INTERNATIONAL STANDARD

ISO 5347-22

First edition
1997-03-01

Methods for the calibration of vibration and shock pick-ups —

Part 22:
Accelerometer resonance testing — General methods

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 5347-22:1997
https://standards.iteh.ai/catalog/standards/sist/a5189ea8-0151-446e-9a9e-e90a9814329b/iso-5347-22-1997

Méthodes pour l'étalonnage de capteurs de vibrations et de chocs —

Partie 22: Essai de résonance par accéléromètres — Méthodes générales

INTERNATIONAL ISO

Reference number
ISO 5347-22:1997(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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 5347-22 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, Subcommittee SC 3, *Use and calibration of vibration and shock measuring instruments*.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 5347 consists of the following parts, under the general title *Methods for the calibration of vibration and shock pick-ups*:

ISO 5347-22:1997
https://standards.iteh.ai/catalog/standards/sist/a5189ea8-0151-446e-9a9e-e90a9814329b/iso-5347-22-1997

— *Part 0: Basic concepts*

— *Part 1: Primary vibration calibration by laser interferometry*

— *Part 2: Primary shock calibration by light cutting*

— *Part 3: Secondary vibration calibration*

— *Part 4: Secondary shock calibration*

— *Part 5: Calibration by Earth's gravitation*

— *Part 6: Primary vibration calibration at low frequencies*

— *Part 7: Primary calibration by centrifuge*

— *Part 8: Primary calibration by dual centrifuge*

© ISO 1997

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

— *Part 9: Secondary vibration calibration by comparison of phase angles*
— *Part 10: Primary calibration by high impact shocks*
— *Part 11: Testing of transverse vibration sensitivity*
— *Part 12: Testing of transverse shock sensitivity*
— *Part 13: Testing of base strain sensitivity*
— *Part 14: Resonance frequency testing of undamped accelerometers on a steel block*
— *Part 15: Testing of acoustic sensitivity*
— *Part 16: Testing of mounting torque sensitivity*
— *Part 17: Testing of fixed temperature sensitivity*
— *Part 18: Testing of transient temperature sensitivity*
— *Part 19: Testing of magnetic field sensitivity*
— *Part 20: Primary vibration calibration by the reciprocity method*
— *Part 21: Shock calibration using laser Doppler velocimeter*
— *Part 22: Accelerometer resonance testing — General methods*

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 5347-22:1997
https://standards.iteh.ai/catalog/standards/sist/a5189ea8-0151-446e-9a9e-e90a9814329b/iso-5347-22-1997

This page intentionally left blank

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 5347-22:1997
https://standards.iteh.ai/catalog/standards/sist/a5189ea8-0151-446e-9a9e-e90a9814329b/iso-5347-22-1997

Methods for the calibration of vibration and shock pick-ups —

Part 22:
Accelerometer resonance testing — General methods

iTeh STANDARD PREVIEW
(standards.iteh.ai)

1 Scope

ISO 5347 comprises a series of documents dealing with methods for the calibration of vibration and shock pick-ups.

ISO 5347-22:1997
https://standards.iteh.ai/catalog/standards/sist/a5189ea8-0151-446e-9a9e-e90a9814329b/iso-5347-22-1997

This part of ISO 5347 lays down detailed specifications for the instrumentation and procedures to be used for accelerometer resonance testing. It applies to rectilinear accelerometers of the piezoresistive, piezoelectric and variable capacitance types in the frequency range 50 Hz to 200 kHz.

The procedures are in general contrary to those described in ISO 5347-14 which is limited to undamped accelerometers. The frequency response of a piezoelectric accelerometer depends on the value of the (lowest) resonance frequency of the instrument when mounted on the structure to be tested. It does not appear possible to specify a test which will determine this frequency for all installations of a given accelerometer. This procedure gives the accelerometer resonance frequency under a set of standard reproducible conditions, with the understanding that the resonance frequency in actual use will in all probability be appreciably different (generally lower, by a factor depending on the mass and compliance of the test structure and the method of attachment). The procedure is not suitable for evaluating the mounted resonance frequency for a field of application; a suitable method is given in ISO 5348.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 5347. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 5347 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 5348:—[1)], *Mechanical vibration and shock — Mechanical mounting of accelerometers.*

---

1) To be published. (Revision of ISO 5348:1987)

3 Apparatus

3.1 Equipment capable of maintaining room temperature at 23 °C ± 3 °C.

3.2 Frequency generator and indicator, having a frequency range of 50 Hz to 200 kHz.

3.3 Power amplifier — vibrator combination, having a frequency range of 50 Hz to 200 kHz.

3.4 Oscilloscope, having a frequency range of 50 Hz to 200 kHz.

3.5 Vibrator and reference accelerometer, having a resonance frequency greater than 50 kHz.

3.6 Analysing equipment, having a frequency range of less than 10 MHz.

3.7 Reference block, a steel block 28 mm × 28 mm × 28 mm, having a mass of about 180 g, for resonance frequencies up to 50 kHz. A beryllium block of the same dimensions shall be used for resonance frequencies up to 100 kHz. For frequencies above 100 kHz a beryllium rod having a diameter of 14 mm and 400 mm long, may be used. One ground surface of the block, and one end of the rod, which shall be used for mounting the accelerometer shall have a surface roughness value (expressed as the arithmetical mean deviation) R_a, of less than 1 µm.

