

WHITE PAPER / GAS DETECTION

The evolution and challenges of gas detection technologies





You may not be able to smell it, taste it, or discern its presence. But, in many industries, toxic and flammable gases present a significant industrial hazard. New technologies are improving gas-detection capabilities, helping safety managers ensure employee health and well-being.

But the same technology that can save workers' lives sometimes can raise privacy concerns.

Here's how to allay those worries and improve adoption of connected solutions for your crew. This paper traces the history of gas detection, with a peek into the future, wherein connected technologies can ensure a safer workplace.

It all started with the canaries.

After performing a study of asphyxia in coal miners, 19th-century scientist John Haldane engaged in dangerous self-experimentation by breathing several toxic gases just to see what would happen. Afterwards, Haldane pronounced carbon monoxide as the cause of the miners' death¹ and proposed a solution: Miners should carry canaries as an early detection system. In addition to the birds' portability, Haldane determined, canaries' anatomy makes them vulnerable to airborne poisons. If a canary stopped singing, miners had an early warning of airborne poisons, and they could escape.

Technology takes over.

The canaries were the miners' only gas detector until 1986, when an "electronic nose," a detector with a digital reading, replaced the birds.² One early answer: gas sensors to estimate gas levels. Initially used in coal mines, these "mine damp" detectors could have an accuracy of 25 percent to 50 percent, depending on the user's experience or training.³



Gas-detection technologies have improved considerably since those early days. And they needed to do so.

Industrial processes increasingly involve the use and manufacture of highly dangerous substances, particularly toxic and combustible gases.

Some industries generate gas hazards or rely on chemistry that itself poses a danger, such as the processes involved in electric power management, water treatment, and paper production.

Identifying dangers early and accurately is of paramount importance, because gas hazards can be invisible and hard to identify.

After all, explosions do generate extremely loud noises. But a gas leak can go unrecognized until the victims experience symptoms of distress – which may be too late.

Traditionally, gas detection has been a standalone function – but that's changing.

Technology for communicating gas hazards has improved, with real-time monitoring that ensures speed and accuracy. In addition, the sensor networks that measure environmental factors are becoming connected to one another, which helps safety professionals identify problems sooner and take action faster.

These technical improvements benefit employers – but they also create new business process challenges.

When an employer tracks workers' whereabouts to confirm their safety, employees sometimes get nervous about privacy invasion. We want to save their lives, but you don't want to offend them, either.

To help the safety manager understand the options, and peek into the future of the technology, here's an overview of gas detection options and a guide to how to assess the right choice for your business.

The three dangers of gas: a refresher

Gas detection is only one of many elements in a comprehensive workplace safety plan. But it's an important one.

Many other dangers are loud, visible, and hard to miss. Not gas hazards. Gas hazards generally are separated into three categories:

- **Flammable** (fire or explosion risks, such as methane or propane)
- **Toxic** (poisoning risks, such as carbon monoxide or chlorine)
- **Asphyxiant** (suffocation risks, primarily oxygen deficiency, including situations where oxygen is consumed or displaced by another gas).

The distinctions are important even though the categories have some overlap.

Many gases are both combustible and toxic, for instance. However, the hazards and regulations involved are different, as are the sensor types required to identify them.

While all gas hazards are dangerous, some are sneakier than others.

More people die from toxic gas exposure than they do from explosions caused by the ignition of flammable gas, though deaths from the latter often get more attention. In addition, toxic substances can affect workers who are exposed to even low concentrations of gas. It's not always about inhalation, either; poison gases sometimes are absorbed through the skin. Because of the adverse effects from long-term exposure to gas additives, it is important to measure both the concentration of gas and the total exposure time.

Toxic gases are present in nearly every industry.

Particularly in gas and oil drilling; chemical plants; refineries and petrochemical facilities; power generation; water treatment; pulp and paper production; marine environments; and military and national security. But there are more. Lots more.

Some gases present unique challenges to specific industries.

In the semiconductor industry, for example, gases including phosphine and arsenic are especially flammable and toxic. Etching and cleaning industries face similar issues with ammonia.

Standards boards identify the acceptable ranges for each airborne substance.

For example, the American Conference of Governmental Industrial Hygienists publishes "Threshold Limit Values"⁴ that define maximum allowable concentrations for each gas. These exposure limits define substances "to which it is believed nearly all workers can be exposed day after day for a working lifetime without ill effect." Data from this and other organizations informs the development of gas-detection equipment across the industry.

Obviously, gas hazards are serious, pervasive and insidious.

While technology has always stepped in to improve detection, the industrial alliance on often-dangerous substances means we have to look for even more safety-measure improvements.





Today's gas detection tools – beyond canaries

An optimal instrument system monitors both short- and long-term exposure levels, as well as instantaneous alarm levels.

The detection process raises an alert.

The alert spurs staff to respond appropriately, in terms of human distress, and to comply with relevant industrial regulations and safety requirements. Comprehensive guides such as the Honeywell Gas Book⁵ have pages and pages of charts documenting dozens of gases, along with their known harmful effects and levels of concentration. With so many substances to identify and measure, it's no wonder that there are several applications for fixed and portable gas detection.

Subsequent tools have built on initial mine damp detector concepts.

The sensors got smaller than canaries or specialized lamps, for one thing. But the goal remains to identify harmful gases, and the devices are judged by attributes including accuracy, speed of response, and sensitivity of output.

Today, there are catalytic controller detectors that use a tiny sensing element.

Or a use case may suggest the adoption of an infrared gas detector, which measures combustible gases where the absorption bands are in the infrared region of the light spectrum. Some instruments use infrared and laser technology in the form of a broad beam that can cover a distance of several hundred meters. And then there are electrochemical sensors, which are compact, require very little power, and generally have a long life span.

