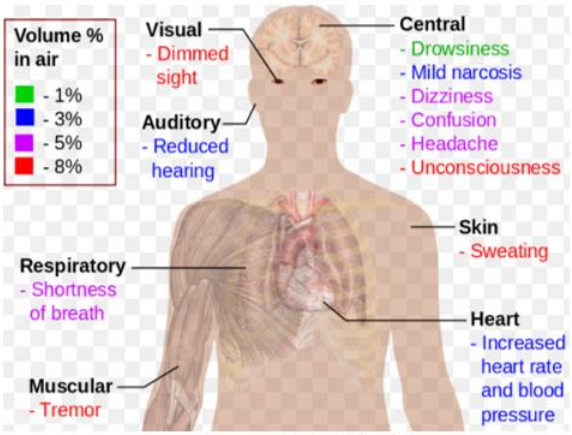
Tips from Training

Issued:
12/6/2020

Carbon Dioxide (CO2) Leaks in Restaurants

Carbon Dioxide Storage Tanks



Symptoms of CO2 Toxicity

Virtually every restaurant, bar or brewery in the country stores pressurized tanks of carbon dioxide for use in beverage systems to carbonate drinks. A CO2 leak inside an enclosed space becomes a potential death trap for anyone caught inside. This is the first Training Tip, in a series of five, created to explore the dangers posed by CO2 gas and CO2 in its solid form as dry ice.

- **The Altair Digital Gas Meter should be carried for its ability to detect low Oxygen levels which may occur due to displacement by CO2.**
- When a leak of a large CO2 cylinder occurs, the leaking CO2 gas can quickly displace the oxygen creating a toxic and potentially deadly atmosphere.
- The FDNY has responded to several CO2 related responses. All of the responses ended safely and without injuries due to the firefighter's knowledge of the hazards of CO2.
- At room temperature, carbon dioxide is a colorless, odorless, slightly acidic-tasting, non-flammable gas that is 1½ times heavier than air. While harmless at low concentrations, carbon dioxide becomes toxic at high concentrations (see photo above).
- Units responding to EMS runs for ill or unconscious patients in restaurants should be cognizant that they may be responding to a CO2 leak**.** Enlcosed spaces and basements are areas vulnerable to CO2 increases.
- As **CO2 is undetectable by human senses**; the only way to safely monitor CO2 is by an alarm system. Alarm systems are required to be installed in occupancies using more than 100 pounds of CO2.
- Members suspecting a CO2 leak must use an SCBA while operating in a potential IDLH atmosphere and immediately call for a Haz-Mat unit with greater metering capability.

For detailed information on this topic, members are encouraged to read: *"The Dangers of Carbon Dioxide in Fast Food-Type Occupancies"* by Battalion Chief Frank Leeb (Now DAC Leeb, Chief of the Fire Academy) WNFY 1-2012.

Submit a potential Training Tip via email to: TrainingTips@fdny.nyc.gov

Tips from Training

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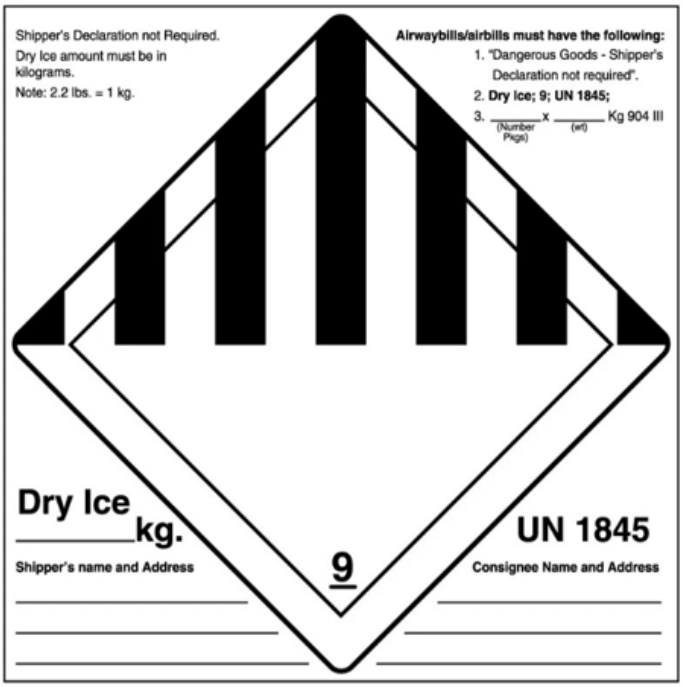
12/7/2020

Dry Ice Hazards



Dry Ice Shipping Label – UN 1845

Some of the first generation COVID-19 vaccines require ultra-low temperature storage until a time just prior to use. Solid carbon dioxide, or dry ice, is an extremely cold material and will be used in the vaccine storage and transport system. To remain safe, we must recognize the hazards of dry ice.

