Reprinted From FACILITY EXECUTIVE Strategies and Solutions for the New Workplace December 2025

How Forklifts Can Trigger CO Alerts

False alerts can cause disruptions in warehouses and manufacturing facilities.

By Jeff Donato

Fire departments are responding to carbon monoxide (CO) alarms at warehouses and manufacturing facilities—but workers aren't being poisoned. Building evacuations are happening, operations are grinding to a halt, and facility managers are baffled.

The real problem? The battery charging for forklifts and other materials handling equipment. Whether facilities operate traditional lead-acid battery vehicles or have transitioned to cleaner technologies like lithium-ion batteries or hydrogen fuel cells, the charging process can cause the release of hydrogen gas. Unfortunately, standard carbon monoxide detectors can't distinguish between CO and hydrogen. This cross-sensitivity creates false alarms that disrupt operations and create regulatory complications.

Case Study: When Fire Inspectors Found A Problem That Wasn't There

A major auto manufacturer in the eastern U.S. experienced this crisis after investing in a fleet of hydrogen fuel cell-powered forklifts for its warehouse. The facility positioned hydrogen fueling stations strategically along the production line to take advantage of fast refueling times and continuous operation capabilities.

During routine inspections, the local fire department's handheld CO detectors registered elevated carbon monoxide levels. The facility's own fixed CO detection system— required by NFPA 72—showed similar readings near hydrogen fueling stations. A safety investigation began. Workers were potentially at risk. Or were they?

The investigation revealed cross-sensitivity as the culprit. The detectors were responding to hydrogen gas releases that occasionally occur during refueling, not carbon monoxide. The facility faced a dilemma: prove to fire officials that no CO exposure was occurring while ensuring they could still detect and respond to actual hydrogen releases, which present their own safety considerations.

Lead-Acid Forklift Batteries Are An Even Bigger Concern

Hydrogen is a concern for all facilities with forklifts. Lithium-ion batteries can release hydrogen gas if they are over-charged or damaged. Lead-acid batteries generate hydrogen gas during normal operation, mostly during charging. As the current forklift fleet still primarily uses lead-acid batteries, their release of hydrogen gas is the biggest concern for facility managers. With growing awareness of batteries' risks, Authorities Having Jurisdiction (AHJ) are proactively addressing hydrogen mitigation in all batteries, including lithium and lead-acid forklift batteries.

Hydrogen is a colorless, odorless gas that becomes explosive at a concentration of 4% in air, known as the Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL). OSHA 1910 mandates that hydrogen levels stay within safe limits. According to the International Fire Code (IFC) and the National Fire Protection Association (NFPA), ventilation systems should keep hydrogen concentrations below 1% (25% of LEL) and, in confined spaces, below 0.4% LEL. Regulations also require conducting a Hazardous Mitigation Analysis (HMA) and developing a Hazard Mitigation Plan (HMP) to assess worst-case and best-case scenarios for hydrogen off-gassing from batteries, including during thermal runaway.

Gas-reduction strategies should be implemented under these conditions, and alert systems must notify personnel if a hazardous situation occurs. Additionally, gas purge fans and other mechanical devices require regular maintenance. The HMP can include automatic measures like hydrogen detectors activating additional fans, increasing building ventilation, and shutting down battery chargers. It should also include procedures for detecting these failures and manual interventions, such as opening doors and windows and ventilating the area.

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Why CO Detectors Fail In Hydrogen Environments

Most commercial and industrial facilities must maintain carbon monoxide detection systems under building codes, including NFPA 72, NFPA 720, International Building Code 915, and International Fire Code 1103.9. These systems typically use metal oxide semiconductor (MOS) sensors to monitor CO levels and protect building occupants.

The problem is molecular. Carbon monoxide and hydrogen are small molecules with similar chemical properties. When either gas interacts with MOS sensors, it causes comparable changes in electrical resistance. The detector registers a signal—but can't tell which gas triggered it. Even CO detectors with filtering techniques like catalytic filters, permeable membranes, or chemical absorbents prove insufficient in hydrogen-rich environments.

Hydrogen-Specific Monitoring: Eliminating False Alarms

The manufacturer solved the problem by implementing hydrogen-specific sensors that eliminate cross-sensitivity entirely. Unlike MOS-based CO detectors, solid-state hydrogen sensors use technology designed to detect only hydrogen without responding to carbon monoxide or other gases.

The facility installed H2scan hydrogen sensors in the warehouse areas where hydrogen accumulation was possible. The sensors provided accurate, continuous monitoring that distinguished between hydrogen and carbon monoxide—ending false alarms immediately. Additional benefits included auto-calibration requiring no maintenance throughout a 10- to 15-year operational life and seamless integration with existing building management systems through standard communication protocols.

The engineering team configured sensors to communicate with PLC controls managing air handlers, enabling automatic ventilation adjustments based on hydrogen concentrations. After conducting hazardous mitigation analysis, the facility maintained its hydrogen levels below the NFPA thresholds of 1% room volume (10,000 ppm) or 25% of the Lower Explosive Limit.

Results were immediate. The hydrogen- specific sensors provided definitive proof to fire officials that no carbon monoxide exposure was occurring. False alarms ceased, operations continued without disruption, and the facility established an ongoing monitoring program that proactively manages hydrogen levels before they reach concerning concentrations.

Why Every Forklift Operation Needs Hydrogen Monitoring

While the case study involved hydrogen fuel cells, accurate hydrogen monitoring is equally critical for traditional lead-acid battery charging operations. OSHA regulations, IFC and NFPA standards, and model codes adopted by states and localities have long required facilities to maintain safe hydrogen levels in charging areas through adequate ventilation and increasingly through active monitoring systems.

Lead-acid batteries—which power approximately three-quarters of electric forklifts today—naturally produce hydrogen gas during charging through electrolysis. This lighter-than-air gas rises toward ceilings and poses fire and explosion risks when it accumulates.

Many facility managers remain unaware they have a hydrogen issue until fire inspectors flag it during routine inspections. Ventilation systems are often sized for original battery fleets and charging schedules. When companies add forklifts or extend operating hours, adequate ventilation may become inadequate. The same hydrogen-specific sensors that solved the false CO alarm problem provide essential monitoring for these battery charging operations, especially for unmanned charging during overnight hours.

There's an additional concern with lead-acid batteries. When overcharged through fast-charging protocols, equipment malfunction, or aging systems, batteries can produce hydrogen sulfide (H_2S)—a toxic gas with a distinctive rotten egg smell. OSHA sets the permissible exposure limit at 20 ppm, and at 100 ppm, it's immediately dangerous to life and health. While hydrogen-specific sensors don't detect H_2S, their presence as part of a comprehensive monitoring program helps facility managers maintain proper charging protocols that prevent overcharge conditions where hydrogen sulfide formation occurs.

The Bottom Line

For less than the cost of repeated false alarm disruptions or ventilation system expansion, facilities can implement continuous hydrogen monitoring that eliminates CO detector cross-sensitivity, provides early warning of accumulation problems, protects worker health, satisfies regulatory requirements, and gives facility managers peace of mind.

Facility managers should not wait for false alarms to disrupt operations or for fire inspectors to mandate action. They should evaluate hydrogen monitoring needs and implement detection systems as part of a comprehensive indoor air quality and safety program.

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