# HONEYWELL BW™ FLEX 4 SERIES

A Guide to $CO_2$ Gas Sensing

Honeywell

# CARBON DIOXIDE GAS SENSING

**Carbon dioxide is a commonly encountered but often misunderstood gas, and as such, the potential hazard it poses to human health is often disregarded. As applications involving the use or possible exposure to $CO_2$ are on the increase, however, the need for dedicated personal carbon dioxide monitoring has never been greater.**

## GAS OVERVIEW

At standard temperature and pressure, carbon dioxide is a colorless, odorless, heavier-than-air gas. $CO_2$ is produced by all aerobic organisms during respiration, during the processes of decay of organic materials and during the fermentation of sugars in bread, beer, and wine making. It is produced by the combustion of wood and other organic materials and fossil fuels such as coal, peat, petroleum, and natural gas.

$CO_2$ is high solubility in water, forming carbonic acid, gives it a sour "soda water" like taste at high concentrations, which may also cause irritation to the body's mucous membranes such as eyes, nose, and lungs. It is naturally present in air at just over 400 ppm and is completely harmless at these concentrations. At higher concentrations, however, as well as being a simple asphyxiant gas, it has a pronounced toxic effect upon the human body. These effects, including increased breathing rate, tiredness, confusion, and eventually unconsciousness, occur at concentrations much lower than those required for suffocation. This toxic effect has led most regions to impose Occupational Exposure Levels (OELs) for carbon dioxide of around 5000 ppm TWA and 15000 ppm STEL[1].

1. Consult local regulatory bodies for specific relevant OELs

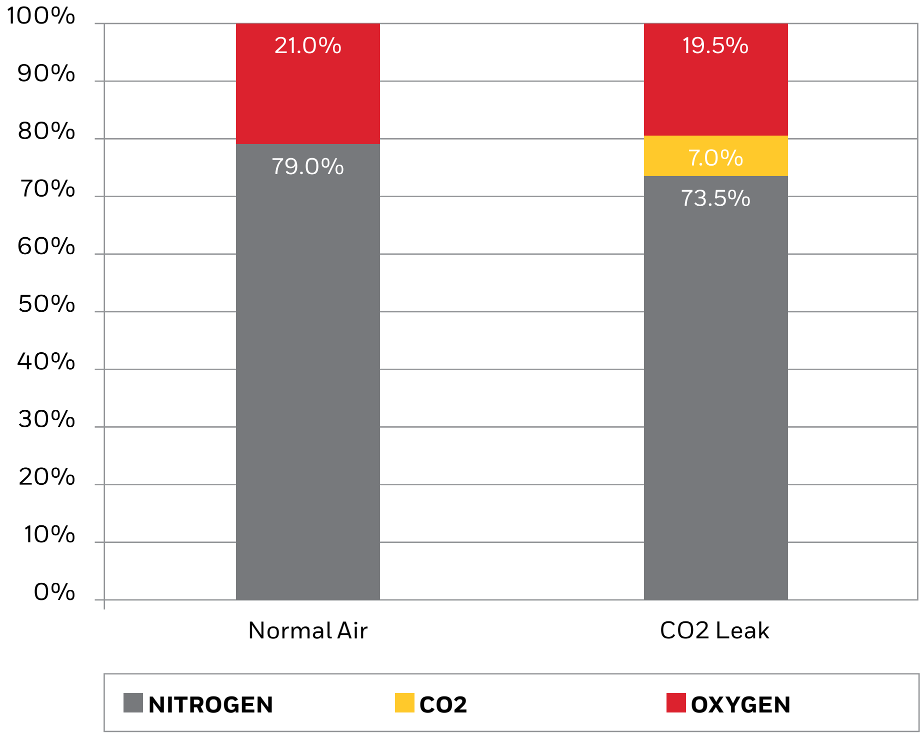
## WHY ARE DEDICATED CO2 SENSORS IMPORTANT?

The ever-increasing number of applications and processes involving potential human contact with dangerous levels of $CO_2$ means that dedicated gas detection can make the difference between life and death. We are often asked the question; "but surely, I'm safe to use a simple oxygen sensor to warn me of dangerous levels of carbon dioxide like I would for any other displacing gas such as nitrogen?"

Were $CO_2$ only an asphyxiant gas, then the above statement may well be true but, unfortunately, it also has a significant debilitating toxic effect on the human body at far lower concentrations than are safely detectable using a simple oxygen sensor alone.

