



# HYDROGEN SAFETY



## Hydroclean, Powerful, and Demanding Respect

Hydrogen is a rising star in the clean energy transition. In just a decade, green hydrogen (made from renewables) has grown more than 100-fold. Blue hydrogen (produced from natural gas with carbon capture) has nearly doubled at the same time.

This rapid growth is driven by hydrogen's versatility: it can store excess renewable energy, stabilize power grids, fuel vehicles, and power large-scale industry.

But with all this promise comes a very real risk.

Hydrogen is colorless, odorless, and non-toxic yet highly flammable when mixed with air. Recent incidents at plants and fueling stations are a clear reminder: hydrogen safety requires technologies built specifically for hydrogen environments.



# The Role of Safety Systems

Hydrogen is highly flammable. It's also invisible, odorless, and impossible to detect without the right equipment. That's why hydrogen safety starts with well-designed systems - and why they must be carefully planned, certified, and maintained.

At the heart of hydrogen safety are combustible gas detectors. These sensors detect the earliest signs of a leak, long before gas builds up to dangerous levels. They're especially critical in enclosed spaces, near storage tanks, valve connections, and high-use areas like refueling stations and chemical facilities. A hydrogen safety system must integrate multiple layers:

1

## Gas detection:

To spot leaks quickly

2

## Fire detection:

To identify invisible flames

3

## Fire suppression:

To act instantly if an incident occurs

These systems must be certified for use in flammable environments and respond in seconds. Every moment matters in a hydrogen event.

## Smart positioning matters

- Install detectors near likely leak points: valve stems, storage tanks, joints
- Position high, near ceilings - hydrogen rises fast
- Consider leak direction and pressure when choosing sensor locations

In complex facilities, automatic air sampling may be needed to draw gas samples from hard-to-access areas. Visual signs like vapor clouds or mist are not reliable indicators of a hydrogen leak.

## If hydrogen is detected, the system should immediately:

- Trigger alarms
- Shut off hydrogen flow if needed
- Activate ventilation to disperse gas

Regulations require that hydrogen alarms go off at 1% hydrogen in air (25% of its flammable limit) in general work areas, and at even lower levels (0.4%) in confined spaces. When sensors can't be placed directly at a leak source, gas may be routed through a sensing tube to a remote detector. In those cases, system response time depends on tube length and airflow.

Early detection buys time, the faster sensors spot a problem, the safer your site stays.



# Understanding Hydrogen: Unique Properties, Real Risks

Hydrogen is unlike any other gas used in industry. It's the lightest element in the universe, and while its simplicity makes it powerful, it also makes it unpredictable and potentially dangerous if not handled properly. Here are a few key properties to know:

1

## It's almost invisible to light

Hydrogen doesn't absorb visible, infrared, or ultraviolet light the way other gases do. That makes optical detection extremely difficult, requiring specialized sensors to detect it.

2

## It moves fast

Hydrogen molecules are smaller and faster than any other gas. That's great for some applications, but it also means a leak can spread rapidly and fill a space before human senses or visual signs can catch up.

3

## It diffuses quickly

Hydrogen disperses into the air faster than most gases, more than four times faster than natural gas. This makes odorants ineffective. By the time a leak could be noticed by smell, it may already be at dangerous levels.

4

## It's extremely light

Hydrogen is about 11,000 times lighter than water, so it rises fast and accumulates near ceilings, that's why detectors are placed high up.

5

## It's highly flammable

Hydrogen ignites easily, at concentrations as low as 4% in air. It continues to burn all the way up to 75%. It also reacts explosively with oxygen and doesn't produce smoke or visible flames, which adds to the risk.

These properties have direct consequences for how hydrogen should be monitored, contained, and controlled. While hydrogen holds immense potential, its unique behavior requires detection systems designed specifically for hydrogen to ensure safe operation.

# Gas Detectors: The First Line of Defense

Hydrogen safety starts with a robust gas detection system. Because hydrogen is invisible and odorless, a leak can go completely unnoticed, and its extreme flammability means that even a small spark could ignite a fire. Hydrogen safety requires a specialized detection approach tailored to its unique risks.

## Why standard gas detectors aren't enough?

Many gas detectors use infrared (IR) technology, great for gases like methane or propane. But hydrogen doesn't absorb infrared light, so IR detectors simply can't 'see' it.

## The solution?

### Catalytic bead sensors

Catalytic bead sensors detect hydrogen by oxidizing it on a heated surface. This tiny chemical reaction produces heat, which alters the resistance of the sensor — triggering an alarm when hydrogen is present.

