Compressed Gas, Cryogenic & Precision Valve Products & Services on a Global Scale
CryoScience Safety

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Cryogenic Safety

- EXTREMELY IMPORTANT
  - Personal
    - Understand Hazards & Safety Precautions
  - Commercial
  - Product

- TW Safety Booklets/Manuals

- Reference CGA Documents (CGA P-12) www.cganet.com

- Reference Gas Supplier Documents
Nitrogen constitutes 78% by volume of earth’s atmosphere

Colorless and odorless

Liquid Nitrogen (LN2) is -196°C
  - LN2 Provides Coldest Economic Temperature
  - Below Glass Transition Temperature (-130°C)

One (1) liter of LN2 = 696 liters of Nitrogen gas
Cryogenic Safety – Personnel

- LN2 -196°C (Freeze Human Tissue)
  - Safety Goggles - Minimum
  - Faceshield
  - Gloves
  - Minimize Skin Exposure
Cryogenic Safety - Personnel

- Clothing
  - Long Sleeves
  - Shoes - Not Sandals
  - No Loose Clothing
  - Cuffless Trousers
Cryogenic Safety - Personnel

- Cryogenic Burns
  - Flush with Luke Warm Water
  - Do NOT use Hot Water
  - Consult Physician Promptly
Cryogenic Safety – Oxygen Deficient Atmospheres

- Asphyxiation
  - Air Contains 78% Nitrogen, 21% Oxygen
  - < 19.5% Oxygen, Risk of Oxygen Deprivation
  - Rapid Nitrogen Venting - Increase Nitrogen Concentration, One Volume of LN2 = 696.5 Volumes of Gas
  - Little Warning, Odorless, Colorless
  - Light Headed, Dizziness, Drowsiness, Unconsciousness, Death
Cryogenic Safety – Oxygen Deficient Atmospheres

- Asphyxiation, Oxygen Deficient Atmospheres
  - 15-19%, Decrease ability to work Strenuously, May Impair Coordination, in Persons with Coronary, Pulmonary or Circulation Problems
  - 12-14%, Respiration increases in exertion, Pulse Up, Impaired Coordination, Perception, Judgment
  - 8-12%, Mental Failure, Fainting, Unconsciousness, Ashen Face, Blueness of Lips, Nausea, Vomiting
Cryogenic Safety -

Oxygen Deficient Atmospheres

- Asphyxiation, Oxygen Deficient Atmospheres
  - 6-8%, 8 Minutes -100% Fatal; 6 Minutes - 50% Fatal; 4-5 Minutes - Recovery with Treatment
  - 4-6%, Coma in 40 Seconds, Convulsions, Respiration Ceases, Death
    - NOTE: Values Approximate, Vary with Individual’s State of Health.
    - NOTE: % by Volume at Atmospheric Pressure
Cryogenic Safety – Oxygen Deficient Atmospheres

- Oxygen Monitor
- Alarms <19.5% O2
  - Audible
  - Flashing Light
    - Inside Room
    - Outside Room
Cryogenic Safety – Storage Media

- After removal from **immersion** in LN2, loosen cap

- Cryotubes (Vial) - Can Shatter
  - LN2 Get Into Vial, Expand, Shatter
  - Californian Researcher Lost An Eye
  - Plastic Shards Embedded in Hands & Faces
Cryogenic Safety – Storage Media

- Storage Media & Storage Containers
  - Bags
  - Straws - Can Shatter
  - Verify Products Stored, infectious
    - Take Appropriate Protection
Cryogenic Safety – LN2 Supply

- LN2 Storage Equipment
  - Select Vessel Designed for Application
  - Use Correct PRESSURE Rated Vessel
  - Use Correct FITTINGS For Gas Service
  - CryoScience Containers - NOT for Oxygen Service.
Cryogenic Safety – LN2 Supply

- Filling Liquid Cylinders (Gas Supplier)
  - Use Trained Staff
  - Protection of Operator
  - Protect Asset
    - Handling
Cryogenic Safety - Transport

