Libyan Civil Aviation Authority

SAFETY NOTICE

Safety Notice

Number: SN-2021/02 **Issue: 1** **06 Jan 2021**

Transportation of COVID-19 Vaccines Requiring Large Quantities of Dry Ice.

This Safety Notice contains recommendations regarding operational safety.
Recipients must ensure that this Notice is copied to all members of their staff who need to take appropriate action or who may have an interest in the information (including any 'in-house' or contracted organizations and relevant outside contractors).

Approved by

21.01.06

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President of Libyan Civil Aviation Authority

FLIGHT SAFETY DEPARTMENT
CIVIL AVIATION AUTHORITY
MINISTRY OF TRANSPORT

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1. Purpose:

This SN provides information and recommendations to persons conducting operations under LYCARs on safety issues related to the transportation of COVID-19 vaccines by air, which may require larger than typical quantities of dry ice for preservation. Operators must comply with applicable Libyan regulations pertaining to the carriage of dangerous goods.

2. Background:

Dry ice is the solid form of Carbon Dioxide (CO2), and is regularly and safely used to keep perishable goods cold, and therefore preserved, during transport. Certain COVID-19 vaccines require a temperature of -70°C (-94°F) for proper preservation. The primary means of maintaining temperature involves packing the vaccine container with dry ice. In order to transport COVID-19 vaccines, operators may plan to carry dry ice quantities larger than quantities they may carry during typical operations. This volume of dry ice may present risks that existing mitigations do not adequately address.

3. Discussion:

Dry ice continually sublimates (transitions directly from a solid to a gas) at temperatures higher than -78°C (-108.4°F) under normal atmospheric pressure. At reduced pressures, the sublimation rate of dry ice will increase, all other factors being equal. A potential risk associated with the sublimation of dry ice is that gaseous CO2 will replace oxygen in aircraft compartments and interfere with the breathing abilities of the occupants. High levels of CO2 gas in compartments can lead to unrecognized degradation of cognitive functioning and present an asphyxiation hazard to persons in that space (e.g., ground crew who handle the loading and unloading of cargo containers). The risk of hazardous conditions increases proportionately with the amount of the dry ice carried, the sublimation rate of that dry ice, and any ventilation degradation of the aircraft. The LYCAA has provided additional information regarding dry ice in Appendix A of this SN.

4. Recommended Action:

When preparing to transport large amounts of dry ice associated with the COVID-19 vaccine, operators should consider the information in this SN. Additionally, operators with an approved Safety Management System must conduct safety risk assessments in accordance with their approved Safety Management System. Operators without an accepted SMS should conduct a safety analysis and apply appropriate risk mitigations.

The LYCAA recommends that operators consider the following information regarding the transportation of dry ice:

4.1. Aircraft manufacturers provide information on maximum recommended dry ice quantities that the aircraft ventilation can accommodate, depending on the sublimation rate.

4.2. An accurate determination of the dry ice sublimation rate is necessary to determine the correct quantity of dry ice that may be safely transported aboard an aircraft.

4.3. As the dry ice sublimates, a loss of weight occurs, affecting the aircraft center of gravity.

4.4. Dispatch with fully operational Environmental Control Systems, including all air conditioning packs and auxiliary power unit (APU), to enable effective ventilation for ground operations and inflight contingencies.

4.5. CO2 sensors installed or carried in the aircraft or worn by the pilots and other crewmembers will assist the operator and crew in recognizing hazardous concentrations of CO2 and implementing effective risk controls.

4.6. Pilot training on specific conditions and procedures can improve pilot decision-making in the event of a CO2 detector alert or other system abnormalities.

4.7. Maximum ventilation, including during the ground de-icing and anti-icing process, will mitigate CO2 accumulation in the aircraft.

5. Operational Considerations:

5.1. Operators transporting dry ice must have an approval for the transport of dangerous goods in accordance with the requirements established in Part SPA.DG of the LYCAR Air Operations and ICAO Annex 6, Part I, operators shall have specific training and

procedures for the transport of dangerous goods. The training and procedures have to be approved by the LYCAA and should be in accordance with ICAO Annex 18 and ICAO Doc 9284, Technical Instructions for the Safe Transport of Dangerous Goods by Air. This should all be reflected in the Operator Operations Manual.

5.2. It is possible to obtain an approval for the transport of certain dangerous goods. Thus, an operator may hold an approval to transport only dry ice. The scope of the approval needs to be taken into consideration before accepting any shipment of the vaccine. Additionally, operators need to perform a risk assessment which includes the specificities of dangerous goods transport, as mandated by ORO.GEN.200 (a) (3) of LYCARs on air operations (as from November 2020, ICAO Annex 6, Chapter 15 also calls for such a risk assessment). Additional guidance contained in ICAO Doc 10102 may also be considered.

5.3. To ensure the transport is done safely, operators transporting quantities of dry ice in excess of that specified in the operations manual or other applicable documents (e.g. OEM/TCH Service Letter or equivalent) should consider additional mitigation actions. The training, procedures and risk assessment mentioned above must take into consideration the specific conditions of this transport. These must also include all the technical considerations mentioned before and apply to all the staff involved and all the stages of the operation, from the acceptance to the un loading. The operator may additionally consider the following:

5.3.1. Lower the temperature in the cargo compartment as much as possible to minimize the sublimation rate;

5.3.2. Evaluate the potential for cargo containing dry ice to be loaded as late as possible and unloaded as early as possible to minimize the potential exposure of ground staff to elevated levels of CO2in the cargo compartment.

