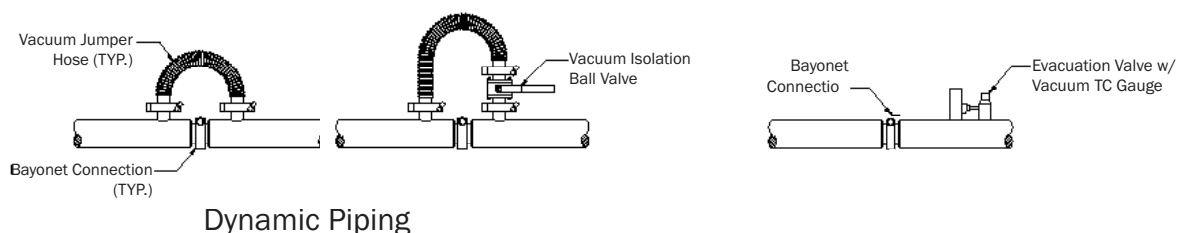


Dynamic Piping	Static Piping	Reference Notes
Requires vacuum pump	No vacuum pump required	(1)
Vacuum leak affects entire system	Vacuum leak affects isolated area	(2)
Pump failure affects entire system	No mechanical parts to fail	(3)
Needs recovery time	No recovery time needed	(4)
Old technology	Latest technology	(5)

Bayonet Connection Detail:



Dynamic Piping

Notes:

- (1) LN2 pipe requires a vacuum inside the space between the inner liquid annulus and the outer jacket. Static systems are sealed at the factory. Dynamic systems utilize a vacuum pump 24/7 on site to achieve this. The vacuum pumps require mechanical oil changes every 3-4 months and diffusion oil changes every 1-2 years. The lifespan of a well-maintained pump is usually around 5 years. Electrical utility is required.
- (2) Due to the vacuum annulus being integral throughout a dynamic system, any vacuum leak will deteriorate the vacuum on the entire LN2 pipe system. This results in the entire pipe system condensing water, dripping, and/or icing (sometimes over electrical, critical processes, offices, etc.). In most cases the result is loss of LN2 delivery to equipment. Trouble-shooting a vacuum leak requires shutting down the system and inserting vacuum isolation valves at all joints for isolation. After the leak is found, it is common to run the system in that condition until a new section is fabricated. Since static systems do not have the vacuum integral throughout, if a vacuum leak develops, it is isolated to only that section. The rest of the system can operate normally without water, ice or delivery issues until the vacuum leak is fixed or the section is replaced. It is highly recommended that static systems be used when disruption to LN2 delivery is not an option.
- (3) If the pump fails (i.e. electricity goes out, pump stops running, oil leaks out of seals, oil gets contaminated with water, etc.) the vacuum will quickly deteriorate resulting in the issues mentioned in paragraph 2 above. Static systems do not have this problem.
- (4) When a dynamic system loses vacuum and the problem is rectified, the recovery time can sometimes be more than a day. This is due to molecular flow. The molecules have to “randomly” find their way back to the vacuum pump. If a decision is made to install a dynamic system, it is recommended to place the vacuum pump/s near the middle of pipe systems to minimize the travel pathway of molecules. On a static system, if a section of pipe loses vacuum, the LN2 will be minimally affected since most of the pipe is still under vacuum hence no recovery time.
- (5) Prior to 1960, cryogenic containers were solely dependent on vacuum pumps to maintain vacuum levels. With the development of TIG welding, purge practices, gettering, sieves, radiation shielding, vacuum monitoring, helium mass spec leak detection, etc.; All tanks, cylinders, and most pipe manufacturing is now of static vacuum design.