Scientific Products Ltd

Cryogenic Equipment, Vacuum Pipeline Systems, Industrial Cryogenics.

- **AS** Scientific was established in 1976
- Abingdon Science Park, Abingdon, OX14 3NB England
- 45-50 Engineering and support staff.
- 40 year + experience in Cryogenic field

About Us

AS Scientific is a specialist Engineering company working in the Cryogenic and Vacuum Market. We offer complete support, from concept design through to final construction and commissioning.

- 95% of AS Scientific's turnover consists of Cryogenic or High Vacuum applications.
- Turnover approximately 5 Million Euros.
- Our Products
  - ✓ SIVL
  - ✓ Furnaces
    - ✓ 1100ºC
    - ✓ 1800ºC
  - ✓ Cryofurnace
  - ✓ Cryostats
    - ✓ Standard 50mm
    - ✓ Standard 70mm
    - ✓ The mini (25mm)
    - ✓ The Maxi (100mm)
  - ✓ Phase Separators
  - ✓ Valve box
  - ✓ Multi Transfer lines

Micron – LN2 Training

Summary

- Vacuum System Description
  1. Vacuum level and pressure.
  2. Vacuum level failure time.
  3. Vacuum level impact reason and seal stable.

- LN2 Pipe supply system description
  1. LN2 pipework and P&ID.
  2. Flexible hose & valve.
  3. Gas vent point design.
  4. Reduce valve design.
  5. LN2 SIVL Manufacture & Installation.

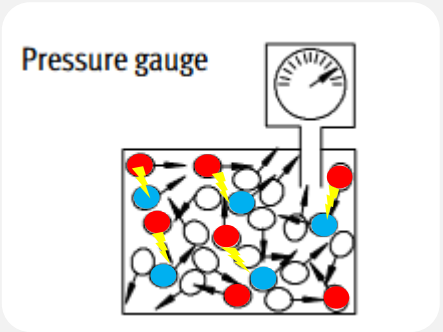
- LN2 Operation / Maintenance
  1. LN2 flow meter.
  2. LN2 SIVL supply and work procedure.
  3. Vacuum pump and power hose.

Vacuum System Description

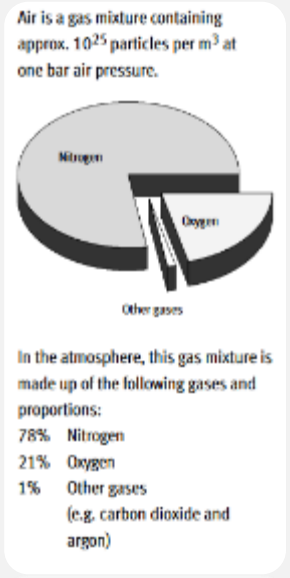
Vacuum level and pressure.

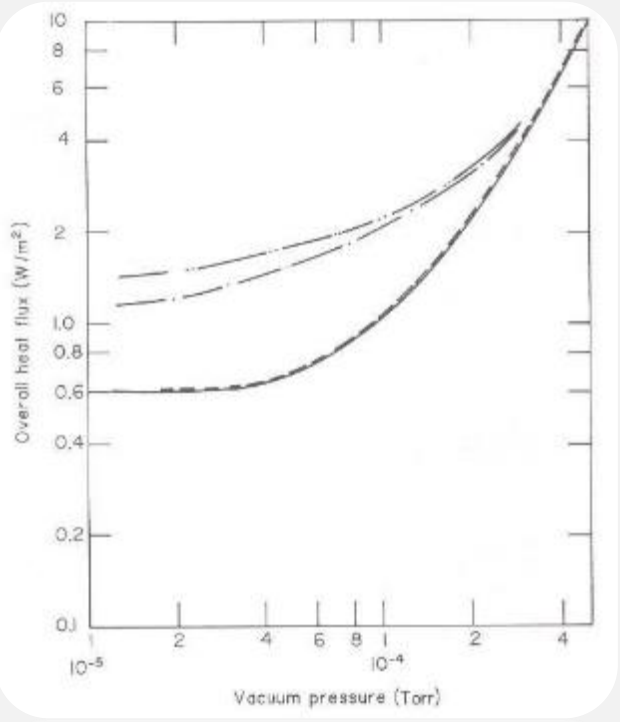
- SIVL under static High vacuum.
  - High vacuum (HV): 10^{-5} / 10^{-6}mbar.
- Reduce Heat by **Convection.**
- **Heat load link to the vacuum.**

Pressure range	Pressure hPa	Pressure Pa	Number density per cm^3
Atmospheric pressure	1,013.25	101,325	$2.7 \cdot 10^{19}$
Low vacuum (LV)	300…1	30,000…100	$10^{19}…10^{16}$
Medium vacuum (MV)	1…10^{-3}	100…10^{-1}	$10^{16}…10^{13}$
High vacuum (HV)	$10^{-3}…10^{-7}$	$10^{-1}…10^{-5}$	$10^{13}…10^{9}$
Ultra-high vacuum (UHV)	$10^{-7}…10^{-12}$	$10^{-5}…10^{-10}$	$10^{9}…10^{4}$
Extremely high vacuum (XHV)	$<10^{-12}$	$<10^{-10}$	$<10^{4}$



Rotary Vacuum Pump

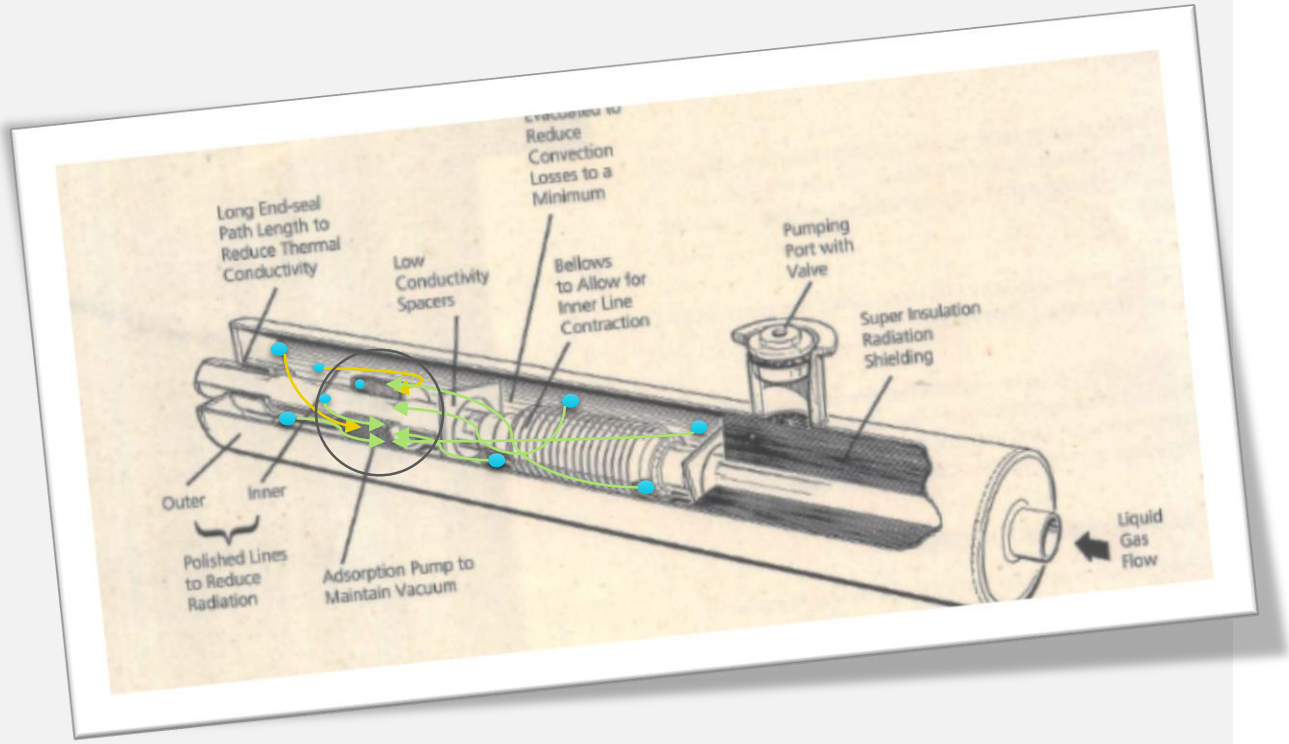


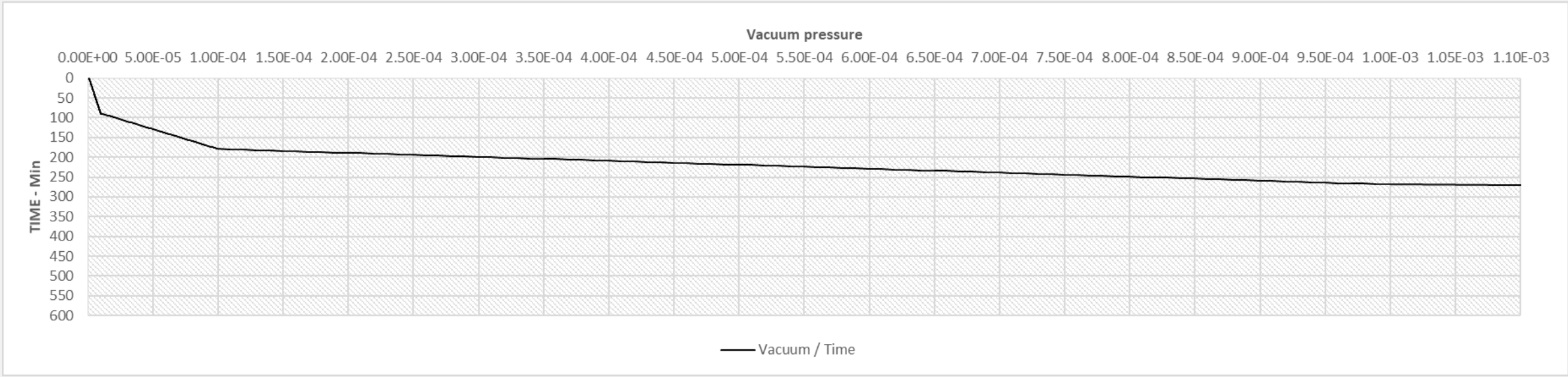


Vacuum System Description

Vacuum level time.

