Instrument Presentation: Liq. N_2 container

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Liquid N_2

- Liquid Nitrogen is colourless, odourless liquid with density of 0.807 g/ml. It’s temperature at ambient pressure is about 77 K. The latent heat of vaporization is about 160 kJ/l.
- Boiling point is -196 °C or 77 K.
- Nitrogen was first liquefied at the Jagiellonian University on 15 April in 1883 by Polish physicists, Zygmunt Wróblewski and Karol Olszewski. It is produced industrially by fractional distillation of liquid air.
- The temperature of liquid nitrogen can readily be reduced to its freezing point 63 K (−210 °C; −346 °F) by placing it in a vacuum chamber pumped by a vacuum pump.

Source: Wikipedia

Uses of liq. N_2

- to store cells at low temperature for laboratory work
- in cryogenics
- as a source of very dry nitrogen gas
- to freeze water and oil pipes in order to work on them in situations where a valve is not available to block fluid flow to the work area; this method is known as a cryogenic isolation
- for CCD cameras in astronomy
- for a high-temperature superconductor to a temperature sufficient to achieve superconductivity
- for vacuum pump traps and in controlled-evaporation processes in chemistry
- as a component of cooling baths used for very low temperature reactions in chemistry

Liquid nitrogen's efficiency as a coolant is limited by the fact that it boils immediately on contact with a warmer object, enveloping the object in insulating nitrogen gas. This effect, known as the Leidenfrost effect.

Heat transfer

There are three ways to transfer heat from one body/location to another. They are conduction, convection, and radiation.

Conduction: transfer of heat directly from body to another by molecular motion. This is entirely dependent upon the physical/chemical properties of the materials in question on how well heat transfers from one body to the next.

Convection: transfer of heat by mass transport of warm fluids/gasses mixing with cooler ones.

Radiation: transfer of heat by the emission of energy from a warm body as electromagnetic radiation (i.e. light).

For an ideal cryogenic container, all these effects for the heat transfer needs to be minimized.

Containers

Liquid nitrogen is stored, shipped and handled in several types of containers, depending upon the quantity required:

- Dewar
- Cryogenic liquid cylinder
- Cryogenic storage tank

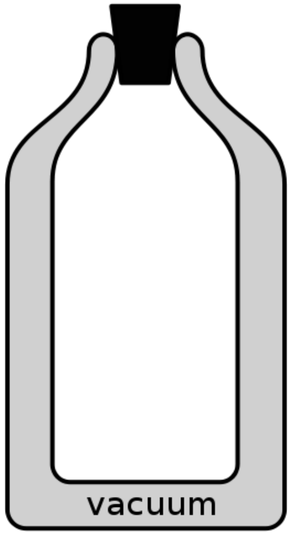
Storage quantities vary from a few liters to many thousands of gallons.

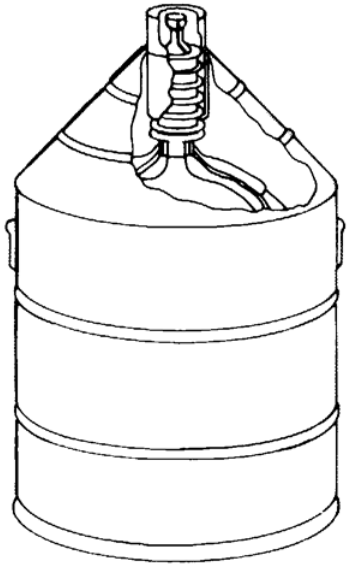
Since heat leak is always present, vaporization takes place continuously.

Rates of vaporization vary, depending on the design of the container and the volume of stored product.

