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Methods for the calibration of vibration and shock transducers —

Part 44: Calibration of field vibration calibrators

Méthodes pour l'étalonnage des transducteurs de vibrations et de chocs —
Partie 44: Étalonnage des calibreurs de vibrations pour usage in situ

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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 ISO documents 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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*.

A list of all the parts in the ISO 16063 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 16063 comprises a series of documents dealing with methods for the calibration of vibration and shock transducers.

This document focuses on field vibration calibrators (FVCs). In this context, FVCs are mainly used for *in situ* checks of vibration and shock transducers providing sine wave vibration at known frequency and magnitude under field conditions. The FVC acts as a calibrated vibration source for *in situ* checks of transducer sensitivity that is specified or requested, for example, in ISO 8041-1 or in ISO 8042.

Operational frequency and acceleration RMS value of FVCs are usually 160 Hz or 159,2 Hz, and 3,16 m/s^2, 9,81 m/s^2 or 10 m/s^2, respectively, which are widely accepted as reference conditions. There are also FVCs with selectable acceleration magnitudes and frequencies. In comparison with stationary calibration systems, FVCs have limitations in shaker power and inertial mass. Therefore, they can be unsuitable for heavy test objects, high acceleration magnitudes and large displacements.

Using the calibration procedure described by this document, the acceleration generated by an FVC can be traceable, through chain of calibration, to a primary or national standard as defined by ISO/IEC Guide 99 (“the VIM”) with associated uncertainty defined by ISO/IEC Guide 98-3 (“the GUM”).

Methods for the calibration of vibration and shock transducers —

Part 44:
Calibration of field vibration calibrators

1 Scope

This document specifies the instrumentation and procedure to be used for performing calibration of field vibration calibrators (FVCs).

It is not applicable to FVCs used for the calibration of transducers. These are covered by ISO 16063-21.

Procedures and requirements of *in situ* calibration by FVC are beyond the scope of this document.

Annex B provides more information on the application of FVC.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. 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 16063-21, *Methods for the calibration of vibration and shock transducers — Part 21: Vibration calibration by comparison to a reference transducer*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

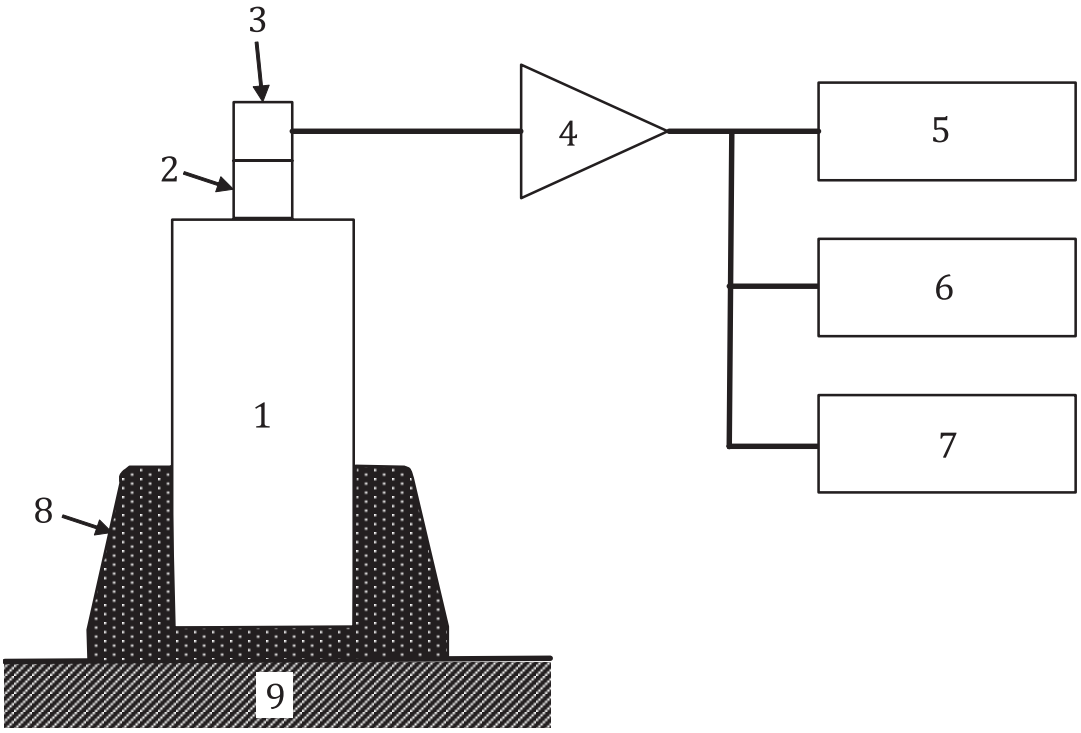
— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Requirements for apparatus and other conditions

4.1 General

Figure 1 shows the apparatus for the calibration. In some cases, reference transducer and amplifier may be a single device as transducer chain.



