

Safe handling of liquid gases and pressurized gases

Liquid gases

All liquid gases have temperatures below -150°C

Gas	nitrogen	argon	oxygen	helium
Boiling point [$^{\circ}\text{C}$]	-196	-186	-183	-269

Example: liquid nitrogen

- Surrounding air contains ca. 80% nitrogen
- Not corrosive
- Not poisonous
- Not flammable
- Chemically inert
- No smell
- colorless



Nothing to worry about, right???

DANGER when liquid...

- Burns
- Suffocation
- Over pressure/explosion
- Condensation of oxygen
- Material damage (brittle)
- Noise (when filling dewars)

Frostbite

- Short contact results in tissue damage
- Frostbite possible by longer contact
- When inhaling, damage of lung tissue
- Contact with cold surfaces
→ the skin sticks to surface

Duisburg, 22.10.2009



Contact with trousers



Wetted socks from
work with liquid O₂

Pay attention!

- Leakage
- If you see gas “escaping”
- Poorly aired rooms
- Filling in buildings
- Handling of already small amounts: 0.3 L liquid N_2/m^3 room volume

Example:

Worker at Hospital Dies; Gas Leak Suspected

By EUN LEE KOH

Published: September 21, 2000

A man who was installing an M.R.I. machine at New York-Presbyterian Hospital was **killed** yesterday, apparently after nitrogen he was using leaked from its tank, officials said. **Six other people were injured** in the incident.

The worker, Paul Ambrose, 25, of England, died about 11:25 a.m., apparently from **asphyxiation**, while working in a poorly ventilated trailer alongside the hospital on 70th Street and York Avenue, said Mayor Rudolph W. Giuliani, who arrived at the hospital shortly after the incident occurred.

Two other workers, after learning that Mr. Ambrose had not left the trailer, went back inside and found him unconscious, the authorities said. The two workers and four other people in the vicinity complained of varying degrees of lightheadedness. They were treated at the hospital and released.

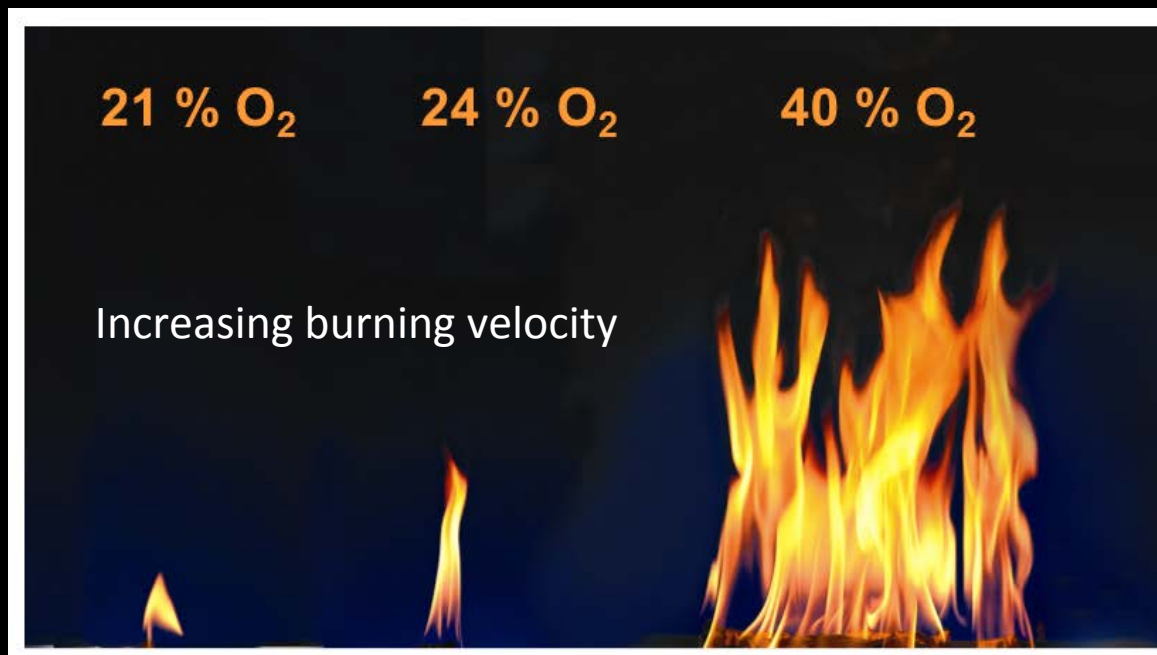
While the authorities are still investigating the cause of the accident, they strongly **suspect that one of the liquid nitrogen tanks that was used while installing an M.R.I. had leaked**, Mr. Giuliani said.[]

Over pressure/explosion

- Heating above the boiling point in closed container without pressure balance → extremely increased pressure -> danger of **explosion**
- External heating (fire)
- Vessels without pressure balance or frozen pressure balance valve → **explosion**

O₂ accumulation

- Liquid He or N₂: danger of O₂ accumulation
- Danger in cool traps: especially in Schlenk lines
- Liquid O₂ and air condensation are **extremely flammable**
- **Explosion risk** in contact with organic solvents, oils,...



Materials failure

- Use highly fluorinated polymers-
they don't become brittle



Signs



Warning low temperatures



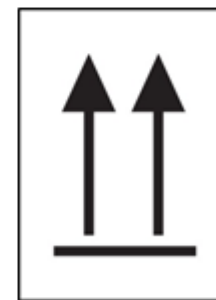
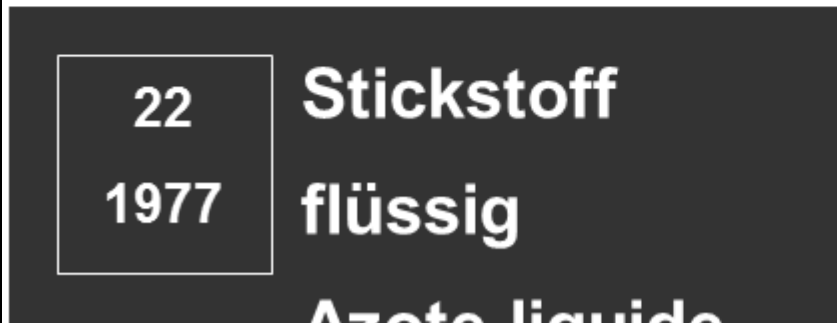
Wear eye protection



Wear cryo gloves



Danger of suffocation



Precaution

- Proper signs
- Inform people what you are working with and inform them about the danger **DO NOT work alone**
- Wear proper clothing, dry not tight clothing (**Lab coat!**), open pockets, avoid pulled up sleeves , closed and proper shoes, cryo gloves, safety glasses, no rings & bracelets and watches...
- Use only authorized equipment, check if the connections are proper, fill slowly, wear protection clothing
- Open windows and make sure the room is **properly ventilated**
- **DO NOT take the elevator together with the dewar!!!**
- **Do not close the dewar tightly**
- **Do NOT touch** tubing or anything which has been in contact with liquid nitrogen



Druckgasbehälter im Brandfall

THE LINDE GROUP

PanGas

Increasing temperatures
→ increasing pressure



Practical demonstrations....

- <https://www.youtube.com/watch?v=9-f5zfMH7QI>
- <https://www.youtube.com/watch?v=f-xmaPSZ6GM>



Discovery

*Schweizerischer Feuerwehrverband
Fédération suisse des sapeurs-pompiers
Federazione svizzera dei pompieri
Federaziun svizra dals pumpiers*



Arbeitsgruppe Technische Fragen Atemschutz (TEFRAS)

**Groupe de travail pour les questions techniques
de protection respiratoire**