- SIVL degradation after 7 days of pumping if not use.
  - ~ 4 Hours.
  - $10–^{5}$ / $10–^{6}$mbar to stabilise around $10–^{2}$mbar.
- Cryo-pumping.
  - The active charcoal absorbed and capture the molecules of all gases left to the 10^{-3} to 10^{-6}mbar as soon as it becomes cold.
- Holding time in good condition and use is up to 15 years.



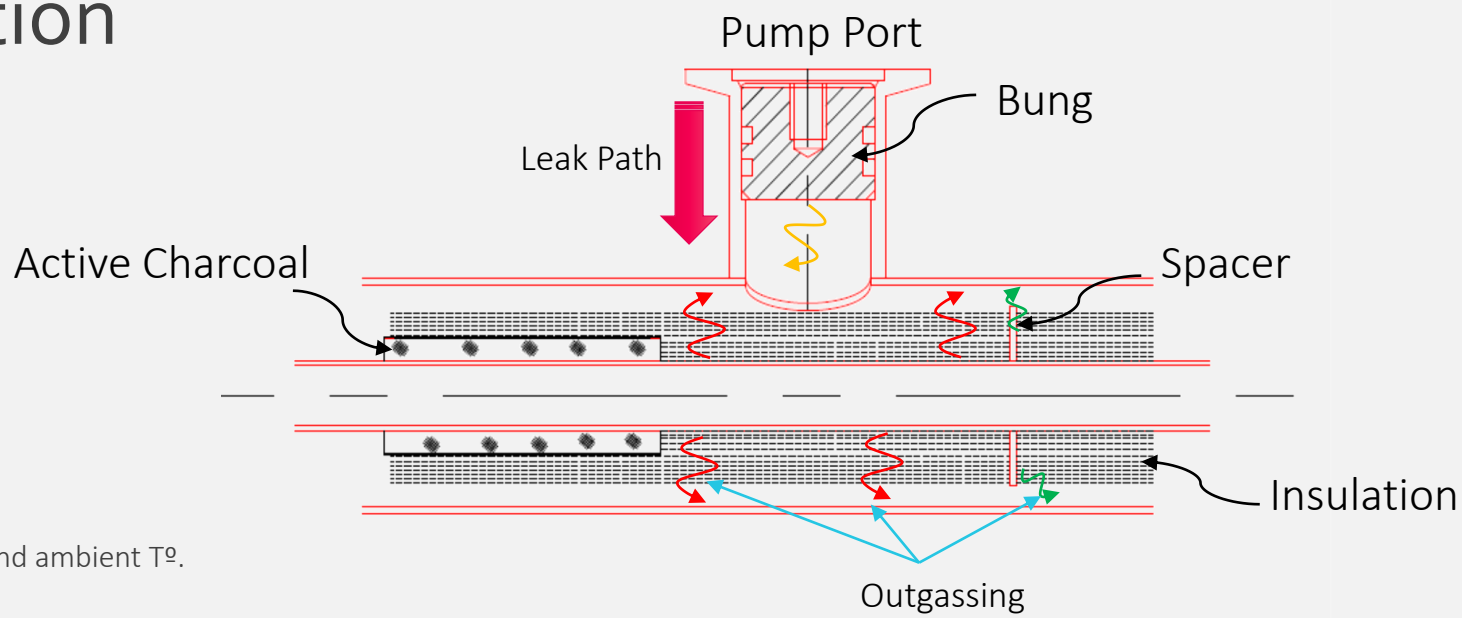


Vacuum System Description

Vacuum failure impact.

- Causes
  - Leak – Welds: outer & inner, pump port assembly.
  - Outgassing – Stainless steel, Mylar, Spacers…
  - Deterioration – Thermal cycle, Lines not use…

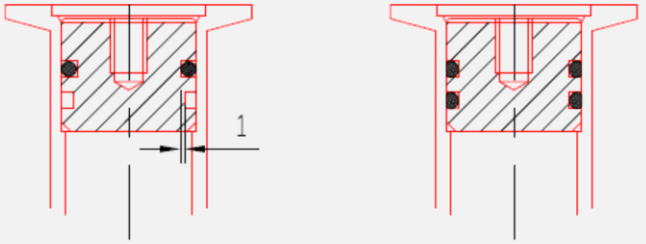
- Lost of Vacuum signs/check.
  - Differential of temperature >5 ºC between outer jacket and ambient Tº.
  - Condensation around spacer and bellow, tee and corner.
  - Condensation everywhere and start frost.
  - Building ice.



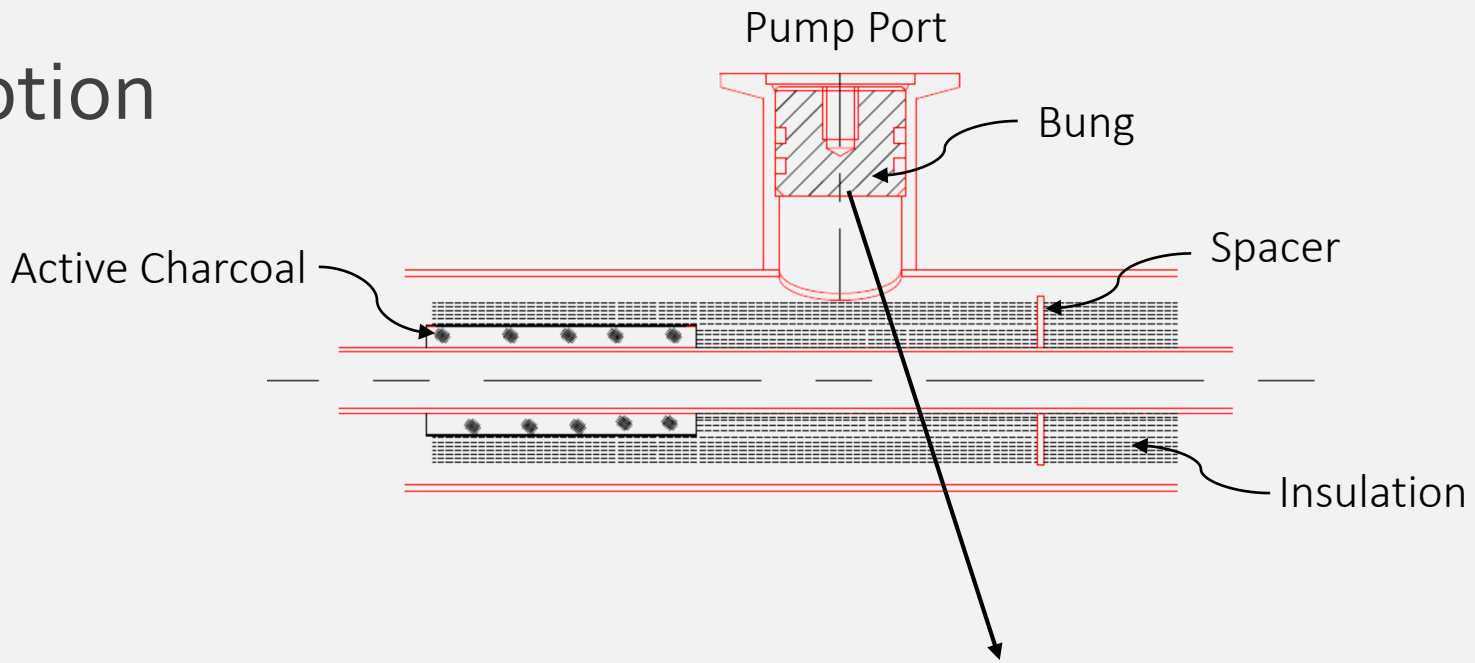
Vacuum System Description

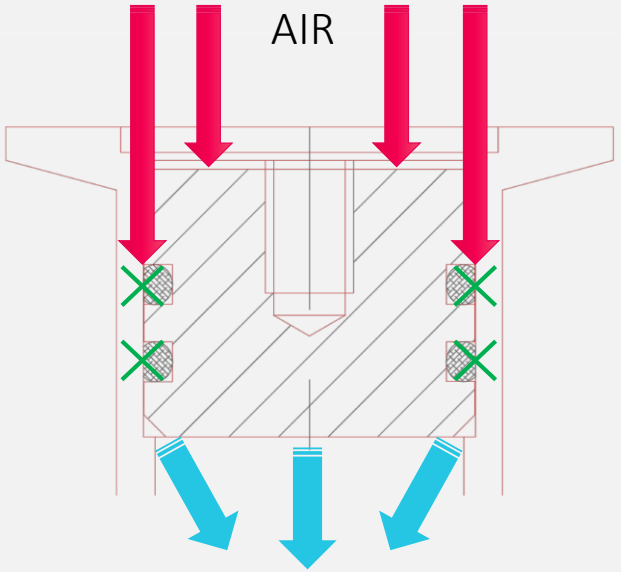
Vacuum failure impact.

- Pump port & brass plug issue.
  - Groove machined too deep.
    - New quality procedure.
    - Full trackability.
  - Change brass plug with new one.
- IF re-pumping required.
  - Use Pump cart.
  - Re pump for 48H minimum.



