



# Dry Ice - CO<sub>2</sub>

## Fact Sheet for Pilots and Flight Crew

### WHAT IS DRY ICE AND IS IT HAZARDOUS?

- Dry ice is:
  - Solid, frozen carbon dioxide (CO<sub>2</sub>) pressed into dry blocks or pellets
  - Used as a refrigerant to package items that must remain cold or frozen during transport such as biological samples, vaccines, or foodstuffs
- When dry ice melts, it does not pool on the ground or form a puddle, it sublimates or changes directly from a solid to a gas
- Dry ice can be hazardous in enclosed spaces that are not well-ventilated due to CO<sub>2</sub> gas inhalation/overexposure; skin contact with dry ice can result in frostbite

### WHAT IS CO<sub>2</sub> GAS AND IS IT HAZARDOUS?

- CO<sub>2</sub> gas is:
  - Naturally occurring component (0.04%) of the atmosphere
  - A physiological respiratory gas
  - Colorless, odorless, and nonflammable
  - 1.5 times heavier than air; tends to accumulate near the ground
- Increased levels of CO<sub>2</sub> cause drowsiness; higher concentrations increase the rate and depth of breathing, increase heart rate, and can cause irregular heartbeats (arrhythmias)
- CO<sub>2</sub> causes suffocation by displacing and diluting the amount of oxygen (O<sub>2</sub>) in the air, leading to hypoxia (lack of oxygen)

### SYMPTOMS OF CO<sub>2</sub> OVEREXPOSURE AND HEALTH EFFECTS

0.04% CO<sub>2</sub> (400 ppm\*): typical outside air CO<sub>2</sub> levels; no physiological symptoms

0.5% CO<sub>2</sub> (5,000 ppm): OSHA occupational exposure limit; subtle to no physiological symptoms

**CO<sub>2</sub> detector/alarm set at 0.5% (5,000 ppm); don O<sub>2</sub> mask and breathe 100% emergency O<sub>2</sub>**

1% CO<sub>2</sub> (10,000 ppm): drowsiness

2% CO<sub>2</sub> (20,000 ppm): headache and difficulty breathing during exertion

3% CO<sub>2</sub> (30,000 ppm): mild sleepiness, reduced hearing, sweating, increased heart rate, difficulty breathing at rest;

**Hazardous, should already be wearing O<sub>2</sub> mask**

5% CO<sub>2</sub> (50,000 ppm): lethargy, dizziness, confusion, rapid breathing/shortness of breath (noticeable inability to breathe fast and deep enough)

8% CO<sub>2</sub> (80,000 ppm): dimmed vision, muscle tremor/twitching, unconsciousness

> 10% CO<sub>2</sub> (100,000 ppm): immediate unconsciousness, seizures and death

\* parts per million

**Symptoms of CO<sub>2</sub> overexposure are different from hypoxia symptoms. Pilots and flight crew should not rely on their “typical hypoxia symptoms” to detect CO<sub>2</sub> overexposure. Standard hypoxia awareness training IS NOT training for overexposure to CO<sub>2</sub> gas**

## CO<sub>2</sub> GAS DETECTORS/SENSORS

- CO<sub>2</sub> detectors/sensors should be worn as low on the body as possible (e.g., attached to a belt or suspended on a neck lanyard)
- Non-dispersive infrared (NDIR) CO<sub>2</sub> detectors/sensors are the most common type of detectors/sensors; however, they are affected by pressure. NDIR CO<sub>2</sub> detectors/sensors used in-flight must have a self-calibrating algorithm or allow manual input concerning pressure
- Pulse oximeters are not recommended; pulse oximeters are ineffective for detecting CO<sub>2</sub> gas (by the time a pulse oximeter detects a decreased blood oxygen saturation level, CO<sub>2</sub> gas build-up is already at a hazardous level)

## FIRST AID/MEDICAL TREATMENT

- Exit the space immediately (if able)
- Seek medical attention

## OTHER MITIGATION STRATEGIES TO CONSIDER

- Airplane must remain well-ventilated during cargo loading/unloading and during flight when transporting dry ice (e.g., leave cargo doors open as much as possible, both air packs and APU should remain running, increase ventilation as needed in-flight)
- Consider having emergency oxygen readily available

### ACTIONS IF YOU DEVELOP SYMPTOMS\* OR CO<sub>2</sub> GAS DETECTOR/SENSOR ALARMS

1. Don oxygen mask, ensure 100% oxygen is selected on the regulator
2. If CO<sub>2</sub> levels do not decrease, consider diversion to nearest suitable airport

\* Drowsiness, reduced hearing, sweating, increased heart rate, lethargy, dizziness, confusion, difficulty breathing, rapid breathing/shortness of breath

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