Safety Precautions for Handling and Storage of Liquefied gases

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WARNING:

Read and completely familiarize all personnel with handling procedures.

Introduction

The category of substances known as liquefied gases includes liquid nitrogen, oxygen, argon, helium and carbon dioxide but those are only a few of the most common ones. There are many others. Liquefied gases are extremely cold liquid. For example, at atmospheric pressures liquid oxygen exists at -297.3°F. Liquefied gases, because of their peculiar nature, require special attention. The following paragraphs outline properties, precautions and safe handling for liquefied gases.

General

To insure safe control of liquefied gases in laboratories, test stations or wherever these liquids are used, all orders for these materials should be cleared through a responsible person. This individual will insure that the potential user is aware of the danger involved and will follow recommended procedures.

Liquefied gases should never be used in combination with other substances without knowing what the result may be. When in doubt, consult a competent authority.

Purity

Liquid nitrogen, when placed in the container at the manufacturer's plant is of a definite purity but this purity is subject to change since the nitrogen evaporates in preference to the very small oxygen impurity. If liquid nitrogen remains in the container until a large portion of the liquid is evaporated, an analysis of the remaining liquid should be made before it is used for any purpose where a high oxygen impurity or a high oxygen content would be dangerous.

Toxicity

Oxygen is nontoxic. Nitrogen, helium and argon are also nontoxic, but if allowed to accumulate in sufficient quantities they may act as asphyxiates. This is because these gases lower the concentration of oxygen that is normally present in the air. (For this reason, liquid nitrogen, helium and argon should never be stored or used in small closed compartments, rooms or excavations without added ventilation. Well-ventilated storage and working space should be provided.)

Combustibility

While oxygen itself does not burn, it does provide an atmosphere that sustains combustion. Oxygen in liquid form can promote intense combustion of explosive violence. For this reason, liquid oxygen must never be stored or used in containers contaminated with oil, grease or carbonaceous materials of any kind. A serious fire may result from disregarding these guidelines.

In the presence of an appreciable oxygen concentration, a spark on certain materials may cause them to burst into flame, whereas in air, fire would not result. (For this reason, liquid oxygen should never be stored or used in small closed compartments, rooms or excavations without added ventilation. Well ventilated storage and working space should be provided.) Materials that should be of special concern in this respect are wood, plastic, powdered metals, combustible rags and clothing. Anyone working with liquid oxygen should never allow one's clothing to become saturated with liquid or gaseous oxygen, as a spark may cause the clothing to burst into flames.

Pressure Buildup

The heats of vaporization of most liquefied gases are low. In addition, a small quantity of liquid produces a large volume of gas at atmospheric pressure. One cubic foot of oxygen, for example, will produce 860 cubic feet of oxygen gas. Small heat flow from the atmosphere into the liquid, therefore, will produce an appreciable volume of gas. For this reason, all storage vessels should be provided with pressure relief devices unless the container is vented properly to provide escape of evaporating gases. All lines and vessels in which the liquid may be trapped between closed valves should be equipped with pressure relief valves. If there is any likelihood that the relief valve may freeze, as for instance, from ice formed from dripping water or condensed moisture, such vessels and lines should be equipped with rupture discs. Both pressure relief valves and rupture discs should be placed and protected so that water cannot splash or condense upon them. In addition, it is desirable and sometimes necessary, to vent relief valves and rupture discs to the outside atmosphere.

Liquefied gases should be transported only in suitable insulated containers that provide means for the escape of gas as liquid evaporates. Never cork or plug the outlet to such containers.

The use of liquefied gases may require other precautions to be taken. It is imperative that all persons using that material be made aware of these precautions.

Handling

Personnel handling liquefied gases should be thoroughly instructed as to the nature of the materials. Training is essential to minimize accidental spilling. This is to prevent damage from the coldness of the liquid or from the fire hazard of the oxygen enriched air.

Small amounts of liquefied gases are frequently handled in glass dewar flasks which occasionally collapse, particularly if the liquid oxygen is splashed on the joint at the neck. These flasks should always be kept behind protective shields while in use.

Liquefied gases, because of their extremely low temperature, will "burn" the skin like hot liquids. Never permit liquefied gases to come into contact with the skin or allow liquid oxygen or liquid nitrogen to soak clothing. Serious burns may result from careless handling.

When personnel are handling liquefied gases, they are advised to protect themselves by

wearing goggles or face shields and leather gloves large enough to allow quick removal. Rubber aprons and high-topped shoes worn with trouser legs outside the tops are also desirable.

Liquid oxygen must never be poured upon clothing, fabrics, rags, waste or other readily combustible materials, nor the gaseous oxygen arising from liquid oxygen be allowed to penetrate clothing. Combustible substances in the presence of oxygen are highly flammable. A spark can start a serious fire and may cause serious personal injury.

Liquid oxygen should never be poured or demonstrated in close proximity to a source of ignition. A spark coming into contact with a combustible material in an oxygen-enriched atmosphere can burst into flames and immediately cover the surface of the combustible material.

When pouring liquefied gases from one container to another, the receiving container should be cooled gradually to prevent thermal shock. The liquid should be poured slowly to avoid spattering. The receiving vessel should always be vented to the atmosphere and high concentrations of gaseous oxygen and/or nitrogen should not be allowed to collect.

Introduction of a substance that is at normal room temperature into a liquefied gas is always somewhat hazardous. There is a violent evolution of gas, and there is likely to be considerable splashing of the liquid. Personnel doing this work should be instructed of the hazard and should always wear full-face shield and protective clothing.

In the event a person is burned by liquefied gas, the following first aid treatment should be given pending the arrival and care of a physician:

1. If any liquid gas contacts the skin or eyes, immediately flood that area of the body with large amounts of unheated water and then protect frozen parts with loose, bulky, dry, sterile dressings.
2. If the skin is blistered or there is any chance that the eyes have been affected, get the patient immediately to a physician for treatment.

Material Limitations

The physical properties of many materials at extremely low temperatures may be quite different from the properties of the same materials at normal temperatures. Therefore, materials that have been cooled to the temperatures of liquid oxygen or liquid nitrogen should be carefully handled until their properties, under these conditions, are known.

Metals to be used for equipment in liquid oxygen or liquid nitrogen, must possess satisfactory physical properties at the low operating temperatures. Since ordinary carbon steels, and to a lesser extent most alloy steels, lose their ductility when subjected to the low temperatures of liquid oxygen or liquid nitrogen, they are considered unsatisfactory for such service. The austenitic nickel-chromium alloys have good ductility at the low service temperatures under consideration, and the most widely known is 18-8 stainless steel. Cooper, monel, brass and aluminum are also considered satisfactory materials for low temperature use.

Each new use for these liquids should be carefully considered before it is instituted and safety precautions should be completely outlined.

WARNING

Inert gases released in a confined space can displace sufficient air to make the atmosphere

incapable of sustaining life. Entering an oxygen deficient atmosphere may cause unconsciousness without warning. Purge the space completely with air and test before entry. Wear an air respirator and have helper stand by also equipped with an air respirator.

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