Dewar

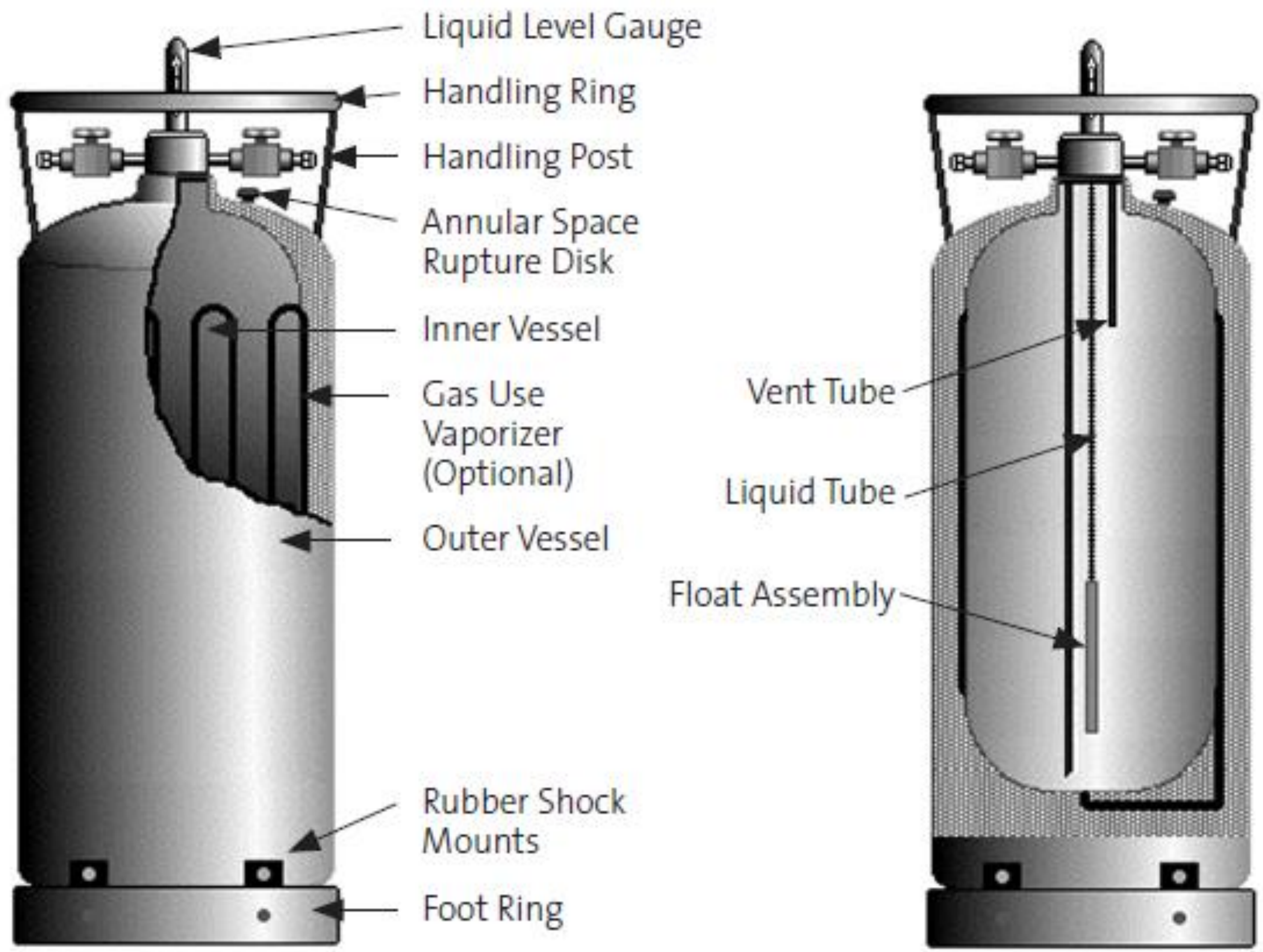
- This type of container is a non-pressurized container. It was invented by Sir James Dewar in 1892.
- The vacuum flask consists of two flasks, placed one within the other and joined at the neck. The gap between the two flasks is partially evacuated of air, creating a near-vacuum which significantly reduces heat transfer by conduction or convection.
- Cryogenic liquid cylinders that are pressurized vessels are sometimes incorrectly referred to as dewars.

