IMI SENSORS
A PCB DIVISION

Industrial Vibration Sensor Selection Made Easy

INDUSTRIAL VIBRATION SENSOR SELECTION MADE EASY

YOUR SENSOR SELECTION CHECKLIST: NINE QUESTIONS FOR SUCCESS

Selecting the best accelerometer for a specific predictive maintenance application can be a daunting task—even for the most seasoned walk-around warrior. Sensor manufacturers' web pages are laden with hundreds, if not thousands, of similar-looking tin cans, all for "vibration monitoring." The selection process can typically be filtered down to a series of nine specific questions. This article will allow you to master the mystery of vibration application engineering. By discovering the answers to the following nine questions as they apply to your personal application, you will be able to find the best vibration monitoring solution.

Question #1 – What do you want to measure?

This may seem obvious at first, but stop for a second—what are your actual goals? What do you expect to do with the data? Vibration can be monitored with accelerometers that provide raw vibration data , or with vibration transmitters that provide the calculated overall RMS (Root Mean Square) vibration via a continuous 4-20 mA signal. Raw vibration data is useful for analysts because it contains true peak amplitudes and frequency content; 4-20 mA outputs integrate easily with PLC (Programmable Logic Controller), DCS (Distributed Control System), SCADA (Supervisory Control and Data Acquisition), and PI (Plant Information) systems. In some cases, customers use both.

By determining which signal type your application requires, you can significantly narrow your search.

Also consider:

- What type of measurement output is required for your application—acceleration, velocity, or displacement?
- Is integrated temperature output a requirement? (Many ICP® accelerometers and 4–20 mA vibration transmitters provide both vibration and temperature data.)
- Does your application require single-axis, biaxial, or triaxial vibration monitoring?

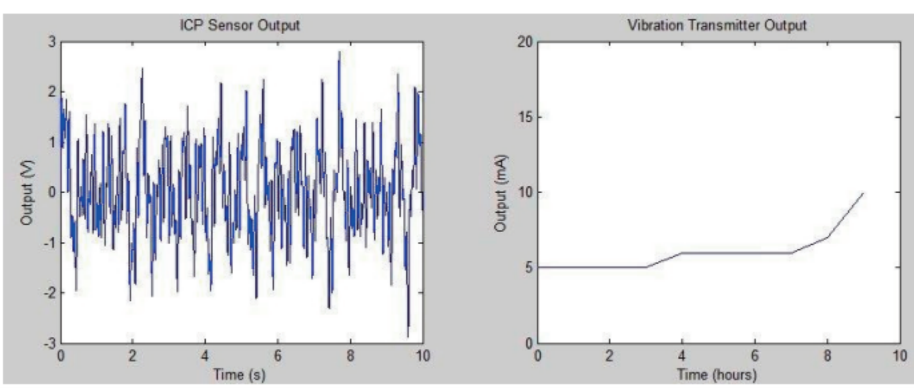

Figure 1: Comparison of ICP® sensor and 4-20 mA transmitter outputs

Question #2 – What is the amplitude of vibration?

The maximum vibration amplitude of the vibration being measured determines the sensor's range. Typical sensitivities for ICP® accelerometers are 100 mV/g for a 50 g range (standard) and 500 mV/g for a 10 g range (low-amplitude or low-frequency). General industrial applications with 4-20 mA transmitters commonly use ranges of 0–1 in/s or 0–2 in/s.

Question #3 – What is the frequency of vibration?

Environmental temperature plays a critical role in the proper functioning and reliability of vibration monitoring equipment. Excessively high temperatures can degrade the internal electronics of ICP® accelerometers and 4–20 mA transmitters, potentially compromising measurement accuracy and sensor longevity.

To address elevated temperature conditions, high-temperature ("HT") models are available and designed to withstand more demanding environments. For applications involving very high temperatures, such as those exceeding the operational limits of sensor electronics, a charge mode accelerometer—without built-in electronics—paired with a remote charge amplifier is strongly recommended.

In ultra-high-temperature environments (above 500 °F / 260 °C), such as gas turbine monitoring or aerospace engine applications, the most suitable solution is a charge mode accelerometer equipped with an integral hardline cable to ensure signal integrity and long-term durability.

Question #4 – What is the temperature of the environment?

