CNP40

Compact On-Site Liquid Nitrogen Generators by Imtek Cryogenics





CNP40 is a compact, fully integrated liquid nitrogen generator designed for laboratories, research facilities, biological storage applications, universities, medical institutions and industrial users requiring a reliable and continuous on-site LN_2 supply. It combines IMTEK Cryogenics' PSA nitrogen generation technology with proven GM cryocooler-based liquefaction in a single, coordinated system. Nominal production exceeds 40 L/day at an operating pressure of 1.5 barg under the specified reference conditions. An available upgrade option increases the production capacity to as much as 50 L/day, providing additional flexibility for facilities with increasing or variable liquid nitrogen demand.

The enclosure contains the air compressor, air-treatment equipment, filtration and condensate-removal components, PSA unit, nitrogen buffer vessel, cryogenic liquefaction system, vacuum-insulated LN_2 storage vessel, PLC, instrumentation and the required operational safety devices. The standard system produces liquid nitrogen directly from atmospheric air and requires only a suitable electrical supply, adequate room cooling and fresh-air ventilation. Its integrated construction reduces site connection requirements and simplifies installation and routine operation. Optional connections for external compressed-air or nitrogen supplies are available when required by installation conditions, existing site utilities or the customer's preferred operating configuration.

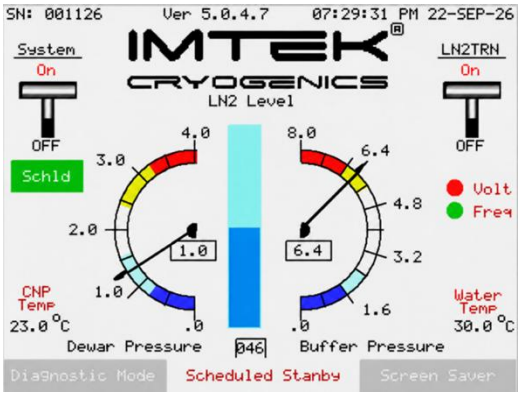
Air Supply Control (IAMA)

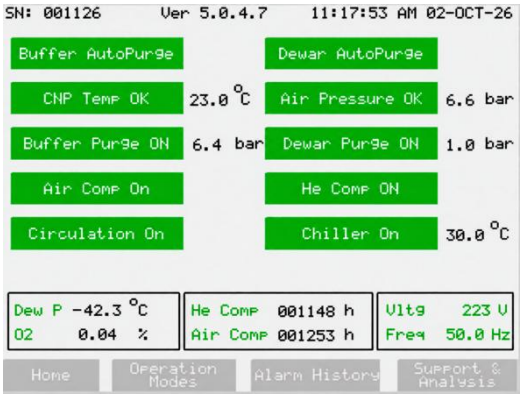
CNP40 incorporates IMTEK's Intelligent Air Management Algorithm (IAMA) for regulation of the compressed-air supply to the PSA system. The control function compensates for pressure variations resulting from PSA cycling, condensate discharge and changes in air demand.

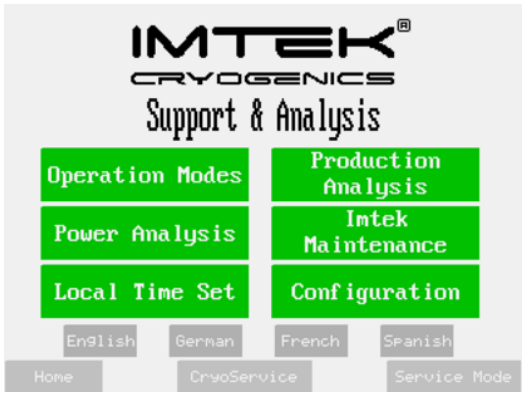
The controlled air supply provides the following operating benefits:

