



**International Society of  
Explosives Engineers**

# **ISEE PERFORMANCE SPECIFICATIONS FOR BLASTING SEISMOGRAPHS 2011**

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This edition of ISEE Performance Specifications for Blasting Seismographs was revised by the ISEE Standards Committee on February 7, 2011, and supersedes all previous editions. It was approved by the Society's Board of Directors in its role of Secretariat of the Standards at its (INSERT DATE) meeting.

**International Society of Explosives Engineers (ISEE) – Standards Committee Members<sup>1</sup>**

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Robert Turnbull, Instantel  
Randall Wheeler, White Industrial Seismology Inc.

<sup>1</sup>This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred.

**Committee Scope:** This Committee shall have primary responsibility for documents on the manufacture, transportation, storage, and use of explosives and related materials. This Committee does not have responsibility for documents on consumer and display fireworks, model and high power rockets and motors, and pyrotechnic special effects.

**Origin and Development of ISEE Standards for Blasting Seismographs**

One of the goals of the ISEE Standards Committee is to develop uniform and technically appropriate standards for blasting seismographs. The intent is to improve accuracy and consistency in vibration and air overpressure measurements. Blasting seismograph performance is affected by how the blasting seismograph is built and how it is placed in the field.

In 1994, questions were raised about the accuracy, reproducibility and defensibility of data from blasting seismographs. To address this issue, the International Society of Explosives Engineers (ISEE) established a Seismograph Standards Subcommittee at its annual conference held in February 1995. The committee was comprised of seismograph manufacturers, researchers, regulatory personnel and seismograph users.

In 1997, the Committee became the Blast Vibrations and Seismograph Section. The initial standards were drafted and approved by the Section in December 1999. Subsequently, the ISEE Board of Directors approved two standards in the year 2000: 1) ISEE Field Practice Guidelines for Blasting Seismographs; and 2) Performance Specifications for Blasting Seismographs.

In 2002, the Society established the ISEE Standards Committee. A review of the ISEE Field Practice Guidelines and the Performance Specifications for Blasting Seismographs fell within the scope of the Committee. Work began on a review of the Field Practice Guidelines in January 2006 and was completed in February 2008 to produce the 2009 edition. A revision to the Performance Specifications was started in 2009 and completed in 2011.

The ISEE Standards Committee takes on the role of keeping the standards up to date every 5 years. This document is the result of the latest effort by the ISEE Standards Committee to keep the standards up to date with current field techniques and technology.

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**Disclaimer:** These performance specifications are intended to provide design guidelines for blasting seismograph manufacturers. It is important that the blasting seismograph operator evaluate field conditions, identify the appropriate field criteria and select the proper blasting seismograph for the field application. In all cases, the operator is responsible for documenting the field conditions and setup procedures in the permanent record for each blast.



## **P**REFACE

Blasting seismographs are used to establish compliance with regulations that have been established to prevent damage to public and private property. The disposition of the rules is strongly dependent on the accuracy of ground vibration and air overpressure data. One goal of the ISEE Standards Committee is to ensure consistent recording of ground vibrations and air overpressure between all blasting seismographs.

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## PART 1. GENERAL GUIDELINES

Blasting seismographs are deployed in the field to record the levels of blast-induced ground vibration and air overpressure. Accuracy of the recordings is essential. These guidelines define the manufacturers' responsibilities when building blasting seismographs for outdoor field use to measure ground vibrations and air overpressures that will be suitable for comparison to limiting criteria presented in United States Bureau of Mines RI 8507 and RI 8485 which often form the basis of regulations for blast vibrations. Blasting seismographs should be deployed in the field according to the ISEE "Field Practice Guidelines for Blasting Seismographs" [3]. The following specifications are considered minimums:

- 1. Digital sampling rate:** 1000 samples/sec or greater, per channel
- 2. Operating temperature range:** 10 to 1200F (-12 to 490C)
- 3. Electrical cross-talk:** Less than 2% of the input signal appears on any other channel

## PART II. GROUND VIBRATIONS MEASUREMENT

Ground vibration sensor response characteristics should conform to the following minimum values:

- 1. Frequency range:** 2 to 250 Hz, within zero to -3 dB of an ideal flat response.
- 2. Accuracy:**  $\pm 5$  pct or  $\pm 0.5$  mm/sec ( $\pm 0.02$  in/sec), whichever is larger, between 4 and 125 Hz.
- 3. Phase response:** Phase shift between 2.5 Hz to 250 Hz shall not cause an error of more than 10% to the maximum absolute value of two

superimposed harmonic vibrations.

**4. Cross-talk response:** Less than 5% of the excited axis indication on either of the mutually perpendicular channels when excited at the natural frequency of the sensor or at 10 Hz for sensors with a natural frequency greater than 250 Hz.

**5. Density of sensor:**  $< 2405$  kg/m<sup>3</sup> (150 lbs/ft<sup>3</sup>) (should be reported for user consideration).

## PART III. AIR OVERPRESSURE MEASUREMENT

Air overpressure microphones should conform to the following minimum values:

- 1. Frequency range:** 2 to 250 Hz, -3 dB at 2 and 50 Hz,  $\pm 1$ dB.
- 2. Accuracy:**  $\pm 1$  dB between 4 and 125 Hz.
- 3. Microphone seismic sensitivity:** Microphone response to a mechanical vibration of 50 mm/s (2 in/s) at 30 Hz, from any angle, must be less than 40 dB below the maximum microphone output, or 106 dB, whichever is lower.

## PART IV. CALIBRATION

To ensure proper operation, blasting seismographs should be calibrated annually by a facility authorized by the manufacturer.

- 1. Frequency:** Annually.
- 2. Traceability:** Calibration equipment accuracy must be traceable to National Institute Standards and Testing, National Research Council or equivalent.

**4. Certificate:** Issued with each calibration and signed by the authorized service representative.

**5. Documentation:** List the frequencies tested along with input and output values at each frequency. Provide documentation of measured frequency response characteristics.

**6. Ground Vibration Sensor:** Calibration must be of the assembled sensor. Component calibrations of individual sensors are not appropriate.

Furthermore, some blasting seismograph field needs are specific to an operator, an application, or a region. For example, blasting seismograph use in arctic-type conditions may require good performance at low temperatures or for close-in construction blasting extended frequency ranges might be necessary.

It is the responsibility of the operator to confirm that the blasting seismograph selected for measurement of ground vibrations and air overpressure in conditions not specifically covered by this standard, has performance characteristics to record data consistent with the tolerances described herein.

## **PART V. MEASUREMENT PRACTICES**

In addition to the Performance Specifications described above, blasting seismograph setup or installation in the field is crucial for accurate defensible data acquisition. These measurement practices are specified in the ISEE Field Practice Guidelines for Blasting Seismographs (2009).

## REFERENCES

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