Defective Bung – Good Bung





Micron – LN2 Training

Summary

- Vacuum System Description
  1. Vacuum level and pressure.
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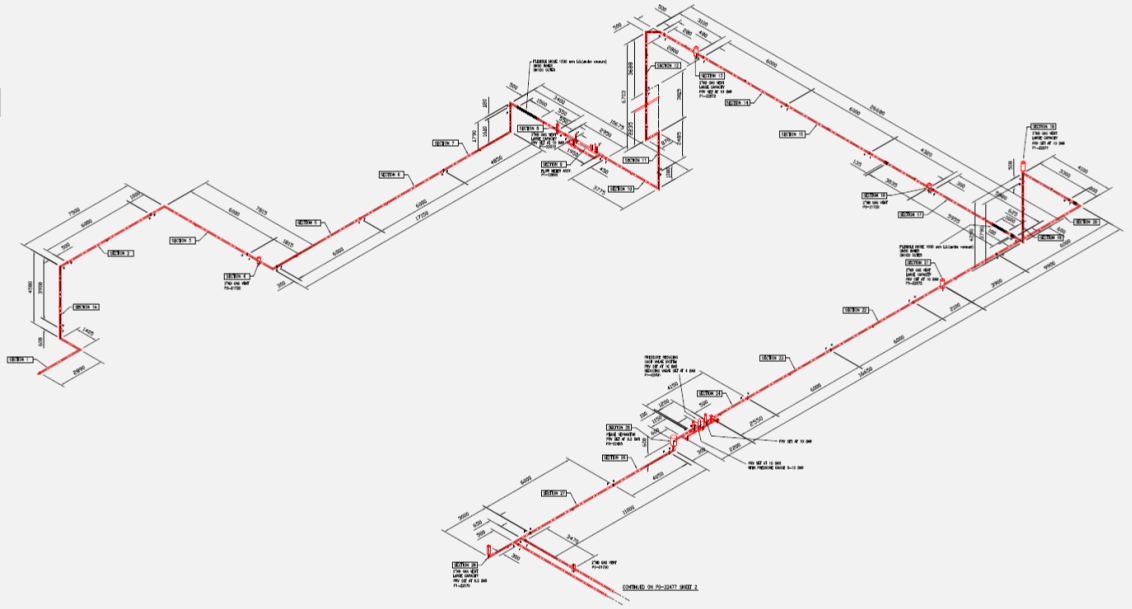
- LN2 Pipe supply system description
  1. LN2 pipework and P&ID.
  2. Flexible hose & valve.
  3. Gas vent point design.
  4. Reduce valve design.
  5. LN2 SIVL Manufacture & Installation.

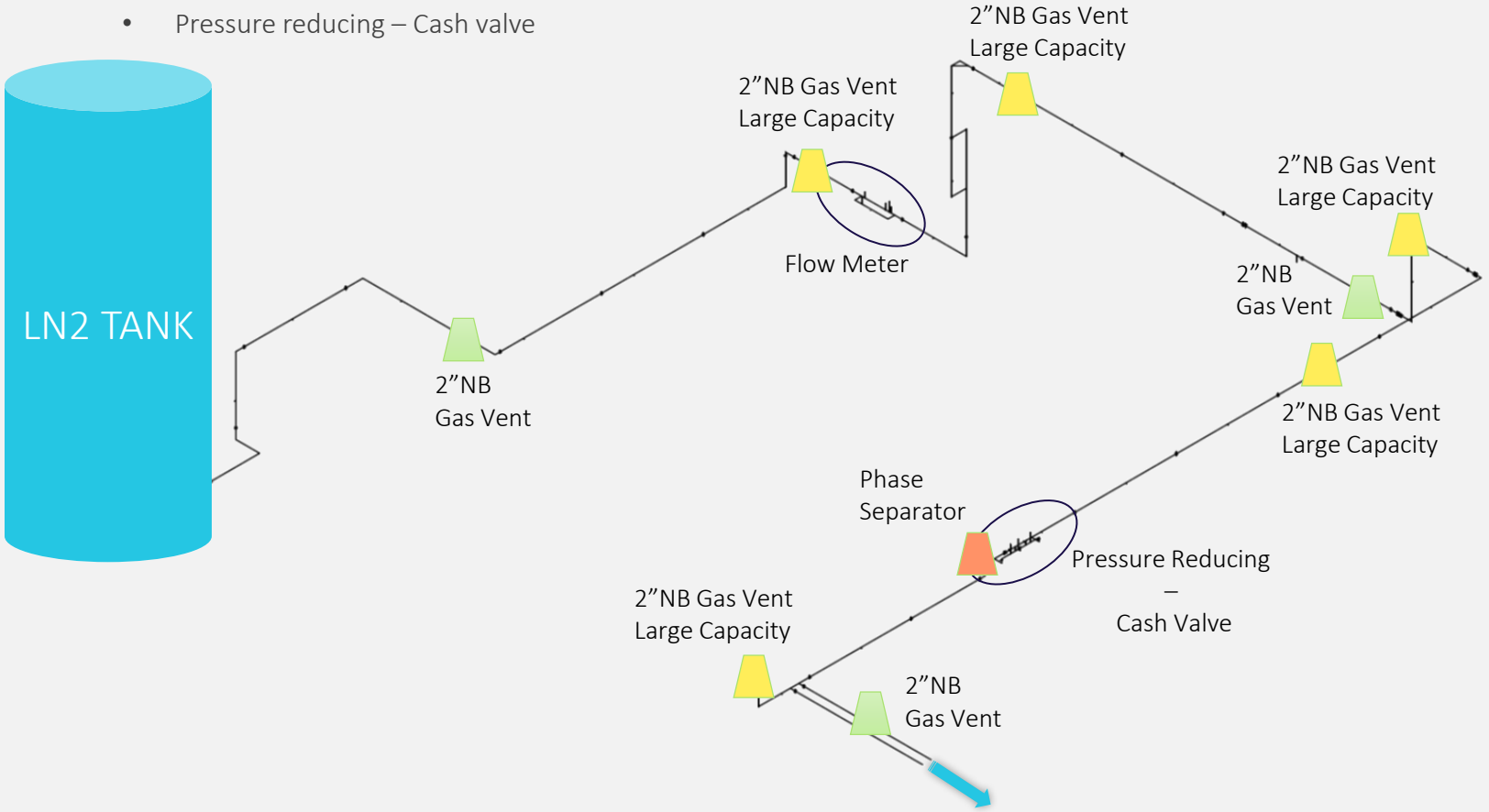
- LN2 Operation / Maintenance
  1. LN2 flow meter.
  2. LN2 SIVL supply and work procedure.
  3. Vacuum pump and power hose.

LN2 Pipe supply system description

LN2 pipework and P&ID – part 1

- Features
  - 2”NB Gas Vent
  - 2”NB Gas Vent Large Capacity
  - Phase separator
  - Flow Meter
  - Pressure reducing – Cash valve

