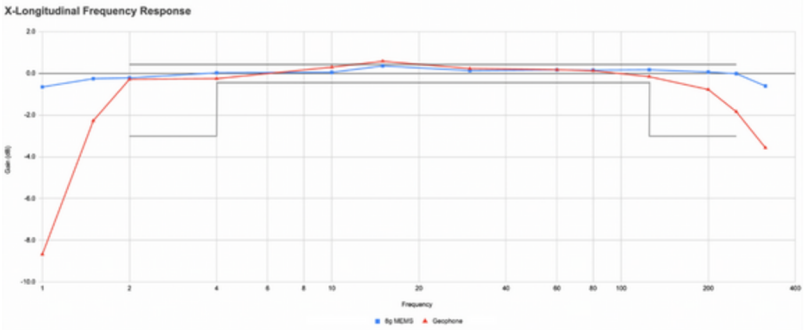
MEMS vs. GEOPHONES

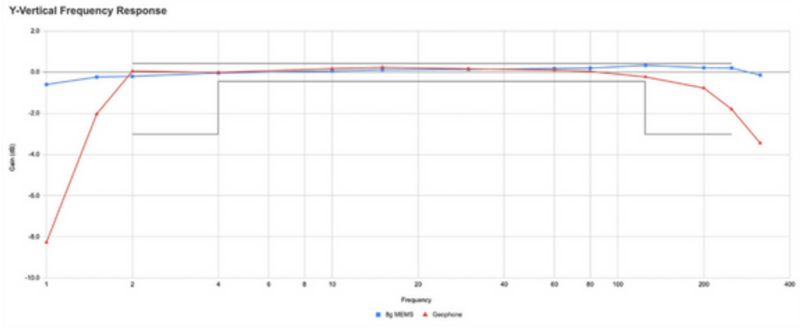
FOR VIBRATION MONITORING

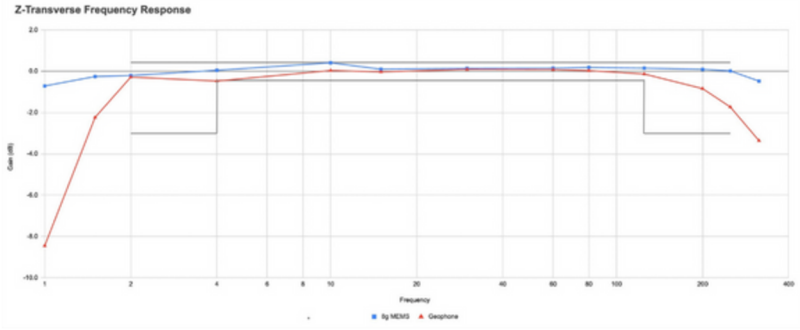
MEMS Accelerometers Proven More Reliable at Low- & High-Frequency Vibration Monitoring

Independent, third-party lab testing compared the MEMS-based accelerometer used by the Inzwa Veva III vibration monitor to a solenoid geophone-based vibration monitor against the ISEE standard. The geophone-based device performed as the manufacturer advertised and as any field practitioner would expect, and was consistent with the manufacturer's calibration report. Both sensing technologies performed within specifications in the middle part of the range. What's glaring, however, is the superior performance of the MEMS technology at both the lower and upper ranges of the scale:

- Lower Range: at 1.5Hz, the geophone-based sensor had approximately 2dB lower response than the MEMS sensor. At 1Hz, that performance gap grew to approximately 8dB – 60% lower than the MEMS sensor.
- Upper Range: At frequency levels above 125 Hz, performance differences as high as 24% were recorded between the different technologies, with the MEMS sensor providing more accurate readings. Also note that beyond the ISEE's upper limit of 250Hz, the MEMS technology continued to perform better than the geophone-based sensor.







The Data Are Clear::

MEMS-based accelerometers not only perform well within the ISEE standard – they also provide SUPERIOR performance for vibration monitoring at frequencies below 2Hz and above 125Hz.

