CRYOGENIC SAFETY

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Introduction

- Cryogenics is the science of ultra low temperatures. Low temperatures are achieved by the liquefaction of gases.
- The gases which are most widely used in industry and research are helium, hydrogen, nitrogen, fluorine, argon, oxygen and methane.
- Properties of Cryogenic Fluids
  - Extreme low temperatures.
  - Large ratio of expansion in volume from liquid to gas.
  - Most cryogenic liquids are odourless and colourlesswhenvapourised to gas.

PROPERTIES OF CRYOGENIC FLUIDS

- Boiling points of cryogens

- Helium -269.9 oC
- Hydrogen -252.7 oC
- Neon -245.9 oC
- Nitrogen -195.8 oC
- Oxygen -183.0 oC

Liquid to gas expansion ratios of cryogens

- Helium 1 to 757
- Hydrogen 1 to 851
- Neon 1 to 1438
- Nitrogen 1 to 696
- Oxygen 1 to 860

Storage of Cryogenic liquid

- Cryogenic fluids are stored in well insulated containers to minimize loss due to boil off.
- The most commonly used container for handling cryogenic fluids is the Dewar flask.
- Dewar flasks are non pressurized, vacuum jacketed vessels.

USE of Cryogenic Fluid in the Department.

Liquid Nitrogen for DMA

HAZARDS IN HANDLING CRYOGENICS

- **OXYGEN DEFICIENCY**: They displace oxygen in non ventilated confined spaces causing oxygen deficient atmosphere, resulting in asphyxiation; work space is considered unsafe for entry if the oxygen level falls below 19.5%.
- **FROST BURNS**: On contact with skin, they can cause frost burns due to extreme cold. Cryogens can cause embrittlement of the exposed body surface because of high water content of the human body. Splashing of cryogens can result in permanent eye damage
- **PRESURE HAZARD**:Pressure build up in the container can cause explosion. Usage of cryogens always present a high pressure hazard as the gases are stored at or near their boiling point. The liquefied gas will be evaporating continuously into the gaseous state and as a result there is always some gas present in the container. The large expansion ratio from liquid to gas provides a source for the build up of high pressure in the container.
- **MATERIAL HAZARD**: Affects properties of materials. Ordinary carbon steels and most alloy steels, rubber becomes brittle when subjected to the low temperatures of cryogens. These materials are considered unsuitable for use with cryogens. Metals which are suitable for cryogenic temperatures are copper, brass, bronze, moneland aluminium.
- **OXYGEN ENRICHMENT:**

PRECAUTIONS:WHILE HANDLING CRYOGENICS

- Cryogenic liquids must be handled in well ventilated areas to prevent excessive concentrations of gas in enclosed spaces.
- The gas released from equipment must not be disposed of in confined/enclosed areas
- Oxygen level detectors to be installed in enclosed spaces where there is chance of build up of gases causing oxygen deficiency
- Keep safe distance from boiling and splashing liquid and its issuing cold gas.
- Boiling and splashing occur when charging a warm container or when inserting objects into the liquid. These operations must be performed slowly to minimize boiling and splashing.
- Any unprotected part of the body must never be allowed to touch uninsulated pipes or vessels containing liquefied gases.
- The extremely cold metal can stick fast and tear the flesh, if an attempt is made to withdraw from it.
- Liquefied gases must be transported only in suitably insulated containers that provide means for the escape of gas as liquid evaporates. Never plug the outlet of such containers.

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- Portable trolleys must be used for moving large containers of cryogens
- Cryogenic containers must not be dropped or tipped on their sides.
- Frost spots may appear in case of loss of insulating vacuum. A vessel in this condition must be removed from service. Repairs must be handled by the manufacturer
- Prevent the entry of liquid cryogen inside the glass vials while inserting the same inside the container. As later the liquid can expand causing the explosion of the vial.
- Tongs must be used to withdraw objects immersed in liquid.

PRECAUTIONS PRESSURE HAZARDS

- Dewars must be kept covered with a loose fitting cap to prevent air or moisture from entering the container, and to allow build up pressure to escape.
- Make sure that no ice accumulates in the neck or on the cover and causes a blockage and subsequent pressure buildup.
- Only containers specifically designed for holding cryogenic liquids must be used.

HAZARD DUE TO OXYGEN ENRICHMENT

- When liquid nitrogen is transferred through uninsulated metal pipes, surrounding air can condense on it.
- An oxygen-enriched condensate is formed on the surface as nitrogen evaporates, increasing the flammability of materials near the system.
- Combustible materials must be stored clear of equipment containing cryogenic fluids to reduce the risk of fire.