BREAKTHROUGH STRATEGIES: THE LEADER'S CODE

OCTOBER 2010
VOL. 79 NO. 10 | www.ohsonline.com

OH&S

OCCUPATIONAL HEALTH & SAFETY

Does Your Gas Monitor Do What You Think It Does?

1105 MEDIA

Does Your Gas Monitor Do What You Think It Does?

Until we have a standardized technical performance specification template for portable gas monitors, users must carefully examine the specifications.

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The conversation usually starts out something like this:

"Do you have an instrument to detect MEBG?" (That's methyl ethyl bad gas, to those of you not in the know.)

"Sure do! You can get an MEBG sensor in a number of configurations in either a single-gas or multi-gas detector."

"What is the measuring range?"

"The measuring range is from zero to about a zillion parts per million."

"That's great! What is the resolution?"

"0.1 parts per million."

"What is the accuracy?"

"Plus or minus two percent."

"Wow! Can you really do that?"

Ahhh, now we have reached the million-dollar question. "Can this instrument really do that?" Or, more accurately stated from the perspective of most industrial hygienists, "Can this gas monitor really do what I want, need, and expect?"

The 21st Century world's foremost authority on everything, Wikipedia, states that an occupational (industrial) hygienist is "one who studies the art and science dedicated to anticipation, recognition, evaluation, communication and control of environmental stressors in, or arising from, the workplace that may result in injury, illness, impairment or affect the well being of workers and members of the community." One of the key methods and tools used by industrial hygienists to assess workplace hazards is the performance of atmospheric surveys using portable gas monitoring instruments. But as Wikipedia also states, the industrial hygienist "does not rely on the accuracy of the equipment or method used, but in knowing with certainty and precision the limits of the equipment or method being used and the error or variance given by using that particular equipment or method." This brings us back to the question, "Is this gas monitor really capable of doing what I need it to do?"

The industrial marketplace is populated by a number of gas detection equipment manufacturers who produce a myriad of portable gas monitoring instruments for industrial hygiene and safety applications, all with specifications that appear very similar. However, each manufacturer has its own interpretation of the meaning of technical performance specifications. With no industry-standard guidelines for the definition of those specifications, instruments that look very synonymous may in fact perform very differently. Often the manufacturers themselves do not have a clear understanding of the limits of the technical specifications they have published. I must confess that when asked recently by an industrial hygienist about the confidence factor associated with a particular accuracy specification, I had no clue. Considering this, when

searching for gas monitoring instruments to meet particular applications, the burden of interpreting and clearly understanding the performance specifications and limitations of the equipment is on the end user. To assist, we will attempt to explain the differences in some of those key performance specifications here.

Measuring Range

The measuring range of a particular sensor would appear to be very straightforward. However, there is a large variance in the measuring ranges of sensors in instruments from various manufacturers that clearly can be a determining factor in whether or not the instrument is satisfactory for your application. Instruments that otherwise appear identically equipped with seemingly simple hydrogen sulfide sensors may have measuring ranges varying from 50 ppm all the way up to 2,000 ppm. As a rule of thumb, a suitable measuring range for a sensor in most industrial hygiene or safety applications will reach the IDLH level of the target compound.

Accuracy

The accuracy of the instrument is specified at plus or minus 5 percent. But 5 percent of what, and under what conditions? Manufacturers may all specify accuracy differently. The accuracy may be specified as a percentage of the reading, or a percentage of full scale, or possibly even a percentage of something else. If the measuring range is 0-500 ppm and the reading is 20 ppm, there can be a very significant difference in the error of that reading if the accuracy is 5 percent of the full scale range of 500 versus 5 percent of the reading of 20. Is the accuracy the same at different temperatures? Is it the same when calibrated with different levels of calibration gas? Often not, but without those details, the accuracy specification is subject to your interpretation.

Repeatability

The repeatability specification is often left unstated by many manufacturers because it is considered to be the same as accuracy. Some instrument manufacturers will contend that if they specify the accuracy as a percentage of the reading value, subsequent readings from the same sample will produce results within that accuracy tolerance and are therefore considered to be repeatable.

In fact, the measure of repeatability is something quite different. Repeatability refers to how often a known sample will produce the same reading. It is truly a measure of the precision of the instrument and a key specification in many industrial hygiene gas monitoring applications. Do not be surprised, however, if the manufacturer you are talking to cannot quote you a true repeatability specification.

Resolution

The sensor measurement or reading resolution is often confused with the minimum detection limit that we will discuss later. Resolution is the minimum single step value between adjacent measurements or readings. Generally speaking, sensors with a measurement range greater than 100 ppm have a reading resolution of 1 ppm. Sensors with a range of less than 100 ppm and less than 10 ppm typically carry a resolution of 0.1 ppm and .01 ppm, respectively.

It is a good rule of thumb to say that a sensor reading should have resolution an order of magnitude finer than the most accepted occupational exposure limit for the target compound and readings indicating that resolution should reliably fall within the accuracy specification.

Minimum Detection Limit

The minimum detection limit is the lowest value that can be measured and displayed within the accuracy specification reliably. A sensor with a reading resolution of 0.1 ppm may in fact have a minimum detection limit of 0.1 ppm. But this often is not the case. Many instruments that claim a resolution of 0.1 ppm or even lower do not utilize sensors that produce enough signal stability to provide a reading at that level that complies with the accuracy specification. You may even find some instruments on the market that claim a resolution of 1 ppm, without stating a minimum detection limit, where the first non-zero reading displayed 5 ppm, 10 ppm, or greater.

Datalogging

The datalogging functionality of an instrument is often critical to many industrial hygiene gas monitoring applications that require data from surveys to be compiled for review at a later time. Although it is not a true performance specification in the sense of those we have been discussing, the functionality is something that varies widely between manufacturers, just like the other specifications.

Most instrument dataloggers are specified to store readings or "events" at a particular interval for a given period of time or number of events. The most common format is to store a reading at one-minute intervals for some time period. But that still does not clearly indicate the true performance of the unit. An instrument that records a reading every minute may accumulate an average of measurements over the course of a minute and store that value; it may hold the peak measurement over the course of a minute and store that value; or it may simply record and store the instantaneous measurement every minute. The resultant information will reflect a much different image of the same picture and leave it up to the user to attempt to interpret the image correctly.

Each of these examples illustrates the confusion that exists in technical specifications from instrument manufacturers and shows the awareness that you must have when choosing a monitor that will give you the desired performance in a particular application. The American Industrial Hygiene Association's Real Time Detection Systems Committee is working to define and develop a standardized technical performance specification template for portable gas monitoring instruments and, when it is complete, will lobby all gas detection equipment manufacturers to adopt it and adhere to it. Until this is accomplished, only your own diligence in examining the specifications will allow you to enter a gas monitoring application knowing that your instrument will really do what you expect. OHS

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