The catalytic bead sensors offer:

- Accurate detection at flammable levels
- Compact, durable form factor
- Compatibility with most hydrogen monitoring systems

But they do require care. Catalytic sensors can become 'poisoned' by common substances like silicone or oils, reducing their sensitivity. So regular maintenance and calibration are essential for long-term reliability.



## Autronica recommends the Det-Tronics Catalytic Gas Sensor (CGS) for Hydrogen

A proven hydrogen sensor, it detects gas from 0–100% of the lower flammable limit (LFL) using rugged, explosion-proof technology. Its stainless-steel body resists vibration, dust, and harsh temperatures (from -55°C to +125°C).

Compatible with Det-Tronics controllers, the CGS sensor supports advanced features like digital displays, heated optics, and configurable outputs (0-20 mA, relays, HART, Modbus).

With this technology in place, your gas detection system becomes the first, and most vital, step in hydrogen safety.

# Flame Detectors: For the Invisible Flame

Hydrogen flames are almost invisible to the naked eye, they don't give off smoke, and they burn with very little light. This makes early flame detection nearly impossible without specialized equipment.

Detection options include:

1

## UV Flame Detectors

Hydrogen flames emit energy mostly in the ultraviolet (UV) spectrum. UV flame detectors are fast and highly sensitive, a strong fit for enclosed hydrogen environments. However, UV detectors can also trigger false alarms from welding arcs, lightning, or even static electricity. This can be disruptive and costly in busy industrial settings.

2

## UV/IR Detectors

These combine UV and infrared (IR) detection, meaning they only trigger when both types of radiation are present. This reduces false alarms, but they may still be sensitive to certain environmental interference.

3

## Multispectrum Infrared (MIR) Detectors

MIR detectors are the most reliable flame detection technology for hydrogen. They combine multiple infrared sensors and filters with smart algorithms to detect low-energy hydrogen flames, even from a distance.

MIR detectors offer:

- Superior range vs. UV-only systems
- High resistance to false alarms (e.g., lightning, welding, sunlight)
- Reliable performance in both indoor and outdoor settings



## Autronica recommends the Det-Tronics X3302 MIR Detector

MIR detectors are the most reliable flame detection technology for hydrogen. The Det-Tronics X3302 can detect a small hydrogen flame from up to 100 feet away and is SIL2 certified for reliability. It automatically calibrates itself, logs data, and includes multiple output options (relay, HART, Modbus).

Its rugged design is explosion-proof and built to last, with options for stainless steel or aluminum housing and built-in heating to keep the lens clear in harsh environments.

When combined with gas detection, flame detection adds a second critical layer of protection, catching fires in their earliest stages, even when they are unseen.

# Acoustic Detectors: Listening for Leaks

In hydrogen systems, especially those under high pressure, leaks can happen fast, and they're not always visible or detectable with gas sensors alone.

That's where acoustic leak detection comes in. Instead of waiting for the gas to reach a sensor, this technology listens for the ultra-sonic sound created when gas escapes from a pressurized system.

## How acoustic detectors work

When pressurized hydrogen escapes, it moves from high pressure to low pressure, creating turbulence and sound, some of it in the ultrasonic frequencies. Acoustic detectors capture this signature sound instantly, even before the gas disperses.

## Benefits of acoustic detection

- Doesn't require contact with the gas
- Detects leaks in any direction (360° coverage)
- Works in windy or open environments
- Responds to low-pressure leaks (as little as 6 Bar / 87 PSI)