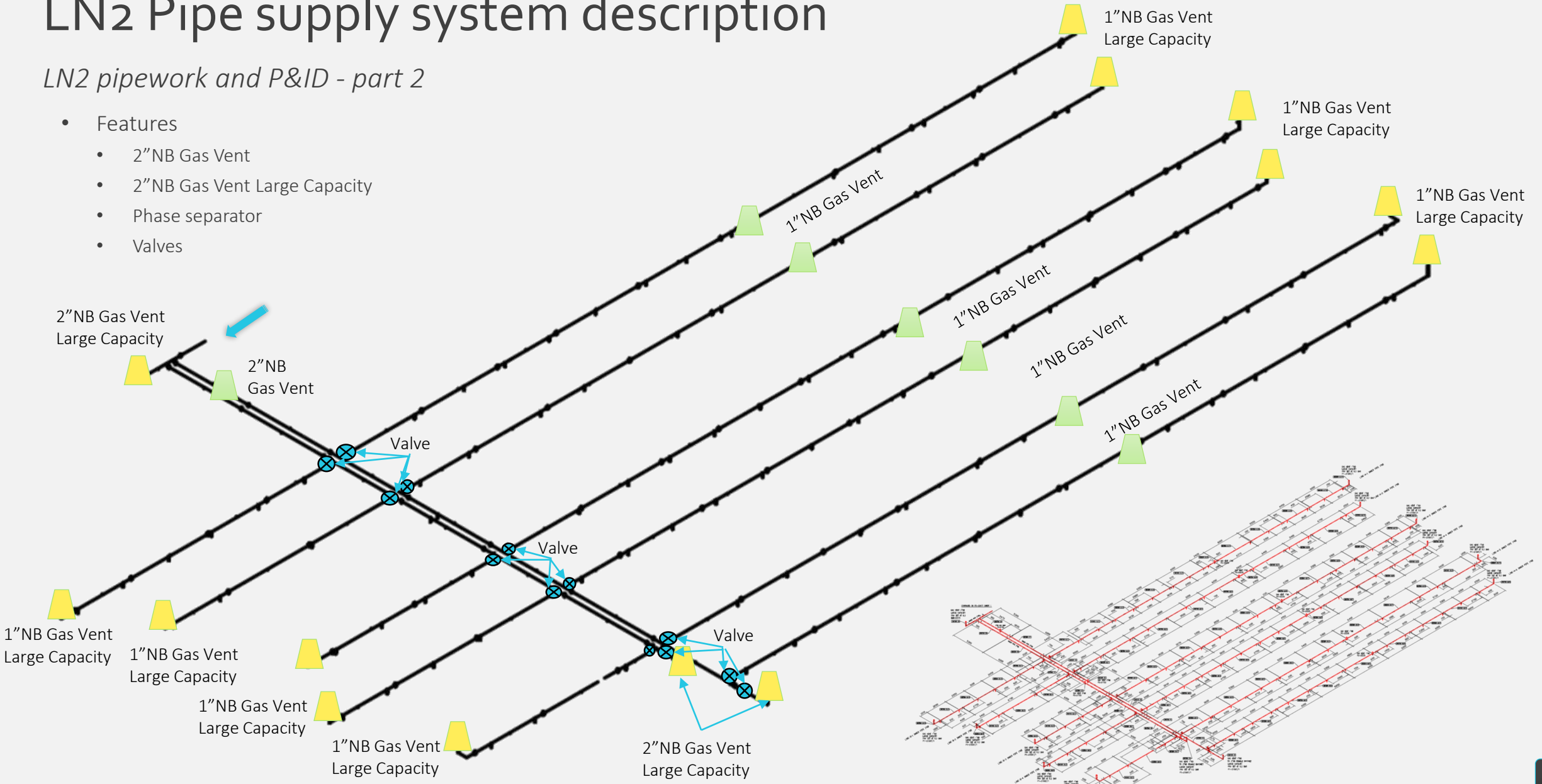




LN2 Pipe supply system description

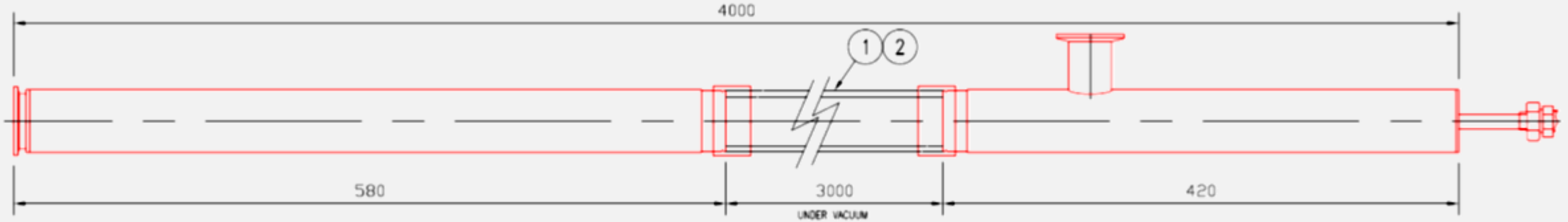
LN2 pipework and P&ID - part 2

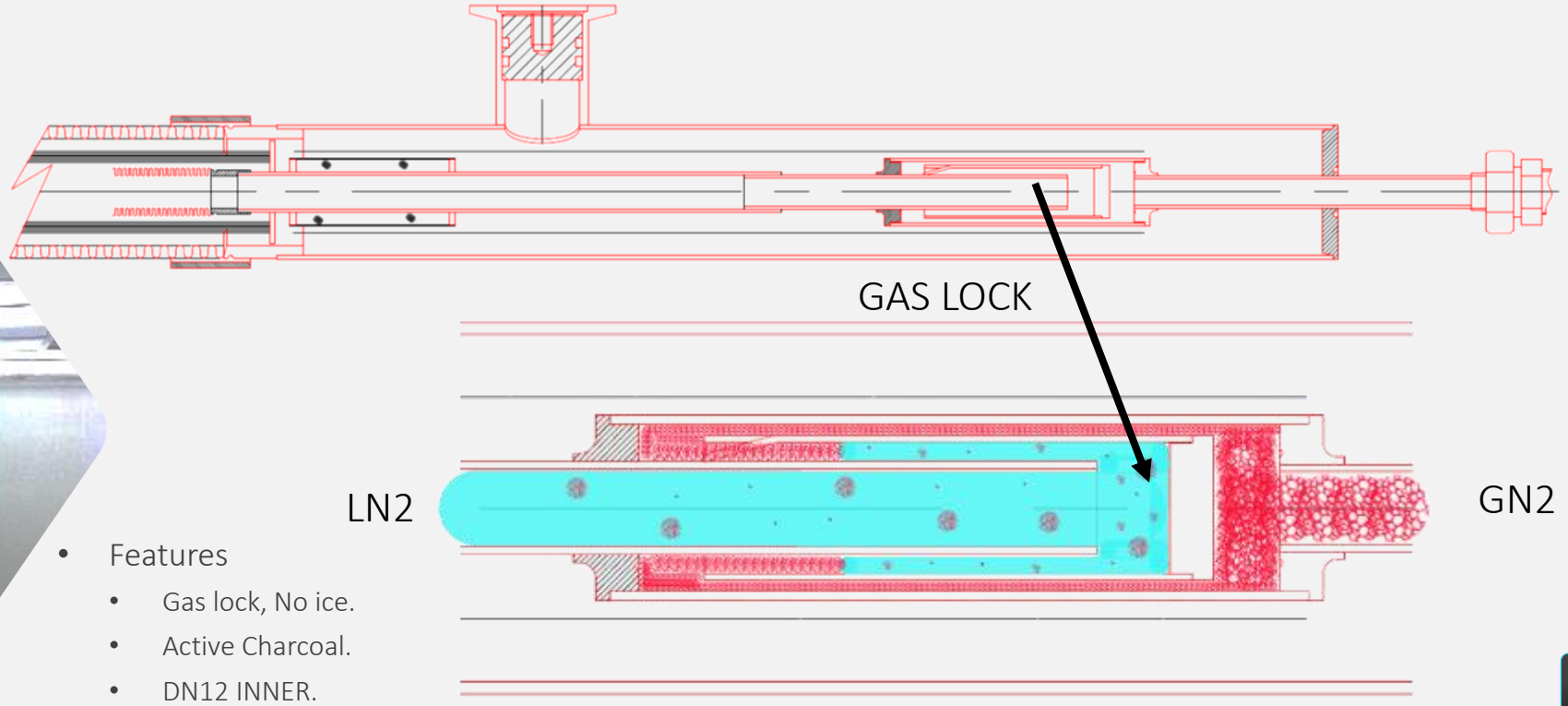
- Features
  - 2”NB Gas Vent
  - 2”NB Gas Vent Large Capacity
  - Phase separator
  - Valves



LN2 Pipe supply system description

Flexible DN40 – Inner DN12.

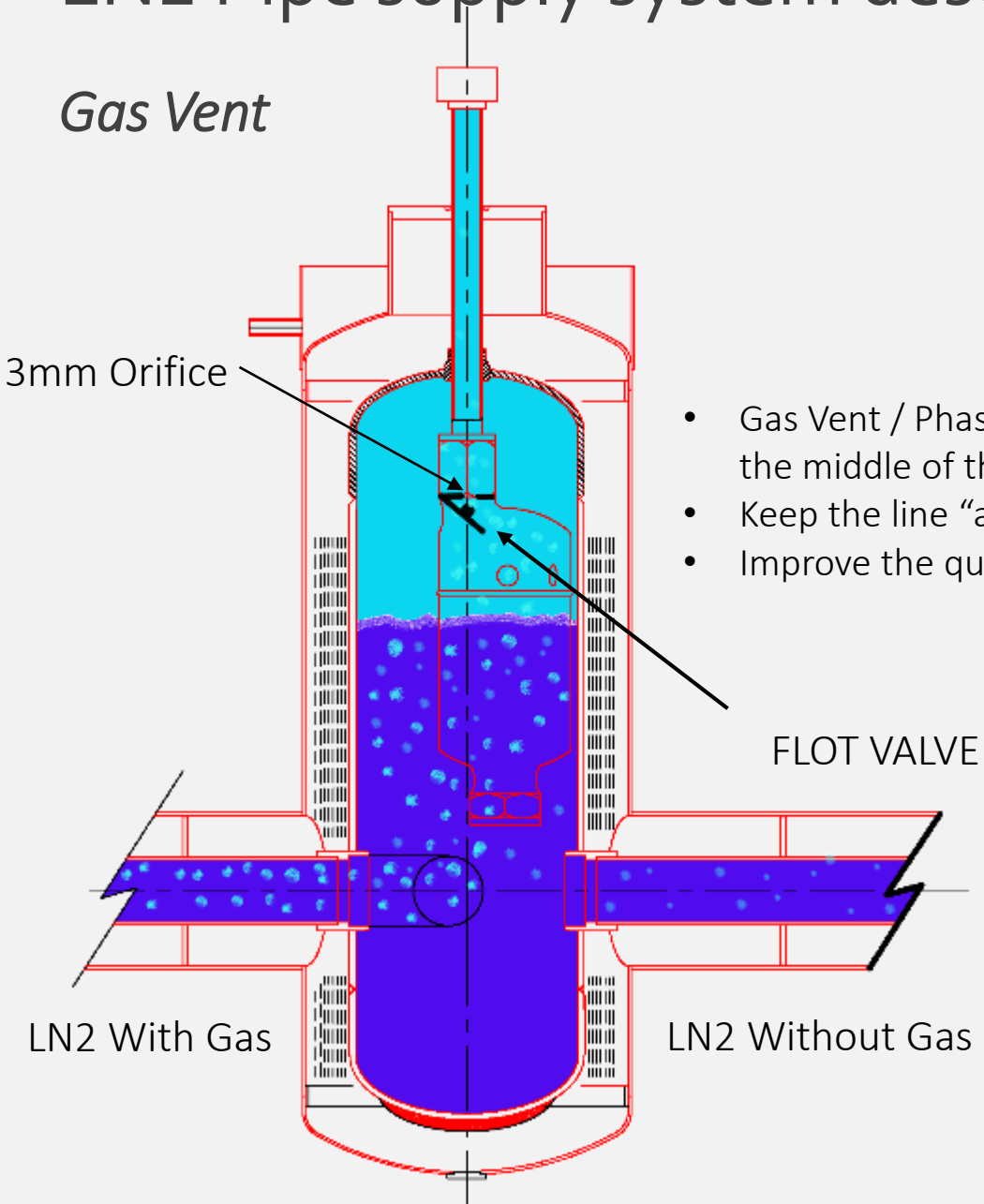




- Features
  - Gas lock, No ice.
  - Active Charcoal.
  - DN12 INNER.

