in any other appropriate manner.

3.5 It shall be possible to protect, by means of seals or marks, those parts and components of the vibration measuring instruments that may influence their accuracy.

3.6 A suitable place for the application of verification marks shall be provided.

4 Metrological testing

4.1 The metrological procedures to be applied for pattern evaluation and verification are indicated in columns 3 and 4 of the table of Annex A of this Recommendation. It is recommended that the interval between successive verifications should not exceed two years.

4.2 Tests to determine compliance with the requirements shall apply to the complete instrument. If the testing procedure is subdivided into tests using mechanical excitation and tests using electrical excitation any interaction between the various elements of the instrumentation shall be taken into account. The means and methods for measuring the characteristics shall be appropriate, both with regard to the principle of measurement and to the accuracy class of the instrument.

4.3 Compliance with requirements that are designated as R 4.3 in the column 3 of the table of Annex A shall be verified by visual inspection of the vibration-measuring instrument and by checking against the relevant specification.

4.4 Performance tests shall generally be carried out under the reference conditions specified in ISO/DIS 5347-3 and ISO 8041:

- temperature according to ISO/DIS 5347-3, subclause 4.1 (23 °C ± 3 °C),

- mechanical excitation according to ISO 8041, subclauses 3.8 and 3.9:
  - frequency 80 Hz, r.m.s. value of vibration acceleration preferably 10 m/s^2 for hand-arm vibration, (*)
  - frequency 8 Hz, r.m.s. value of vibration acceleration preferably 1 m/s^2 for whole-body vibration, x-y, z, combined,
  - frequency 0.4 Hz, r.m.s. value of vibration acceleration preferably 0.1 m/s^2 for whole-body vibration, severe discomfort, z,

- other reference conditions: the ranges of humidity, acoustic noise, magnetic field strength and other influence quantities shall be specified to ensure that they have negligible effects on any metrological characteristics of the instrument.

When testing the effects of deviations from reference conditions only one parameter shall be changed at a time.

4.5 For tests using mechanical excitation, a comparison calibration method according to ISO 5347-0, subclause 6.3 may be applied.

The apparatus for performing the comparison method shall cover at least the frequency range specified in ISO 8041, Table 1. The relative partial error due to the test method (for example: comparison standard, transverse motion and distortion of the mechanical vibration generator, mechanical mounting of transducer, environment) shall not exceed 2 %. The calculation of the total uncertainty shall be based on a confidence level of at least 95 % and may be performed according to ISO/DIS 5347-3, Annex.

If the requirements of 4.2 above are met, testing procedures may be subdivided into tests using mechanical excitation and tests using electrical excitation. For frequencies beyond the range stated in ISO 8041, Table 1, tests of the vibration-measuring instrument using mechanical excitation may be omitted if the amplitude-frequency response of the transducer forming part of the vibration-measuring instrument has been measured according to ISO 5347-0, subclause 5.2.1 and is taken into account.

At frequencies below the range stated in ISO 8041, Table 1, care shall be taken to ensure that the total harmonic distortion of the sinusoidal excitation signal remain small, to prevent any harmonic components having an unwanted influence on the measurement of the slope of the filter characteristic at low frequencies.

4.6 The transverse sensitivity of the vibration transducer shall be tested according to ISO 5347-0, subclause 5.3.3.

(*) However, in ISO 8041 (note to 3.9) a reference calibration acceleration of 1 m/s^2 is preferred.

ANNEX A
(mandatory)

PROCEDURES FOR PATTERN EVALUATION AND VERIFICATION

Preferably five specimens of the same pattern should be submitted for pattern evaluation. If fewer than three specimens are tested the acceptance for verification may be limited to two years so that further experience with the pattern may be gained.

The subclauses cited in column 2, "Requirement subclause", of the following table are those of ISO 8041. The subclauses cited in column 3, "Testing subclause", refer to this Recommendation if designated by R, otherwise to ISO 8041. The tests specified in column 4 shall be applied only if the respective mode of operation or function is a feature of the instrument.

