CNP ECO1D Extendible

Reliable LN2 Production with Dual-Refrigeration Architecture

CNP ECO1D introduces a new level of reliability and operational continuity in compact liquid nitrogen generation systems. Designed around two independent refrigeration circuits, two storage tanks, and two cryogenic cold heads, ECO1D provides uninterrupted liquid nitrogen availability for laboratories, research facilities, biological storage centers, and industrial users.



Unlike conventional liquefiers that rely on a single refrigeration unit, ECO1D distributes the liquefaction process across two independent 500-liter storage vessels, each equipped with its own dedicated cryogenic cold head and helium compressor. This architecture improves serviceability, reduces operational risks, and enables continued LN_2 production even when one refrigeration circuit is unavailable.

Powered by IMTEK Cryogenics' proven PSA technology and advanced control algorithms, ECO1D combines reliable nitrogen generation, intelligent process management, and engineered redundancy into a single compact platform.

The integrated PSA system delivers 15 Nm^3/h of nitrogen gas to the liquefaction stage, supporting a liquid nitrogen production capacity of approximately 240 liters per day while maintaining stable purity and long-term operational reliability.

This architecture minimizes downtime risks and provides a level of operational continuity rarely found in compact liquid nitrogen generation systems.

Intelligent Air Management Algorithm (IAMA)

Despite its compact footprint, ECO1D incorporates the same advanced air management technologies used in IMTEK's larger cryogenic plants.

The Intelligent Air Management Algorithm (IAMA) continuously compensates for pressure fluctuations originating from PSA cycling, auto-drain operation, and varying air demand conditions.

By dynamically stabilizing the air supply to the PSA module, IAMA improves nitrogen purity consistency, enhances adsorbent lifetime, and contributes to stable liquefaction performance under varying operating conditions.

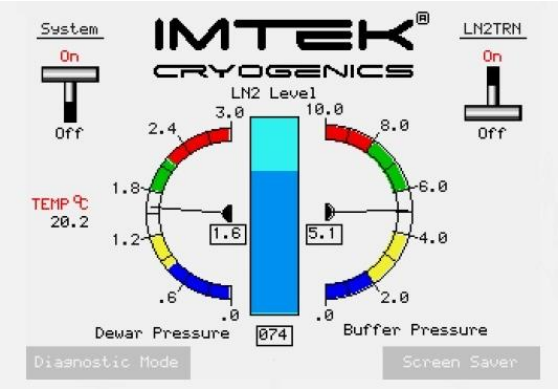
Integrated condensate removal, multi-stage filtration, and advanced dew-point control ensure that only clean and dry air enters the PSA system, protecting critical components and supporting long-term operational reliability.

The same architecture has been successfully validated in long-term operation across IMTEK's cryogenic plant installations worldwide.

Atmospheric air is compressed and delivered to an air buffer tank where it undergoes a multi-stage purification process.

Water droplets and particulates are removed through an automatic condensate separator and filtration system, while the integrated dryer reduces the dew point to as low as –40 °C or –70 °C depending on configuration.

The purified air is then processed by IMTEK's dual-column Pressure Swing Adsorption (PSA) system. Carbon molecular sieves selectively adsorb oxygen, carbon dioxide, and residual moisture, producing high-purity nitrogen suitable for cryogenic liquefaction.



The PSA system is optimized to achieve:

- High nitrogen production efficiency
- Reduced air consumption
- Long adsorbent lifetime
- Stable nitrogen purity
- Low operating cost

The generated nitrogen is accumulated in a nitrogen buffer tank before entering the liquefaction stage.

Intelligent Reliability Architecture

ECO1D combines intelligent diagnostics with physical redundancy.

The control system continuously monitors:

- Air pressure
- Nitrogen pressure
- LN_2 level
- Cryocooler performance
- Compressor status
- Process temperatures
- Valve operation
- PSA operating conditions

Advanced diagnostic algorithms identify deviations from normal operating behavior and generate predictive warnings before faults occur.

This proactive approach minimizes downtime, simplifies maintenance planning, and improves long-term operational reliability.

The PLC continuously records system data, operating trends, alarms, and service events, providing valuable information for maintenance and system optimization.

Operational Continuity

Unlike conventional liquefiers that depend on a single refrigeration circuit, ECO1D incorporates two fully independent refrigeration systems.

