

Guidance for the safe operation of liquid nitrogen food freezers

Liquid nitrogen has been widely used to freeze foods for more than fifty years and has many benefits. Achieving these benefits also means that certain risks must be managed. This safetygram gives precautions for potential hazards and advice for the safe operation of liquid nitrogen food freezers.

General precautions

- **Guard against oxygen deficiency:** Within the industry, there have been incidents where operators have been exposed to potential harm when nitrogen has escaped from a cryogenic food freezer and reduced the surrounding oxygen to an unacceptably low level. Persons operating or maintaining the equipment need to be aware that although nitrogen itself is nontoxic, it can reduce the oxygen concentration of atmospheric air locally to levels that may become hazardous to health and ultimately may be fatal. Atmospheric air contains about 21% oxygen, and reductions in this concentration are increasingly harmful and diminish mental alertness such that a person may not recognize symptoms nor realize they are in danger. Be aware of the first symptoms of oxygen deficiency—increased pulse and breathing rate, giddiness, loss of judgment. Air Products' Safetygram 17, "Dangers of Oxygen-Deficient Atmospheres," gives more details on the dangers of oxygen-deficient atmospheres.
- **Wear protective equipment:** Liquid nitrogen is very cold, and contact with it, or any part of the freezer that has recently been in contact with it, may cause frostbite or cold contact burns to unprotected skin. Protective equipment designed for personal protection from cold, as well as for hygiene reasons, must be worn when operating the equipment. In addition, cleaning and maintenance should be delayed until the temperature of the freezer has reached a safe level.
- **Beware of moving parts:** A food freezer has moving parts that may cause injury. Guards protect critical moving parts, while covers give additional protection during operation. Covers can be removed for cleaning, but guards should remain in place and be removed only in accordance with a recognized lock-out procedure. Ensure all covers and guards are fixed in place before operation. Emergency stop systems must be in place and maintained so that they remain in working order.

- **Keep the machine clean:** Food processors must have systems in place to maintain the sanitary condition of the food freezer. Air Products' food freezers are designed to be easily cleaned. Ensure that the freezer is cleaned sufficiently often to maintain the quality of the food. This frequency will depend on the nature of the food.

Specific operational advice

- **People must not enter or occupy areas with less than 19.5% oxygen.** Since people cannot detect the presence of nitrogen, install room oxygen monitors in the production room. Monitors should be equipped with a visual and audible alarm to alert workers if oxygen levels fall below 19.5% oxygen, allowing prompt evacuation to a safe area. The number and location of oxygen monitors is critical to ensuring safe operations. Consideration should also be given to having portable or personal oxygen monitors to supplement the fixed system. Personal oxygen monitors may be used to provide additional protection by monitoring in the vicinity of the

worker's breathing zone. Operation and maintenance of oxygen monitors is a user responsibility. It is important to keep oxygen monitors calibrated and maintained in good working order per manufacturer's specifications. Air Products can assist with site-specific recommendations on oxygen monitoring systems.

- Air Products recommends the liquid nitrogen flow control system be equipped with a liquid flow control valve, manual valves and an automatic safety isolation valve. The liquid flow control valve regulates the liquid nitrogen flow rate to maintain the desired freezer temperature. Manual valves allow operators to shut off the nitrogen supply when necessary. These valves must be easily accessible in safe areas to facilitate emergency response to low oxygen levels. A manual valve should be located outside the building, typically at the liquid nitrogen supply tank. Thermal relief valves must be installed between valves to prevent trapped liquid from overpressurizing piping. An automatic safety isolation valve shuts off the liquid nitrogen supply in an emergency. It is recommended that the nitrogen supply be shut off automatically by the oxygen monitor signal at a minimum of 18% oxygen.



- Ensure the freezer exhaust fan runs sufficiently fast to remove all nitrogen from the freezer. An indication that the exhaust flow is inadequate is sometimes given by vapor clouds at low level in the vicinity of the freezer. It is recommended that the exhaust be boosted to maximum speed automatically by the oxygen monitor signal at 19.5% oxygen.
 - **Do not alter alarm values or interlock settings that stop the machine or the nitrogen supply when activated.** Equipment should not be operated if any safety interlock is bypassed or rendered inoperable.
 - Personnel should be trained on the symptoms and hazards of oxygen-deficient atmospheres.
 - For these related safetygrams, visit airproducts.com/safetygrams: Safetygram 2, “Gaseous Nitrogen;” Safetygram 7, “Liquid Nitrogen;” Safetygram 16, “Safe Handling of Cryogenic Liquids;” Safetygram 17, “Dangers of Oxygen-Deficient Atmospheres.”
- For Safety Data Sheets for nitrogen and nitrogen (refrigerated), visit www.airproducts.com/msds.
- Ventilate the production room with adequate supplies of fresh air. The required fresh air needed depends on the room size and the number, size, and type of liquid nitrogen food freezers in the room. With the increasing need for hygienically designed food factories, also be aware that reducing airborne contamination by reducing fresh air intake can increase the chance of oxygen depletion.
 - Consult Air Products’ food freezing specialists on changes to ventilation. Do not move the freezer or make changes to the structure of the building without consulting Air Products. Changes may reduce the ventilation around the freezer.
 - Do not change nitrogen valves or nozzles without consulting Air Products, as this may permit a higher nitrogen flow than can be safely removed. For the same reason, do not increase storage tank pressure.
 - Close the manual nitrogen supply valves on the freezer at the end of the production day.
 - Follow all safety recommendations and procedures described in the Freezer Operating Manual. Only approved, trained personnel should operate, maintain and clean the freezer.
 - Maintain the food freezer and electronic controls in good working order. Equipment can be damaged during normal operations. Damaged parts should be replaced, especially if the damage creates sharp edges that could result in a laceration hazard.
 - Inspect the strainer in the liquid nitrogen supply line for contamination on a periodic basis. As compared to ambient air, cryogenic nitrogen is less contaminated, both physically and microbiologically, but it is important to remember that maintenance activities can lead to contamination of the nitrogen or the freezer.

Air Products has food freezing specialists around the globe to answer questions about the safe operation of liquid nitrogen food freezers. Visit our Food Industry Global Contacts/Locations website at www.airproducts.com/industries/FoodBeverage to find the contact for your region.

Emergency Response System

T 800-523-9374 (Continental U.S. and Puerto Rico)

T +1-610-481-7711 (other locations)

For regional ER telephone numbers, please refer to the local SDS 24 hours a day, 7 days a week for assistance involving Air Products and Chemicals, Inc. products

Technical Information Center

T 800-752-1597 (U.S.)

T +1-610-481-8565 (other locations)

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