



OPERATION MANUAL

ELAN2 LIQUID NITROGEN GENERATOR WITH AUTOTRANSFER



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CAUTION

Contact with Liquid Nitrogen (LN2) can result in severe frostbite. Keep hands and face away from the dewar or thermos during transfer of LN2. Gaseous Nitrogen is a simple asphyxiate. Avoid the vapor during transfer and avoid spills of LN2 in any closed area. Seek adequate ventilation.

*** ALERT ***

The filter at the rear of the elan2 Liquid Nitrogen Generator must be replaced per the directions under Maintenance in this manual, at least once a month. Failure to do so will result in loss of the product warranty.

Dusty environments may require more frequent replacement.

SYSTEM OPERATION PROCEDURES

Description

The elan2 produces liquid nitrogen from the surrounding air. It consists of 2 separate subsystems. The Compressor/PSA and the Liquefier.

In the Compressor/PSA subsystem, a compressor pressurizes the air to 100 psi (8 bar) and passes it through a Pressure Swing Absorber PSA. The PSA removes humidity, carbon dioxide, and impurities from the stream of pressurized air. The dry compressed air is then transferred to the Liquefier subsystem.

The elan2 is a device that can be used in the office to produce liquid nitrogen. Gaseous nitrogen is extracted from the air, cleaned, dried, and then liquefied. The system consists of three parts, the liquefier, an external storage dewar shown in Fig. 1, and an Air Compressor/Pressure Swing Absorber (PSA) that cleans and dries the compressed air, shown in Fig. 2. Air enters the compressor through a particle filter, is compressed to about 8 atmospheres pressure (100psig), and is dried and cleaned in the Pressure Swing Absorber.



Figure 1. elan2 Liquid Nitrogen Generator with Autotransfer

The output of the PSA is fed to the liquefier through a feed line to the back of the liquefier. In the liquefier cabinet, the clean, dry compressed air is passed through a

membrane filter that removes most of the oxygen. The resultant output is 98% pure, dry nitrogen gas. This then enters the cryogenic part of the device.

The cryogenic system of the elan2 is based on MMR Technologies, Inc, refrigeration technology that endows the system with an exceptional level of reliability and efficiency.



Figure 2. Pressure Swing Absorber and Air Compressor module

The cooling system pre-cools the incoming nitrogen gas to a temperature a little above the boiling point of liquid air. The gas condenses as a liquid (LN2) and is collected in the internal storage dewar or thermos.

An electronic depth gauge measures the amount of liquid collected in the dewar and illuminates a series of LEDs that indicate $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ or a full internal dewar.

Other LEDs indicate when the nitrogen is dry enough to allow liquefaction to begin, the temperature of the dewar, and the status of the refrigeration system, i.e., whether it is operating or in standby mode. Automatic controls transfer LN2 from the internal dewar to the 20 L external dewar when ever the internal dewar becomes $\frac{3}{4}$ full. When the external dewar is full, the system continues to fill the internal dewar until it is completely full, then switches off the refrigeration system and goes into the standby mode. The refrigeration system re-starts after LN2 has been dispensed or when the level of nitrogen in the external or internal dewars fall below their full point from evaporation over the course of time.



Figure 3. Top view of elan2 AutoTransfer snout showing Display Panel at the top and the Numerical Display (blank) next to the red and green Security LEDs. The volume of LN2 in the external dewar can be seen by pressing the pushbutton on the snout of the elan2-TR just below the Display Panel.



Figure 4. Activate the Numerical Display to show the volume in Liters of LN2 in the external Storage Dewar by pressing the Push-Button between the two Security LEDs.

An automatic defrost system cleans and defrosts the cooler every few days. It is normally programmed for Saturday evening but can be set for other days or times at the convenience of the customer.

Installation

The Installer will set up the Air Compressor and PSA in a suitable location with a dedicated power outlet, and sufficient ventilation to provide air for the air-input, and cooling air for the compressor. The pressure, flow, and humidity of the air and the proper functioning of the PSA will be checked. Special instrumentation is required for this step.

After all tests have been completed successfully the output of the Air Compressor/PSA will be connected to the liquefier and the electronic control line connected between the Air Compressor and liquefier.



Figure 5. Connections, Power Switch, Fuse, and Air Filter

The liquefier should then be turned ON and the Mechanical Timer on the back panel of the liquefier set for one hour. The Air Compressor/PSA will start automatically and will run for an hour to dry the connecting line, purge any moisture from the interior of the liquefier and then begin the cool-down process.