To displace enough oxygen from normal air to trigger a low alarm on a standard oxygen gas detector, the $CO_2$ concentration would need to be in the region of 7 %V/V or 70,000 ppm. This value is 14 times higher than the standard EU Occupational Exposure Limit (TWA) of 5000 ppm, meaning employing an oxygen detector alone would be a wholly insufficient method of protection against this gas.

Using a dedicated $CO_2$ sensor also gives us the ability to offer both Instantaneous Alarm Thresholds as well as the Time Weighted Average (TWA & STEL) alarms usually required by local national legislation. Above 5 % (50,000 ppm), the effects on the human body quickly become very serious, leading to tiredness, confusion, hyperventilation and, eventually, to unconsciousness and potentially death. Typical 8-hour time weighted average Occupational Exposure Limits sit at around one tenth of this value, and represent the average allowable exposure over an 8-hour standard work shift period and would apply to all workplaces.




CO₂

# APPLICATION OVERVIEW

## THE DRINKS INDUSTRY

This industry has numerous processes dependent on the use of $CO_2$ or which themselves produce this gas as a byproduct. On top of this, a global upturn in the emergence of the smaller craft or microbrewery segments is reaffirming the need for better $CO_2$ safety practices in the workplace.

We can identify three major subcategories within this industry, each with its own unique set of circumstances and potential risks: beer & wine production, distilleries, and the wider hospitality industry such as pubs, bars, and restaurants.

### Beer Brewing and Wine Making

It's widely understood that the conversion, by yeast, of certain sugars during the anaerobic fermentation process produces alcohol and, as a byproduct, releases substantial volumes of carbon dioxide. A portion of this $CO_2$ may be allowed to remain in solution giving the characteristic "fizz" in beers and sparkling wines, but much is released as a by-product. Traditionally with smaller breweries and winemakers, this excess $CO_2$ is simply vented to the immediate environment, which can lead to considerable fluctuations in the local environmental $CO_2$ levels, potentially exceeding the local Occupational Exposure Limits. Due to its heavier than air property, there is also potential for this gas to collect in low-lying spaces such as pits and drains, leading to serious oxygen depletion. In modern high volume brewing facilities, this excess $CO_2$ from the fermentation process may be captured and stored for later use in the carbonation process. This introduces the risks associated with the storage and management of large volumes of compressed $CO_2$. Cleaning of the fermentation vessels, which may still contain the $CO_2$ byproduct, is often a very manual process involving the brewer/winemaker fully entering these confined spaces, usually without proper ventilation or SCBA.

### Distilling

The process of distilling begins with a very similar fermentation process to create an alcoholic "wash" and so distilling liquor such as whiskey, gin, and rum introduces the same risks of $CO_2$ exposure as beer and wine making. The exception with this application is that the process of distillation also includes further gas hazards that the user should be fully aware of. Distillation requires a strong heat source which is more commonly powered by natural gas. As well as this, the product of the distillation process is a strong alcoholic liquor of up to 65 % to 70 %ABV. With alcohol being itself a potentially flammable Volatile Organic Compound (VOC), this gives the distiller two further potential gas hazards to monitor for. Portable multi-gas detection, which includes both $CO_2$ and flammable gases as a minimum, would be the preferential choice in this application.