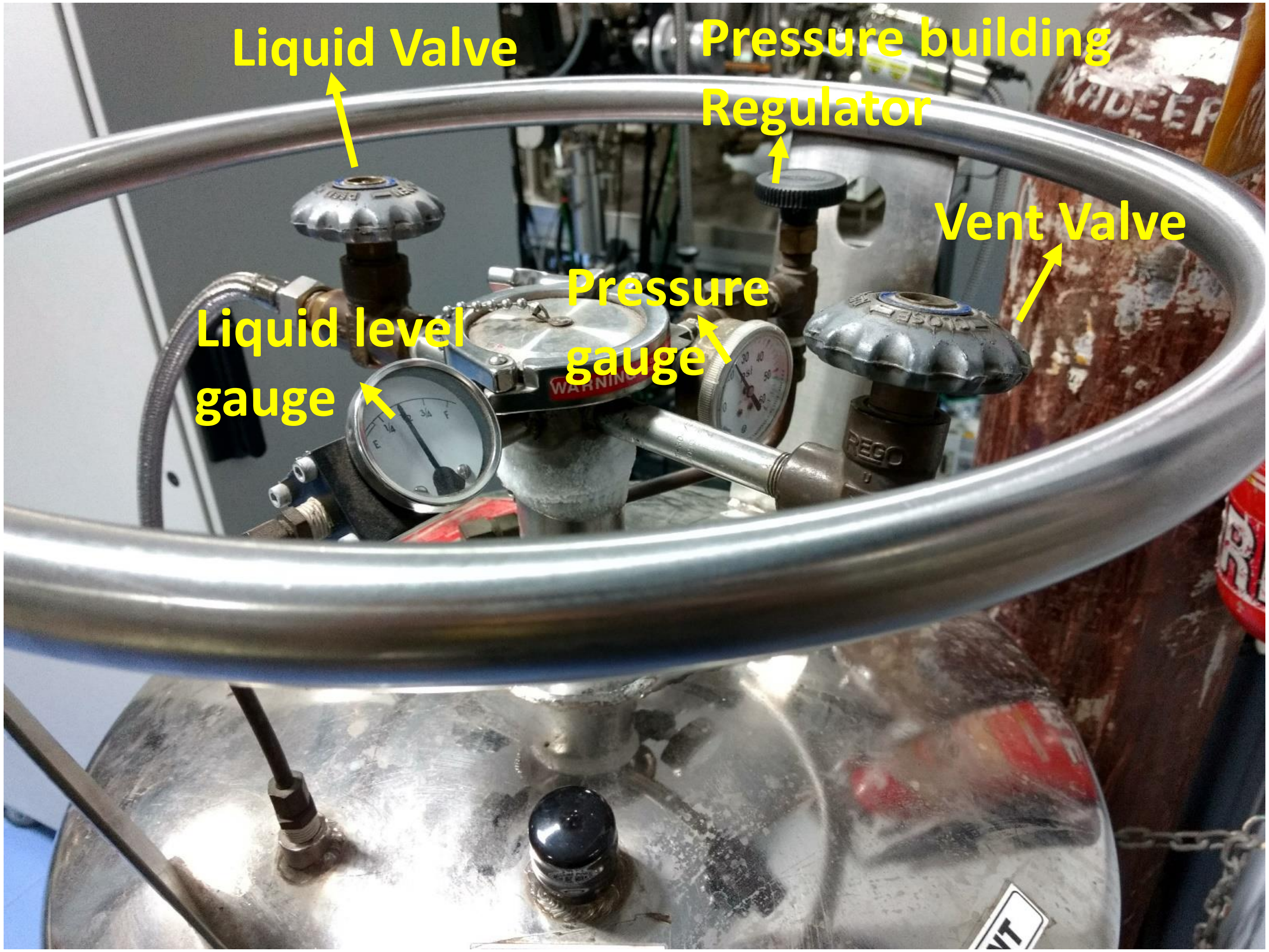




Cryogenic liquid cylinder

- Cryogenic liquid cylinders are insulated, vacuum-jacketed pressure vessels.
- They come equipped with safety relief valves and rupture discs to protect the cylinders from pressure buildup.
- These containers operate at pressures up to 350 psi and have capacities between 80 and 450 liters of liquid.
- Product may be withdrawn from the container as a liquid under its own vapor pressure.


Liquid Level Gauge
Handling Ring
Handling Post
Annular Space Rupture Disk
Inner Vessel
Gas Use Vaporizer (Optional)
Outer Vessel
Rubber Shock Mounts
Foot Ring
Vent Tube
Liquid Tube
Float Assembly


Liquid Valve
Pressure building Regulator
Vent Valve
Pressure gauge
Liquid level gauge

- Liquid valve:
  - Liquid is withdrawn through this valve
- Pressure gauge:
  - Displays internal pressure of the container
- Liquid level 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

Safety

- Keep in a well ventilated room
  - Liquid nitrogen, when turned to the gaseous state, can displace oxygen from the air and can create an oxygen-deficient atmosphere under the right conditions.
  - A non ventilated room could very quickly become oxygen deficient.
  - It is also recommended that the building that the nitrogen is stored in has an exhaust ventilation system to outside the building. All lab buildings have this system.
- Do not leave Dewar containers uncovered, but make sure to have an exhaust system.
- Don’t try to carry or drag the container.
- Keep the container upright.
- Don’t try to pull the container, always push.
- Avoid mechanical or thermal shock.
  - Sudden environmental change could potentially change the pressure.

Thank you