The flatness of the ground surface shall be such that the surface is constrained between two parallel planes at a distance apart of 5 µm.

The drilled and tapped holes for connecting the transducer shall have a perpendicularity tolerance to the surface of less than 0,5°.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

3.8 Transverse test block, a beryllium block 28 mm × 28 mm × 28 mm with four ground surfaces, each of which shall have a roughness value, expressed as the arithmetical mean deviation R_a, of less than 1 µm.

The flatness of the ground surfaces shall be such that the surface can be constrained between two parallel planes at a distance apart of 5 µm.

ISO 5347-22:1997
https://standards.iteh.ai/catalog/standards/sist/a5189ea8-0151-446e-9a9e-e90a98143329b/iso-5347-22-1997

The drilled and tapped holes for connecting the transducer and accessories shall have a perpendicularity tolerance to the surface of less than 0,5°.

This test accelerometer shall be mounted on one ground side of this block. A mass identical to the accelerometer mass shall be symmetrically mounted in the opposite side for counterbalance (see figure 1).

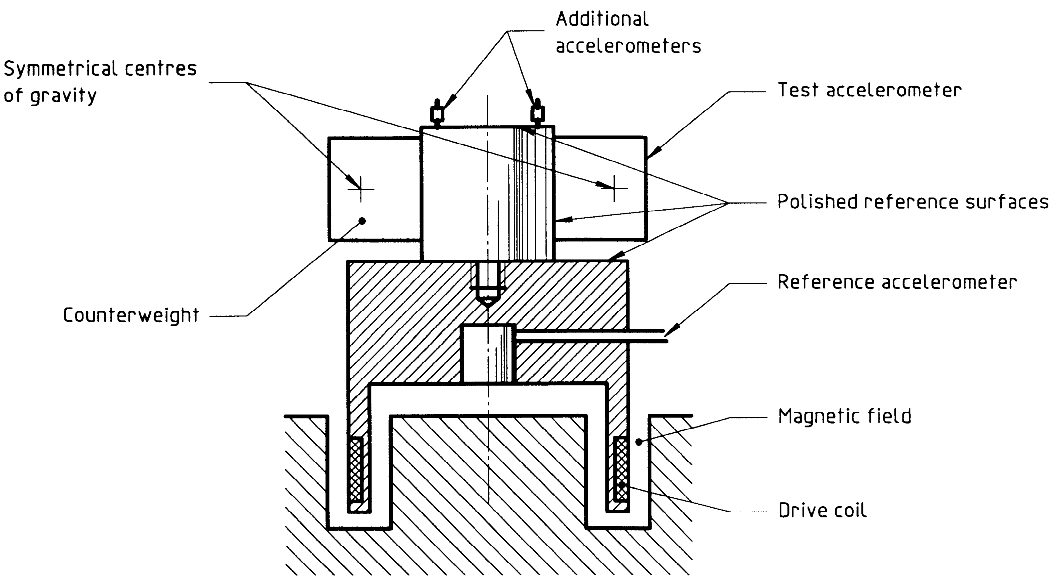

Figure 1 — Accelerometer transverse resonance frequency testing

4 Procedure

4.1 Mounting

The testing shall be carried out under well-defined conditions in accordance with ISO 5348.

The accelerometer and its accessories shall be mounted according to the manufacturer's recommendations.

4.2 Mounted resonance frequency, sinusoidal vibrator method

Measure the accelerometer output using the comparison method throughout the frequency range including and above the resonance frequency of the accelerometer. The resonance frequency is the frequency of maximum sensitivity. The phase angle relative to the standard accelerometer changes by about 180° in the range of frequencies near the resonance frequency of the accelerometer. There may be minor or local resonances detected where the phase angle changes to about 90° but returns to 0° at a slightly higher frequency. Report these frequencies as local resonances where minor increases in sensitivity are detected.

The standard accelerometer with known resonance frequencies should be built into the vibrator armature (see figure 2). The resonance frequency of the vibrator is determined by measuring the transfer function between the drive coil current and the standard accelerometer output. Use the vibrator only throughout the range up to 95 % of its moving parts including accelerometer resonance frequency.

