# Occupational Health Program Safety Training Series

## Safe Handling and Use of Liquid Nitrogen

UW-MADISON SAFETY

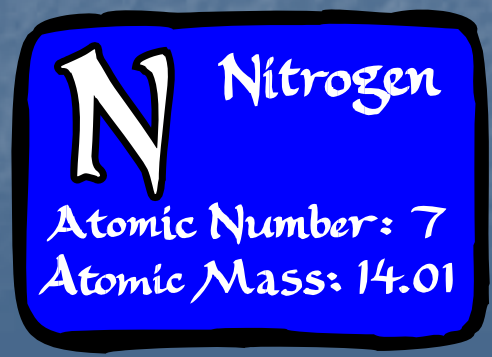
# Safety Training Outline

**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. $LN_2$ = 700 cu.ft. $N_2$)
  - May cause an explosion of a sealed container.
  - Displaces oxygen and may cause asphyxiation.
- Oxygen may condense on surface of $LN_2$
  - 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 $LN_2$:
## 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 $LN_2$:
## Bench top Containers

- Bench top containers are utilized for small scale use in labs
- Transfer $LN_2$ 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 $LN_2$ can cause splashing
  - Utilize specialized withdrawal devices instead of pouring ($LN_2$ Pump)
- Transfer liquid slowly to prevent thermal shock, pressure buildup, and splashing.
- Always where appropriate PPE.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NITROGEN

# Liquid Withdrawal

- Transfer of $LN_2$ 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 where 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

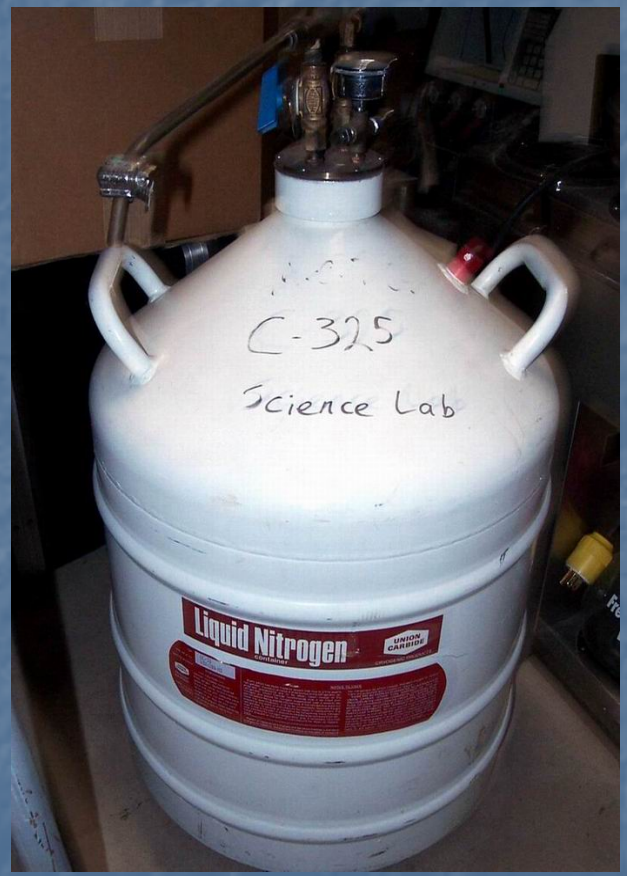
# Handling Cryotubes

- **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**

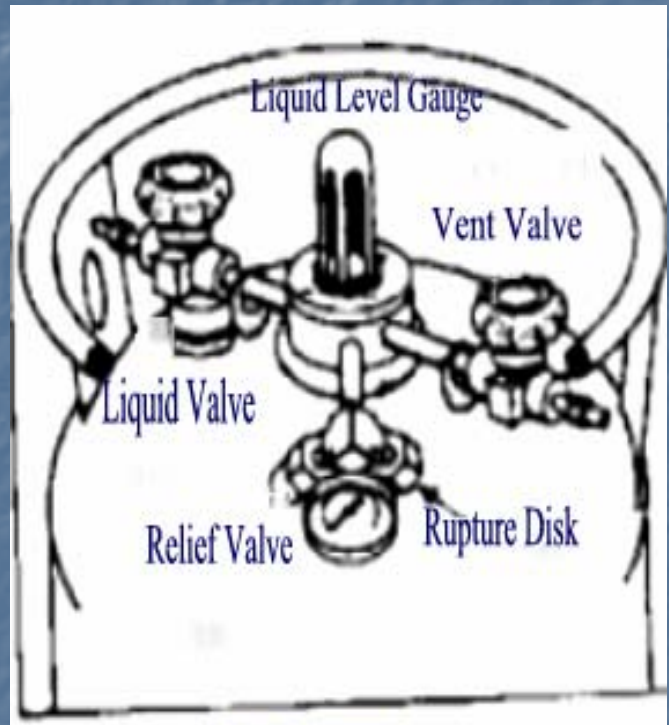
# Low Pressure $LN_2$ Container Components

- 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

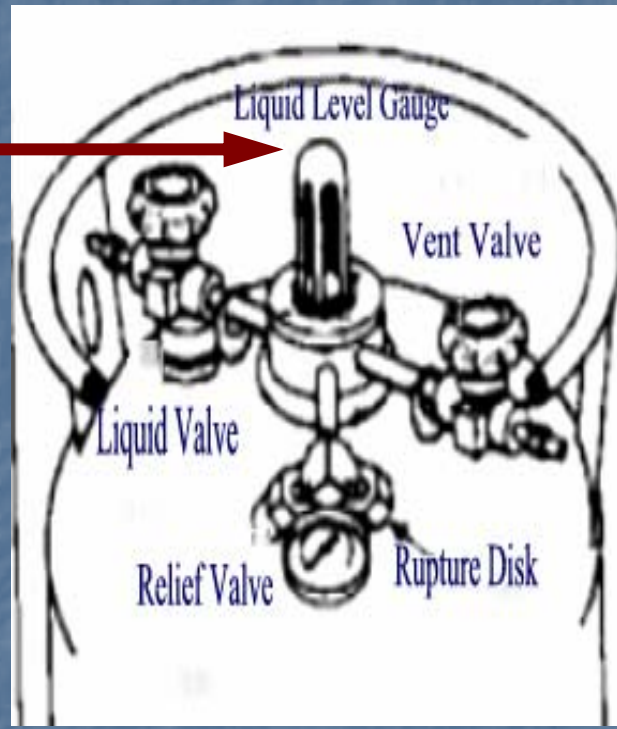
  -Burst disk rated to protect the inner vessel




Low Pressure Liquid Container Components

# 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 <u>will not</u> slow down the liquid to gas conversion.**

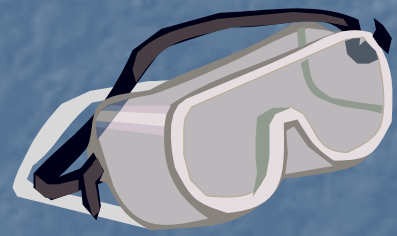
# Warning!

- Never plug, restrict, or remove any relief device.
- Never attempt to cap or seal a venting relief device in any way.
- 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 (PPE)

- When working with $LN_2$, the recommended PPE includes:



  - Eye Protection
    - Full Face Shield with safety goggles is best
  - Heavy, Loose-Fitting leather or Cryogenic Gloves

  - Lab Coat
  - Long Pants - cuff-less to avoid spill collection
  - Closed toe shoes
  - 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.**

FOR QUESTIONS
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