Each refrigeration circuit contains:

- One F70 helium compressor
- One cryogenic cold head
- One dedicated 500-liter LN_2 storage tank

If one refrigeration circuit is taken offline for maintenance or experiences an unexpected disturbance, the second circuit continues operation automatically.

This redundancy provides:

- Higher availability
- Reduced production interruptions
- Increased operational security
- Simplified maintenance planning
- Greater resilience against component failures

Instead of a complete production shutdown, ECO1D automatically transitions to a reduced-capacity operating mode while maintaining liquid nitrogen availability.

Dual Refrigeration Architecture

At the core of ECO1D is IMTEK's Dual Refrigeration Architecture, consisting of two independent refrigeration circuits, each equipped with an F70 helium compressor, a cryogenic cold head, and a dedicated 500-liter LN_2 storage tank. Both circuits operate simultaneously while sharing a common nitrogen generation platform.

This architecture improves system availability, simplifies maintenance, distributes the thermal load between two storage vessels, and enhances operational flexibility. In the event of maintenance or an unexpected disturbance affecting one refrigeration circuit, the remaining circuit can continue operation at reduced capacity, maintaining liquid nitrogen availability and minimizing downtime risks.

Compared to conventional single-circuit liquefiers, ECO1D provides a significantly higher level of operational continuity and reliability while preserving a compact system footprint.

Expandable Platform Architecture

ECO1D is built on the same mechanical, electrical, and control platform used in IMTEK's ECO2 series. By utilizing the ECO2 architecture from the beginning, the system is already prepared for future capacity expansion.

When additional liquid nitrogen demand arises, ECO1D can be upgraded to ECO2 configuration by simply adding two helium compressors. The existing PSA system, control architecture, air management system, and installation footprint remain unchanged.

This scalable approach protects the user's investment while providing a simple and cost-effective path toward higher production capacities with minimal operational disruption.

User Experience and Maintenance

ECO1D is designed for simple and reliable daily operation.

Features include:

- One-button system start-up
- Fully automatic operation
- Automatic process optimization
- Intelligent alarm management
- Remote monitoring capability
- Operator-friendly HMI interface
- Simplified maintenance procedures

Routine maintenance primarily consists of filter replacement and periodic inspections.

The system is designed for long maintenance intervals and maximum operational availability.

Features

High Performance Liquefaction

- Up to 240 L/day LN_2 production
- Dual refrigeration architecture
- 2 × F70 compressors, 2 × cold heads
- 2 × 500 L LN_2 storage tanks
- Stable and efficient liquefaction

Purity Stability & Air Management

- Intelligent Air Management Algorithm (IAMA)
- Real-time pressure stabilization
- Multi-stage filtration and drying
- Dew point down to –40 / –70 °C
- Long-term purity stability

Optimized PSA Technology

- Dual-column PSA system
- 15 Nm^3/h nitrogen generation
- Optimized nitrogen-to-air ratio
- Reduced compressed air consumption
- Stable purity and long adsorbent life

Reliability & Smart Control

- Intelligent PLC platform
- Real-time diagnostics
- Predictive maintenance functions
- Smart alarm management
- Redundant refrigeration architecture

User Experience & Maintenance

- Fully automatic operation
- One-button start-up
- Remote monitoring capability
- Easy service access
- Simplified maintenance with long service intervals

Specifications

Parameter	ECO1D
LN_2 Production Capacity	≥ 240 liters/day
LN_2 Production Rate	≥ 10 liters/hour
LN_2 Storage Capacity	2 × 500 liters
Total Storage Volume	1000 liters
Nitrogen Generation Capacity	15 Nm^3/h
Nitrogen Purity	≥ 99.9%
Cryogenic Cold Heads	2
Helium Compressors	2 × F70
PSA Technology	Dual Column PSA
Control System	PLC + HMI
Operation Mode	Fully Automatic
Remote Monitoring	Optional
Dew Point	–40 °C / –70 °C
Maximum Altitude	4,500 meters
Noise Level	< 65 dB @ 1 meter
Electrical Rating	380/400/415 VAC, 3Ph, 50 Hz or 480 VAC, 3Ph, 60 Hz
Power Consumption*	Approx. 14kW
Chiller Power Consumption*	Approx. 5 kW
Air Compressor Power Consumption*	3 kW
Total Installed Power*	Approx. 22 kW
Maintenance Interval	Up to 15,000 operating hours

* Values may vary depending on final configuration and site conditions.