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# INTERNATIONAL STANDARD



# 2954

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

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## **Mechanical vibration of rotating and reciprocating machinery — Requirements for instruments for measuring vibration severity**

*Vibrations mécaniques des machines tournantes ou alternatives —  
Spécifications des appareils de mesurage de  
l'intensité vibratoire*

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## FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

International Standard ISO 2954 was drawn up by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, and circulated to the Member Bodies in January 1973.

It has been approved by the Member Bodies of the following countries :

Belgium	Italy	Sweden
Bulgaria	Japan	Thailand
Czechoslovakia	New Zealand	Turkey
Egypt, Arab Rep. of	Portugal	United Kingdom
France	Romania	U.S.A.
Germany	South Africa, Rep. of	U.S.S.R.

The Member Body of the following country expressed disapproval of the document on technical grounds :

Australia

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# Mechanical vibration of rotating and reciprocating machinery — Requirements for instruments for measuring vibration severity

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard states the requirements which a measuring instrument for vibration severity of machines should meet if inaccuracies of measurement, particularly when making comparisons between one machine and another, are not to exceed a specific value. Instruments meeting the requirements of this International Standard are suitable for use in carrying out the procedures specified in ISO 2372 and ISO 2373 and are designated "Measuring instruments for vibration severity in rotating and reciprocating machines".

The instruments covered by this International Standard give direct indication or recording of root-mean-square vibration velocity, which is defined as the measuring unit of the vibration severity.

### NOTES

1 A method of checking true root-mean-square indication is described in an annex.

2 Subject to limitation of the measuring-frequency range, these instruments may be used for other applications where similar accuracy of measurement is required, for example measurement of vibration velocity of structures, tunnels, bridges, etc.

## 2 DEFINITIONS

The terms used in this International Standard are defined in the following IEC Publications and ISO International Standards :

IEC 184, *Methods for specifying the characteristics of electromechanical transducers for shock and vibration measurements*.

IEC 222, *Methods for specifying the characteristics of auxiliary equipment for shock and vibration measurement*.

ISO 2041, *Vibration and shock — Vocabulary*.

ISO 2372, *Mechanical vibration of machines with operating speeds from 10 to 200 rev/s — Basis for specifying evaluation standards*.

ISO 2373, *Mechanical vibration of certain rotating electrical machinery with shaft heights between 80 and 400 mm — Measurement and evaluation of the vibration severity*.

## 3 GENERAL REQUIREMENTS

A vibration measuring instrument usually consists of : a vibration pickup; an indicator set which contains an amplifier, correcting filter networks for the frequency response and an indicating or recording instrument; and a power supply system.

The requirements described in this clause apply to the general characteristics of the complete assembly of the pickup and the true  $v_{rms}$  indicator set. Clauses 4 and 5 contain the detailed requirements for each of these main units.

**3.1** The frequency range of the vibration severity measuring instrument shall be from 10 to 1 000 Hz.

NOTE — This means that the frequency range corresponds to the frequency interval employed in the evaluation scale in ISO 2372.

**3.2** The sensitivity within the measuring-frequency range shall not deviate from the reference sensitivity at 80 Hz by more than the quantities given in the table.

TABLE — Sensitivity relative to the reference sensitivity at 80 Hz and limiting values of the permissible deviation within the frequency interval from 1 to 10 000 Hz

Frequency Hz	Relative sensitivity		
	Nominal value	Minimum value	Maximum value
1	—	—	0,01
2,5	0,016	0,01	0,025
10	1,0	0,8	1,1
20	1,0	0,9	1,1
40	1,0	0,9	1,1
80	1,0	1,0	1,0
160	1,0	0,9	1,1
500	1,0	0,9	1,1
1 000	1,0	0,8	1,1
4 000	0,016	0,01	0,025
10 000	—	—	0,01

To minimize measurement errors caused by the interference due to vibrations with frequencies outside the measuring-frequency range, the sensitivity shall decrease

rapidly in a clearly defined manner at the limits of the frequency range. Both the required nominal values of the sensitivity and the permissible minimum and maximum values are given in the table.

To preclude doubts about the course of the sensitivity between the cutoff frequencies shown in the table, figure 1 illustrates the course of the nominal value of the relative sensitivity and the limit of the permissible deviation within the whole frequency range from 1 to 10 000 Hz.

NOTE — In some cases it may be necessary to limit further the measuring-frequency range at its upper or lower boundaries to avoid interfering vibrations which are irrelevant to the assessment of the vibration characteristics of a machine. For this purpose the instrument may be equipped with additional high-pass or low-pass filters. It is recommended that the cutoff frequencies and edge steepness of these filters be selected in accordance with IEC specifications.

When the measuring-frequency range is narrowed down by additional filters, the measured value should not be used for assessing the vibration severity in accordance with ISO 2372 and ISO 2373. To avoid errors, it is necessary to state the cutoff frequencies for the measuring-frequency range as well as the measured value, for example  $v_{rms}$  (40 to 100 Hz) = 7,5 mm/s.