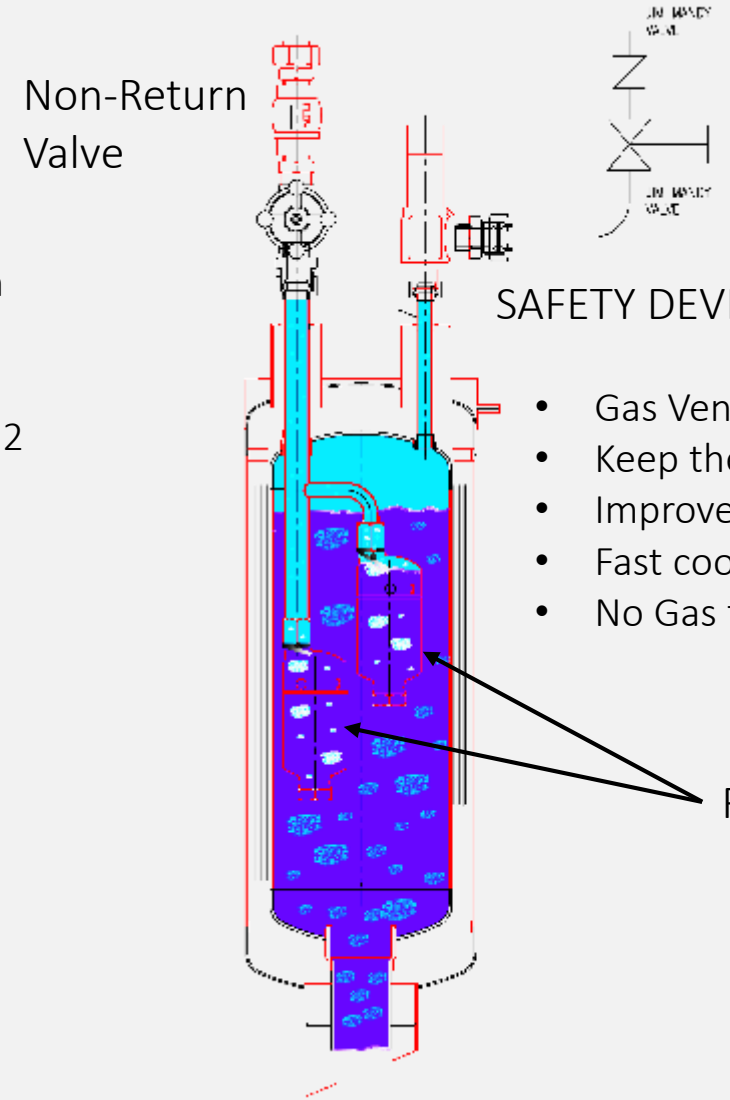
LN2 Pipe supply system description

Gas Vent



- Gas Vent / Phase separator in the middle of the line.
- Keep the line “alive”
- Improve the quality of the LN2

Gas Vent Large Capacity

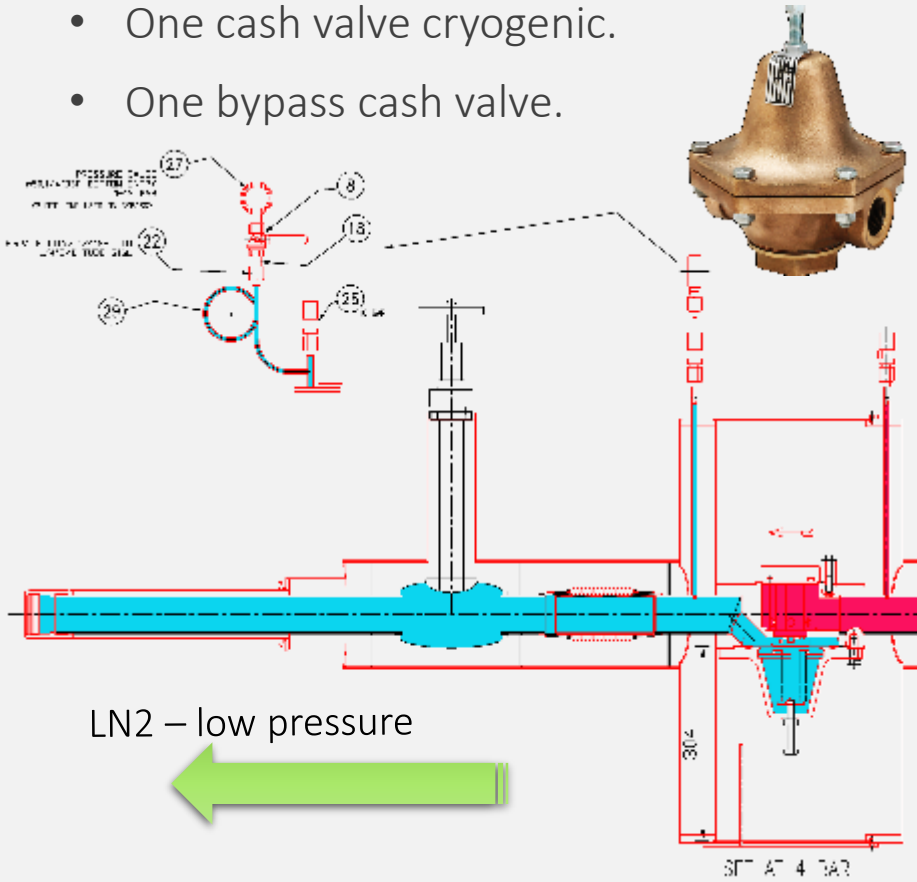


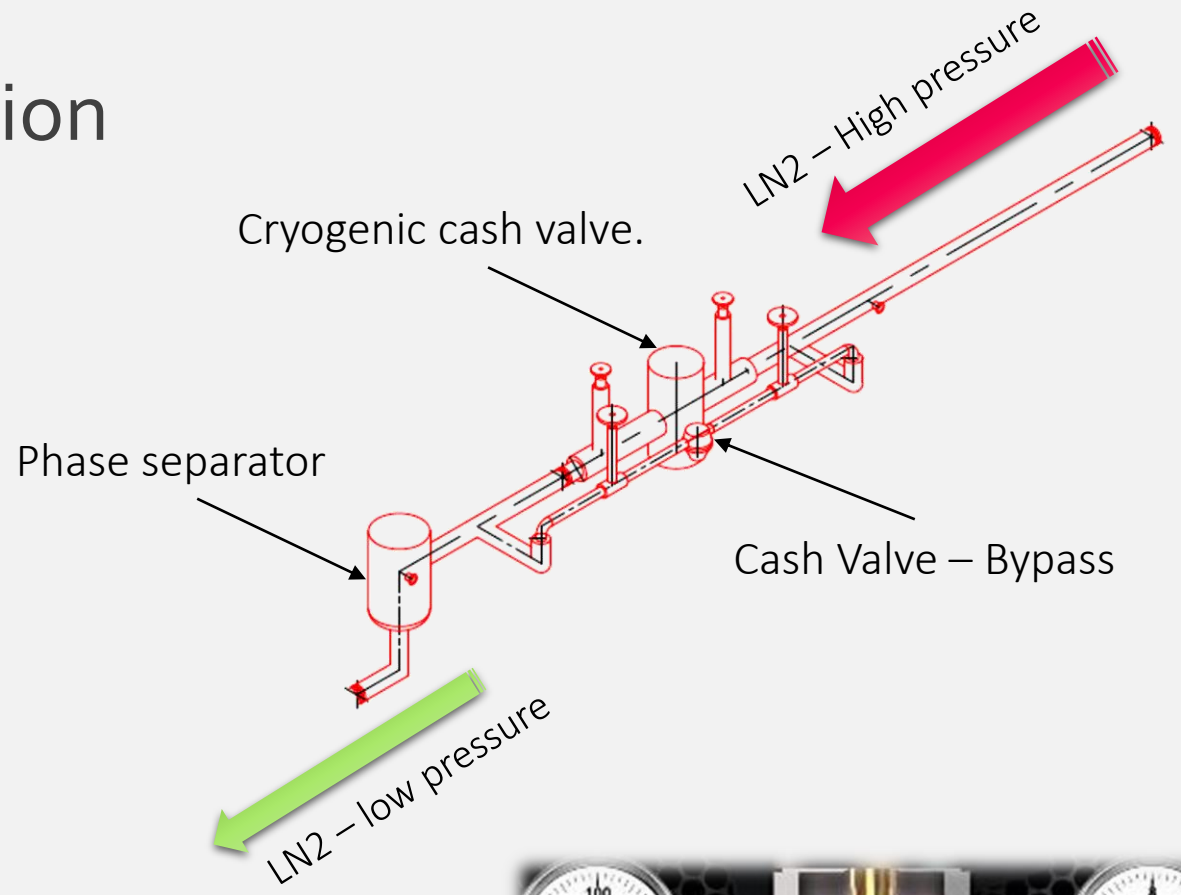
- Gas Vent at the end of the line.
- Keep the line “alive”
- Improve the quality of the LN2.
- Fast cooling power.
- No Gas trap in the system.

LN2 Pipe supply system description

Reduce Valve design

- Pressure from the Tank too high.
- Equipment works at low pressure.
- Better quality calorific at low pressure.
- One cash valve cryogenic.
- One bypass cash valve.



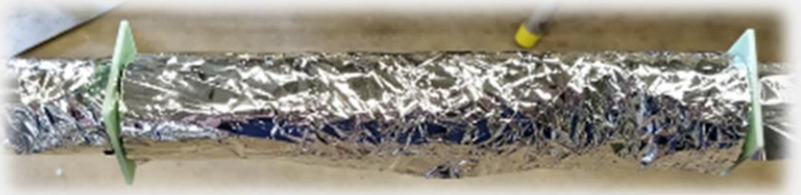


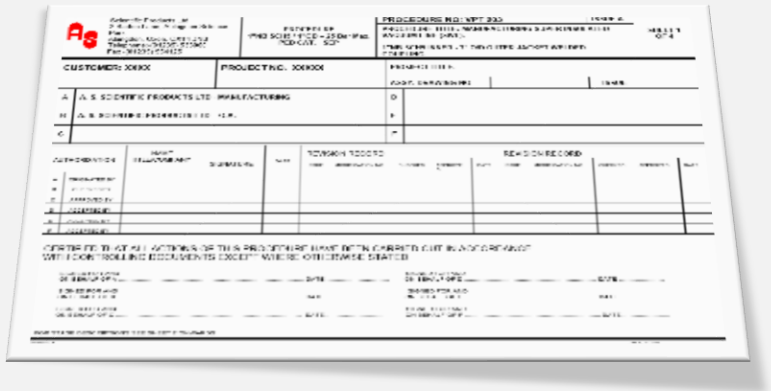
Pressure reduce by passing through a controlled small orifice.