6. Additional Information:

Additional information on dry ice and associated, hazards and risk mitigation may be found in the following documents:

6.1. Advisory Circular FAA (AC) 91-76A, Hazard Associated with Sublimation of Solid Carbon Dioxide (Dry Ice) Aboard Aircraft (https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_91-76A.pdf

6.2. EASA (Transportation of Vaccines Using Dry Ice Guidelines in relation to the COVID-19 pandemic)

https://www.easa.europa.eu/sites/default/files/dfu/easa_guidelines_-_transportation_of_vaccines_issue_1_17.12.2020.pdf

6.3. IATA - Guidance for Vaccine and Pharmaceutical Logistics and Distribution; Edition 1, 16 November 2020

https://www.iata.org/contentassets/028b3d4ec3924cb393155c84784161ac/guidance-for-vaccine-and-pharmaceutical-logistics-and-distribution---extract.pdf

7. Queries:

Any queries as a result of this Safety Notice should be addressed to Head of Flight Operations Section at the following e-mail address: ops@flightsafety.caa.gov

Appendix A.

1. Dry Ice and CO2 Fact Sheet for Aviation Professionals

Dry ice is widely used in aviation to keep perishable goods cold as they traverse the supply chain. When properly vented and shipped in small quantities, dry ice poses little risk to aircraft occupants. However, when a large amount of dry ice is involved, sublimation can cause serious risks. The sublimation of dry ice occurs when it passes directly from a solid state to a gaseous state at temperatures higher than -78° C (-108.4°F), under normal atmospheric pressure.

2. What is dry ice and is it hazardous?

2.1. Dry ice is:

2.1.1. Solid (frozen) carbon dioxide (CO2) pressed into dry blocks or pellets.

2.1.2. Used as a refrigerant to package items that must remain cold or frozen during transport, such as biological samples, vaccines, or foodstuffs.

2.2. 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.

2.3. Dry ice can be hazardous in poorly ventilated, enclosed spaces due to CO2 gas inhalation/overexposure; skin contact with dry ice can result in frostbite.

3. What is CO2 gas and is it hazardous?

3.1. CO2 gas is:

3.1.1. A naturally occurring component (0.04%) of the atmosphere.

3.1.2. A physiological respiratory gas.

3.1.3. Colorless, odorless, and nonflammable.

3.1.4. 1.5 times heavier than air and tends to accumulate near the ground.

3.2. Increased levels of CO2 cause drowsiness; higher concentrations increase the rate and depth of breathing and increase heart rate.

3.3. CO2 gas in higher concentrations is both an asphyxiant and a toxicant. It causes suffocation by displacing and diluting the amount of oxygen (O2) in the air, leading to hypoxia (lack of oxygen) and is toxic to brain functioning.

4. Is there a difference between CO2 gas overexposure and hypoxia?

Symptoms of CO2 overexposure are different from hypoxia symptoms. Pilots and flight crew should not rely on typical hypoxia symptoms (e.g. breathlessness, excessive yawning, euphoria, tiredness, and fatigue) to detect CO2 overexposure. Standard hypoxia awareness training IS NOT training for overexposure to CO2 gas.

5. What are symptoms of CO2 overexposure and health affects?

5.1. 0.04% CO2 (400 ppm): typical outside air CO2 levels; no physiological symptoms.

5.2. 0.5% CO2 (5,000 ppm): regulatory limit for transport category aircraft occupational exposure limit; subtle to no physiological symptoms.

5.3. 1% CO2 (10,000 ppm): drowsiness.

5.4. 2% CO2 (20,000 ppm): headache and difficulty breathing during exertion.

5.5. 3% CO2 (30,000 ppm): mild sleepiness, reduced hearing, sweating, increased heart rate, difficulty breathing at rest.

5.6. 5% CO2 (50,000 ppm): lethargy, dizziness, confusion, rapid breathing/shortness of breath (noticeable inability to breathe fast and deep enough).

5.7. 8% CO2 (80,000 ppm): dimmed vision, muscle tremor/twitching, and unconsciousness.

5.8. >10% CO2 (100,000 ppm): immediate unconsciousness, seizures, and death.

6. How does the sublimation of dry ice affect air transportation?

6.1. Quoted sublimation rates outside those recommended in Advisory Circular (AC) 91-76A, Hazard Associated with Sublimation of Solid Carbon Dioxide (Dry Ice) Aboard Aircraft, are established under a specific set of conditions. If the operational conditions are not the same, the actual sublimation rate will be different.

6.2. Decreased pressure, e.g., 8000-foot cabin altitude, will increase the sublimation rate.

6.3. Reducing cabin pressure will draw CO2 gas from a package(s), increasing the CO2 concentration in the compartment. For this reason, existing smoke/fire/fume procedures should not be used unless they are modified to address this phenomenon.

6.4. At the end of a flight, compartments containing dry ice will tend to have a high CO2 concentration that can take several minutes to dissipate. When the cargo door is opened, the area immediately outside the door also experiences a high CO2 concentration for several minutes.

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