

Basic Operating Principles of the ELAN2™

The operating principles for the production of liquid nitrogen (LN2) in the ELAN2™ are described below. It involves four steps.

1. Compress room air
2. Separate nitrogen from room air
3. Liquefy nitrogen
4. Transfer liquid nitrogen to external container

1. Compress room air

Air is extracted from the room through a particle filter and is then compressed to a moderate pressure of 6 to 8 atmospheres. It is then dried and cleaned in a Pressure Swing Absorber dryer.

2. Separate nitrogen from room air

The compressed air is fed to a membrane nitrogen separation module. The membrane module separates the nitrogen portion (78%) from the air. This technology is a widely used industrial technique to separate and purify gases. The module contains a bundle of hollow fiber membranes. Compressed air enters one end of the bundle of fibers, and as the air flows along the fiber, the oxygen, carbon dioxide and water vapor permeate the wall of the fiber, which is the membrane, and escape to the atmosphere. The nitrogen, which does not permeate the wall so easily, continues along the fiber and is collected at the far end. The resulting stream is about 98% pure, dry nitrogen. This passes through to the cryogenic refrigeration unit for liquefaction.

3. Liquefy nitrogen

The cryogenic system of the ELAN2™ is based on MMR Technologies' patented refrigeration technology. This provides *two unique advantages* that allow the system to achieve exceptional levels of reliability and efficiency.

i) The patented technology cleans the oil and other contaminants from the refrigerant continuously, without any moving parts, and without the need of any replaceable filters or absorbers. No build up of contaminants can occur, and as a result, no refrigeration system maintenance is required.

Traditional cryogenic refrigeration systems fail because of build-up of contaminants. These freeze in the cryogenic parts of the refrigerator blocking the flow of refrigerant. MMR's patented design allows continuous operation at cryogenic temperatures for many years with no maintenance.

ii) MMR's proprietary (CFC-free) working fluids maximize both the capacity for heat transfer and the thermodynamic efficiency of the cooling system. This allows the design of a compact and energy efficient liquefier suitable for office or laboratory use.

4. Transfer liquid nitrogen to external storage container

Once the liquefier is full, the refrigeration unit turns off. It restarts automatically when the liquid nitrogen level falls below the 0.95 full mark. Transfer of liquid nitrogen is accomplished by pressurizing the nitrogen in the liquefier forcing it out through a transfer siphon to the user's container .

High quality liquid nitrogen, the same as that produced by the gas companies, is available 'on tap' from the device at the push of a button.