

Calibration of vibration and shock pick-ups —

Part 1: Methods for primary vibration calibration by laser interferometry

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The preparation of this British Standard was entrusted by the General Mechanical Engineering Standards Policy Committee (GME/-) to Technical Committee GME/21, upon which the following bodies were represented:

- Electricity Association
- Federation of Civil Engineering Contractors
- Imperial College of Science and Technology
- Institute of Sound and Vibration Research
- Institution of Mechanical Engineers
- Lloyd’s Register of Shipping
- Ministry of Defence
- Open University
- Power Generation Contractors Association [PGCA (BEAMA Ltd.)]
- Railway Industry Association of Great Britain
- Sira Test and Certification Ltd.
- Society of British Aerospace Companies Limited

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- British Coal Corporation
- Health and Safety Executive
- Society of Environmental Engineers
- University of Cranfield

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National foreword

This Part of BS 6955 has been prepared under the direction of the General Mechanical Engineering Standards Policy Committee. It is identical with ISO 5347-1:1993 *Methods for the calibration of vibration and shock pick-ups — Part 1: Primary vibration calibration by laser interferometry* published by the International Organization for Standardization (ISO).

ISO 5347-1 was prepared by Technical Committee ISO/TC 108, Mechanical vibration and shock, in which the UK played an active part.

BS 6955 consists of the following Parts, which are identical with the corresponding Parts of ISO 5347:

- *Part 0: Guide to basic principles;*
- *Part 1: Methods for primary vibration calibration by laser interferometry;*
- *Part 2: Method for primary shock calibration by light cutting;*
- *Part 3: Method for secondary vibration calibration;*
- *Part 4: Method for secondary shock calibration;*
- *Part 5: Method for calibration by Earth's gravitation;*
- *Part 6: Method for primary vibration calibration at low frequencies;*
- *Part 7: Methods for primary calibration by centrifuge;*
- *Part 8: Method for primary calibration by dual centrifuge;*
- *Part 9: Method for secondary vibration calibration by comparison of phase angles;*
- *Part 10: Method for primary calibration by high impact shocks;*
- *Part 11: Method of test for transverse vibration sensitivity;*
- *Part 12: Method of test for transverse shock sensitivity;*
- *Part 13: Method of test for base strain sensitivity;*
- *Part 14: Method of test for resonance frequency of undamped accelerometers on a steel block;*
- *Part 15: Method of test for acoustic sensitivity;*
- *Part 16: Method of test for mounting torque sensitivity;*
- *Part 17: Method of test for fixed temperature sensitivity;*
- *Part 18: Method of test for transient temperature sensitivity;*
- *Part 19: Method of test for magnetic field sensitivity.*

Part 20 of ISO 5347 is in preparation. It is envisaged that when it is published it will be implemented as Part 20 of BS 6955.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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 primary calibration of rectilinear accelerometers using laser interferometry for dynamic displacement measurements.

It is applicable for a frequency range from 20 Hz to 5 000 Hz and a dynamic range from 10 m/s² to 1 000 m/s² (frequency-dependent).

The limits of uncertainty applicable are as follows:

- ± 0,5 % of reading at reference frequency (160 Hz or 80 Hz) and reference amplitude (100 m/s² or 10 m/s²) and reference amplifier gain setting;
- ± 1 % of reading for frequencies ≤ 1 000 Hz;
- ± 2 % of reading for frequencies > 1 000 Hz.

2 Apparatus

2.1 Equipment capable of maintaining the ambient conditions, within the requirements specified in clause 3.

2.2 Frequency generator and indicator, having the following characteristics:

- uncertainty, for frequency: maximum ± 0,01 % of reading;
- frequency stability: better than ± 0,01 % of reading over the measurement period;
- amplitude stability: better than ± 0,01 % of reading over the measurement period.

2.3 Power amplifier/vibrator combination, having the following characteristics:

- total distortion: 2 % maximum;
- transverse, bending and rocking acceleration: kept to a minimum, maximum 10 % of the acceleration in the intended direction at frequencies used; above 1 000 Hz, a maximum of 20 % is permitted;
- hum and noise: 70 dB min. below full output;
- acceleration amplitude stability: better than 0,05 % of reading over the measurement period.

The attachment surface shall not introduce base strain to the accelerometer.

2.4 Seismic block for vibrator and laser interferometer (the same block), with a mass at least 2 000 times the mass of moving elements of vibrator, fixture and transducer.

The seismic block shall be suspended by low damped springs. If floor vibrations influence, the suspension resonance frequency vertically and horizontally shall be < 2 Hz.

2.5 Laser, of helium-neon type; in laboratory conditions of air pressure 100 kPa, temperature 23 °C and relative humidity 50 % the wavelength is 0,632 8 µm, which value is used in this part of ISO 5347.

If the laser has manual or automatic atmospheric compensation, this shall be set to zero or switched off.

2.6 Interferometer, of Michelson type, with light detector for sensing the interferometer bands and having a frequency response from d.c. to 15 MHz.

2.7 Counting instrumentation, (for Method 1, frequency range from 20 Hz to 800 Hz), having the following characteristics:

- frequency range: 10 Hz to 20 MHz;
- uncertainty, maximum: ± 0,01 % of reading.

The counter can be substituted by a ratio counter having the same uncertainty.

2.8 Tunable band-pass filter or spectrum analyser, (for Method 2, frequency range from 1 000 Hz to 5 000 Hz), having the following characteristics:

- frequency range: 100 Hz to 10 000 Hz;
- bandwidth: < 12 % of centre frequency;
- filter slopes: better than 24 dB/octave;
- signal-to-noise ratio: better than 70 dB below maximum signal;
- dynamic range: better than 60 dB.

2.9 Instrumentation for zero detection, (for Method 2 — not needed with spectrum analyser), with a frequency range from 30 Hz to 5 000 Hz. The range shall be sufficient for detection of output noise from the bandpass filter.

2.10 Voltage instrumentation, measuring true r.m.s. accelerometer output, having the following characteristics:

- frequency range: 20 Hz to 5 000 Hz;
- uncertainty, maximum ± 0,01 % of reading; below 40 Hz: 0,1 %.

The r.m.s. value shall be multiplied by a factor of $\sqrt{2}$ to obtain the (single) amplitude used in the formulae.

2.11 Distortion-measuring instrumentation, capable of measuring total distortion of 0 to 5 % and having the following characteristics:

- frequency range: 5 Hz to 10 kHz;
- uncertainty, maximum: ± 10 % of reading.