Extremely high temperatures can pose a threat to the electronics in ICP® accelerometers and 4-20 mA transmitters. IMI Sensors offers "HT" (high temperature) versions of both. For very high temperatures, use charge mode accelerometers (no built-in electronics) with remote charge amplifiers. For ultra-high-temperature applications above 500 °F—such as gas turbine monitoring—choose charge mode sensors with integral hardline cable.

Temperature	Type of Sensor	Built In Electronics
185 °F (85 °C)	4-20 mA Transmitter	Yes
250 °F (121 °C)	ICP® Accelerometer	Yes
255 °F (125 °C)	"HT" 4-20 mA Transmitter	Yes
325 °F (162 °C)	"HT" ICP® Accelerometer	Yes
500 °F (260 °C)	Charge Accelerometer	No
900 °F (482 °C)	Integral Hard-line Charge Accelerometer	No

Question #5 – Will the Sensor Operate in a Submerged Environment?

For applications requiring submersion in liquid, it is important to select accelerometers designed for such conditions. IMI's industrial accelerometers with integral polyurethane cables are fully submersible and suitable for permanent installations in environments with pressures up to 1,000 psi. For high-pressure applications, it's best practice to pressure-test sensors at the operating pressure for at least one hour to ensure long-term reliability. Even in less extreme environments—such as machine tools exposed to spray or cutting fluids—sensors with integral cables are still recommended for optimal protection.

Question #6 – Will the Sensor be exposed to harmful chemicals or debris?

IMI's industrial accelerometers are constructed with stainless-steel bodies for chemical and corrosion resistance. In chemically aggressive environments, consider using PTFE cable with corrosion-resistant boot connectors—and always consult a chemical-compatibility chart. For debris exposure (e.g., cutting chips), armor-jacketed cables offer excellent protection.

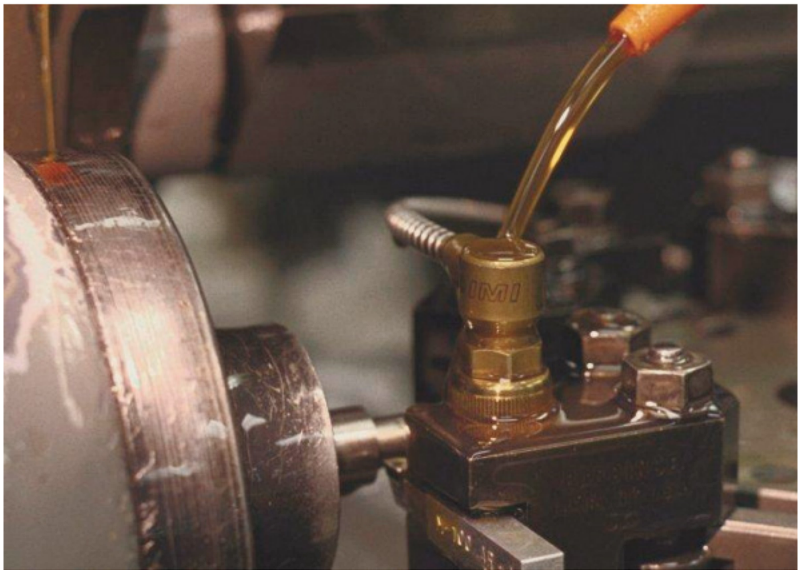

Figure 2: IMI 607A61 Swiveler® and armor-jacketed cable immersed in cutting oil

Question #7 – Do you prefer top-exit, side-exit, or a low-profile Swiveler®?

Installation space and orientation matter more than geometry for performance. IMI's patented Swiveler® design is one of the lowest-profile industrial accelerometers available. Its locknut design lets you orient the sensor before tightening, which is especially favorable when working with integral cable in tight spaces.

Question #8 – Should you use a precision or low-cost sensor?

There are two main differences between low-cost and precision sensors. First, precision accelerometers typically receive a full calibration across frequency; the sensitivity response is plotted with respect to the usable frequency range. Low-cost accelerometers receive a single-point calibration; the sensitivity is shown only at a single frequency. Second, precision accelerometers have tighter tolerances on some specifications, such as sensitivity and frequency range. For example, a precision accelerometer may have a nominal sensitivity of 100 mV/g ± 5%, while a low-cost accelerometer may have a sensitivity of 100 mV/g ± 10%. Regarding frequency, a precision accelerometer will typically publish ranges where the maximum deviation is 5%, while low-cost accelerometers may only publish a 3 dB range. If you normalize inputs in your data-acquisition system, low-cost sensors can yield repeatable, accurate data at a lower price.