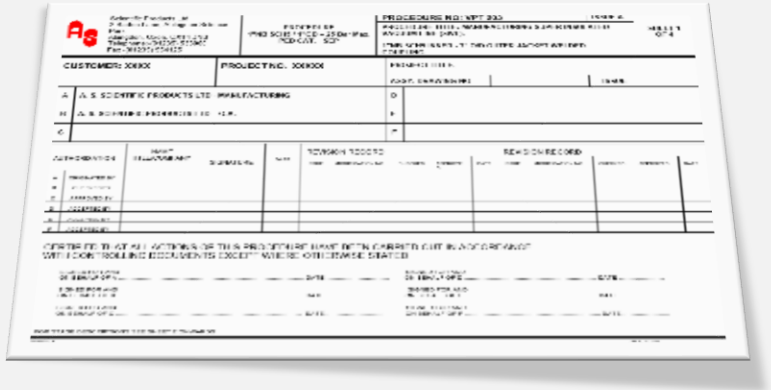
LN2 Pipe supply system description

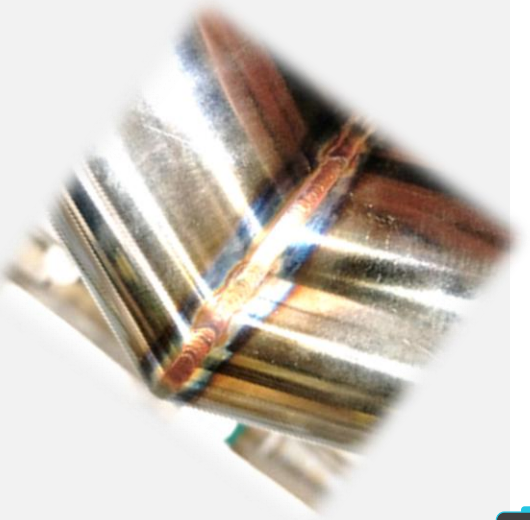
SIVL Manufacture & Site assembly

- SIVL built under procedure VPT 203.
- SIVL tested to VPT 201.





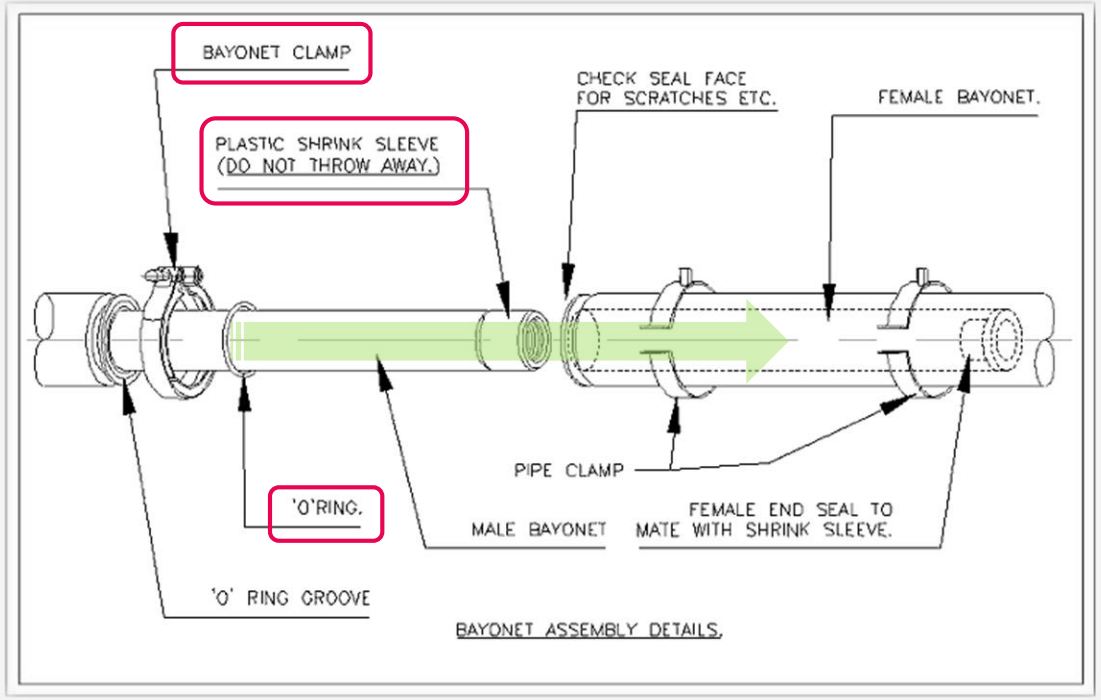


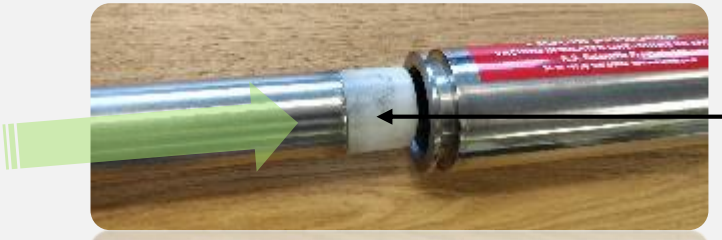


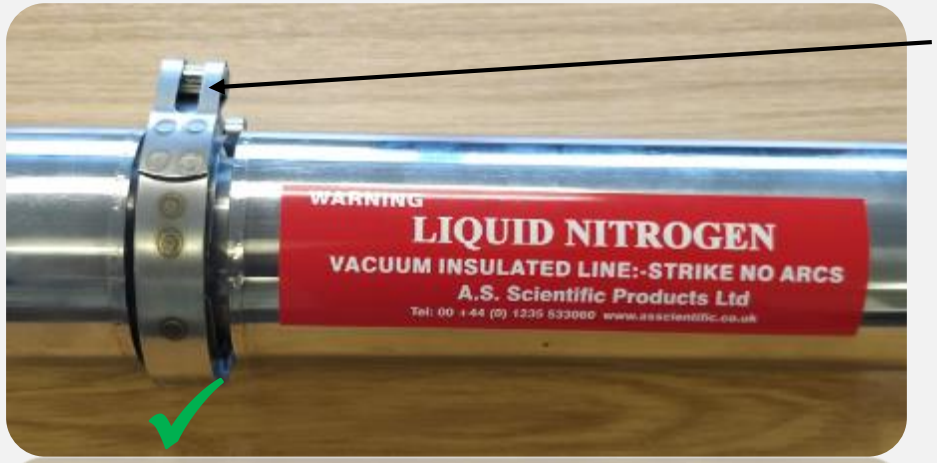
LN2 Pipe supply system description

SIVL Manufacture & Site assembly

- Bayonet Assembly – Plug & Play.
  - One spacer needed.
- self-maintenance.







Micron – LN2 Training

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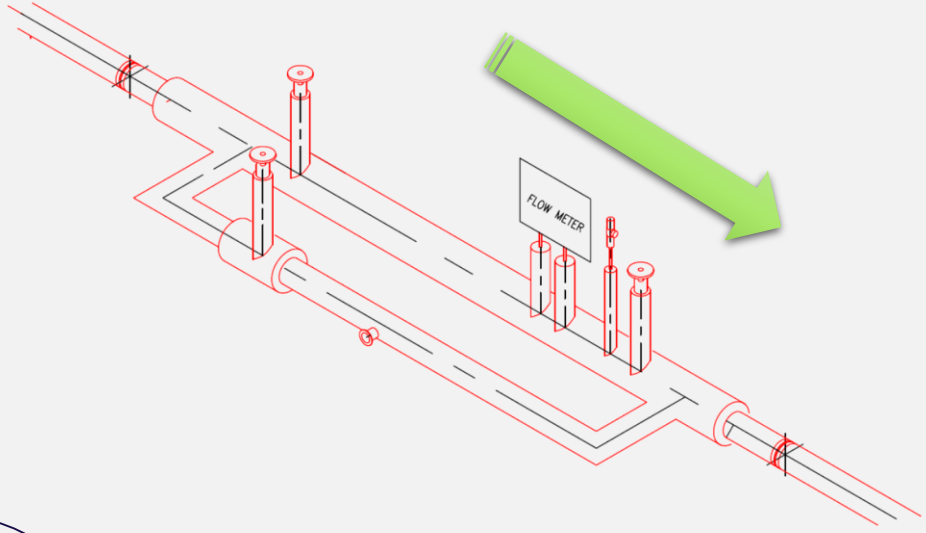
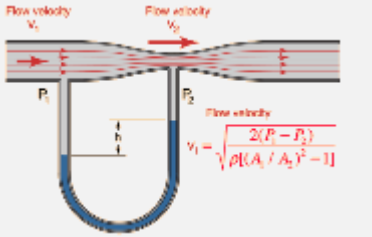
LN2 Operation / Maintenance

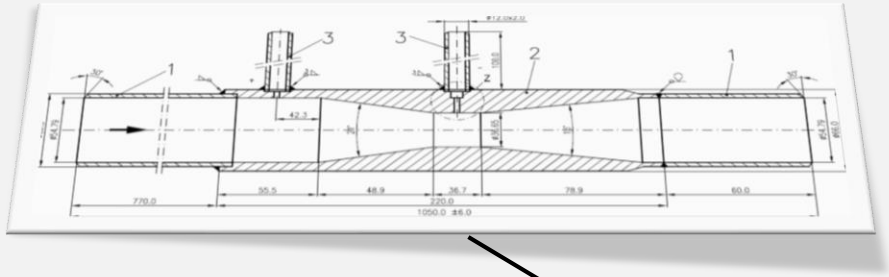
LN2 flow meter

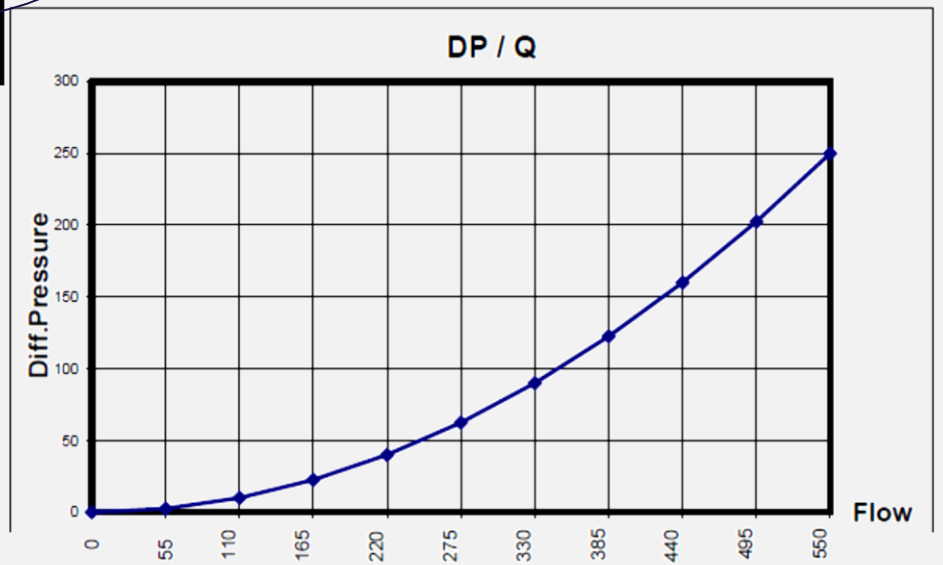
- A **flow meter** is an instrument used to measure mass flow rate of a liquid or a gas.
- Flow meter venturi type.