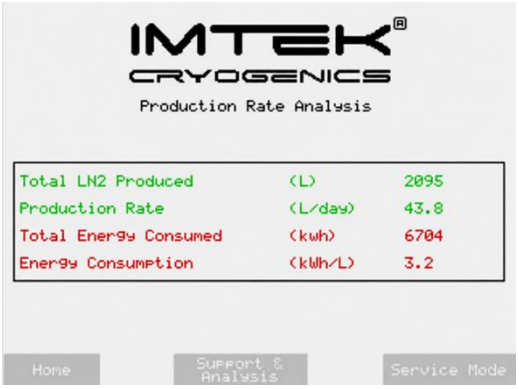
- Stable nitrogen purity
- Reduced compressed-air consumption
- Extended adsorbent service life
- Stable liquefaction conditions
- Reliable long-term operation

Four HMI views provide the principal operating and diagnostic information. The Main User Screen displays LN_2 level, dewar and nitrogen-buffer pressures, operating mode and current system state. The Diagnostic Screen shows component status, process temperatures, dew point, process O_2 concentration, helium-compressor operating hours, voltage and frequency. Support & Analysis provides access to operating-mode selection, power analysis, maintenance information, local time settings, alarm history and system configuration. Production Rate Analysis displays total LN_2 production, current or average production rate, total electrical energy consumption and specific energy consumption in kWh/L.









The PLC continuously monitors pressures, temperatures, LN_2 level, dewar vacuum, process oxygen, dew point, phase sequence, voltage, frequency and cooling conditions. Deviations are indicated through the two-stage alarm system, with warning-level and shutdown-level messages defined according to the relevant process parameter. Alarm records support fault diagnosis and maintenance planning. Automatic condensate removal, multi-stage filtration and continuous dew-point monitoring ensure that clean, dry air is supplied to the PSA system and that abnormal operating conditions are identified before they affect nitrogen production.

Nitrogen Generation System

Atmospheric air is compressed and processed through a multi-stage air treatment system consisting of filtration, condensate removal and drying stages.

The integrated dryer reduces the process pressure dew point to approximately −40 °C. The dew point is continuously indicated on the Diagnostic Screen when the humidity sensor is enabled.

The treated air is supplied to IMTEK's dual-column Pressure Swing Adsorption (PSA) system, which uses carbon molecular sieve to separate nitrogen from air. The PSA system provides:

- High nitrogen production efficiency
- Long adsorbent service life
- Low compressed air consumption
- Low operating cost
- Stable nitrogen purity

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

Cryogenic Liquefaction System

At the heart of CNP40 is a GM-type cryocooler refrigeration system consisting of:

- One Sumitomo F40 helium compressor
- One Sumitomo CH110 cryogenic cold head
- One vacuum-insulated liquid nitrogen storage vessel

The refrigeration system liquefies the nitrogen and delivers it directly to the integrated vacuum-insulated storage vessel.

The cold head is designed for industrial operation and offers maintenance intervals of up to 15,000 operating hours. The helium compressor operates in a closed-cycle helium circuit and requires maintenance only at intervals of up to 30,000 operating hours.

System Monitoring and Protection

The PLC continuously monitors the principal operating and safety parameters:

- Air-buffer, nitrogen-buffer and dewar pressures
- LN_2 level and dewar vacuum
- Process dew point and oxygen concentration
- Cabinet, process, motor and cooling temperatures
- Helium-compressor gas pressure and status
- Phase sequence, voltage and frequency
- PSA and cryocooler operating conditions
- System alarms, warnings and shutdowns

Operation and Maintenance

CNP40 is designed for automatic operation with limited operator intervention. Standard functions include:

- One-button start-up
- Fully automatic level-based production control
- Continuous, Scheduled and One-Cycle operating modes
- Two-stage warning and shutdown management
- Optional remote monitoring
- Operator-friendly PLC/HMI interface
- Operating-hour and maintenance tracking
- Configurable internal or external air and nitrogen supply selection

Routine maintenance primarily consists of filter replacement and periodic inspections.

The cold head can be serviced on site, subject to the procedures and requirements stated in the Service Manual.