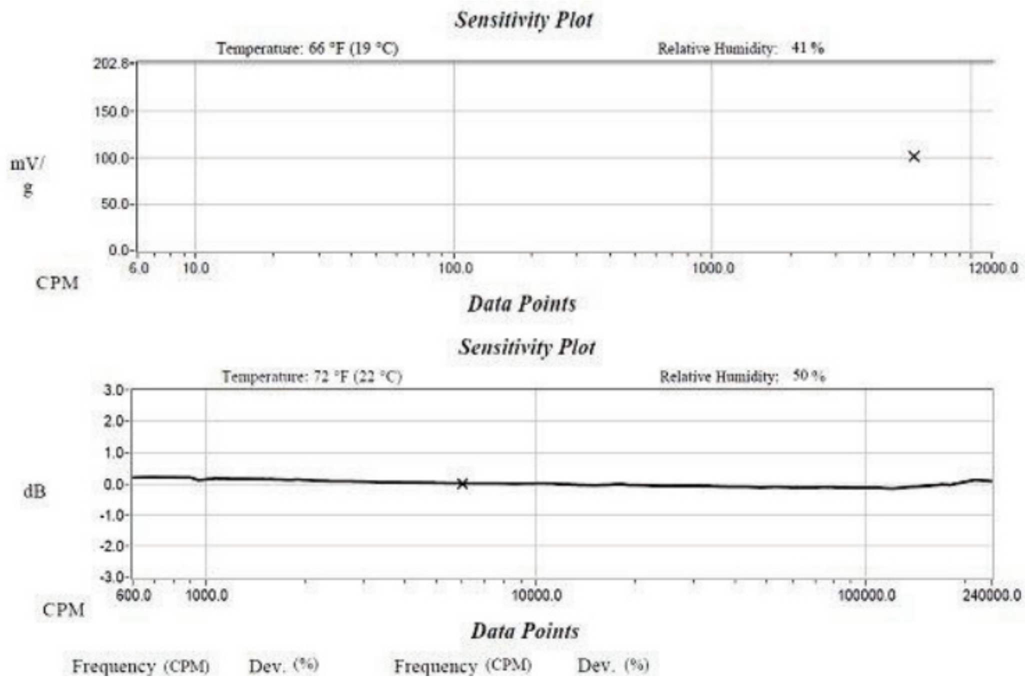

Figure 3: Comparison of calibration data for a low-cost (top) and precision (bottom) accelerometer

Question #9 – Are Specific Industry Approvals or Certifications Required?

Depending on your application environment, certain regulatory or safety certifications may be necessary. Both ICP® accelerometers and 4–20 mA vibration transmitters are available with CSA and ATEX certifications for use in hazardous or classified areas.

It's essential to match your application's compliance requirements with the sensor's published approvals and certifications. Keep in mind that not all configurations are compatible—for example, a particular model may not simultaneously support specific certifications or environmental tolerances. For complex or highly regulated environments, additional factors may need to be considered.

Notes

[1] **Accelerometers** are vibration transducers that measure acceleration. They are most commonly piezoelectric sensors that provide dynamic vibration signals. Power supplies and data-acquisition systems are required to collect raw data.

[2] **Predictive Maintenance (PdM)**, unlike scheduled preventive maintenance, uses machine-health data to optimize maintenance timing.

[3] **Raw Vibration Data** (time waveform) is the complete time history of the signal associated with vibration; it requires data-acquisition tools to interpret.

[4] **Vibration Transmitters** (loop-powered 4-20 mA) output RMS or calculated peak values for continuous monitoring.

[5] **RMS (Root Mean Square)** indicates average vibration level and is most commonly used for trending changes over time.

[6] **True Peak** is the actual maximum vibration level measured; Calculated Peak equals RMS × 1.414.

[7] **Sensor sensitivity** is the relationship between the electrical output and the mechanical input. It is expressed as output voltage per unit acceleration (mV/g) or velocity (mV/in/s).

[8] **Charge Mode Accelerometers**, unlike ICP®, have external charge amplifiers. Although they are more susceptible to noise, charge mode accelerometers are useful in high temperature environments that would destroy the internal electronics of an ICP® accelerometer.

IMI SENSORS
A PCB DIVISION

3425 Walden Avenue, Depew, NY 14043 USA

pcb.com/imi-sensors | imi@pcb.com | 800 959 4464 | +1 716 684 0003

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