IMI SENSORS
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The value of keeping sensors in-spec

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When sensors underperform until your equipment fails, the result can be incredibly dangerous

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Are your sensors performing to spec? If you rely on them for predictive maintenance, you bet your factory on it daily.

The widespread use of sensors in industry allows technicians and engineers to acquire a wide variety of data on the health of machine assets. However, data quality depends on the ability of you and your team to ensure that the sensors are performing in spec and with a high degree of reliability.

Victor Viola is Director, Industrial Division, at PCB-IMI Sensors, Depew, NY. He has spent nine years in the industrial-sensor market with a focus on Condition Monitoring, and he is responsible for global sales and marketing of all IMI products in the following areas: Predictive Maintenance, Process Monitoring, and Protection/Control Products.

In the following interview, IMI Sensors' Victor Viola reveals why you should always view advertised sensor specifications with a healthy dose of skepticism–and what can happen if you don't. For more information, visit www.pcb.com.

Q: What would cause a sensor to perform outside of its manufacturer's advertised specifications?

A: There are a few possibilities—the most obvious being damage to the sensor due to mishandling or misuse. Inadvertent use of a sensor outside of its temperature range, use in a harsh environment that the sensor wasn't built for, or exposure to electrostatic discharge, that sort of thing can lead to a sensor underperforming. Luckily, this one has a pretty straightforward solution: read manufacturer warnings and use the sensor as intended.

Sometimes users aren't aware, or were never informed by the manufacturer, that all sensors do need to be calibrated at regular intervals to make sure they're providing accurate data. The frequency of calibration depends on use, but for piezoelectric sensors, PCB recommends yearly calibration (which we provide at our facility, both for our sensors and for sensors from other manufacturers.) Quartz sensors can last a little longer before needing to be recalibrated, but they have their own limitations and environmental sensitivities to watch out for. All of this really comes down to making sure you're using and caring for the sensor in the way it was intended.

Unfortunately, there is a third possibility that is completely outside of the user's control, and that is: that the sensor coming from the factory was never up to spec in the first place. And this falls on the quality standards of the manufacturer. Sensor performance is always verified in some way before leaving the factory, but not all verification methods are equal. As a consumer, it pays off to check out the calibration standards of the manufacturer. How are they arriving at their advertised specifications? Are calibration methods accredited to national standards? Are all the basic performance attributes present on the spec sheet? I really encourage customers to read the fine print on how the sensors were tested. The more information you can get on a sensor's proven performance over time, the better.

Q: What happens when the sensors you are using to monitor vibration on machines are not giving accurate measurements?

A: When you're using sensors to monitor machinery, sometimes you'll get false trips that make it obvious that something's off. But sometimes a sensor can underperform without showing any signs until your equipment fails, and that's when your result varies from expensive and incredibly dangerous.

I know of a paper mill customer that once was scurrying to install an accelerometer on a paper machine roller following a very expensive bearing replacement. This roller did not yet have a permanent sensor installed on this end like most other rollers on this paper machine. The mill standardly used our precision sensors on paper machine rollers due to potential loss of production and expensive bearing failures/replacements. They also tested all these sensors using our portable vibration calibrator every six months.

During the process to get the paper machine up and running, a technician was sent to get a sensor and cable out of the storeroom. The way the sensors are installed, the cables are run to a BNC box away from the rollers purely for safety reasons. The technician installed the sensor and cable to the BNC box and the paper machine was finally restarted and running again.

The vibration group took baseline readings on the roller which seemed to be a little higher compared to other rollers but were not out of line. The next night, the bearing on that roller again failed causing production to stop once again.

During the RCA analysis of why this happened, it turned out that the technician installed a sensor that was not a precision sensor, but a low-cost sensor that had not really been tested for a few years. The sensitivity tolerance on this sensor was 20% vs. our precision sensor of 5%. After a test of the sensor, it turned out to be barely within the 20% spec.

The RCA report showed that the bearing was installed improperly which caused the failure. The report also stated that the accelerometer was not the proper model specified by the plant and that if the right one was installed, they believe that the initial vibration data collected upon startup would have showed an issue.

Q: Is there any data showing how common it is for manufacturers to advertise inaccurate or incomplete specifications?

A: I'm not aware of a solid figure for how often this occurs, but I do know that PCB has tested sensors from other manufacturers that came up short of their advertised specs.

For example, we tested an accelerometer directly from factory – I won't name the manufacturer – but the sensor tested was of very high quality, from a highly reputable company. The sensor was advertised to be within 5% of 50 pC/g at 120 Hz.

And it was; we measured it to be 50.39 pC/g at 120 Hz. But the datasheet also stated that the sensor's output will remain within +/- 5% of the sensitivity at 120 Hz (so 50.39 pC/g) through the frequency range of 5 Hz to 3000 Hz. This was not the case. Our calibration lab – accredited by A2LA and offering some of the lowest uncertainties in North America for accelerometers (possibly the lowest) – found the sensitivity to drop by more than 17% at 10 Hz and by over 11% at 5 Hz.

Furthermore, the datasheet said something about calibration that the international standard for accelerometer calibration (ISO 16063-21) does not agree with: "No subsequent calibration is necessary."

During the RCA analysis of why a roller bearing kept failing, thereby causing production to stop repeatedly, it turned out that the technician installed a sensor that was not a precision sensor, but a low-cost sensor that had not really been tested for a few years.

Of course, the calibration data proves the manufacturer's statement false; subsequent calibration is indeed necessary. Had this sensor been used in a real application, vibration data at 10 Hz would have 17% error on the low side (i.e., 0.50 g's actual vibration would display as 0.415 g's).

And it's worth noting that, even if the specifications had been correct, sensor performance can be influenced by shock events or temperature shifts, or even just naturally over time. So you can see why that standard exists.

Q: How can you be sure your sensors of choice are performing per the advertised specs for them?

A: Do your research when it comes to how those specifications were established. There are a number of accrediting bodies that can really help eliminate the guesswork on a manufacturer's testing standards. Scan the fine print for mentions of NIST (National Institute of Standards and Technology), NVLAP (National Voluntary Lab Accreditation Program), or A2LA (American Association for Lab Accreditation).

And, we already talked about the importance of regular calibration, which can be done by the manufacturer, hired-in specialists, or even in the field by your own maintenance team if you're ready to take calibration into your own hands. In addition to our calibration services, PCB offers products from handheld shakers to portable calibration tables, some of which are capable of printing ISO certified calibration certificates. Whatever method you go with, the important thing is that you do calibrate.

Q: Returning to the point of checking sensor specifications, are there any additional resources you can provide to help customers navigate manufacturers' claims?

A: Not really. You have the world at your fingertips with a web search – we all research our purchases that way – but I would just encourage readers to dig deeper than a search for, say, "reliable accelerometer." The reputation of the manufacturer is important, so find out what you can about manufacturing practices and calibration standards. And don't hesitate to reach out directly to the manufacturer – there is always performance data that can tell a bigger story than the spec.

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