Hazards of Dry Ice:

- There is a potential for explosion due to pressure buildup within tightly sealed containers with no pressure relief device.
- Primary health hazard occurs when dry ice returns to its gaseous CO2 state. Gas quickly expands and displaces oxygen inside enclosed spaces.
- The 'off-gassing' from dry ice can occur quickly and result in **oxygen displacement**. A 0.5% drop in the oxygen level due to the presence of CO2 gas can result in unconsciousness.
- Contact with unprotected skin will cause severe thermal injury **equivalent to third and fourth degree burns.**
- Dry ice and the interior of transport containers are extremely cold with temperatures around -109 F making them an extreme contact hazard. Unprotected skin may become stuck to the material or container.

Tips from Training

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12/8/2020

Operating at Dry Ice Emergencies

COVID-19 vaccines require storage in dry ice containers until a time just prior to use. Dry ice is the solid state of Carbon Dioxide (CO_2). FDNY units may be requested when there are leaks in known dry ice containers, when there are reports of container over-pressurization, for unknown gas clouds, vapor leaks, or when ill or unconscious individuals are encountered. Consider the following when operating at dry ice emergencies:

- **First Arriving Ladder Companies should use the Altair Digital Gas Meter to monitor oxygen-depleted atmospheres until there is containment and ventilation of the gas.**
- Isolate the area and deny entry except for the immediate rescue of victims. Ensure all members wear full PPE **with a donned SCBA facepiece**.
- For small leaks without other hazards or for breaches in dry ice containers, ventilate the space and secure the area until the leak is depleted.
- **Structural turnout gear, fire gloves offer limited protection to extreme cold temperatures;** they can be utilized to make immediate rescues only. They **should not be relied upon to handle dry ice products** or containers.
- Rescue, Squad, Haz-Mat 1 and HMTU Engines have meters that read Carbon Dioxide.
- **The use of self-contained breathing apparatus is required to operate safely in and around these atmospheres.**
- Hazardous Materials Response Team may be needed to manage and mitigate larger or uncontrolled incidents involving dry ice. Visible indicators could include high pressure leaks, bulging drums or sealed containers, or “persons down”.
- Hazardous Materials Response Team carry specialized equipment to manage extremely cold materials to operate safely in and around these CO_2 atmospheres.

Tips from Training

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Oxygen Level Readings with the Altair Digital Gas Meter

Link to Emergency Procedures, Natural Gas Addendum 2: MSA Altair Digital Gas Meter: http://www.fdny.org/fire_operations/dcu/pdf/fd_books/ep/ep_eme_nat_gas_a2.pdf

With the transport/distribution of COVID-19 vaccines we can expect an increased response to emergencies involving **solid Carbon Dioxide (CO2), commonly known as dry ice.** Spills/leaks of dry ice in an enclosed space can create an Oxygen deficient atmosphere. The widespread use of CO2 pressurized tanks in restaurants may also be a source of responses to CO2 emergencies. **The Altair Digital Gas Meter is the first line of defense that all Engine and Ladder companies carry to identify a potential IDLH environment by detecting Oxygen (O2) levels.**

Altair Oxygen Readings:

- In fresh air, the normal sensor readings on the LCD should read 20.8%.
- The meter will alarm at the following O2 levels:

  23.5% (Oxygen enriched)

  19.5% (Oxygen deficient)

- After alarm activation consider using an additional meter to verify readings and calling Haz-Mat.

Tips from Training

Issued:
12/10/2020

Treating Dry Ice Burns

The transportation of COVID-19 vaccines may increase the chances of accidental leaks or improper handling of dry ice. When treating dry ice burn injuries, the following points must be considered:

- Unprotected skin may become stuck to the material or container. The contact area will need to be warmed or it will not be able to separate without tearing the skin off.
- Where skin is injured due to exposure to dry ice, remove any clothing that is not frozen to the skin.
- Warm to separate the skin from other materials. Place the affected part of the body in a warm water bath (not above 104°F).
- Do not rub frozen body parts because tissue damage may result.
- Significant-sized dry ice burn injuries should be transported to a burn center, if feasible.

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IAFC Hazardous Materials Committee
White Paper on Dry Ice (Carbon Dioxide) Response

November 23, 2020

Some of the first generation COVID-19 vaccines require ultra-low temperature storage until a time just prior to use. The unprecedented creation, movement, and storage of these materials at ultra-low temperatures (approximately -80^{o}C) will present hazards for first responders at a variety of locations if the materials are not transported or handled correctly or are involved in an accident. Therefore, the fire service must be prepared to manage these incidents at any step in the process. The use of dry ice in this process creates the potential for container overpressure (explosion), chemical exposures, leaks, and contact with ultra-cold materials. First responders must be cognizant of these hazards along with safe operating practices when responding to unknown vapor clouds and dry ice incidents.

Solid carbon dioxide, or dry ice, is an extremely cold material and will be used in the vaccine storage and transport system. Carbon dioxide (CO_2) is a colorless and odorless gas found naturally in the earth's atmosphere. When gaseous carbon dioxide is placed under extreme pressure and compression, it changes into the solid phase known as dry ice. When dry ice sublimes it converts from a solid state directly to carbon dioxide gas at -78°C (-109°F). The carbon dioxide gas then expands and cools the surrounding area.