MEMS Accelerometers

IN BLAST-INDUCED SHOCK & VIBRATION MONITORING

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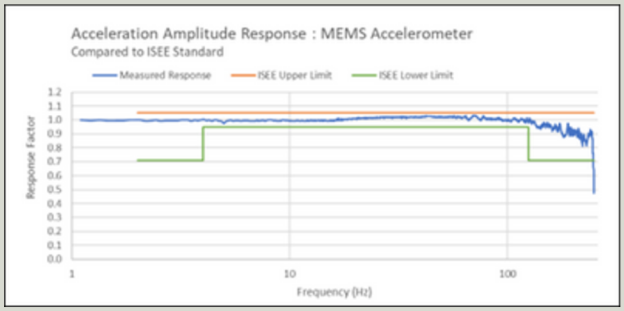
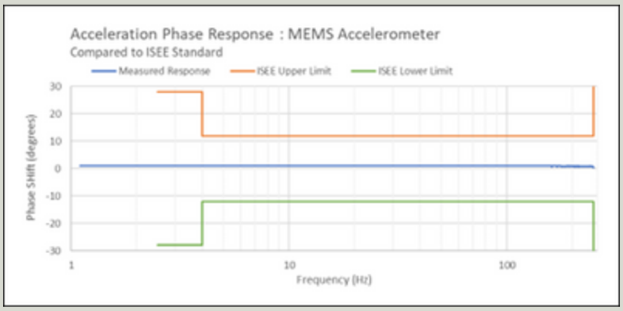
Are MEMS accelerometers a reliable alternative for explosive industry applications? This 2022 research study set about to answer this question. The first step was to conduct a test to compare MEMS performance against a calibration standard via a series of shaking table tests. This test used a rig that housed both an embedded MEMS accelerometer and a calibration accelerometer (the Bruel & Kjaer type 4370). Following a zero Hz frequency static calibration, the data captured underwent an FFT conversion into the time domain. The results indicate the accurate and reliable performance of the MEMS device at measuring vibratory events well within ISEE standards.

Amplitude response compared to the ISEE Standard.

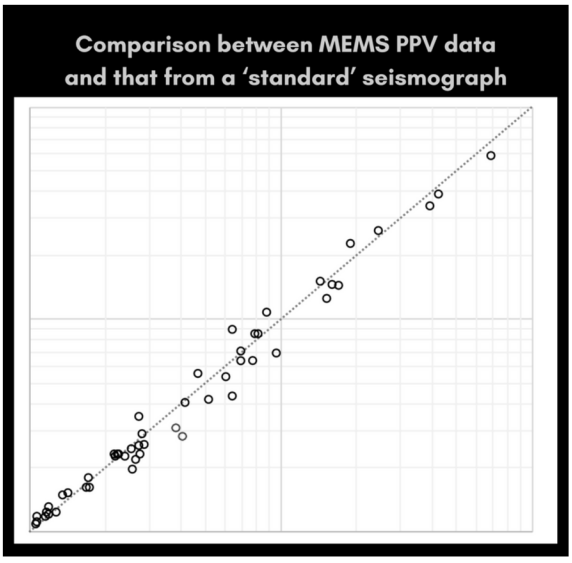


Phase response compared to the ISEE Standard.



A prototype MEMS accelerometer was then developed and placed in field trials against two of the industry's widely accepted seismographs known for compliance with ISEE standards. A total of 55 events were monitored with resultant PPV values ranging from 0.8 mm/s (0.03 i.p.s) to 58.5 mm/s (2.3 i.p.s).

Resultant PPV values from the standard seismographs plotted against that recorded with the accelerometer-based prototype showed correlation coefficient between the data sets is 0.992.



Conclusion:

"The use MEMS based accelerometers in blasting seismographs has been proven to be perfectly feasible and it has been shown that such equipment can easily meet the requirements of the ISEE Standard."

Presented at ISEE 2023 and reproduced with authors' permission. To access the full report, please visit inzwa.io/isee-vibration-monitoring-research