

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. A risk assessment of each installation is required by the facility operator. Air Products can provide assistance with regard to the assessment. This safetygram gives precautions for potential hazards and advice for the safe operation of liquid nitrogen food freezers that should be considered during the assessment.

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 20.9% 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.
- Fresh air should be supplied to the production area to ensure that the extraction fan performance is not affected and that any residual nitrogen is diluted to maintain an oxygen concentration of 20.9%.
- Fixed oxygen monitoring must be installed within the production area in the vicinity of the nitrogen chilling equipment. The monitor shall be installed, operated, calibrated, and maintained as prescribed by its manufacture. The monitor warning/alarm lights should be visible from the room entrance door or remote indication supplied at each entrance door.

- **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 un-protected 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 prevent contact with 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.

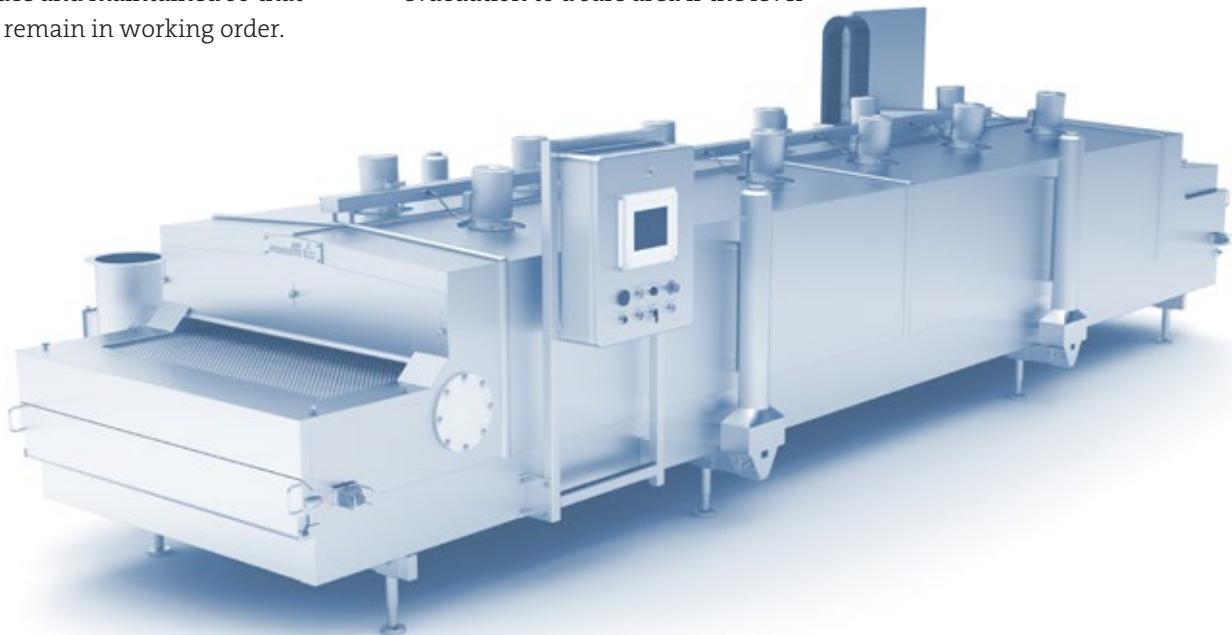
- An operational readiness inspection shall be carried out on all equipment whether new or modified to confirm compliance before any gas is introduced into the system for the first time.

Specific operational advice

- **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.
- Since people cannot detect the presence of nitrogen, it is a mandatory requirement by Air Products that Oxygen room Monitoring is installed 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 if the level

continues to drop. The number and location of oxygen monitors is critical to ensuring safe operations.

- Monitors shall be installed to manufactures instructions, if supplementary splashproof protection is used during clean-down it must be removed when the machine is in service, if permanent splashproof protection is used this must not affect the performance or response time of the monitor.
- **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. Personal oxygen monitors should be used to provide additional protection by monitoring in the vicinity of the worker's breathing zone.**



- Air Products mandates the liquid nitrogen flow control system be equipped with a liquid flow control valve, manual valves and an automatic safety isolation valve, that shuts off the supply at minimum of 18% Oxygen depending on local specifications. 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 over-pressurizing piping. These relief valves must be set higher than that of the pressure relief system at the supply tank and piped outside or to a safe location.

The freezer exhaust fan must operate such that all nitrogen is effectively removed from the freezer and surrounding area. An indication that the exhaust flow is inadequate is sometimes given by vapor clouds at low level in the vicinity of the freezer or low temperature alarms at the infeed or outfeed. It is recommended that the exhaust be boosted to maximum speed automatically by the oxygen monitor signal when in warning or alarm state. Ensure

that the extraction system is not blocked with snow, ice or any foreign body.

- **Do not alter alarm and trip values or inter-lock 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. Any alarm or inter-lock forms part of a critical safety system which must be working to provide safe effective equipment operation. If you have any doubt contact Air Products immediately.
- 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.”
- **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 and clean the freezer.
- Emergency preparedness shall be a major part of any procedure that is developed.
- The freezer must be maintained in accordance with local standards and any activities related to the nitrogen system should only be carried out by Air Products approved Engineers. Equipment can be damaged during normal operations and any unserviceable parts should be replaced, especially if the damage impacts the safety integrity of the equipment or creates sharp edges that could result in a laceration hazard.

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.

For Safety Data Sheets for nitrogen and nitrogen (refrigerated), visit <https://sds.airproducts.com>.

Emergency Response System

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

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