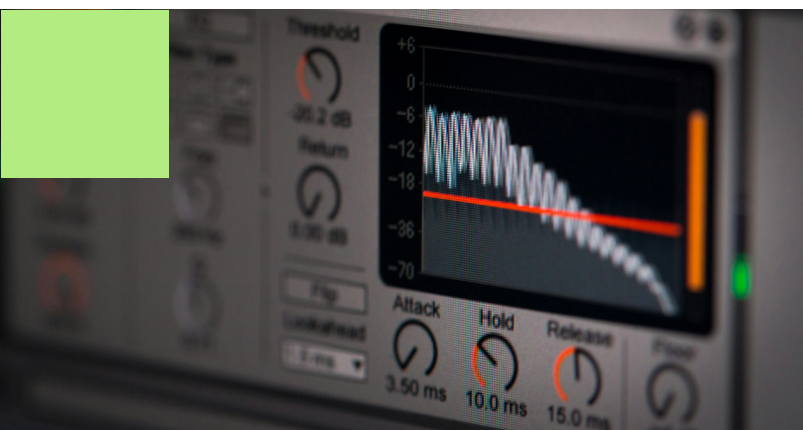


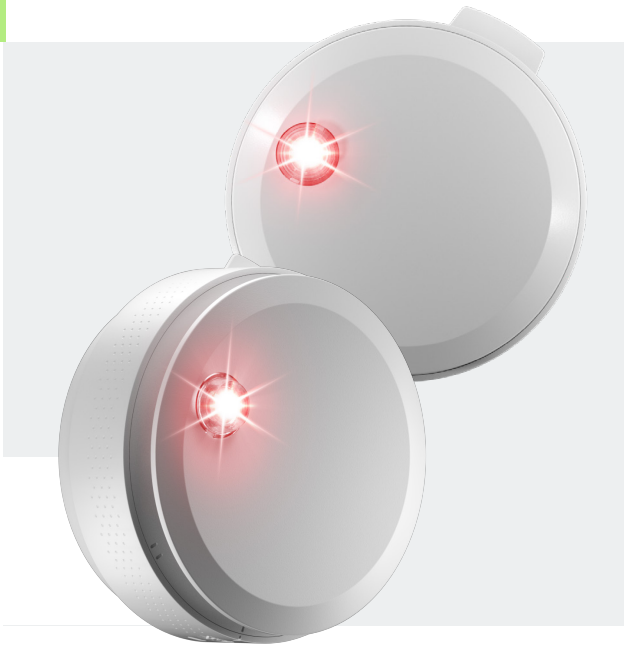
## Autronica recommends the Det-Tronics FlexSonic Acoustic Detector

The FlexSonic detector is engineered to recognize the unique sound signature of a hydrogen leak. It adapts to its environment, filtering out background noise while remaining sensitive to even small, pressurized leaks.

Certified to SIL2 and tested to detect leaks as low as 0.004 kg/s, FlexSonic delivers early warning without delay. It also includes built-in diagnostics and fail-safe features, giving operators confidence that it's working, even when they can't see or smell a thing.

The FlexSonic detector is especially useful in open-air environments, pipe racks, compressor stations, and high-pressure hydrogen systems where early leak warning is critical.





**AutoGuard:**  
*For complete, real-time safety visibility, with fewer false alarms, lower maintenance, and better protection.*

## AUTOGUARD: One System, Complete Coverage

Hydrogen safety depends on more than just good detectors; it depends on how well those detectors work together. That's what Autronica's AutoGuard platform is built for: an integrated safety platform that brings everything under one roof.

### Connects and protects

AutoGuard combines flame, gas, smoke, and heat detection with alarms, interface modules, and voice evacuation, all in a single, easy-to-manage system.

- Combines smoke, heat, CO detection, sounders, lights, and voice alerts into one unit
- Plug-and-play setup with fast, tool-free installation
- Designed for harsh environments: salt, oil mist, vibration, dust, and extreme temperatures
- Built-in diagnostics and QR-code identification for easy maintenance
- Tested to the highest standards (SIL2, UL268, EN54) and engineered to reduce false alarms while ensuring a rapid response to real threats.

### Smarter detection, fewer false alarms

AutoGuard uses advanced DYFI3D technology to analyze the shape and signature of smoke, telling the difference between real fires and harmless steam or dust. It also self-verifies 100% of the signal path and 99% of its components.

Sounders and beacons are built in, loud, visible, and attention-grabbing with two sound levels and 16 tones, plus multilingual voice messages.

Whether you're protecting one room or a multi-site hydrogen network, AutoGuard ensures that every alert, every action, and every safety signal is part of a seamless system.



Sounder  
with high  
sound  
pressure



Smoke  
Detection



Heat  
Detection



Visual  
alarm  
device  
(VAD)



Carbon  
Monoxide  
detector

# Why Autronica?



## Hydrogen Safety

Autronica offers a comprehensive hydrogen safety solution, covering everything from generation and storage to transport and end use. As a global leader in fire and gas safety, we play a vital role in advancing hydrogen safety by understanding its unique risks and delivering smart, reliable technology that protects both people and operations.

## Global Recognition

Autronica has global presence and support capability. Our commitment to excellence has earned us recognition from industry leaders and clients alike.

## End-To-End Solutions

Autronica provides turnkey solutions, from manufacturing to life-cycle support. Our holistic approach ensures seamless integration and optimal performance.

## Personalized Service

Dedicated technical and commercial support staff forge lasting relation-

ships with clients. We understand your unique needs and tailor solutions accordingly.

## Performance And Reliability

Autronica's solutions set industry benchmarks for performance and reliability. Our track record speaks volumes about our unwavering commitment to quality.

## Scalability

Whether you're a small business or a global enterprise, Autronica adapts to your requirements. Our flexibility ensures that your investment grows with your business, from small and efficient systems to sitewide solutions.

## Certified Expertise

Autronica's in-house capabilities are backed by global certifications and demonstrated expertise. You can trust us to deliver results that exceed expectations.