Figure 6. Timer on back of elan2.

Δ NOTE: If you wish to repeat the defrost cycle, wait at least one hour to allow the internal heater to cool down.

Liquefier Operation

In everyday operation, before starting the liquefier, check that the Air Compressor power cord is plugged into a wall socket, and the plastic (or copper) air line is connected to the liquefier from the Air Compressor. The electrical control line must also be connected to the Air Compressor from the liquefier.

◆ **WARNING:**

DO NOT ATTEMPT TO RUN THE LIQUEFIER OR THE AIR COMPRESSOR IF ANY OF THESE LINES IS DISCONNECTED OR DAMAGED. IF THERE IS A PROBLEM CONTACT YOUR INSTALLER OR MMR TO SEE HOW TO RE-CONNECT THESE LINES.

To start the liquefier, turn ON the switch at the lower back of the liquefier. (Press the side of the switch marked with a “1”). See Fig. 7. The fans should start, and if the system is dry the Green LED (“C”) on the left of the Display Panel will come on, and the Air Compressor will start. Every half minute the PSA will release a quiet burst of air as it proceeds with its cleaning operation. This is a normal and necessary operation.



Figure 7. On/Off Switch on back of elan2

The refrigeration system will start a minute after the liquefier is turned on. A built-in delay is provided to guarantee a proper re-start in the event of a power outage. The sound of the refrigeration system starting is similar to the familiar sound of a home refrigerator.

Cool down

The liquefier takes about an hour to cool down before liquefaction of nitrogen can begin. This process is tracked by the Orange LED (“B”) and Blue LED (“A”) located on the left of the Display Panel above the Green (“C”) LED. See Fig. 8. When the temperature falls below -73°C (200K) the Orange LED comes on. This occurs about twenty-five minutes after start-up. When the temperature reaches -173°C (100K) the Blue LED comes on and liquefaction begins shortly thereafter. Liquefaction begins about an hour after start-up.

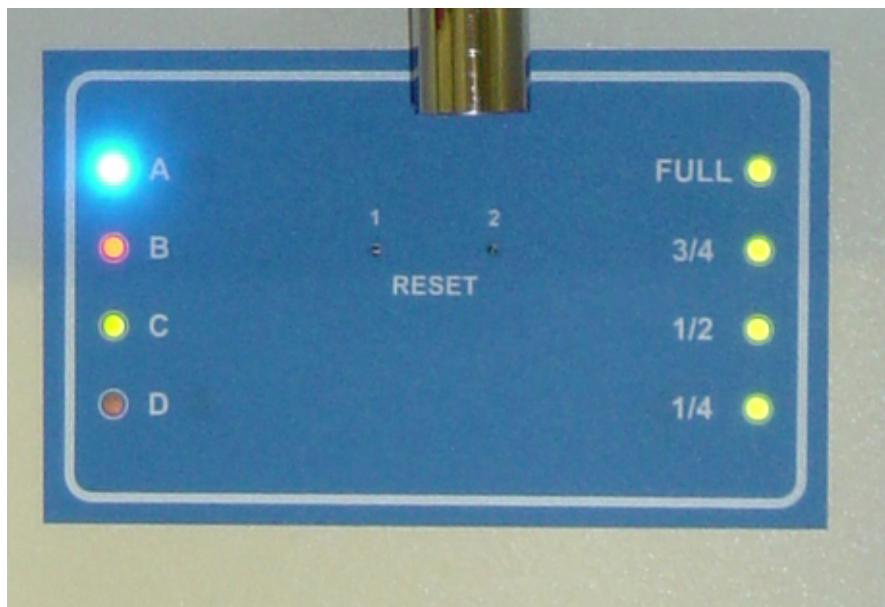


Figure 8. Display Panel LEDs

Liquefaction

Once liquefaction has begun it takes another hour and a quarter for the internal storage dewar to fill to the point when the quarter-full ($1/4$) LED on the right of the Display Panel comes on. A quarter of a liter of LN₂ would then be available. This can be dispensed into an external dewar as described below.

The liquefier will continue to liquefy nitrogen and each LED, ($1/2$, $3/4$, and full) will come on successively, approximately an hour and a quarter apart after this, and until the internal dewar is full. Shortly after reaching full, the refrigerator and air compressor will switch off automatically. They will restart and run for about half an hour every hour and a half or so, after this, to make up for evaporation losses from the dewar, and to keep the dewar full. If LN₂ is drawn from the liquefier by activating the Dispense button, the liquefier will restart and turn on the air compressor and PSA to refill the dewar. The liquefier is designed to be left on, so as to provide a supply of LN₂ at all times.