**3.3** The selection of the measurement range shall be such that the indication of the lowest level of the vibration severity to be measured shall be equal to at least 30 % of the full-scale value. The minimum and maximum levels of the vibration severity range (for example in accordance with table 1 of ISO 2372) shall be stated, for example "Measuring instrument for vibration severity with measurement range 0,28 to 28 mm/s".

**3.4** The error of the vibration severity measuring instrument is composed of the permissible deviations for the frequency response in accordance with 3.2 and the error in the absolute value of the sensitivity at the reference frequency of 80 Hz (i.e. calibration error). The measurement error may be up to a maximum of  $\pm 10\%$  of the indicated value, including the calibration error, at 80 % of full-scale value.

These limits of error apply over the whole operating temperature range authorized for the vibration pickup and indicator set (see 4.8 and 5.4), for all types of attachments to the vibration pickup (see clause 4), for all lengths of connecting cable between the vibration pickup and the indicator provided by the manufacturer (see 4.14) and a  $\pm 10\%$  fluctuation in the supply voltage.

NOTE — Only one of the above parameters shall be checked at a time.

**3.5** For calibration, the pickup shall be excited by a sinusoidal vibration with a vibration direction which deviates by not more than  $\pm 5^\circ$  from that of the sensitive axis of the pickup. The total harmonic distortion of the exciting vibration velocity shall not exceed 5 %. The velocity of the exciting vibration must be known with an uncertainty of less than  $\pm 3\%$  within the whole measuring-frequency range.

It is recommended that the reference value of the sensitivity at 80 Hz be adjusted to  $v_{rms} = 100$  mm/s at a room temperature of  $20 \pm 2^\circ\text{C}$ .

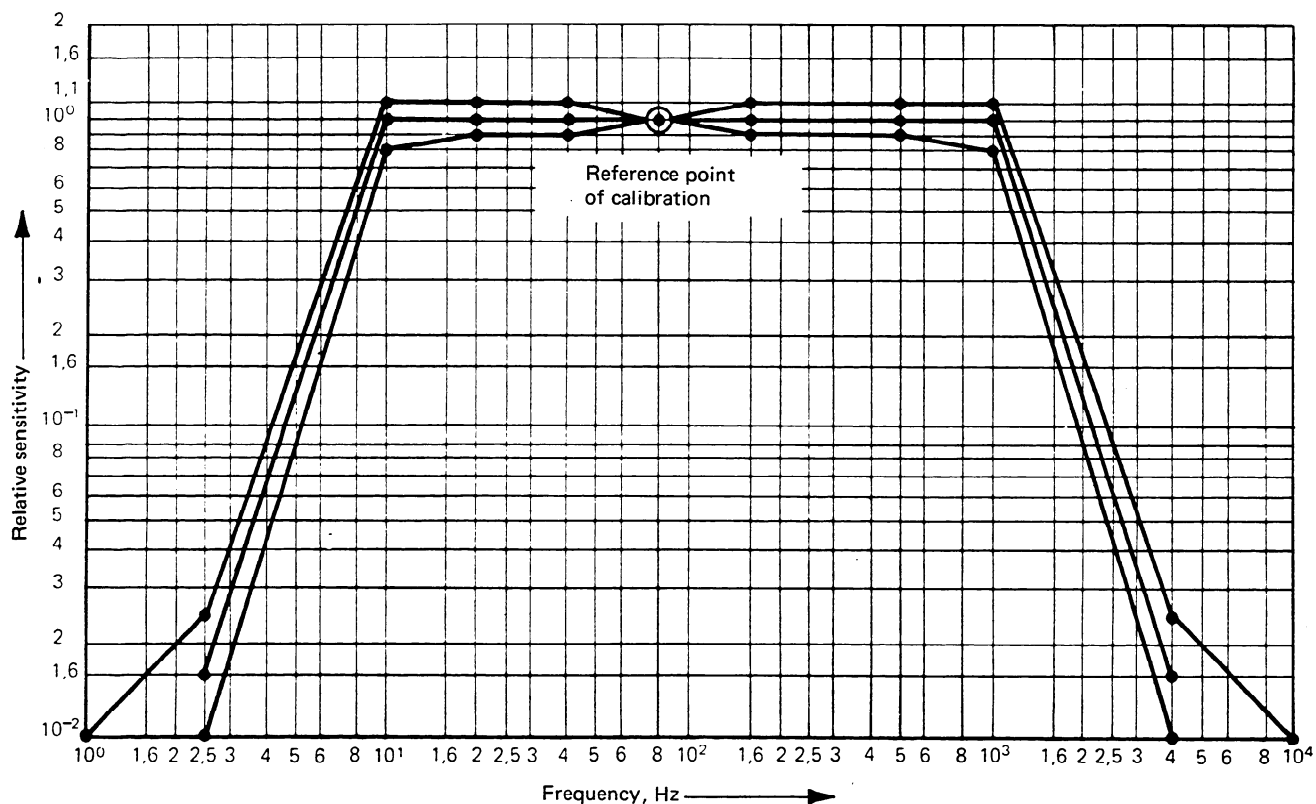


FIGURE 1 — Nominal value of relative sensitivity and limits of permissible deviation



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