DELCO Hazmat Training Bulletin – December 2020

DRY ICE - CARBON DIOXIDE HAZARDS

The recently approved Pfizer COVID-19 vaccine must be stored at -70° C (-94°F). To maintain this low temperature during shipment and storage, vaccine vials are frequently packed in dry ice, which is the common name for frozen Carbon Dioxide. CDC guidelines recommend that once a shipment is received, it should be repacked with dry ice within 24 hours. This repacking should be repeated every 5 days, for a maximum of 15 days, then it can be stored in a refrigerator at 2^{O} to 8° C (35.6^{O} to 46.4^{O} F), provided it's used within 5 days.

Essentially, there's going to be plenty of dry ice around while the Pfizer vaccine is being administered.

So, what are the hazards of frozen Carbon Dioxide? First, let's look at some of its physical and chemical properties:

Physical Description Odorless, colorless gas, but forms white clouds when cool and the molecules are condensed

Chemical Formula	CO_2	
Molecular Weight	44	It's heavier than air and will accumulate at ground level
Boiling Point (BP)	-109.2^{O} F	It's a gas at ambient temperatures
Freezing Point (FP)	-109.2^{O} F	It's basically the same as the BP (Don't ask – I'll bore you with the answer)
It **Sublimes**	Because the BP = FP, it goes directly from a solid phase to a gas phase	
It's **Non-Flammable**	It's actually used as a fire extinguishing agent, right?	
Ionization Potential	13.77 eV	We cannot read it with our 10.6 eV PID
TLV-TWA	5000 ppm	Acceptable exposure for 8-hour day, 40-hour workweek
IDLH	40,000 ppm	Immediately Dangerous to Life and Health (NIOSH)

With the above values in mind, the **Primary Hazard of Dry Ice is Oxygen Displacement**.

In order to keep the vaccine vials cool, the Dry Ice absorbs heat when it changes from the solid phase to the gas phase. The Latent Heat of Vaporization is 247 BTU/lb., which is very effective for cooling materials. During this process CO_2 gas is formed and because of it's Molecular Weight, it stays low to the ground. With adequate ventilation, CO_2 gas will dissipate as it warms up. But,

this could take time and is a function of the ambient temperature. Smaller shipments shouldn't present a problem unless the vials are stored in confined areas for extended periods of time.

How can we evaluate the hazard of oxygen displacement? First of all, the 911 call might be for someone who felt lightheaded or passed out (or worse), while retrieving a vile from an enclosed area. Other signs and symptoms of exposure include: headaches, dizziness, restlessness, increased heartrate etc. Any of these should make us suspicious.

We can use Four or Five gas meters to evaluate oxygen deficiency, providing the meter has an O_2 sensor (ours do). The normal atmospheric O_2 Level is 20.9% (209,000 ppm) and the alarm setpoint is 19.5% (195,000 ppm).

So, where's the IDLH value of 40,000 ppm fit in?

Bear in mind that each O_2 level drop of 0.1% on your meter represents an atmospheric displacement of approximately 5,000 ppm. So, if you observe a drop from 20.9% to 20.1%, it represents a displacement of approximately 40,000 ppm. In other words, there's potentially 40,000 ppm of Carbon Dioxide in the atmosphere – this is the IDLH! Notice that the meter has not alarmed at this point. The area should be well ventilated!!

The **secondary hazard of Dry Ice** is its low temperature of – 109.2^{O} F. This poses a **frostbite hazard**. Use cryogenic gloves when handling.

Keep this information in mind during responses.

Stay safe, stay healthy,

Bob Marchisello, DELCO Haz-Mat Team Leader

(See photos below.)

DELCO Hazmat Cryogenic Gloves

Cryogenic Gloves located on driver’s side top compartment, second enclosed shelf.