Transfer of LN2 to the External Dewar

To set up the system to fill the external 20L dewar automatically, do the following:

Insert the key in the lock on the side of the elan2 and turn it to the OFF position. See Figure 9. Lift the 20L dewar onto the Scale so that it is positioned over the micro-switch located in the base, and the neck of the dewar is positioned under the LN2 spigot under the snout of the elan2-TR. Now turn on the Security Key. The RED LED next to the Push Button should come on indicating the system is 'armed', i.e. the automatic transfer feature is activated. See Figures 3 & 4. At the same time, provided the dewar is correctly positioned under the spigot, the GREEN LED will also come on, indicating the Safe micro-switch is activated. An automatic transfer may be initiated at this time depending upon the status of the liquefier.



Figure 9. Security Key on side of Liquefier.

The system can now be left to cool-down and collect LN2. The $\frac{1}{4}$, $\frac{1}{2}$ and then the $\frac{3}{4}$ LED will come on in sequence as the internal dewar fills with LN2. When the Full LED is activated, it will trigger the transfer of LN2 to the external dewar. This transfer takes about one minute to complete. Then the liquefier will again begin to fill the internal dewar and the process will be repeated. When the external dewar is nearly full the transfer process will stop and the *internal* dewar will then be filled completely, instead. Shortly after reaching full, the refrigerator and air compressor will switch off automatically. They will restart and run for about half an hour every hour and a half or so, after this, to make up for evaporation losses and keep the internal dewar full.

Status of External Dewar

The volume of LN2 in the External Dewar may be determined at any time by pressing the pushbutton next to the RED and GREEN LEDs on the snout of the elan2-TR. The reading gives the volume of LN2, in liters. See Figure 4.

Removal of External Dewar

The External Dewar can be safely removed from the Scale upon which it is placed, by first switching the Security Key OFF. This prevents an accidental activation of a transfer while the dewar is being moved. BOTH the RED and GREEN LEDs should then be OFF, indicating it is safe to remove the dewar. Before turning off the Security Key it is possible to top up the External Dewar to its full 20 L capacity by pressing the Red Pushbutton next to the Key. When the Security Key is OFF this process is deactivated.

Internal Dewar

When the internal dewar is full as indicated by the $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and Full LEDs all being on and the Standby LED (“D”) is also on, the air compressor will be Off. After the internal dewar is full and the system has switched to Standby, the level of LN2 in the dewar will gradually fall due to evaporation until the Full LED goes off. Shortly after this the liquefier will restart and refill the internal dewar.

Switching off the elan2

If LN2 will not be needed for a few days and continuous operation is not needed, the elan2AutoTransfer can be switched off by switching the switch on the lower back of the liquefier (See Fig. 7) to the OFF position (Push the “0” side of the switch). This also turns off the Air Compressor and the PSA via the control line between the liquefier and the Air Compressor. DO NOT unplug the Air Compressor/PSA.

Restarting the elan2

To restart the elan2 simply turn the switch on the lower back of the liquefier to the ON position. The Air Compressor and PSA will start immediately and purge the air line and interior tubing of the elan2 of any moisture that might have accumulated in these connections. A minute later the liquefier itself will start, and the cooling sequence will begin. A quarter liter of LN2 will be available about two and a half hours after this when the “ $\frac{1}{4}$ ” LED comes on. A lesser amount of LN2 can be dispensed after about one and a half hours from start-up.

Safety Features

The elan2 has several safety features built into its design. To prevent the unauthorized dispensing or use of LN2, a system key is required to enable the dispensing of LN2. Keep the key in a safe place to which children or unauthorized persons do not have access.

The elan2 and the Air Compressor each have thermal cut-out switches installed to turn off the units if their temperatures rise above a safe level.

The elan2 cannot liquefy nitrogen if it is contaminated with moisture. If the PSA fails, the moisture content of the incoming air will rise. This is sensed and a valve will shut off the flow, thus protecting the liquefier from contamination. Liquefaction will be resumed when the moisture content falls to an acceptable level.

Maintenance



Figure 10. Filter Replacement

The Liquefier of the elan2 requires unobstructed airflow to function properly. A replaceable air filter, located in the back of the unit, protects the Liquefier from dust and debris in the air. To prevent voiding the warranty, to extend the life of your elan2, and ensure the lowest power consumption per unit of LN2 produced, you must replace the Air Filter at regular intervals of 1 month. Replacement air filters are available from MMR (p/n 1230041-012).