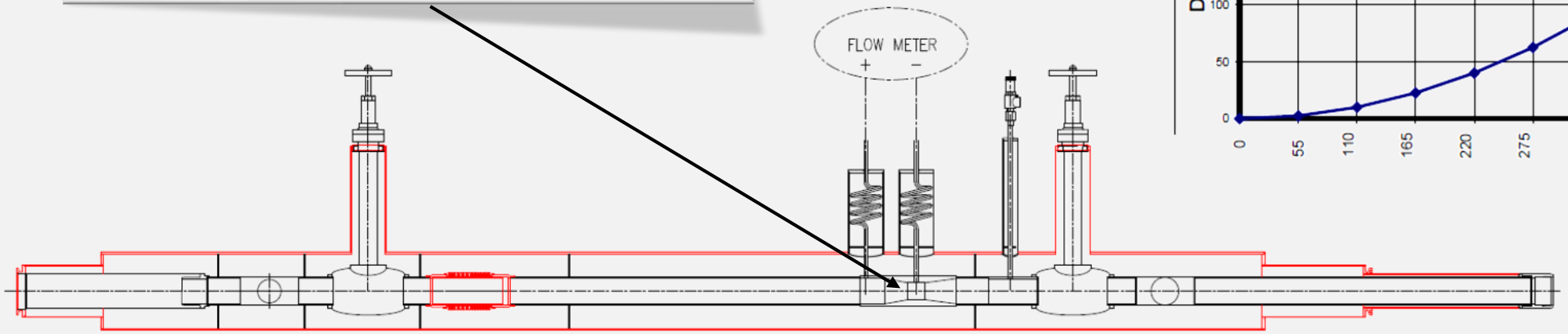


Menge/Range l/min	dP mbar	dpv mbar
0	0	0
55	2,500	0,00
110	10,000	0,00
165	22,500	0,00
220	40,000	0,00
275	62,500	0,00
330	90,000	0,00
385	122,500	0,00
440	160,000	0,00
495	202,500	0,00
550	250,000	0,00





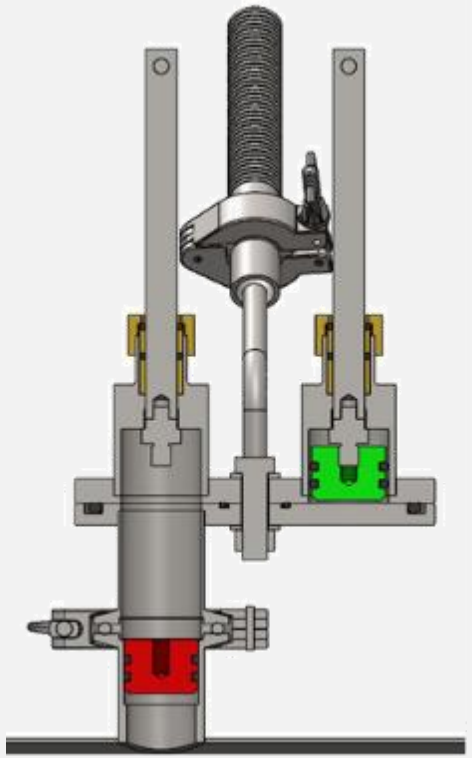


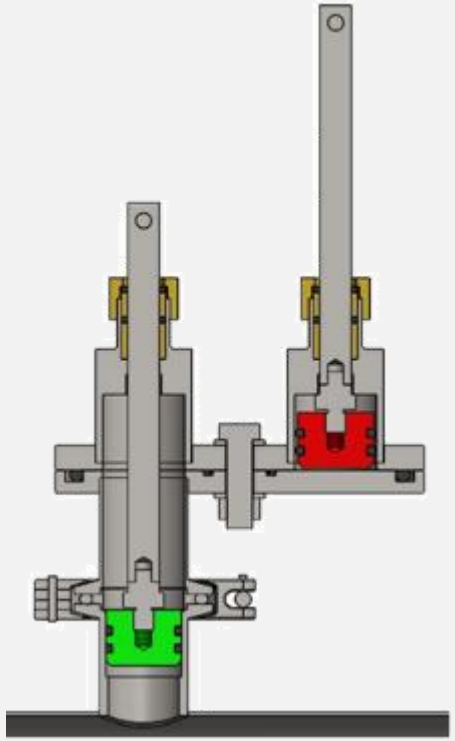


LN2 Operation / Maintenance

LN2 SIVL supply and work procedure

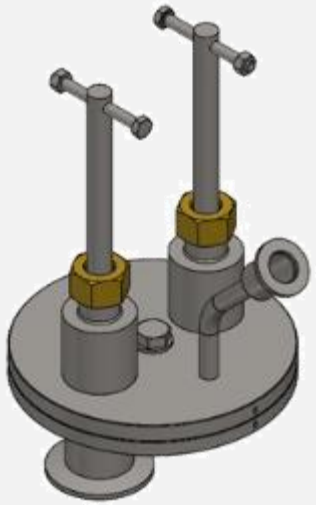
- Bayonet connections provide an economic method of joining vacuum-insulated transfer lines.
- They allow for liquid savings because of low heat influx, decreased installation time, and lower field installation costs.
- Once installed, they require no maintenance, and the insulation suffers no deterioration during operation regardless of where the pipeline is installed.





- General maintenance:
  - Check Vacuum – re-pump if necessary.
  - Check for leak – Replace Brass plug or weld.
    - Procedure Reference BCP002

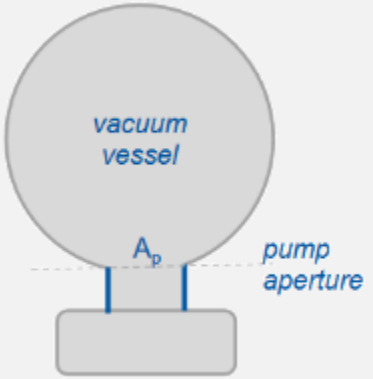
Checking the delta between outer Jacket and temperature ambient.



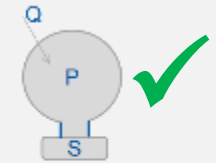
LN2 Operation / Maintenance

Vacuum pump and power hose.

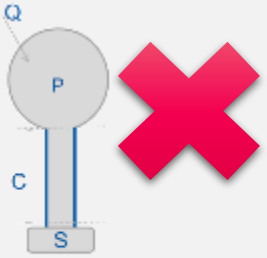
- Shorter length and larger diameter piping is best.
- The pumping system should be physically located as close as possible to the chamber.
- The number of bends, elbows and turns should be kept to a minimum.
- Maximum flow rate via AS Scientific pump port is **8.95 m³/min.**
- Maximum flow rate via DN16 Flexible is **3.25 m³/min.**



$$[S] = \frac{[Volume]}{[Time]} = [conductance]$$



$$P = \frac{Q}{S} + P_0$$



$$P = \frac{Q}{S_{eff}} + P_0 = \frac{Q(C+S)}{C \times S} + P_0$$

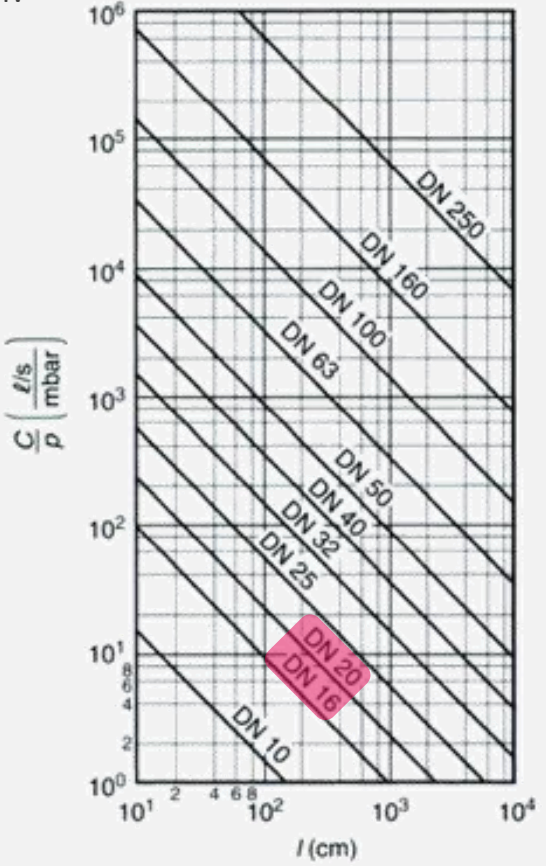
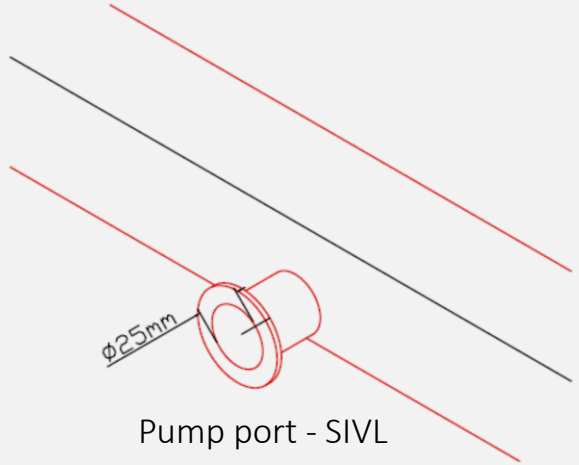


Fig. 4.25 Conductance C according to Eq. (4.83) divided by the mean pressure $\bar{p} = \frac{1}{2}(p_1 + p_2)$ for laminar airflow (20 °C) through tubes with circular cross section of given tube sizes (in mm) versus tube length l.



