Understanding Multi-gas Monitor Readings - The Importance of Knowing your Equipment

RECOMMENDATIONS

The NIOSH Fire Fighter Fatality Investigation and Prevention Program (FFFIPP) recommends fire departments ensure all firefighters responding to natural gas and propane incidents are trained to:

- Interpret data from their specific multi-gas monitors to determine if a hazardous atmosphere is present. This can include low oxygen levels or dangerous concentrations of carbon monoxide, hydrogen sulfide, or other toxic gases.
- Calibrate and maintain gas detection equipment properly by performing bump testing at the beginning of each shift following manufacturer's guidance.
- Use of gas detection equipment under a wide variety of conditions including when at the lower explosive limit (LEL) and upper explosive limit (UEL) of a gas or vapor.
- Utilize multi-gas monitor readings to establish isolation zones and ensure a continuous risk assessment is conducted throughout the incident.

Firefighter Using Multi-Gas Monitor
Photo Credit: Chief Jerry Knapp

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FFFIPP INVESTIGATION

On July 10, 2018, a 34-year old paid-on-call fire Captain died, and another firefighter was injured in a building explosion while responding to a report of a natural gas leak. At 1820 hours, the local combination fire department was dispatched for a report of gas odor at an intersection approximately one block away from the fire station. The initial arriving crew immediately began evacuating the surrounding buildings. The Captain, along with firefighters from the initial responding crew, entered a building near the suspected leak to control utilities in the basement. Firefighters reported the gas monitor showing high levels of explosive gas. As the crew was exiting, the building exploded. While misreading a gas monitor was not contributing factor in this incident, it still highlights the dangerous nature of natural gas leaks. Inadequate training on gas monitors puts firefighters (especially hazardous materials teams) at risk. Details of this incident are available in the full NIOSH report.

QUESTIONS & ANSWERS

What gases do multi-gas monitors detect?

Firefighters and hazmat teams use multi-gas monitors to measure a variety of different gases in the environment. These gases usually include oxygen (O_2), carbon monoxide (CO), hydrogen sulfide (H_2S), as well as a range of flammable gases and vapors (to determine the LEL.) Users must understand that the LEL may not be completely accurate as the calibration gas and the gas or vapor encountered at the incident scene will respond differently to the monitor (i.e. methane calibration gas vs.propane gas being measured as the incident scene).

What do LEL and UEL mean?

The LEL is the minimum concentration of a gas or vapor in air below which propagation of a flame does not occur in the presence of an ignition source. The UEL is the maximum concentration of flammable gas or vapor in air above which propagation of flame does not occur on contact with a source of ignition. The range between LEL and UEL is the flammable range. The UEL is extremely hazardous as it may displace oxygen creating an IDLH atmosphere and in the event fresh air is added the atmosphere could move into the flammable range.

Why is bump testing, routine calibration, and maintenance needed?

Sensors become less accurate over time due to a wide variety of factors including mechanical impacts (e.g. drops), dirt/dust that can block the sensor inlets, and extreme environmental conditions such as heat. Users can mitigate this with bump testing, routine calibration, and sensor replacement in accordance with the manufacturer's recommendations. Firefighters should follow the manufacturer's use and maintenance recommendations to ensure monitors will operate as intended. Calibrate monitors at least monthly to ensure accuracy.

What can emergency responders do to ensure personnel understand proper use of multi-gas monitors and how to interact with public utilities or specific propane retailers?

Fire departments and emergency responders should conduct regular hands-on training so firefighters can become proficient with their department's unique multi-gas monitors and the manufacturer's recommendations. NIOSH recommends departments partner with utility companies when conducting training to better understand each responder's role when arriving on scene of a natural gas or propane emergency. This training should be part of a department's standard operating procedures/guidelines for responding to hazardous materials calls.

Where can I find more information about responder competencies needed to respond to a hazardous materials event?

National Fire Protection Association consensus standard NFPA 470. *Hazardous Materials/Weapons of Mass Destruction (WMD) Standard for Responders*, provides the minimum requirements for personnel responding to hazardous materials incidents