

FS No. 55-028-1220

## EXPOSURE CONSIDERATIONS FOR SHIPPING WITH DRY ICE

### BACKGROUND

As major drug manufacturers are finishing COVID-19 vaccine candidate studies, the focus is naturally shifting to the logistical considerations of handling a mass vaccine distribution. Of key importance is keeping vaccines at the appropriate temperature to maintain potency. Failure to properly store and handle vaccines can lead to inadequate immune response and the need to revaccinate. Always consult the manufacturer on the proper temperatures and procedures for storing and shipping vaccines.<sup>1</sup> While the Centers for Disease Control and Prevention (CDC) typically warns against using dry ice when shipping vaccines, Pfizer® has announced plans to distribute their vaccine in temperature-controlled shippers using dry ice to maintain temperatures of  $-70^{\circ}\text{C}\pm 10^{\circ}\text{C}$ . Pfizer touts the ability to use the containers for temporary storage up to 15 days by refilling dry ice.<sup>2</sup>

### DRY ICE

Dry ice is solid carbon dioxide ( $\text{CO}_2$ ) and releases  $\text{CO}_2$  gas as it cools (skipping the liquid phase), a process known as sublimation. Dry ice is relatively easy to manufacture and has a variety of commercial, industrial, and scientific applications. In the food industry, dry ice is used to preserve food in shipping when conventional refrigeration is unavailable; dry ice is also used for flash freezing. Industrial uses include blast cleaning, metal-working processes, and fabricating mechanical assemblies. Workers and Soldiers in laboratories may already be familiar with dry ice used for cold chemical reactions and in shipping biological samples, to name a few common uses.

### DRY ICE HAZARDS

The main hazards workers face with dry ice are related to extreme cold and sublimation of dry ice. The most obvious hazard dry ice poses is due to its extremely low temperature that can quickly result in frostbite to bare skin in as little as 10 seconds. Sublimation can pressurize shipping and other containers if they are not properly ventilated, posing an explosion risk. The off-gassing of  $\text{CO}_2$  in small areas with poor airflow can quickly create an oxygen-deficient environment and pose an asphyxiant hazard to workers or Soldiers. For this reason, dry ice is considered hazardous by the Department of Transportation (DOT) when shipping via air or water transportation<sup>3</sup> and is regulated by the International Air Transportation Association when shipping via commercial air, by the International Maritime Dangerous Goods Code when shipping via navigable water, and by the Air Force Manual 24-604 when shipping via military air. At a minimum, when dry ice is used as a refrigerant to preserve commodities, the packaging must be designed and constructed to permit the release of  $\text{CO}_2$  gas and to prevent a build-up of pressure that could rupture the packaging. Shippers must make arrangements with the operator(s) for each shipment to ensure ventilation safety procedures are followed. Each package containing dry ice shall be marked with the words "Dry Ice" or "Carbon Dioxide, Solid", "UN1845", and the net mass of the dry ice. Each package shall also be labeled with a "Class 9 – Miscellaneous Dangerous Goods" hazard label. These marks and labels should alert workers to exercise caution and don appropriate personal protective equipment (PPE) prior to handling packages. Further information on cold chain management can be found in Defense Logistics Agency

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Regulation 4145.21 Preparation of Medical Temperature-Sensitive Products Requiring Cold Chain Management for Shipment.<sup>4</sup>

## **WORK PRACTICES**

Store dry ice in well-ventilated locations in a container designed for the storage of dry ice, such as a Styrofoam™ chest or similar container that does not seal and allow gas to build up.

Do not handle dry ice with bare hands. Always use tongs or other tools to handle dry ice.

Wear proper PPE while handling or working with dry ice. The minimum PPE should include cryogenic gloves rated for temperatures below -80°C to handle containers or vials stored with dry ice and appropriate eye protection. Gloves should be loose-fitting and easily removable to limit contact if dry ice should fall inside the gloves.

Educate employees on dry ice hazards and shipping regulations and requirements. Always dispose of dry ice properly (do not put in the trash or down drains); simply allow it to sublimate into gas in a well ventilated space. This process can be hastened with the addition of warm water.

## **FIRST AID FOR COLD INJURIES<sup>5</sup>**

In case of exposure to dry ice:

- Remove any clothing that is not frozen to the skin
- Place affected part of the body in a warm water bath (not above 40°C)
- Seek immediate medical attention

Note: Tissue damage from cold injury can be worsened by rubbing frozen or frost-bitten body parts.

## **REFERENCES:**

1. CDC. 2020. Vaccine Storage and Handling Toolkit.  
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<https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-conclude-phase-3-study-covid-19-vaccine>
3. Department of Transportation. Is Dry Ice in Your Package?  
<https://www.transportation.gov/sites/dot.gov/files/docs/check-box/322331/ctb-dry-ice-fact-sheet.pdf>
4. DLAR 4145.21 Preparation of Medical Temperature-Sensitive Products Requiring Cold Chain Management for Shipment. April 2019.  
[https://www.dla.mil/Portals/104/Documents/LandAndMaritime/V/VS/Packaging/DLAR%204145\\_21.pdf?ver=2019-06-06-163133-657](https://www.dla.mil/Portals/104/Documents/LandAndMaritime/V/VS/Packaging/DLAR%204145_21.pdf?ver=2019-06-06-163133-657)
5. OSHA Quick Facts. Laboratory Safety: Cryogenics and Dry Ice.  
<https://www.osha.gov/Publications/laboratory/OSHAquickfacts-lab-safety-cryogenics-dryice.pdf>

## **POINT OF CONTACT**

The Industrial Hygiene Field Services Division can be reached directly through email at [usarmy.apg.medcom-phc.list.org-ohs-ohs@mail.mil](mailto:usarmy.apg.medcom-phc.list.org-ohs-ohs@mail.mil).

Other contact information for the U.S. Army Public Health Center is available on the APHC Website <https://phc.amedd.army.mil/Pages/Contact.aspx>.

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