Fault Conditions

If the temperature of the interior of the Air Compressor or the liquefier rises above a safe level to activate either of the thermal cut-out switches, the liquefier or air compressor will be turned off. Such a rise in temperature can occur if the air intakes are blocked, or partially blocked; or dust has restricted the free flow of air in and out of the units; if there is inadequate ventilation in the room where the liquefier or air compressor are located; or if the temperature in the immediate vicinity exceeds 30°C (86°F); or a cooling fan fails.

If any of these safety cut-outs activate, the unit will switch off, the interior temperature will fall, but eventually the unit will restart. The system will then cycle on and off. This will result in a reduction in the yield of LN2 that should alert the user to the problem. In this case TURN OFF the unit. Check the room temperature; check the air intakes for obstructions and remove any objects closer than 6" from the intakes; set the room thermostat to 25°C (77°F) if air conditioned; and check ventilation. After all of these

checks have been completed, and if the temperature of the room has returned to a safe figure below 30°C, turn on the liquefier. If the problem persists, contact MMR Technologies, Inc., at (650) 962-9620 or by e-mail at elan2support@mmr.com.

If a failure occurs in the PSA, moist air can reach the elan2 liquefier. This will result in the green, “C” LED turning off – indicating a WET condition. At the same time, a valve will close to prevent moist nitrogen from entering the liquefaction column. In this case no LN2 will be produced, the elan2 will cool down anomalously *fast* because of the absence of the nitrogen feed, and *the 1/4, 1/2, 3/4 and Full LEDs may all come on*, but no LN2 will be produced.

Contact MMR Technologies at (650) 962-9620 or by e-mail at elan2support@mmr.com. A replacement PSA can be shipped to you and the defective PSA repaired.

In the event of a power surge the fuse to the liquefier can blow. In this situation the elan2 fans, LEDs and compressor will not come on, upon switching on the ON/OFF switch of the liquefier. Similarly, the Air Compressor will remain off.

Contact MMR Technologies at (650) 962-9620 or by e-mail at elan2support@mmr.com. Instructions will be supplied on how to replace the fuse and restart the unit. **DO NOT** attempt to replace the fuse without first checking with MMR. Significant damage can be done to the unit if the wrong type of fuse is used, and the warranty will be voided.

Specifications**Electrical Service**

Voltage	115VAC	230 VAC
Phase	Single	Single
Frequency	60 Hz	50 Hz
Power	900 Watts	750 Watts
Number of Electrical Outlets Required*	2 standard wall outlets	

* The elan2 should not be connected on the same electrical circuit as any large power usage instrument like a sterilizer, etc.

Operating Environment

Temperature	60 °F - 90 °F [16 °C - 32 °C]
Humidity	< 80% RH
Dust	Standard office environment
Noise	< 55 dBA at 1 meter

Liquid Nitrogen

Generation Rate	185 cc/hour (4.5 liters/day)
Purity	98% (< 2% O ₂)
Storage Capacity	20.5 liters
Static Evaporation Rate*	0.095 liters/day
Normal Working Duration**	135 Days (4 ½ months)

**Static Evaporation rate and static holding time are nominal. Actual rate and holding time will be affected by nature of container use, atmospheric conditions, and manufacturing tolerances.

***Normal Working Duration is an arbitrary reference useful to estimate container performance under normal operating conditions. Actual working time may vary due to current atmospheric conditions, container history, manufacturing tolerances, and individual patterns of use.

Dimensions and Weight

Generator with scale	13" W x 29" D x 38" Ht 33 cm W x 74 cm D x 97 cm Ht Weight 85 lbs (39 kg)
Air Compressor Provided	17.5" W x 17.5" D x 15" Ht 45 cm W x 45 cm D x 38 cm Ht Weight 60 lbs (27 kg)
External Dewar	2.18" (55.5 mm) neck opening 25.7" (652 mm) height overall 14.5" (368 mm) outside diameter

Specifications are subject to change without prior notice.

Spare Parts List

Part Number	Description
5192040-001	20 L Dewar (135 days normal working duration rating)
1230041-012	Package of Air Filters (qty 12)
9530020-002	Elan2 Liquid Nitrogen Generator with Autotransfer, User Manual

Frequently Asked Questions

What does the elan2 system do?