- Transporting Dewars
  - Liquid Cylinder (Harper Trolley, 4-wheel)
    - Beware of Rough Surfaces/Slots/Crevasses/Grates
  - Liquid Cylinders With Castors are Not for Rough Surfaces
- Safety Shoes & Clothing
Cryogenic Safety – Relief Devices

- Safety Devices - Relief Device
- Pipe away

CLOSED

OPEN
Cryogenic Safety – Relief Devices

- Safety Devices - Safety Head/Burst Disc

![Diagram of bursting disk/safety head (inner container)](image-url)
Cryogenic Safety – Relief Devices

- Safety Devices
  - Always Have Relief Device Between Shut-Off Locations
  - Recommend to Replace Every Three Years
  - Do Not Try to Repair
    - Relief Device, Safety Head/Burst Discs
  - Replace with Correct Size
Cryogenic Safety - Connection

- Connecting Liquid Cylinder to Freezer
  - Close Liquid Valve
  - Don’t change when hose is cold
  - Teflon tape on NPT threads
Cryogenic Safety - Dispensing

- LN2 Dispensing Into Smaller Containers
  - Do Not Leave While Filling
  - Personal Protection - Safety Equipment
  - Correct Length Cryogenic Hose and Phase Separator
Cryogenic Safety - General

- General
  - Do Not use Tubes to Measure Liquid Level
  - Electric Hazards
    - Emergency Power Outlet
  - Defective Equipment - Call Supplier/Distributor
- BE SAFE
  - Your Family
  - Your Company
  - Your Customer
Cryogenic Safety - Product

- Liquid or Vapor Phase Storage
- Temperature Required at the top of the freezer
Cryogenic Safety - Product

- Rack located in or out of LN2
- If in Vapor then Less LN2 spill/waiting to Drain
  - Time exposure of product
- Redundancy - Alarms
  - Alarm, 4-20mA
  - Dip Stick
Cryogenic – Better Temperature Profile

- **NEW?**
  - Use long term smaller neck freezers
  - Use Aluminum racking system

- **EXISTING?**
  - Add an aluminum vapor sleeve
  - Proper retrieval/storage procedures
  - Proper maintenance
Cryogenic – Better Temperature Profile

- Proper retrieval/storage procedures
  - Get In/Out
    - Less than 2 minutes
  - NEVER use top of racks as work space
    - Risks top to thaw/refreeze
    - Decreased viability
  - Store critical samples mid-freezer
    - Colder than GTP
Cryogenic – Maintenance

- Lost articles = Lost storage
- Cardboard boxes breakdown
- Ice Buildup = Decreased temp and improper readings
Cryogenic – Maintenance

- Lost vials = Lost work
Cryogenic – Maintenance

- Broken lids occur from all of the above
- Lids buildup ice
- End result decreased temp, hinge failure, increased usage
Cryogenic – Maintenance

- Proper placement of temp probes
- Calibration
  - Temp
  - Level
- Verification
  - Functionality
  - Alarms
- Preventative maintenance schedule

- Daily
  - Dipstick
- Weekly
  - Remove ice from lid
- Monthly
  - Test alarms
- Yearly
  - Calibration
  - Verification
- Every 3 years
  - Replace valves
  - Warm & clean
- Every 10 years
  - Revac. (Mfgs. design expectancy)

Daily

Weekly

Monthly

Yearly

Every 3 years

Every 10 years
Cryogenic – Safety Accessories

- Vial Caps
- Vial Labels
- LN2 Sticks
- Cryo Claw
Cryogenic – Safety Solutions

- Team-up w/ EHS
  - Seismic, O2 monitoring, evacuation notices, training

- Know your code
Cryogenic – Example, Laboratory Suite

Monitoring system

Diamond Plate

LN2 (3) valve system

Cryogenic freezers
Cryogenic – Common Room, Before & After
CryoScience Safety
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