Integrated System Design

Air preparation, nitrogen generation, liquefaction, storage and control equipment are installed in one mobile enclosure. Air-cooled and water-cooled configurations are available. Removable top and side panels provide access for inspection and service.

Section	CNP40 Technical Specification
Plant Performance & Capacity	CNP40 provides fully automatic LN_2 production under the specified reference conditions. Production is controlled according to the selected operating mode, LN_2 level and process limits. Nitrogen purity is continuously monitored by an inline oxygen sensor.
Air Compressor & Air Treatment	The standard enclosure contains the air compressor, air buffer, multi-stage filtration, automatic condensate removal and dryer. Process dew point is continuously monitored. An external compressed-air connection is optional.
PSA Nitrogen Generator	IMTEK's dual-column CMS PSA system produces nitrogen and supplies it through a dry buffer vessel to maintain stable pressure and flow before liquefaction. An external nitrogen connection is optional.
Cryogenic Liquefaction System	A Sumitomo CH110 GM cold head driven by an F40 closed-cycle helium compressor liquefies nitrogen directly into the integrated storage vessel.

Helium Compressor System	The Sumitomo F40 circulates helium in a sealed, closed-cycle refrigeration circuit. Compressor status, helium pressure, motor temperature and cooling conditions are monitored by the PLC.
LN_2 Storage Dewar	Liquid nitrogen is stored in an integrated high-vacuum, multi-layer insulated vessel. Independent level control automatically starts and stops production according to the selected operating mode. LN_2 level, pressure and vessel vacuum are continuously monitored.
PLC & HMI	The industrial PLC/HMI controls automatic operation, warnings, alarms and protective shutdowns in Continuous, Scheduled and One-Cycle modes. It displays process data, alarm history, operating hours, LN_2 production and energy analysis. Ethernet remote monitoring is optional.
Service & Maintenance	Removable top and side panels provide access to filters and principal components. The mobile enclosure can be repositioned for service and secured by lockable wheels. Operating-hour and maintenance records support planned servicing.
Certificates & Documentation	CNP40 is supplied in accordance with applicable project and CE requirements. Documentation includes the Safety, Installation and Operation Manuals, electrical drawings, P&ID, model data, spare-parts information, training documents and project-specific conformity documentation.

Specifications	**CNP40**
LN_2 Production Capacity	>40 L/day at 1.5 barg; upgrade option to 50 L/day *,**
LN_2 Operating Pressure	1.5 barg nominal
LN_2 Storage Capacity	100 L or 155 L
Process Nitrogen Demand	Approx. 1.2 m^3/h
Nitrogen Purity	Typically, 99.2–99.5% N_2
Cryogenic Cold Head	Sumitomo CH110
Helium Compressor	Sumitomo F40
PSA Technology	Dual-column CMS PSA
Control System	Industrial PLC + color touchscreen HMI
Operating Modes	Continuous, Scheduled and One-Cycle
Remote Monitoring	Optional Ethernet-based access
Process Pressure Dew Point	Approx. −40 °C (-70 °C optional)
Operating Dimensions (W × D × H)	780 × 1350 × 1385 mm (100 L) 870 × 1600 × 1385 mm (155 L)
Noise Level	<60 dB(A) at 1 m
Standard Electrical Supply	380-415 V / 3 Ph / 50 Hz; 460 V / 3 Ph / 60 Hz**
Maximum CNP Consumption	4.6 kW
Cooling Configuration	Air-cooled or water-cooled
Maximum Heat Rejection	AC: 4.6 kW to room / WC: 4.6 kW to cooling-water circuit
Electrical Connection	5 × 4 mm^2 TTR; direct panel connection; 3Ph C32 A branch
Maintenance Intervals	Cold head: up to 15,000 h / Helium-compressor adsorber: up to 30,000 h

* Values may vary depending on final configuration and site conditions.
** Other electrical configurations and higher production capacities are available on request.

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