NOTE — The low-frequency suspension and rigid-body rise in amplitude and change in phase may be ignored.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 5347-22:1997
https://standards.iteh.ai/catalog/standards/sist/a5189ea8-0151-446e-9a9e-a0008143298/iso-5347-22-1997

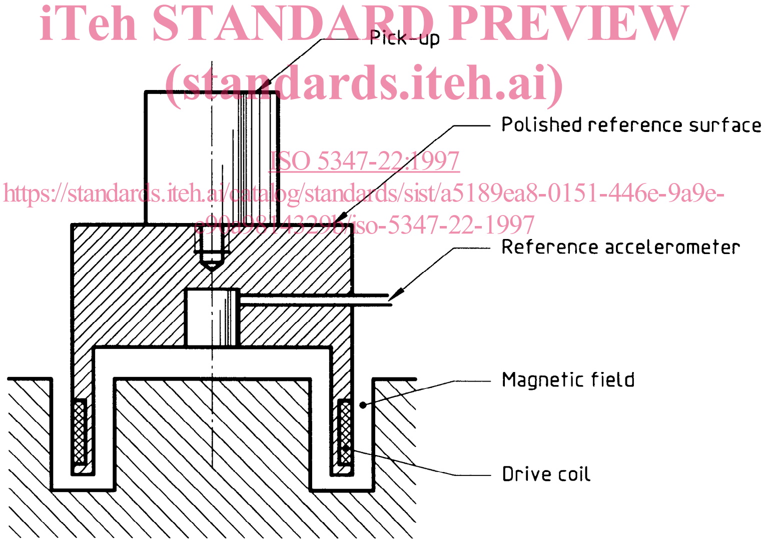

Figure 2 — Accelerometer resonance frequency testing

The resonance frequency of the vibrator armature may also be determined with an accelerometer whose damped natural frequency has been determined by the shock method and found to be above the vibrator resonance frequency.

Damped natural frequency of accelerometers may be determined by comparison of the phase angle. The frequency where 90° phase shift is detected is defined as the damped natural frequency. This measurement is typically used for accelerometer with damping ratios equal to, or greater than, about 0,7.

4.3 Mounted cross axis resonance frequency

The mounted cross axis resonance frequency may be determined using the same vibrator as in 4.2. The accelerometer mounted on the transverse test block described in 3.8 shall be mounted on the vibrator with the accelerometer's sensitive axis perpendicular to the axis of vibration. Two additional accelerometers shall be mounted on the transverse test block to determine that the entire vibrator, block, accelerometer structure is moving uniaxially. The two accelerometers should be in phase to ensure that the assembly is not rotating. Rotation would result in a false transverse resonance frequency.

NOTE — Alternatively, laser interferometric vibration sensors may be used to detect such rotational or differential velocity components, these are advantageous (non-contact) load-free measurement. True differential laser vibrometers generate the difference signal within the optical system and therefore do not encounter the matching problems suffered by pairs of individual sensors.

The accelerometer under test should be rotated in 30° intervals over 90° to determine the maximum response and lowest resonance frequency (see figure 1).

4.4 Mounted damped natural frequency, shock method

The accelerometer is mounted on the block or rod described in 3.7. This assembly shall be supported by a soft elastic suspension.

The damped natural frequency of the accelerometer shall be determined by mechanical excitation due to a short transient shock pulse whose pulse duration is about three times the natural period of the accelerometer. If the transient shock pulse is generated by an impact the rise time will decrease with decreasing contact area of the impact tool or hammer. For frequencies greater than 300 kHz, short rise time shock pulses shall be generated by fracture of a glass or lead rod on the end surface of the rod.

The output of the accelerometer shall be captured in memory through an analogue-to-digital convertor or on a storage oscilloscope whose sampling rate shall not be less than two times the resonance frequency of the accelerometer. The frequency response of all electronic equipment must be adequate for fidelity of accelerometer output at these high frequencies.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

An analysis of the transducer output will indicate the frequency with highest output. This frequency is the natural damped resonance of the accelerometer. There may be other frequencies where a significant increase in accelerometer output is observed. If these output levels are less than 50 % of the output at the natural damped resonance frequency the frequencies at which these lower output levels are observed shall be reported as local or minor resonances.

ISO 5347-22:1997
https://standards.iteh.ai/catalog/standards/sist/a5189ea8-0151-446e-9a9e-e90a9814329b/iso-5347-22-1997

This page intentionally left blank

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 5347-22:1997
https://standards.iteh.ai/catalog/standards/sist/a5189ea8-0151-446e-9a9e-e90a9814329b/iso-5347-22-1997