Safe Handling and Use of Liquid Nitrogen

Presented by the Office of Biological Safety
Safety Training Outline

This awareness training is intended for laboratory users of Liquid Nitrogen

- Characteristics of Liquid Nitrogen and associated Hazards
- Handling Liquid Nitrogen
- Liquid Cylinders
- Storage
- Personal Protective Equipment (PPE)
- Transporting Liquid Cylinders
- Emergencies
Characteristics of Nitrogen

- Nitrogen = 78% of Atmosphere
- It is Colorless, Odorless, Tasteless, and Nontoxic
- Boils at -320 degrees Fahrenheit (-196 C)
- Non-Flammable
- WILL NOT SUPPORT LIFE
- Gas is slightly lighter than air
Hazards

- Liquid Nitrogen is extremely cold: -320F
  - Can cause severe frostbite or eye damage upon contact
  - Substances may become brittle upon contact with liquid nitrogen and shatter, sending pieces flying

- On vaporization, Liquid Nitrogen expands by a factor of almost 700 (1 cu.ft. LN₂ = 700 cu.ft. N₂)
  - May cause an explosion of a sealed container.
  - Displaces oxygen and may cause asphyxiation.

- Oxygen may condense on surface of LN₂
  - Highly reactive with organic materials
Oxygen Deficiency Precautions

- LN$_2$ should be used and stored in well-ventilated areas.
  - High concentrations of nitrogen reduce the breathable oxygen in the air.

- LN$_2$ release can cause oxygen deficiency:
  - When transferring between containers
  - From leaking valves
  - From liquid tank venting
  - From open containers
Transporting LN$_2$ Containers

- Containers must always be stored in the upright position.
- LN$_2$ cylinders vary in weight and size. They are all heavy and cumbersome.
- Do not roll, either vertically or horizontally.
- Always use the specially designed cylinder cart when moving LN$_2$ cylinders.
- If the container tips over, let it go.
Handling LN₂: Transferring from Primary Container

- Always wear safety equipment including heavy loose-fitting leather or cryogenic gloves, and eye and face protection
- Prior to use, ensure the fittings on the regulator match the fittings on the liquid container
- Never use unregulated adaptors on liquid containers
- Open valves slowly to minimize thermal effects and control gas escape
- Do not fill Dewars or secondary containers to more than 80% of capacity; expansion of gases may cause pressure buildup
Handling $\text{LN}_2$: Bench top Containers

- Bench top containers are utilized for small scale use in labs
- Transfer $\text{LN}_2$ only from Dewars or secondary containers, never from primary pressurized tank
- Never dispense liquid into an unapproved container, such as a Thermos® bottle. It will shatter.
- Transfer of $\text{LN}_2$ can cause splashing
  - Utilize specialized withdrawal devices instead of pouring ($\text{LN}_2$ Pump)
- Transfer liquid slowly to prevent thermal shock, pressure buildup, and splashing.
- Always where appropriate PPE.
Liquid Withdrawal

- Transfer of LN\textsubscript{2} can cause splashing
- Use caution when inserting open-ended pipes or tubes. Cold liquid/gas may spurt through warm end.
- Ensure that withdrawal hose is equipped with a phase separator to prevent splashing
- Transfer liquid slowly to prevent thermal shock, pressure buildup, and splashing
- Always wear appropriate PPE
Safe Use in Labs

When handling LN$_2$ in labs, ALWAYS REMEMBER

- Only trained personnel should work with LN$_2$
- Have a plan
  - Inform others in lab
  - Use in well vented and low traffic areas
- Wear appropriate PPE
- Instruments and withdrawal devices in contact with LN$_2$ become extremely cold
- LN$_2$ should only be handled in approved containers
  - Do not transport in uncovered containers
- Avoid breathing LN$_2$ vapors
- Carry transport containers away from body and face
- Do not leave open containers unattended
Handling Cryotubes

• Cryotubes used to contain samples stored under liquid nitrogen may explode without warning when handling and thawing.

• When thawing cryotubes, take the following protective steps:
  • Wear a face shield and safety goggles, whenever handling cryogenic liquid.
  • Wear appropriate insulated gloves.
  • Wear a buttoned lab coat and pants and closed toed shoes.
  • Place the cryotube in a heavy-walled container (e.g., a dessicator) or behind a safety shield while thawing.
What’s wrong with this picture?
Different Types of LN$_2$ Containers

Use only containers specially designed to hold liquid nitrogen
- Check with the manufacturer
Low Pressure LN$_2$
Container Components

- **Liquid Withdrawal Valve**
- **Pressure Gauge** - Displays internal pressure of the container
- **Contents Gauge** - A float-type liquid level gauge indicates approximate level of liquid.
- **Vent Valve** - Primarily used in the fill process to vent the vapor space while filling. Can be used to vent unwanted pressure during storage and use
- **Pressure Relief Devices (2)**
  - Protect vessel from over-pressurization
  - Re-seating spring-loaded relief valve releases at 22 psig
  - Burst disk rated to protect the inner vessel
Content Gauge on Liquid Cylinders

The container **contents** gauge is a float-type liquid level sensor that indicates the level of the liquid.

The gauge is an indication of approximate container content, and should not be used for judging the **weight** of the container.

Containers are always filled by Weight!
Pressure Relief Devices

- The liquid-to-gas conversion rate is about 2.3% per day.
- Pressure will build until released by the control valve.
  - Unless released, gas can build up to dangerous levels
- Hearing a slight hiss from a LN$_2$ cylinder is the normal operation of its pressure relief device.
- LN$_2$ cylinders should always be stored in well ventilated areas.
- **Contrary to popular belief, storage of LN$_2$ in cold rooms will not slow down the liquid to gas conversion.**
Warning!

■ Never plug, restrict, cap, seal or remove any relief or venting device.

■ Ice or frost buildup on a pressure relief valve should be removed with a damp cloth.

(Wear proper Personal Protective Equipment (PPE) when removing the frost.)
Personal Protective Equipment Needed

- Eye Protection
  - Full Face Shield with safety goggles is best

- Heavy, **Loose-Fitting** leather or Cryogenic Gloves

- Lab Coat

- Closed toe shoes

- Long Pants
  - Avoid cuffs
  - **Do not tuck pants into shoes/boots**
Emergencies

- If there is a large spill or rupture of a container, call 911 and warn others in building.
  - Evacuate. There may be oxygen deficiency in the area of the spill.
- Cold burns should be immediately flushed with tepid water or placed in a warm water bath.
  - Notify Supervisor
  - Seek medical evaluation
    - UW Hospital and Clinics Emergency Room
  - DO NOT RUB SKIN – may damage tissue
Thank you for your participation.

Your safety is important to us.

QUESTIONS?

contact

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