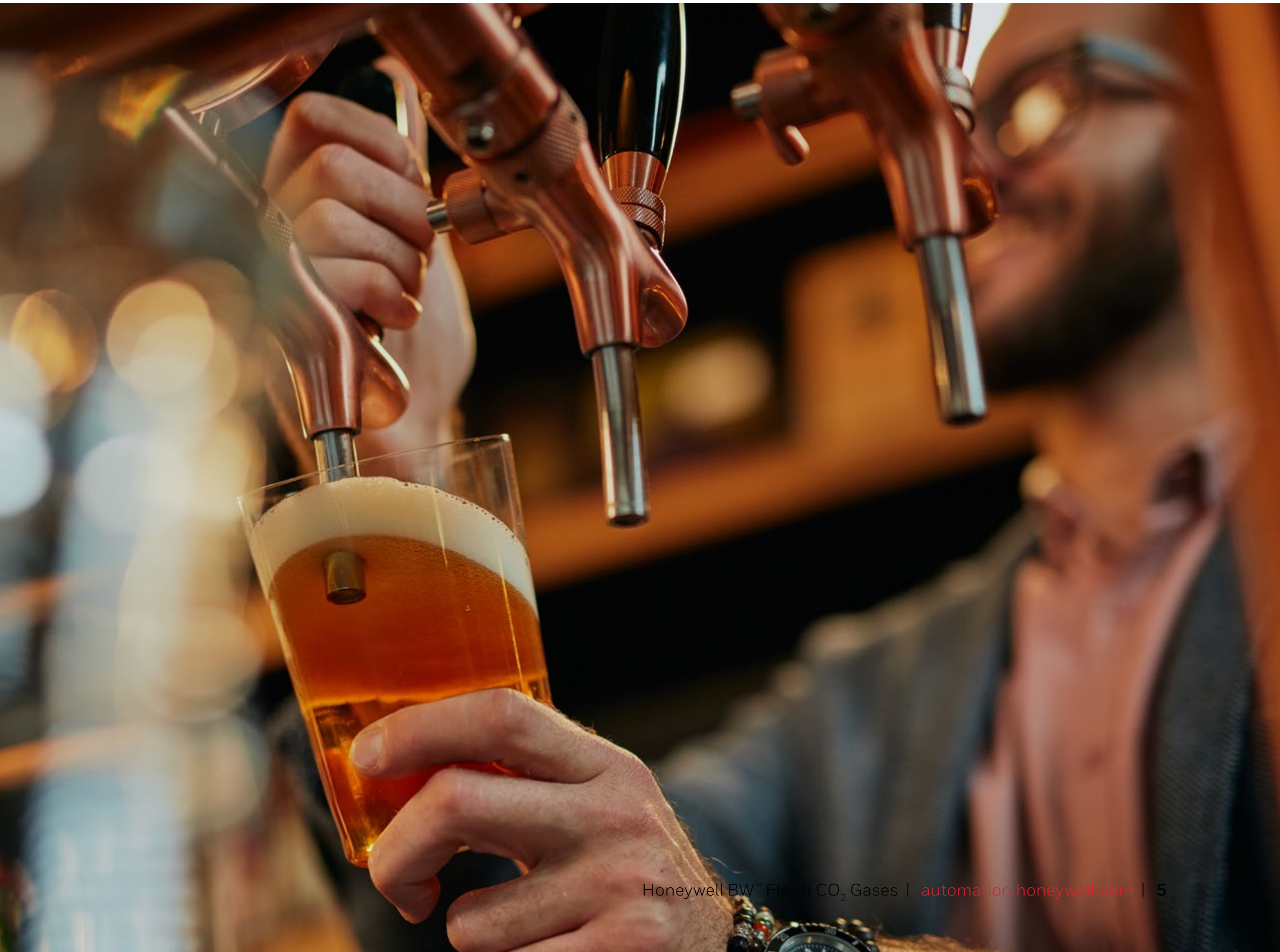
## The Hospitality Industry

The modern hospitality industry incorporates many applications, but the use of compressed $CO_2$ to carbonate drinks, or as a propellant to disperse them, is widespread, and so are the risks. The market for carbonated and draught drinks includes not only bars, restaurants, and pubs but hotels, cinemas, fast-food restaurants, and more. This also means that the area at risk has diversified away from the classic pub/restaurant cellar to a wide variety of purpose-built storage areas acting as confined spaces. All these spaces should be risk assessed with the same rigor as the traditional pub cellar commonly is, ensuring the most appropriate personal $CO_2$ protection is employed where necessary.

## Other Gases to Consider: Sulfur Dioxide

It's not just $CO_2$ that is of concern in the drinks industry, Sulfur Dioxide ($SO_2$) is often used in this industry as a preservative and antioxidant. Usually harmless to healthy individuals when kept in recommended concentrations, it can induce asthma when inhaled or ingested by sensitive individuals, even in high dilution. In high doses, it can be very dangerous. Exposure to sulfur dioxide may also occur when manufacturing or preparing food and drink in factory, restaurant, and home settings.

2. http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/
   https://www.hse.gov.uk/carboncapture/assets/docs/major-hazardpotential-carbon-dioxide.pdf



## CARBON CAPTURE

Carbon capture and storage (CCS) is the process of capturing waste carbon dioxide from bulk industrial processes such as power generation, steel, and cement and sequestering it away, so it never re-enters the atmosphere and doesn't contribute to further climate change. These vast quantities of $CO_2$ are injected deep into the earth, often in oil and gas fields or unmineable coal seams, where the rock formations are stable enough to safely absorb and contain the waste carbon dioxide.

CCS will result in $CO_2$ being handled in quantities much greater than it is today. For example, a coal-fired power station consuming 8000 te (metric ton) a day of coal (in the region of one GW power generation) will produce up to 30 000 te/day of $CO_2$ to be captured and transported to long-term storage facilities. Whereas in existing $CO_2$ handling facilities, an inadvertent release of $CO_2$ may have created a small-scale hazard, potentially only affecting those in the local vicinity; a very large release of $CO_2$ from a CCS scale operation has the potential to produce a harmful effect over a significantly greater area and as such it would be likely to affect a significant number of people. CCS scale of $CO_2$ operation, therefore, has the potential to introduce a major accident hazard (MAH) where currently one does not exist[2].