The fire service has been called upon for years to respond to dry ice incidents related to its use as a coolant and refrigerant, for low temperature transport and storage of food and medical products, for carbonating beverages, and as a rodenticide. An expanded risk of dry ice will now come from its use in the transportation of COVID-19 vaccines. Dry ice as a refrigerant may be encountered in aircrafts, over-the-road transport vehicles, and in storage areas. If gas is released while in transport or in storage, hazards may include inert atmospheres in enclosed spaces or an increased potential for an explosion due to pressure buildup within tightly sealed containers with no pressure relief device.

The primary health hazard occurs when dry ice returns to its gaseous carbon dioxide state. The gas quickly expands and displaces oxygen inside enclosed spaces such as in transport compartments, small buildings, walk-in coolers, etc. The 'off-gassing' from dry ice can occur quickly and result in oxygen displacement. Although CO_2 is not considered a knockdown gas, oxygen displacement can take someone down very quickly. A 0.5% drop in the oxygen level due to the presences of carbon dioxide gas can result in unconsciousness.

Scene Management, Dry Ice Incidents

First responders may be requested when there are leaks in known dry ice containers, when there are reports of container over-pressurization, for unknown gas clouds, vapor leaks, or when ill or unconscious individuals are encountered. First responders should isolate the area and deny entry except for immediate rescues in appropriate personal protective equipment. For small leaks without other hazards or for breaches in dry ice containers, fire crews usually can manage these types of incidents by ventilating the space and securing the area until the leak is depleted. A four-gas meter should be used to monitor oxygen-depleted atmospheres until there is containment and ventilation of the gas. When conducting air monitoring with a four-gas meter, responders need to understand the potential for sudden extreme changes in temperature that can affect oxygen sensor performance. Even if the environment shows oxygen (O_2) levels are within acceptable limits initially, a rapid change can drop the O_2 levels to an unsafe percentage. The use of self-contained breathing apparatus and "a buddy system" are required to operate safely in and around these atmospheres. Cold containers should not be handled or moved without special cold temperature gloves.

Hazardous materials response teams may be needed to manage and mitigate larger or uncontrolled incidents involving dry ice. Visible indicators could include high pressure leaks, bulging drums or sealed containers, or "persons down". Hazardous materials response teams carry specialized equipment to manage extremely cold materials.

If possible, every attempt should be made to preserve the ultra-cold environment for the protection of the vaccines.

Scene Management, Personnel Safety

Larger, more complicated, incidents will require a buddy system with a backup team to operate safely in and around these CO_2 atmospheres. Self-contained breathing apparatus is required for respiratory protection. An N95 mask or air purifying respirator may not be worn for respiratory protection during CO_2 incidents or in oxygen-deficient atmospheres. Structural turnout gear, fire gloves, and extrication style gloves offer limited protection to extreme cold temperatures; they can be utilized to make immediate rescues only. They should not be relied upon to handle dry ice products or containers. Specialized cryogenic gloves, approved for cold contact and conductive cold, are required when handling dry ice or damaged and leaking containers. Cryogenic gloves need to be loose-fitting so they can be readily removed if liquid material or dry ice splashes or drops into them.

Storage Information

Dry ice must be stored in well-ventilated locations and placed in insulated and ventilated storage containers, insulated coolers, or special containers designed for the storage of dry ice. Due to its thermal expansion, dry ice should never be stored in a tightly sealed container such as an ultra-low freezer or glass container. Note that dry ice will sublime about 5 to 10 pounds every 24 hours in a typical storage container. Where possible, continuous monitoring of CO_2 should be implemented to ensure that levels remain below 5,000 ppm.

Health Hazards and Patient Management

Vaccine Concerns - Current information suggests that the new class of mRNA (messenger RNA) type vaccines for COVID-19 will be those first released for use and will require ultra-cold storage during transportation and while on site. The Pfizer and Moderna vaccine candidates are both mRNA type vaccines. ***The vaccines themselves are not harmful if accidentally released, spilled, or released from broken containers. They contain no "live" or toxic material.***

Oxygen Deficiency - A 0.5% drop in the oxygen level on a four-gas meter indicates up to 25,000 ppm of carbon dioxide gas is present. Exposure to those oxygen deficient atmospheres can quickly lead to poor judgment, impaired ability to escape, and unconsciousness. Deaths have occurred from these situations.

Thermal Burns - Contact with unprotected skin will cause severe thermal injury equivalent to full-thickness burns. Dry ice and the interior of transport containers are extremely cold with temperatures around -79^{o}C (-109^{o}F) making them an extreme contact hazard. Unprotected skin may become stuck to the material or container. The contact area will need to be warmed or it will not be able to separate without tearing the skin off. Where skin is injured due to exposure to dry ice, remove any clothing that is not frozen to the skin. Warm to separate the skin from other materials. Place the affected part of the body in a warm water bath (not above 104°F). Do NOT rub frozen body parts because tissue damage may result. Significant-sized cold injuries should be transported to a burn center, if feasible.