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

Part 13:
Testing of base strain sensitivity

Méthodes pour l'étalonnage de capteurs de vibrations et de chocs —
Partie 13: Essai de sensibilité de contrainte de base

Reference number
ISO 5347-13:1993(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 5347-13 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, Sub-Committee SC 3, *Use and calibration of vibration and shock measuring instruments.*

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

— *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*

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— *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*

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

Part 13:
Testing of base strain sensitivity

1 Scope

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

This part of ISO 5347 lays down detailed specifications for the instrumentation and procedure to be used for base strain sensitivity testing. It applies to rectilinear accelerometers, mainly of the piezoelectric type.

This part of ISO 5347 is applicable for the following parameters:

a) Reference values:

— pick-up base radius of curvature: 25 m

— base strain: $2{,}5 \times 10^{-4}$

b) Check values:

— radius of curvature 62,5 m, strain of base 1×10^{-4}

— radius of curvature 12,5 m, strain of base 5×10^{-4}

2 Apparatus

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

2.2 Cantilever beam, designed so that it can produce the range of radii of curvature and base strains specified in clause 1. The beam shall have its bending plane horizontally.

The surface to which the pick-up is connected shall be ground so as to have a roughness value, as the arithmetical mean deviation, R_a, of less than 1 µm.

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

The drilled and tapped holes for connecting the pick-up shall have a perpendicularly tolerance to the surface of less than 10 µm, i.e. the centreline of the hole shall be contained in a cylindrical zone of 10 µm in diameter and a height equal to the hole depth.

A steel beam clamped into a rigid support at one end is recommended. The test location is 40 mm from the clamped end, where the area is 12,5 mm ± 0,1 mm thick and 76 mm ± 0,5 mm wide. No requirements are specified as regards the rest of the beam, but a length of 1,5 m is convenient.

On both sides of the test pick-up, strain gauges can be bonded.

It is recommended to apply a force slowly at a known distance, measured with an error of < ± 1 mm, from the test location instead of measuring strain. If this gives too low a frequency, it is recommended that the beam be deflected and then be allowed to vibrate freely.

The force and the cantilever beam measures can be calculated from the following formulae:

$$F = \frac{E \times \varepsilon \times b \times h^2}{6 \times l}$$

$$R = \frac{h}{2 \times \varepsilon}$$

where

- F is the force applied at the free end of the beam, in newtons;
- E is Young's modulus, in newtons per square metre (for steel, $E = 2{,}1 \times 10^{11}$ N/m^2);
- ε is the strain;
- b is the beam width, in metres;
- h is the beam thickness, in metres;
- l is the distance from the test location to the force, in metres;
- R is the radius of curvature, in metres.

2.3 Pick-up amplifier, low frequency type, for piezoaccelerometer charge amplifiers.

2.4 Low frequency measuring instrumentation, with uncertainty maximum ± 1 % of reading.

2.5 Strain gauges, power supply, amplifier and **recorder** (optional).

2.6 Force-measuring equipment (optional), covering the range from 0 to 100 N and with uncertainty maximum ± 2 % of reading.

3 Method

3.1 Test procedure

Mount the beam for horizontal deflection.

Apply forces slowly to the free end, in both directions, to give specified base strains to the transducer.

If the application of these forces gives too low a frequency for the pick-up or its amplifier, deflect the beam with a force to give a strain higher than the reference value. Then release the beam and allow it to vibrate freely on its resonance frequency, which is about 5 Hz.

Measure the output from the pick-up and from the strain gauges on a recorder.

Determine the maximum outputs from the pick-up and from the strain gauges, if any, for the three specified strains. Repeat the tests at four different pick-up directions.

3.2 Expression of results

Calculate the strain sensitivity, S_ε, in metres per second squared, from the following formula:

$$S_\varepsilon = \frac{a_\varepsilon}{\varepsilon}$$

where

- a_ε is the pick-up output, in metres per second squared;
- ε is the applied strain where $2{,}5 \times 10^{-4}$ is the reference value.