In testing, location and context matter.

Sensors that detect gas levels may collect data in a geographical area (such as “in the factory” or “in the northwest corner of the third floor”) or at personal locations (wherein the worker wears instruments that sample their breathing zone). Deciding which methods are right for a company's staff depends on the specific situation.

Other issues may affect the gas detection process.

Safety managers are advised to use portable monitoring tools to limit risks when they modify or close a plant or when they change its processes. These scenarios pose additional site risks because they represent deviations from standard, well-understood processes.

Then there's the matter of complexity.

How much information does a manager need? If they expect to use a gas detection system only for warnings, system outputs can be simple, with no requirements for data storage. At the other extreme, a complicated industrial process that integrates with large-scale IT systems and government reporting changes the requirements list significantly.

The choices, however, are not only about technology.



How to tackle the issue of privacy

Microchip sensors and high-speed wireless networks allow gas-detection systems to monitor worker safety—in real time.

One way it does this – assuming you turn on the functionality – is location tracking.

Managers can see where each worker is. In an emergency situation, the manager knows how to find every employee, and in the worst of situations can dispatch an emergency crew to the worker's exact location.

From a business viewpoint, this feature translates into clear benefits.

If something goes awry, no one has to wonder, “Where’s Harry? Last I knew, he was headed to the storage room – right where we just got that alert.” Undoubtedly, location tracking becomes a significant safety feature that can save Harry’s life.

However, many workers react to this feature with apprehension.

They see location tracking as an invasion of privacy. Many employees don’t want their managers to know where they are at all times, such as when they take a coffee break.

Ultimately, ensuring individuals’ safety wins out over individual discomfort, but it does so best in an atmosphere of business transparency, with better decision-making across the organization.

Part of ensuring a safe workplace is assuring employees that they are respected and honored, and some new technologies raise real-world privacy concerns to which safety managers need to respond.



Communication tips

When you talk to your workers about this, it's important to keep their perception in mind.

Recognize the objection. Your aim should be to get workers on your side. Here's how to do that:

- It's the organization's intent to keep people safe. The purpose of location data is to avoid emergency situations and to be better prepared when they do occur.
- Your company should establish and post guidelines about when and where the company can collect and access the workers' locations – for instance, only when someone is in an alarm situation.
- Safety managers should show employees the nature of the data that's collected, how it's used, who can access it, and for how long the data is kept.

It's easier to establish trust when the organization has already demonstrated a commitment to safety, and has shown respect for its employees.

If your business has a Behavior-Based Safety program, it's easier to make the argument that everybody needs to buy into the importance of safety.



Integrating gas detection in an always-on safety-first environment

With 50 years of industry experience, many of our award-winning products have set new performance and ease-of-use benchmarks for gas detection.

Today, Honeywell is connecting safety systems in ways that benefit workers, professional safety engineers, and the companies that employ them.

Many of the baseline technologies for identifying gas hazards have a long, proven history. However, new technologies let us improve our products' detection capabilities, helping managers ensure that every worker goes home at night, safe and sound.

Honeywell is working to integrate sensors, PPE, software applications, and databases to create an accurate real-time picture of plant-wide safety.

Connected safety solutions and real-time intelligence can let experts respond to safety threats, manage business risk, and improve productivity.

Honeywell gas detectors provide real-time data visibility.

Some equipment can collect sensor data, which helps identify and resolve problem areas. The recorded data also makes it easier to gather and manage critical compliance data.

There are many business benefits when disparate data is joined for analysis, collaboration, and reporting.

Gas readings are among the information gathered, which helps safety managers make better-informed decisions and sometimes connect otherwise unconnected dots.

You don't have to become a gas detection expert yourself.

Honeywell offers consulting expertise to help safety managers assess their needs, identify the proper equipment, and ensure compliance. Because we provide solutions in every category, we are not beholden to one "right" answer. We can outfit an operation with appropriate gas detection equipment – from protective masks to plant-wide systems – after an assessment is complete.

Honeywell's Lone Worker Software⁶

integrates real-time data about toxic gases, radiation, biometric hazards, and other information collected from remote sensors, which it shows on computers, tablets, and phones.

Honeywell's software, Safety Suite⁷,

automatically collects critical safety data from across a business, and stores the current state of PPE, worker training, and regulatory compliance. This saves time in compliance reporting, highlights missteps, and lets safety engineers focus on the most important matter – taking care of workers.



Conclusions

It is important to test and monitor in any environment where humans may come in contact with harmful gases.

As with so many other things, when it comes to gas detection solutions, it's important to choose the appropriate tool for the job.

That means – just to start – identifying which gases to detect, recognizing possible sources where they may be found, and asking the right questions.

Even in traditional scenarios, the product decision process includes contemplating ease of use for operators and routine servicing.

In the old days, this simply may have meant buying and caring for canaries. But we've evolved.

Notes

¹<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4091013/>

²<http://www.bbc.co.uk/archive/mining/6923.shtml>

³<http://england.prm.ox.ac.uk/englishness-Miners-lamp.html>

⁴<https://www.acgih.org/forms/store/ProductFormPublic/documentation-of-the-threshold-limit-values-and-biological-exposure-indices-7th-ed>

⁵https://www.honeywellanalytics.com/~/_media/honeywell-analytics/documents/english/11296_gas-book_v5_0413_lr_en.pdf?la=en-gb

⁶<https://www.raesystems.com/products/software>

⁷<https://www.honeywellsafety.com/SafetySuite/?LangType=1033>

As technologies become more powerful, new challenges emerge. With Honeywell as your partner, we're confident that we all will succeed.

Visit our site www.honeywellsafety.com or contact a Honeywell representative at **1-XXX-XXX-XXXX** to learn more about gas-detection solutions.

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