Key

1 FVC
2 dummy mass
3 reference transducer
4 amplifier
5 distortion meter
6 voltmeter
7 frequency counter
8 fixing attachment (only for hand-held FVCs)
9 base

Figure 1 — Calibration apparatus

4.2 Reference transducer and amplifier

The reference transducer (preferably together with amplifier) shall be calibrated in accordance with the comparison method given in ISO 16063-21 or other known methods with expanded uncertainty of less than 2 % (magnitude). The uncertainty is the expanded uncertainty using a coverage factor of 2. When the FVC allows selectable acceleration magnitudes and frequencies, the reference transducer shall be calibrated at each magnitude and frequency in advance.

The reference transducer shall have a low transverse sensitivity of preferably less than 2 % to minimize the influence of the FVC's transverse vibration. The mass of the reference transducer shall be equal to, or smaller than the capability of the FVC to be tested. Additional mass (dummy mass) may be employed for evaluation of acceleration, distortion and other performances of the FVC.

4.3 Voltage measuring instrument for true RMS transducer chain output

A voltmeter measuring true RMS at the reference transducer chain output is used. Required expanded uncertainty of voltmeter is 0,3 % at the selected reference frequency (coverage factor of 2).

4.4 Frequency measuring instrument

A frequency counter at the reference transducer chain output is used. Required expanded uncertainty is 0,05 % at the selected reference frequency (coverage factor of 2).

4.5 Distortion measuring instrument

A distortion meter or an FFT analyser for total distortion evaluation (minimum up to 5th harmonic) at the reference transducer chain output is used. Required relative expanded uncertainty of the instrument is 10 % at the selected reference frequency (coverage factor of 2). When a narrowband FFT analyser is used to render the transducer chain output signal value, the observation time shall be at least three times the reciprocal of the FFT line window width and the levels of the FFT lines clustered about the calibration frequency shall be energy-summed into one result and reported.

4.6 Dummy mass

A set of different dummy masses may be employed as additional mass to the reference transducer in order to test stability at changing loads. The dummy masses shall have appropriate threads on both sides for the shaker and the reference transducer. The mounting surface of the dummy masses shall be appropriately finished by means of mechanical geometry. It shall be cylindrical to ensure symmetrical load of the FVC and be designed in a way that the reference transducer stays as close as possible to the FVC. If the distance becomes too wide, transverse vibrations of the FVC can affect the calibration due to leverage. Material, geometry and each mass of the dummy masses may be reported upon request.

4.7 Environmental conditions

These shall be as follows:

Room temperature: (23 ± 10) °C

Relative humidity: 75 % max

Vibration noise: Sufficiently isolated less than 0,1 m/s^2 (RMS value) at the base surface of the calibration apparatus in Figure 1.

5 Calibration procedure

5.1 Preparation of calibration

The FVC to be calibrated should be placed on a rigid and stable base. The mounting method and direction of the FVC should be the same as its operation condition that is specified by the FVC manufacturer. If the FVC is operated by handheld, it shall be fixed by an appropriate attachment. The attachment shall hold the FVC tightly but shall not give mechanical stress to the FVC. Item 8 in Figure 1 shows an example of such a fixing attachment. The attachment has to be made of a soft and flexible material. A hard material can cause coupling resonances between the calibrator case and the fixture, which might interfere with the vibration output.

A proper power supply (battery) shall be provided during the calibration as specified by the FVC manufacturer. A mounting surface of the FVC should be checked to see whether there is any serious damage (scratch) on it. If there is, it shall be reported to the customer to confirm whether the calibration should be terminated or the scratches should be smoothened for calibration. The reference transducer shall be screw-mounted with an appropriate torque. Transducer mounting should be in accordance with ISO 5348. It can be necessary to calibrate the FVC in different directions referred to earth's gravity.

The reference transducer, voltmeter, distortion meter and frequency counter shall be connected as shown in Figure 1. Dummy mass is also fixed if needed.