5 common mistakes when choosing a gas detector

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The biggest mistake you will make when choosing a gas detector is making your choice based purely on price. Not all gas detectors are created equally and, like most things in life, you will get what you pay for. Listed in this article are 5 common features, or specifications, of gas detectors where mistakes can be easily made. These features are:

1) Calibration and Maintenance

2) Measurement Range

3) Lifespan or Longevity

4) Temperature Effects

5) Response Time

1 – calibration and maintenance

In today's world it is expected that technology is easy to use and requires little to no maintenance. Few of us have the time to read hundreds of pages of a manual, nor can we afford to constantly check and maintain our gas detectors.

Fortunately, some CO2 detectors have an automatic calibration function that means they need little ongoing maintenance. The patented technology is called Automatic Baseline Correction (ABC) and you need to ensure your CO2 detector has this feature. ABC is ideally suited for indoor air quality (IAQ) and office building installations. It assumes that at 4am there is no person inside the office and the baseline CO2 value at this time should be approximately 400ppm. Advanced ABC units can check these values over successive nights and the automatically correct for any drift away from 400pm.

Unfortunately, every other gas detector does not have ABC and, even with the ABC feature, you must check the integrity of your gas detector at regular intervals. There is no official standard to adhere to, but generally the calibration/maintenance timing depends on the application. If it is an office application then checking the sensor once a year should be fine. If the application is in any type of industrial environment then quarterly checks should be undertaken. For any scientific application then calibration checks on a regular basis should be undertaken.

This does not mean that every year or quarter you need to uninstall your gas detector and return them to the manufacturer or supplier to be checked. You can check the detector quickly with a portable meter. The values of the fixed detector should be within ±10% (or less if it is a scientific application) of the value detected on the portable meter. If the values are outside of this range then you should definitely consider uninstalling the unit and returning it to the manufacturer or supplier for additional checks.

2 – measurement range

The measurement range of a gas detector is obviously of utmost important but it is surprising how many people overlook or misunderstand this parameter. Every specification sheet should state the measurement range and if it is missing you should definitely consider a different supplier or manufacturer! There are two primary mistakes commonly made with measurement range: units of measurement and expected values for a particular application.

The first confusion with measurement range is the stated measurement units of the gas detector. Unfortunately, there is no rule, let alone consistency, when stating measurement units for gas detectors. Common units for atmospheric gas detectors, such as CO2 or CO detectors, is parts per million (ppm) or percentage (%). We have provided an online calculator that converts between ppm and %. Usually, for indoor air quality (IAQ) and related applications only the ppm or % values need to be known. For dissolved gas sensors, and scientific applications, there are more measurement units and it can be more confusing. For example, you will need to know the difference between mass-fraction, mole-fraction and volume-fraction and the units mg/kg, umol/mol and uL/L, let alone how these relate to mmHg.

The second confusion with measurement range is the expected measurement range for your particular application. There is a CO table and a CO2 table outlining expected values and how these values impact on safety. Note the values for maximum limits and continuous exposure over a 15 minute time period versus an 8 hour time period.

The measurement range for scientific applications is particularly important. Any researcher should consult the literature to determine the typical measurement range that will be expected for their particular application. There is no rule and it will depend on hypotheses, experimental conditions, and a range of other factors. One example is measuring soil CO2 concentration – a highly variable parameter that depends on soil type, moisture levels and soil depth. In the top 10cm of soil, measurement range may be between 0 and 5,000ppm. At 30cm depth, however, measurement range could be as high as 20,000 ppm. Therefore, the soil CO2 sensor will need to be able to measure over this expected range.

3 – lifespan and longevity

The lifespan, or longevity, of a gas detector is something that is very important but is often easily overlooked. A good supplier of a gas detector will always inform you of how many years the detector is expected to perform. If this information is not supplied you really need to ask why.

Obviously, it is preferred that the gas detector will have the longest life possible. But a good analogy can be made with batteries (and a range of gas detectors, such as galvanic cell type detectors, perform similarly to batteries). High quality batteries can have a long lifespan compared with low quality batteries however there can also be a significant difference in price. It is the same with gas detectors.

High quality gas detectors can have lifespans of 15+ years, whereas low quality gas detectors may only have a lifespan of 2 years. This is critically important in terms of budgeting and upfront costs of a project. Often, the expense of an installation is judged on the upfront cost of providing and installing the sensors. Considerations of longer term maintenance or replacement of sensors is not always given. The upfront cost of a gas detector with a lifespan of 2 years can be considerably cheaper than a gas detector with a lifespan of 10 years. But if you need to replace the sensor every 2 years then the cost of that cheap sensor can quickly become considerable – just think of the amount of time and labour will be needed to replace sensors every 2 years.

Additionally, the lifespan of 2 years does not commence from the time you install the detector but from the time it was manufactured and, presumably, calibrated. From the time that a detector is manufactured to the time that it is shipped to you, sat on a shelf while you completed other aspects of your project, and you installed it, can be several months. Therefore your 2 year sensor has been reduced to an 18 month sensor or less.

4 – temperature effects

Gas detectors, based on diffusion of the target gas from the environment to the sensing point, are affected by temperature. That is, if you measured CO2, for example, at 10C and then at 20C you will find a different answer not because CO2 concentration has changed but because the temperature has changed. Scientific research has shown that, depending on the sensor model, a change in temperature by 10C can affect the measured output by as much as 5 to 20% (Yasuda et al 2012).

The reason why there is a temperature effect on your gas detector is because the rate of diffusion of the gas changes. With increasing temperature, the rate of diffusion of the target gas increases and this can lead to an increased in the measured value of that gas.

The temperature dependency of gas measurements is critical for scientific applications and some industrial safety applications. For these applications, users will either need to simultaneously measure temperature and post-correct data (see Yasuda et al 2012 as an example), or source a high quality detector that automatically corrects for temperature variations.

For handheld portable meters, IAQ and office building applications, the effect of temperature is less important. With your handheld portable meter, particularly for measuring CO2 with NDIR measurement principle (this will be just about all of the portable CO2 meters commercially available), ensure that it has an automatically in-built calibration feature. These meters can be calibrated when they are initially switched on or periodically when needed. When you perform a calibration, ensure you do so in fresh air and at a temperature where you will be using most often. If you calibrate the meter early in the morning then you may need to re-calibrate at midday when the temperature has changed.

For IAQ and office buildings applications, temperature effects are not so critical as office temperatures are maintained at a consistent level.

5 – response time

The response time of a gas detector means the length of time it takes for the maximum value of a gas to be detected. Response time is important for scientific applications and is generally not considered as important for IAQ, office buildings or industrial applications. Generally, though, a fast response time is better than a slower response time and is often listed in the specifications.

Due to the physics of gas detection, the sensor does not measure all of the gas in the sample instantaneously. It can take time for the gas to diffuse into the measurement chamber or, for semiconductor type sensors, to react with the base metal. For Clark-type microsensors, response time can be less than 0.3 seconds, for laser sensors the time can be about 5 to 10 seconds, whereas for some NDIR and semiconductor CO2 or CO sensors the response time can be on the order of 2 to 5 minutes.

Specification sheets will often list response time as T63 or T90. The value T63 means the length of time it takes for the gas detector to reach 63% of its maximum value whereas T90 is 90% of its maximum value. Some manufacturers will only list the T63 value whereas the T90 value is more important and indicative of true sensor performance. Always check which value is being stated as this can have a significant impact on your experimental outcomes.