

JJF

**INDUSTRY STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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**Calibration Specification for Shock Measuring Instruments
(English Translation)**

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1 Scope

This Specification is applicable to the shock measuring instruments that characterize the shock performance using various types of shock acceleration time history with shock acceleration peak range of $(50 \sim 2.0 \times 10^6)$ m/s² and pulse duration range of $(0.015 \sim 10)$ ms, including standard shock acceleration measuring instruments and working shock acceleration measuring instruments with/without adaptive amplifier and display part, as well as the calibration of shock acceleration laser measuring instruments.

Note: Pulse duration greater than 10 ms can refer to this Specification.

2 Normative references

This Specification refers to the following documents:

JJF 1156 Terminology and definitions for measurement of vibration, shock and rotating velocity

JJG 2072-2016 Measuring instruments for shock acceleration

GB/T 2298-2010 Mechanical vibration, shock and condition monitoring -

Vocabulary (ISO 2041:2009)

GB/T 20485.1-2008 Methods for the calibration of vibration and shock transducers

- Part 1: Basic concepts (ISO 16063-1:1998)

GB/T 20485.13-2007 Methods for the calibration of vibration and shock transducers

- Part 13: Primary shock calibration by laser interferometry (ISO 16063-13:2001)

GB/T 20485.22-2008 Methods for the calibration of vibration and shock transducers

- Part 22: Shock calibration by comparison to a reference transducer (ISO 16063-

22:2005)

For dated references, only the dated version applies to this specification; for undated references, the latest version (including all amendments) applies to this specification.

3 Overview

The shock meter is an instrument used to measure the time history of shock acceleration, mainly characterized by its peak value and pulse duration. It usually consists of an

5.2.1 Shock acceleration standard/calibration device

The standard shock acceleration meter (or shock acceleration standard kit) or shock acceleration laser meter used as the main standard of the shock acceleration standard/calibration device shall be calibrated with the absolute shock metrology reference or metrology standard device. Other shock meters can be calibrated with the absolute or comparative shock acceleration standard device.

5.2.2.1 Digital storage oscilloscope

The oscilloscope shall have a bit number of not less than 12 bits, a sampling rate of not less than 100 MHz, a bandwidth of not less than 1 MHz, an integral error of less than 1%.

5.2.2.2 Data acquisition system

The amplitude resolution, sampling rate, storage space of the data acquisition system or waveform recorder shall meet the needs of shock acceleration measurement. Usually, the amplitude resolution of the acquisition card is not less than 10 bits; the sampling rate is at least greater than $10/T$, where T is the pulse duration of the shock waveform.

For a measurement system that uses charge amplifier integration to obtain a shock velocity waveform, its single integral error shall be less than 3%; for a system that uses software integration to obtain an shock velocity waveform, its integral error shall be less than 2%.

5.2.2.3 Dynamic signal analyzer

The frequency indication error of the dynamic signal analyzer is better than 0.01%; the spectrum amplitude indication error is better than 2%; the amplitude consistency between any two channels of the instrument is better than 0.1 dB; the phase consistency is better than 1° .

5.2.3 Filter

To avoid signal aliasing and suppress noise, the filter used shall have appropriate amplitude-frequency and phase-frequency responses; the filter effect of the selected cutoff frequency shall meet the measurement uncertainty requirements.

5.2.4 Standard capacitor (optional)

The standard capacitor of 1000 pF or 10000 pF has an accuracy level of 0.1.

5.2.5 Sine signal generator (optional)

The distortion of the single-frequency sine signal generated by the sine signal generator is less than 0.1%; the frequency stability is better than 0.1%; the amplitude stability is better than 1% (8 h).

6.1 Calibration of shock acceleration peak sensitivity

Use the specified torque value to rigidly fix the accelerometer of the shock measuring instrument to be calibrated on the shock standard/calibration device; the sensitivity of the matching adaptive amplifier is set at 1 pC/Unit (or mV/Unit). It is recommended to select no less than 7 points (including the minimum and maximum acceleration peaks) within the range of the calibrated shock measuring instrument for measurement, to obtain a set of shock acceleration sensitivities S_i under the conditions of a standard shock acceleration peak a_i , $i = 1, 2, \dots, N$, N is the number of shock calibration points.

The expanded uncertainty of the shock acceleration peak sensitivity S_i is evaluated in accordance with Appendix A or Appendix B.

6.2 Calibration of shock acceleration peak indication error

It is recommended to select no less than 7 calibration points (including the minimum and maximum acceleration peaks) within the operating range of the shock meter; the shock meter is set to the corresponding shock acceleration sensitivity gear. Measure once at each of the selected calibration points to obtain two measurement columns $\{a_0, i\}$ and $\{a_1, i\}$ of the standard shock acceleration peak and the shock meter indication respectively. At the same time, record the corresponding pulse duration measurement columns $\{T_0, i\}$ and $\{T_1, i\}$. The pulse duration is the time interval between the shock acceleration rising to 10% of the peak value and falling to this value. If the shock meter to be calibrated has an integration function, it is also necessary to record the velocity change $\{v_0, i\}$ calculated by the shock acceleration standard/calibration device and the velocity change $\{v_1, i\}$ calculated by the shock meter.

Calculate the acceleration indication error $\Delta a_{a, i}$ of each point according to formula (1):

6.3 Calibration of shock acceleration peak measurement repeatability

Under the condition that the standard/calibration device can produce repeated shock power; when the accelerometer is stationary, measure and calculate the variance of the noise as σ^2 ; the maximum measurable sinusoidal voltage peak value of this position is U (given in the manual), then the dynamic range D (in dB) is:

7 Expression of calibration results

The calibration certificate shall include at least the following information:

- a) Title: "Calibration certificate";
- b) Name and address of the laboratory;
- c) Location of calibration (if different from the address of the laboratory);
- d) Unique identification of the certificate (such as number), page number, total number of pages;
- e) Name and address of the customer;
- f) Description and clear identification of the object to be calibrated;
- g) Date of calibration and, if relevant to the validity and application of the calibration results, the date of acceptance of the object to be calibrated;
- h) Name and code of the technical specification on which the calibration is based;
- i) Traceability and validity of the measurement standard used for this calibration;
- j) Description of the calibration environment;
- k) Description of the calibration results and their measurement uncertainty;
- l) Description of deviations from the calibration specification;
- m) Signatures of the calibrator, verifier, approver;
- n) Statement that the calibration results are only valid for the object to be calibrated;
- o) Date of issuance of the calibration certificate and a recommendation on the time interval between recalibrations;
- p) Statement that the certificate may not be partially reproduced without the written approval of the calibration laboratory.

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