Determining Optimal Sensor Mounting Height for Fixed Gas Detection Systems

Introduction

One of the most common questions with regards to the installation of fixed gas detection systems is: “How high should I mount my sensors?”. Unfortunately, this is also one of the more difficult questions to answer.

Whereas other types of detection systems, like smoke detectors, are highly regulated with clearly defined requirements for mounting height, gas detectors usually do not have the same standards. Some guidelines are published by the National Electric Code (NEC), Canadian Electric Code (CEC), and National Fire Protection Association (NFPA); however, these guidelines do not apply to all gases and tend to be very generic with detail too vague to be relevant in many applications. Some specifications are also published by regulatory bodies to inform of the minimum gas detection requirements; but again, these vary widely by locality and do not always provide the information required to determine optimal mounting height. If no state or local regulations are present, the determination of mounting height is often left up to the discretion of the system designer. This creates an environment of uncertainty as designers will have different opinions and different lines of reasoning for selecting a particular sensor mounting height.

The following information is intended to present those different lines of reasoning, bringing attention to some key details that are critical in the decision-making process for determining the optimal sensor mounting height in a fixed gas detection system.

Rule of Thumb

In the absence of other rules, select a mounting height based on the anticipated location of the gas. Follow the criteria below to determine where the gas can reasonably be expected and where to place the sensor as a result.

- For gases lighter than air (e.g., Methane, Hydrogen, Ammonia), mount sensors near the highest ceiling points. Follow guidelines for smoke detectors and consider any ceiling divisions that may be in place.
- For gases with densities approximately equal to air (e.g.,Carbon Monoxide, Ethane, Oxygen), mount sensors at the average breathing level. Consider if occupants will be standing, sitting, or lying down and if there are any obstructions that might prevent representative readings.
- For gases heavier than air (e.g., Butane, Sulfur Dioxide, Hydrogen Sulfide), mount sensors near the floor. Be aware of liquids and dust that may contaminate the sensor. Also consider any areas underneath the floor like voids and drains that may accumulate gas.

Figure 1 shows the specific gravity, also known as relative density, of some common gases at normal temperature and pressure (20°C, 1 atm). The table compares the mass per unit volume of gases with reference to air. Gases with specific gravities higher than 1 are heavier than air while those with specific gravities lower than 1 are lighter.

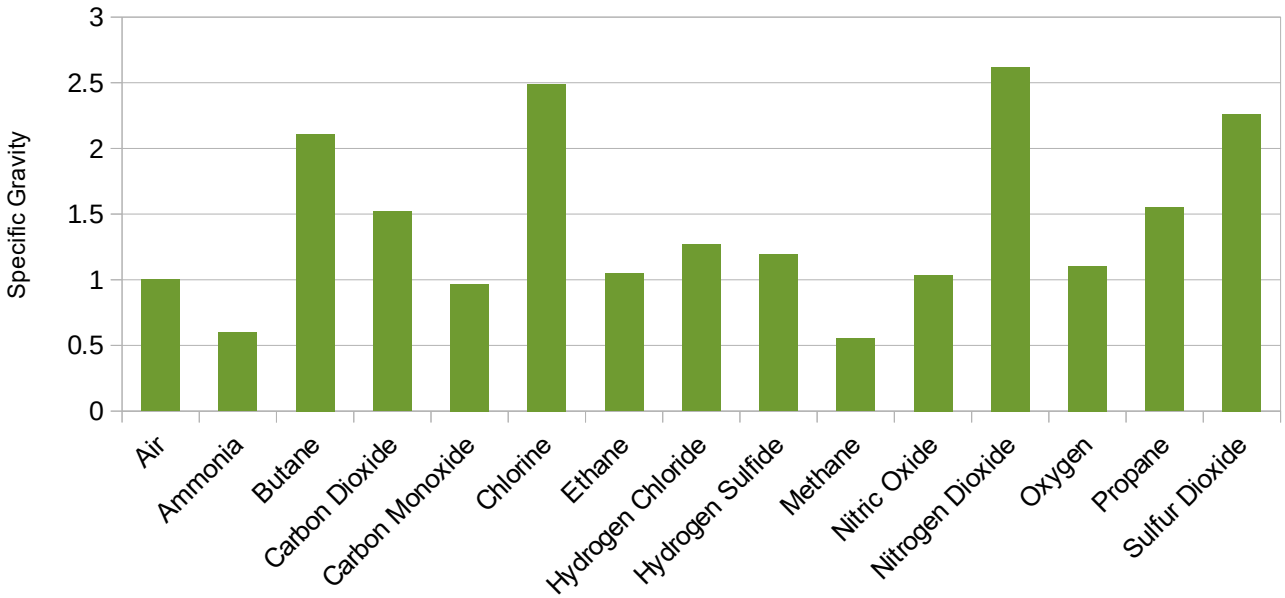

Figure 1: Specific Gravity of Common Gases at NTP (Air = 1)
Source: Praxair Direct (https://www.praxairdirect.com/Specialty-Gas-Information-Center/Techical%20Data/Physical-Properties-of-Gases.html)

In most circumstances, following the above guidelines will yield acceptable results and work sufficiently to detect the presence of any gas build-up. However, there are some other key factors to consider before settling on a specific mounting height.

Other Factors for Consideration

The source of the gas can make a large difference in its anticipated location. Take for example nitrogen dioxide (NO_2). Nitrogen dioxide is often found as a byproduct of burning diesel fuel. At room temperature, nitrogen dioxide is heavier than air; but when heated, as it is when being exhausted from a vehicle, it is lighter than air. This results in the hot gas first rising to the ceiling before cooling down and settling at the floor. Furthermore, some diesel vehicles exhaust from a tailpipe mounted underneath the rear bumper while others exhaust through a stack on the top of the vehicle. Although the gas is the same, the mounting height of the sensor may need to change to obtain a quicker response time. A sensor mounted at breathing height is still a safe option, but it may not be the most optimal in certain applications.

The classification of gas is another very important consideration. The primary danger from toxic gases comes when they are inhaled. Thus, mounting sensors at breathing height can make a lot of sense in a variety of situations. Conversely, flammable and/or corrosive gases do not need to be in contact with humans to pose a danger. The mounting height most optimal for them is the one that will yield the quickest response time.

The final key factor to pay attention to is the type of sensor being used to monitor an area. An infrared (IR) sensor relies on having line-of-sight to properly detect the presence of a gas. If there are obstructions like tables, cabinets, or vehicles in the way, the effectiveness of the sensor will be reduced. Care should be taken to mount these so they can “see” over any long-term obstructions. Other types of sensors like electrochemical or MOS sensors are less particular as they sample the air near the sensor. Still, mounting the sensor at a height where air circulation is poor will hurt its ability to accurately measure concentrations of gas.

Conclusion

The answer to the perpetual mounting height question is that it depends. There is not necessarily a right answer but there are certainly wrong ones. Gas type, application, temperature, airflow, building layout, local laws, etc. all play an integral part in determining how high to mount the sensors in a fixed gas detection system. Following the aforementioned rule of thumb and watching out for any special considerations will greatly help in finding a good mounting height and maximizing the effectiveness of the system. If these are not enough, contacting the gas detector manufacturer is a good way to learn more about how the system is designed to work and how best to implement it in specific applications.

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