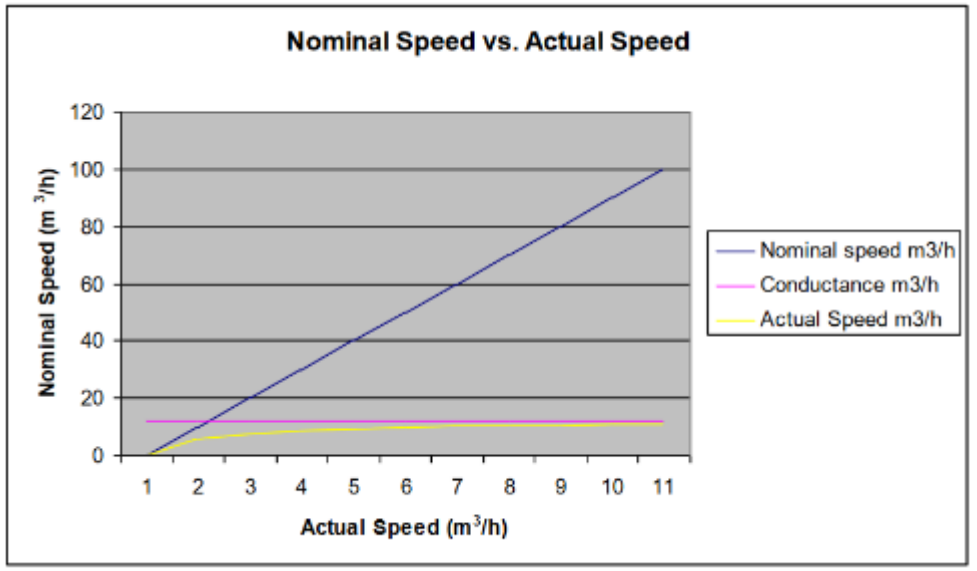
Pump port - SIVL

LN2 Operation / Maintenance

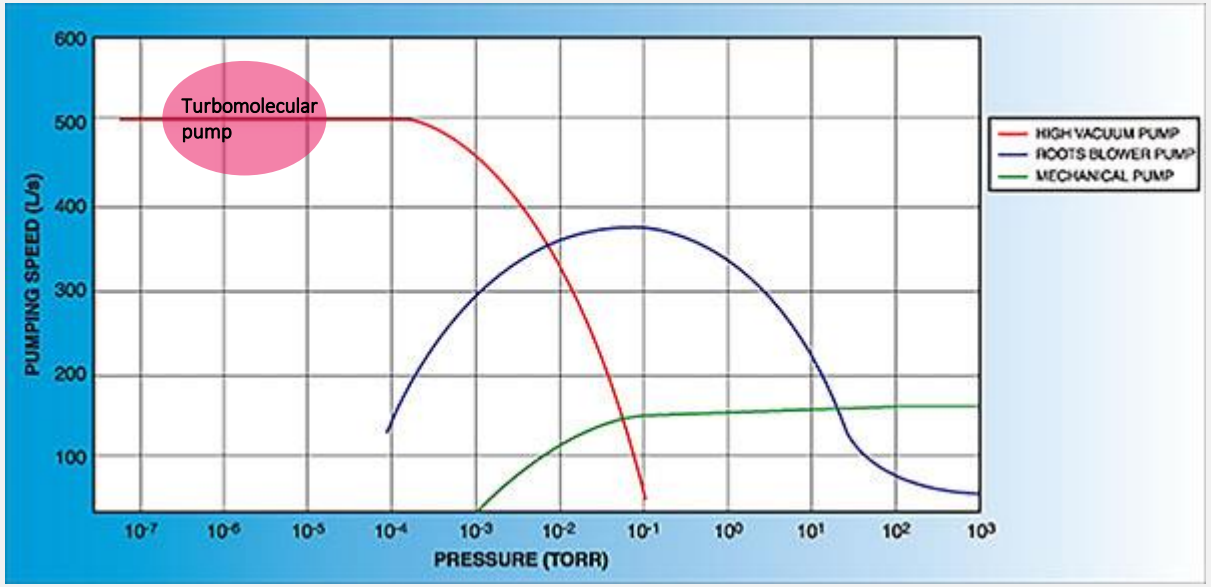
Vacuum pump and power hose.

- Pump ranges
  - High vacuum. Pump + Turbo = **10–^{5}mbar.**
- Calculate a system's vacuum needs.
  - 6 meter x 3”OD ~ 0,**3 m³ = 28 L of air.**
  - **Humidity.**
  - **Outgassing.**

- The time required to pump a system down can be approximated using this formula:
  $t = (V \times n) \div 4q$,
  where:
  t is time, min
  V is system volume, ft^3
  q is flow capacity, cfm, and
  n is a constant for the application.
- Pumping time recommended is **48H** for a section of SIVL.
  - Pump speed need to be > **3 m³/h.**
  - Turbo speed **> 50-80 litres/sec.**



Actual effective speed for a vacuum pump.

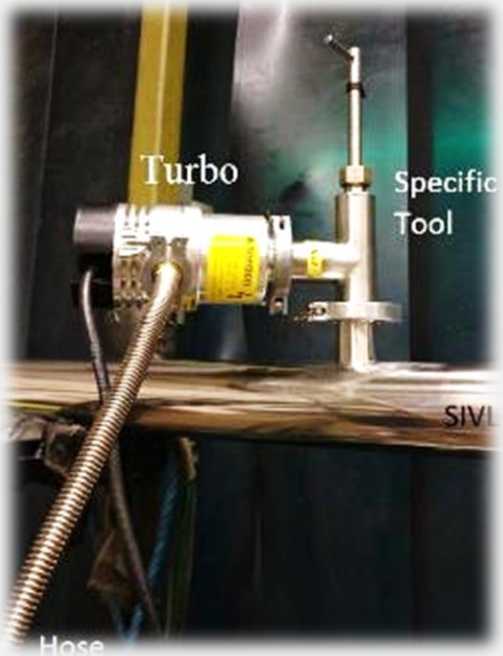


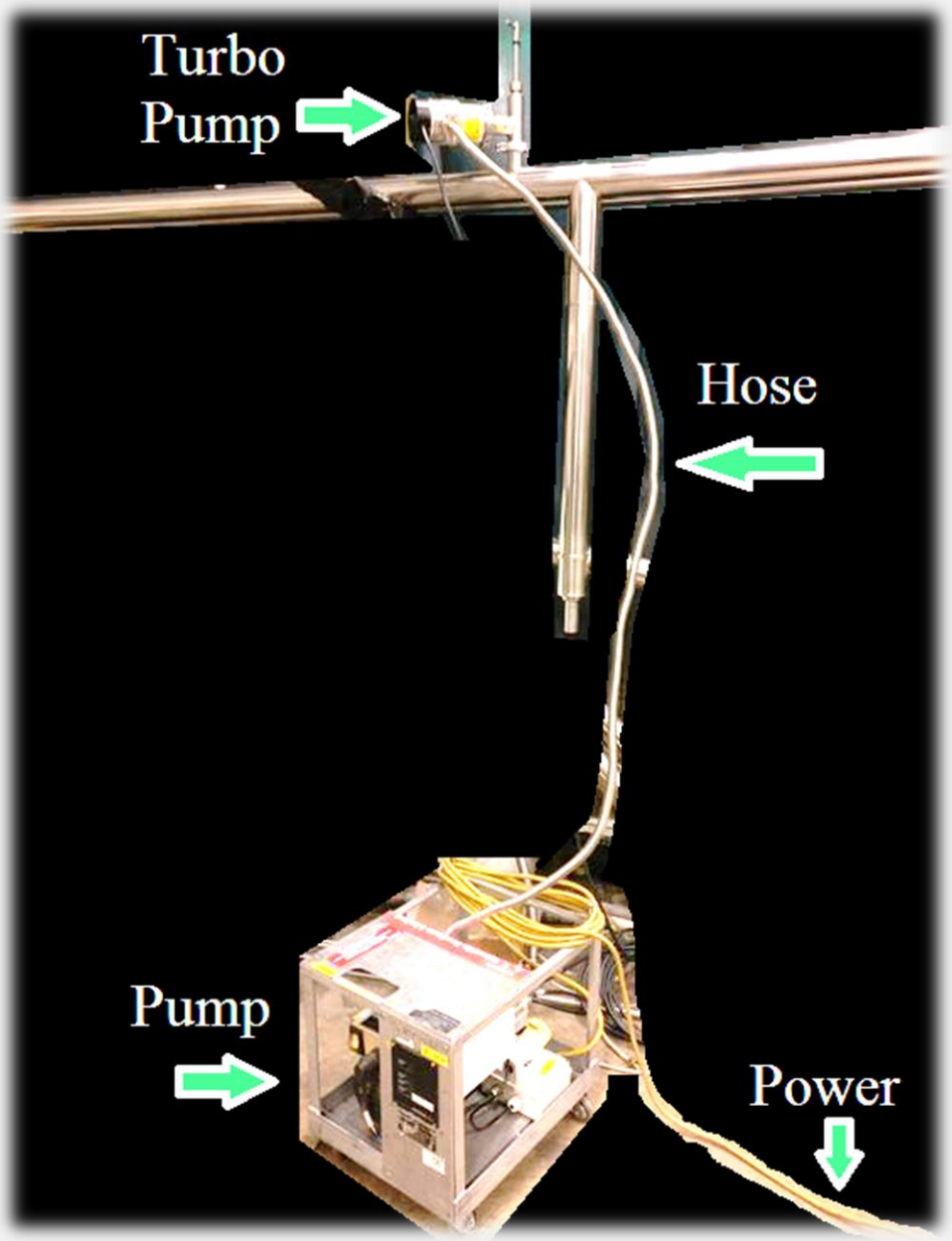
Ranges – Type pump.

LN2 Operation / Maintenance

Vacuum pump and power hose.

- Pumping cart
  - Rotary pump up to 10–^{3}mbar
  - Turbo up to 10–5mbar
  - Turbo close to the orifice.
  - Mobile to bring as close as possible.





ThankYou

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