## SEWERS AND WASTEWATER

The aerobic digestion of sewage sludge is known to produce up to 30 %V/V carbon dioxide as well as other waste gases such as methane. This aerobic digestion may be harnessed as part of the wastewater treatment process, and the risk of exposure to this $CO_2$ to a degree may be limited to the waste treatment sites themselves.

However, as aerobic digestion is a naturally occurring process, $CO_2$ is commonly formed throughout the sewer system. Unlike other waste gases from this process, such as methane, $CO_2$ is a heavier than air gas which can potentially remain trapped within the subterranean sewage network leading to toxic atmospheres.

### Other Gases to Consider: Oxygen, Hydrogen Sulfide, and Flammable

Hydrogen Sulfide ($H_2S$) is a common sewer gas released from waste material as it begins to decompose. This can cause both toxic and flammable hazards. $H_2S$ is highly poisonous and can cause death within minutes. Exposure to concentrations as low as 10 ppm can affect personnel. In addition, $H_2S$, with an LEL of 4.3%, is highly flammable. Confined space environments can rapidly become explosive due to the lack of ventilation and low percentage flammability.

Oxygen ($O_2$) is also considered a sewer gas, especially when monitoring $O_2$ depletion. There is constantly a 20.9 % volume of Oxygen in the air; the volume must stay within this percentage to keep personnel healthy and alive. As individuals work in confined spaces - like sewers and wastewater plants, $O_2$ can be replaced by $CO_2$ as humans breathe. Even a 3 % change in volume can be hazardous; therefore, monitoring is vital.

## OTHER APPLICATIONS

Only a few applications involving possible exposure to $CO_2$ at toxic levels have been covered in this document, but there are many other environments known to contain similar potential hazards.

- Landfill
- Biogas
- Mining
- Horticulture
- Refrigeration
- Food production

# OUR SOLUTION
# HONEYWELL BW™ FLEX 4 SERIES

With a choice of 12 different sensor types, the Honeywell BW™ Flex protects workers from multiple gas hazards, in a small, rugged, and easy to use device. BW™ Flex keeps specialists operating in confined spaces, or general workers on a plant, safe from gas hazards while making safety compliance for the business easy.


*For the detection of the most common gas hazards including: Flammable gas (LEL), oxygen ($O_2$), carbon monoxide (CO), hydrogen sulphide ($H_2S$), carbon dioxide ($CO_2$), sulphur dioxide ($SO_2$), chlorine ($Cl_2$), nitric oxide (NO), nitrogen dioxide ($NO_2$), and hydrogen cyanide (HCN)*

## WORK THE WAY YOU WANT TO

The IntelliFlash™ and ultra-bright alarm LEDs provide users an instant overview of the detectors status. Red for stop, amber as a warning, and green you're good to go, gives that simple view inexperienced users need. The display can also be configured to show all the gases at the same time or one at a time. Either way the operator gets all they need to know at a glance.

## MORE GASES FOR MORE APPLICATIONS

Select up to 4 sensors from 12 different gas types. With common gases covered and a growing range of "exotic" sensors too, the Honeywell BW™ Flex can be used to protect workers in even more industries.

## READY FOR THE CONNECTED FUTURE

Pairing the Honeywell BW™ Flex with your smart mobile device via Bluetooth™ allows remote measurement, field reporting of incidents, or even full instrument configuration and calibration. What's more everything is recorded for download when needed.

## FEATURES

- **Reliable –** The Honeywell BW™ Flex can be used in potentiality explosive atmospheres. Indoor, outdoor, onshore or offshore
- **Advanced connectivity –** Using a smart mobile device or PC. operators can fully configure their device using Safety Suite solutions on iOS®, Android™, or Windows™ platforms
- **Easy to maintain –** The modular design makes service and maintenance easy. Compatibility with IntelliDoX automated test and calibration system, makes the routine efficient
- **Status at a glance –** The IntelliFlash™ status indicator enables quick visual compliance status checks in the field using an intuitive green, amber and red color coding
- **Responsive –** Offering instantaneous alarms, with time weighted average exposure levels (STEL/TWA), users are protected all round, from flammable, oxygen, and toxic gases
- **Easy to use –** The single pushbutton operation, intuitive user interface, and simple green/amber/red alarm system simplifies training and enables users to be up and running quickly

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