1	2	3	4	
Characteristic properties	Requirement subclause	Testing subclause	Testing at Pattern evaluation	verification
A.1 Indication				
A.1.1 Indicated quantities	6.1	R 4.3	x	
A.1.2 Nominal range	6.4	R 4.3	x	
A.1.3 Overlap of indicator ranges	5.3	R 4.3	x	
A.1.4 Scale interval for analog indication	6.5	R 4.3	x	
A.1.5 Scale spacing for analog indication	6.5	R 4.3	x	
A.1.6 Resolution for quasi-analog indication	6.5	R 4.3	x	
A.1.7 Indicated quantities for digital indication	6.6	R 4.3	x	
A.1.8 Resolution for digital indication	6.6	R 4.3	x	
A.2 Maximum permissible errors (*)				
A.2.1 Maximum permissible errors at reference conditions	4.4	R 4.4 R 4.5	x	x
a) analog indication (**)	6.5			
b) digital indication (**)	6.6			

(*) In group A.2 maximum permissible errors are stated which do not specially concern the frequency weighting (group A.3) or the time weighting (group A.4).

(**) In an appropriate way, compliance with the maximum permissible errors shall also be tested for any electrical signal output if included.

1	2	3	4	
Characteristic properties	Requirement subclause	Testing subclause	Testing at Pattern evaluation	verification
A.2.2 Change in reading	4.6 Tab.3	R 4.2	x	
A.2.3 Repeatability of analog indication for calibration	6.5	R 4.3	x	
A.2.4 Internal electrical noise	5.6	8.6	x	x
A.2.5 Linearity deviation (detector-indicator)	6.7 Tab.12	6.7	x	
A.2.6 Total harmonic distortion at electrical output	5.7	R 4.2	x	
A.2.7 Maximum permissible errors of range setting	5.7	R 4.2	x	x
A.3 Frequency weighting				
A.3.1 Nominal frequency response and maximum permissible errors for severe discomfort, z-axis, f = 0.1 Hz to 1 Hz	5.1 Tab.4	R 4.5	x	x
A.3.2 Nominal frequency response and maximum permissible errors for whole body, x-, y-axis, f = 1 Hz to 80 Hz	5.1 Tab.5	R 4.5	x	x
A.3.3 Nominal frequency response and maximum permissible errors for whole body, z-axis, f = 1 Hz to 80 Hz	5.1 Tab.6	R 4.5	x	x
A.3.4 Nominal frequency response and maximum permissible errors for whole body, combined, f = 1 Hz to 80 Hz	5.1 Tab.7	R 4.5	x	x
A.3.5 Nominal frequency response and maximum permissible errors for hand-arm, f = 8 Hz to 1 000 Hz	5.1 Tab.8	R 4.5	x	x
A.3.6 Nominal frequency response and maximum permissible errors for "flat" response	4.3.1	R 4.5	x	x
A.4 Time weighting				
A.4.1 Time weighting characteristics	4.3.2	R 4.2	x	x
A.4.2 Error characteristics for exponential time weighting	6.2.1 Tab.9 Tab.10	6.2.1 8.5 Tab.10	x	x
1	2	3	4	

Characteristic properties	Requirement subclause	Testing subclause	Testing at Pattern evaluation	Testing at verification
A.4.3 Error characteristics for linear integration	6.2.2 Tab. 11	6.2.2 8.5 Tab. 11	x	x
A.4.4 Error caracteristics for peak indication	6.3 Tab. 10	6.3 Tab. 10 8.5.2	x	x
A.5 Sensitivity to various environments				
A.5.1 Influence of mechanical vibration (mechanical endurance)	7.1	7.1	x	
A.5.2 Influence of magnetic and electrostatic fields	7.2	7.2	x	
A.5.3 Influence of temperature	7.3	7.3	x	
A.5.4 Influence of humidity	7.4	R 4.2	x	
A.5.5 Influence of transverse motion	4.7	R 4.6	x	
A.6 Other requirements				
A.6.1 Battery voltage	4.5	R 4.3	x	
A.6.2 Overload indication	5.5	8.5	x	x