Particularly Hazardous Substance (PHS)

Safe handling of Cryogenic Liquids

Introduction to Liquid Nitrogen

Liquid nitrogen is inert, colourless, odourless, noncorrosive, non-flammable, and extremely cold. Nitrogen makes up the major portion of the atmosphere (78.03% by volume, 75.5% by weight). Nitrogen is inert and will not support combustion; however, it is not life supporting. Nitrogen is inert except when heated to very high temperatures, where it combines with some of the more active metals, such as lithium and magnesium, to form nitrides. It will also combine with oxygen to form oxides of nitrogen and, when combined with hydrogen in the presence of catalysts, will form ammonia.
Since nitrogen is noncorrosive, special materials of construction are not required to prevent corrosion. However, materials of construction must be selected to withstand the low temperature of liquid nitrogen. Although used more commonly in the gaseous state, nitrogen is commonly stored and transported as a liquid, affording a more cost-effective way of providing product supply.

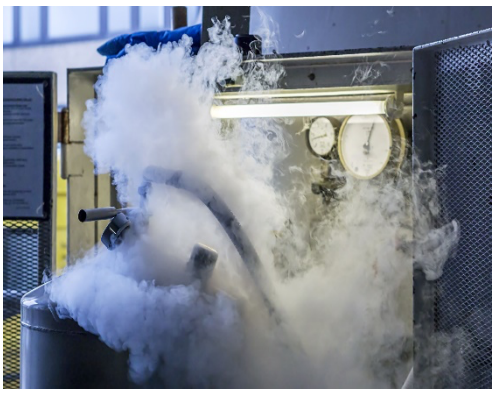
Liquid nitrogen is a cryogenic liquid. Cryogenic liquids are liquefied gases that have a normal boiling point below –130°F (–90°C). Liquid nitrogen has a boiling point of –320°F (–196°C). The temperature difference between the product and the surrounding environment, even in winter, is substantial. Keeping this surrounding heat from the product requires special equipment to store and handle cryogenic liquids.

General safety hazards

1.All cryogenic liquids are extremely cold. Cryogenic liquids and their vapors can rapidly freeze human tissue and can cause many common materials such as carbon steel, rubber, and plastics to become brittle or even break under stress. Cryogenic liquids in containers and piping at temperatures at or below the boiling point of liquefied air [–318°F (–194°C)] can condense the surrounding air and can cause a localized oxygen-enriched atmosphere. Extremely cold cryogens such as hydrogen and helium can even freeze or solidify the surrounding air.

2. Vaporization of a cryogenic liquid, except oxygen, in an enclosed area can cause asphyxiation by displacing the air. Vaporization of liquid oxygen in an enclosed area can cause oxygen enrichment which could saturate combustibles in the area such as workers' clothing. This can cause a fire if an ignition source is present. Although oxygen is not flammable it will support and vigorously accelerate the combustion of other materials.

3.Fog clouds do not define the vapor cloud: They define the area where the vapours are still cold enough to condense the moisture in the air. The vapours can extend well beyond the fog cloud, depending on the product and atmospheric conditions. Although fog clouds may be indicative of a release, they must never be used to define the leak area and should not be entered by anyone. The dense fog clouds associated with the handling or transfer of cryogenic liquids can obstruct visibility.



Handling Hazards

Always handle cryogenic liquids carefully. Their extremely low temperatures can produce cryogenic burns of the skin and freeze underlying tissue.

When spilled on a surface, they tend to spread as far as the quantity of liquid spilled and the physical confines of the area permit. They can cool large areas. The vapours coming from these liquids are also extremely cold and can produce burns.
Exposure to these cold gases, which is too brief to affect the skin of the face or hands, may affect delicate tissues, such as the eyes.

Stand clear of boiling and splashing liquid and the cold vapours that are released. Boiling and splashing always occur when charging a warm container or when inserting objects into the liquid. Always perform these operations slowly to minimize the splashing and boiling.

Never allow any unprotected part of your body to touch uninsulated pipes or vessels containing cryogenic liquids. The extremely cold material may stick fast to skin and tear the flesh when you attempt to withdraw it.

Even non-metallic materials are dangerous to touch at this low temperature.

Personal Protective Equipment

The eyes are the most sensitive body part to the extreme cold of the liquid and vapours of cryogenic liquids.

The recommended personal protective equipment for handling cryogens includes a full face shield over safety glasses, loose-fitting thermal insulated or leather gloves, long-sleeved shirts, and trousers without cuffs.

In addition, safety shoes are recommended for people involved in the handling of containers. Depending on the application, special clothing suitable for that application may be advisable. Gloves should be loose-fitting, so they are able to be quickly removed if cryogenic liquid is spilled on them.

Containers

Cryogenic liquids are stored, shipped, and handled in several types of containers, depending on the quantity required by the user. The types of containers in use are the Dewar, cryogenic liquid cylinder, and cryogenic storage tank. Storage quantities vary from a few litres to many thousands of gallons. Since heat leak is always present, vaporization takes place continuously. Rates of vaporization vary, depending on design of the container, ambient conditions, and the volume of stored product.

Cryogenic Liquid containers

Cryogenic liquid cylinders are insulated, vacuum-jacketed, pressure vessels. They come equipped with safety relief valves and rupture disks to protect the cylinders from excessive pressure build-up.

These containers operate at pressures up to 350 psig and have capacities between 80 and 450 litres of liquid.

Safe Handling of Compressed Gas cylinders

Compressed gas cylinders should be handled only by those familiar with the hazards and who are trained in the proper handling techniques. Cylinders containing compressed gases are heavy and awkward to move. Improper handling of compressed gas cylinders can result in sprains, strains, falls, bruises, or broken bones. Other hazards such as fire, explosion, chemical burns, poisoning, and cold burns could occur if gases accidentally escape from the cylinder due to mishandling.

Take the following precautions to prevent injuries caused by the improper handling of compressed gas cylinders.

NEVER

• Drag or slide cylinders, even for short distances.

• Drop cylinders or permit them to strike each other violently.

• Subject cylinders to mechanical shocks that may cause damage to their valves.

• Use cylinders as rollers for moving material or other equipment.

• Tamper with pressure-relief devices.

• Permit oil, grease, or other readily combustible substances to come in contact with cylinders, valves, or other equipment in oxidizer service.

• Remove any product labels or shipping hazard labels.

• Refill compressed gas cylinders. This is to be done only by qualified producers of compressed gases.

• Lift a cylinder by its cap using a sling or a magnet.

• Attempt to catch a falling cylinder.

ALWAYS

• Move cylinders using a suitable hand truck or cart.

• Leave the valve protection cap and valve seal outlet in place until the cylinder has been secured in place and is ready to be used.

• Secure cylinders when in storage, transit, or use.

• When returning cylinders to the supplier, properly close the cylinder valve, replace and secure any valve outlet seals, and properly install the cylinder cap.

• Use a cylinder cage or cradle to lift a cylinder.

• Use the proper PPE for cylinder handling. Wear safety glasses with side shields, leather gloves, safety shoes, and other appropriate equipment.

• Use extreme care and restrict the movement of portable banks to localize movement on clean, smooth, level stationary surfaces.

• There are two people for localized manual movement of a portable bank. Stay out of the bank's travel path. Also, be aware of escape routes should the bank get out of control or start falling.