The elan2 liquid nitrogen generator generates liquid nitrogen from the air, at a rate of up to 4.5 liters per 24 hour period. The air we breathe is approximately 78% nitrogen gas – it makes sense to use that as an inexpensive source.

Once the air is brought into the elan2, the air is compressed to remove water vapor and other contaminants. The nitrogen is then filtered from the remaining air, and the oxygen and other gases are returned to the room. The nitrogen is then liquefied, and transferred to the internal storage container, ready to deliver on-demand when needed.

What is the difference between the Office Generator and the Autotransfer system?

The Office Generator has an internal reservoir that can hold 0.75 liters of liquid nitrogen. Once this tank is full, the system goes into a standby mode until some or all of the liquid nitrogen has been used. At this point, the elan2 will power up and start production again. It will take approximately 6 hours to fill the internal reservoir.

The Autotransfer system produces liquid nitrogen at the rate of up to 4.5 liters every 24 hours, but continuously transfers this to a large external 20 liter tank. It takes approximately 4.5 days to fill this tank. When you need larger volumes of liquid nitrogen at a time, this is the ideal set up – you can take what you need from the larger tank, and then continue production

How quickly does the elan2 generate liquid nitrogen?

The elan2 systems can generate liquid nitrogen as much as 4.5 liters of liquid nitrogen every 24 hour period (this equates to between 2 and 4 CryAcs every 6 hours, depending on the size).

What is the warranty on the instrument?

This instrument has a one year warranty. If you would like information on our standard warranty terms, please contact us, and we would be happy to provide you with this agreement.

What maintenance is required?

Once a month, you will need to change a filter. This takes roughly 2 minutes to do, through an easy access door on the back of the unit. The cost of filters is approximately \$40 per year¹. A one year supply is included with the initial system purchase.

The elan2 has a self cleaning cycle that it undergoes once a week, in the middle of the weekend. This will not affect your ability to get liquid nitrogen as you need it.

¹ Prices subject to change. Please contact your local sales representative for actual pricing.

How large is the elan2?

The elan2 Liquid Nitrogen System with Autotransfer is also composed of two parts: The Generator with Autotransfer and the Air Compressor.

Compressor: 17.5" wide x 17.5" deep x 15" high
(45 cm wide x 45 cm deep x 38 cm high)

Generator with Autotransfer: 14.5" wide x 35" deep x 37" high
(37 cm wide x 89 cm deep x 94 cm high)

The compressor can be located anywhere within a 15 foot (4.5 meter) distance of the Generator with Autotransfer.

What do I need to operate the elan2?

You need two things to operate the elan2:

1. Standard electricity from a wall outlet: 2 outlets

Note: It is recommended this is not on the same circuit as other heavy equipment like lasers, sanitizers, autoclaves, etc.

2. Good airflow in the room the elan2 is installed.

Note: These may not be installed in a small closer or storage room where there is not good air flow. The elan2 uses the nitrogen from the air to produce liquid nitrogen. An inadequate air supply, like that found in a small closet, could result in damage to the instrument, not covered under warranty.

How is this system safer than the liquid nitrogen I have delivered?

There are three tiers of safety built into the elan2 liquid nitrogen generator, for the safety of you and your staff:

1. Liquid nitrogen is available only when you push a button. There is no automatic delivery of this to your container. The liquid nitrogen will only dispense as long as you hold the button down.
2. The system has a key – if the key is not placed in the system and turned to the on position, no liquid nitrogen will be transferred, even if you push the button. This allows you to control who has access.
3. Liquid nitrogen cannot be dispensed unless there is an RFID tagged container placed below the delivery spout. This tag will unlock the dispensing mechanism and enable transfer. This way there is no possibility of accidentally pressing the button and letting the liquid nitrogen dispense with no container present.

How is this liquid nitrogen different from the liquid nitrogen I have delivered?

The liquid nitrogen you have delivered is approximately 98% pure, but it frequently has additional particulate matter and water that are picked up when it is transferred several times between where it is generated and delivery to your office.

The liquid nitrogen from the elan2 is 98% pure, and you are in control of the nitrogen from the time it is generated – ensuring minimal water or contamination between the time you get what you need and use it.

What is the cost per liter of liquid nitrogen generated?

The cost of operating the elan2 varies based on the cost of electricity, but an average estimate is between \$26 and \$43 per month in electricity – approximately the same as a refrigerator.

Who uses these systems?

These liquid nitrogen generators are found in dermatology offices, government and military medical centers, research facilities, and scientific laboratories.