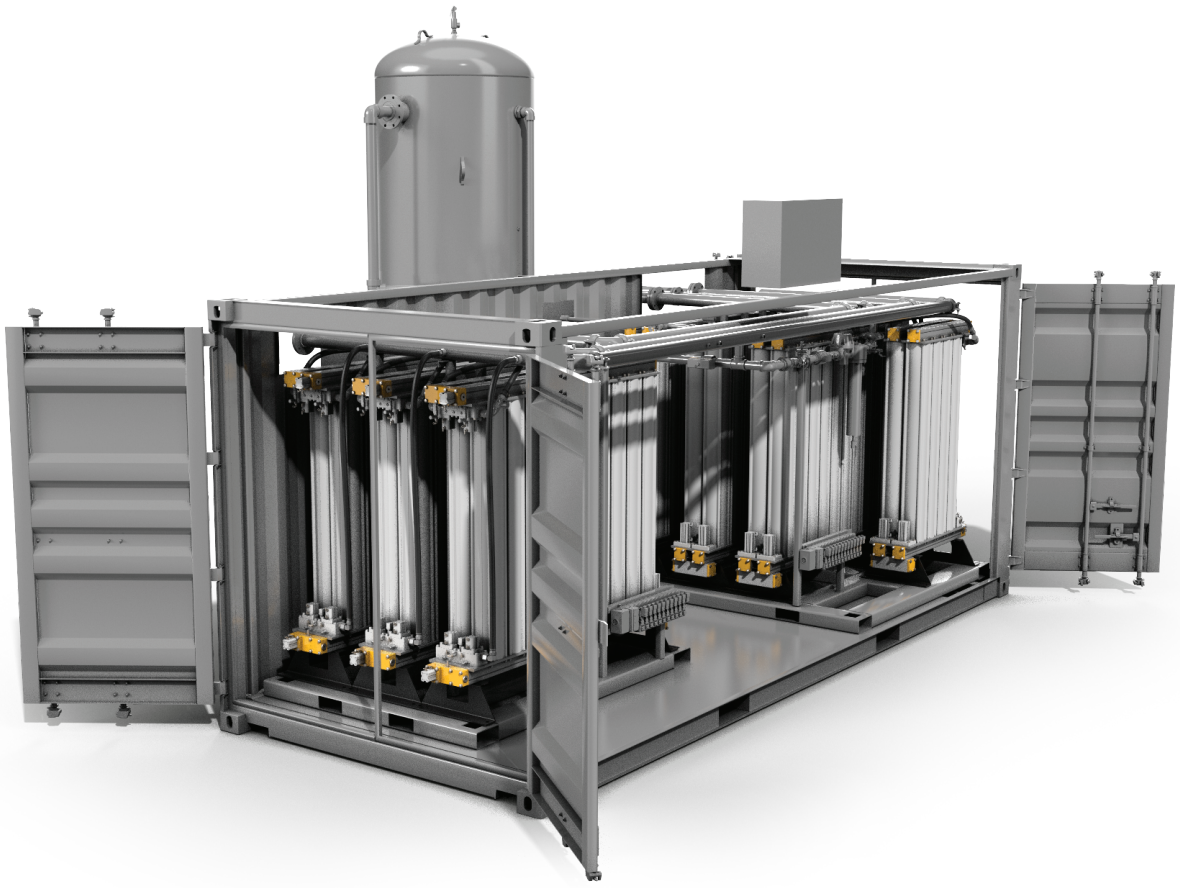


CNS Series Containerized Nitrogen Gas Generation Systems

For Large Flow Applications

Parker

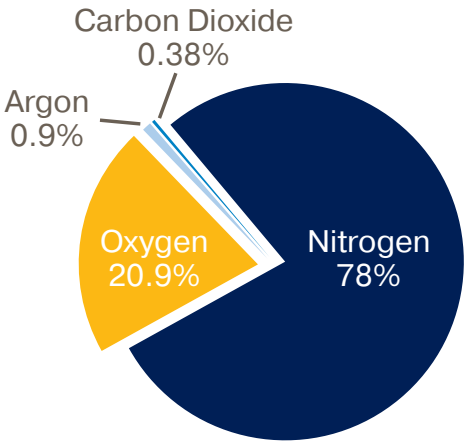
ENGINEERING YOUR SUCCESS.

Why Nitrogen?

Nitrogen (N_2) is a colorless, odorless and tasteless gas, which makes up 78% of earth's atmosphere. Its inert properties and natural abundance have made it a highly popular choice throughout industry.

Because it is a clean, dry, inert gas, nitrogen is ideal for displacing oxygen, which can have very undesirable effects on certain products or production processes.

By removing oxygen, we can prevent oxidation of materials, stop bacterial growth, and reduce the risk of combustion and explosion.

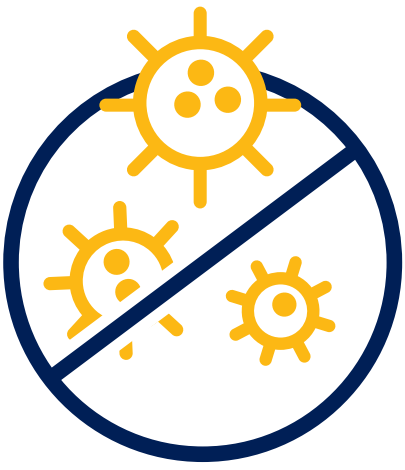


The Earth's Atmosphere

Nitrogen is used for a wide range of industrial applications, including:

- Food and beverage
- Lasers
- Chemicals
- Electronics
- Pharmaceuticals
- Oil & gas
- Heat treatment
- Aviation
- Fire prevention
- Training and fitness

Prevents Oxidation



Prevents Bacterial Growth

Prevents Combustion and Explosion

2

Traditional Methods of Nitrogen Supply

Traditionally, nitrogen and other industrial gases have been delivered to users' sites by gas supply companies in high pressure gas cylinders, liquid dewars, or bulk liquid storage tanks. This gas is produced through a process called cryogenic distillation, which is very expensive and consumes large amounts of energy.

With traditional methods of gas supply, users are responsible for 'hidden extra costs' such as cylinder rental, delivery and administration charges on top of the headline gas price. Additionally, traditional gas supply methods result in waste. Liquid 'boil-off' from dewars vents expensive gas into the atmosphere, and approximately 10% of the gas in every cylinder is returned to the supplier unused.

Even more importantly, delivered gas is a safety hazard. High-pressure gas cylinders sit at pressures up to 3000 psi g (207 bar g) and require restraints when in storage. These high-pressure vessels must be manually handled when it's time for changeout, which requires personnel competence training.

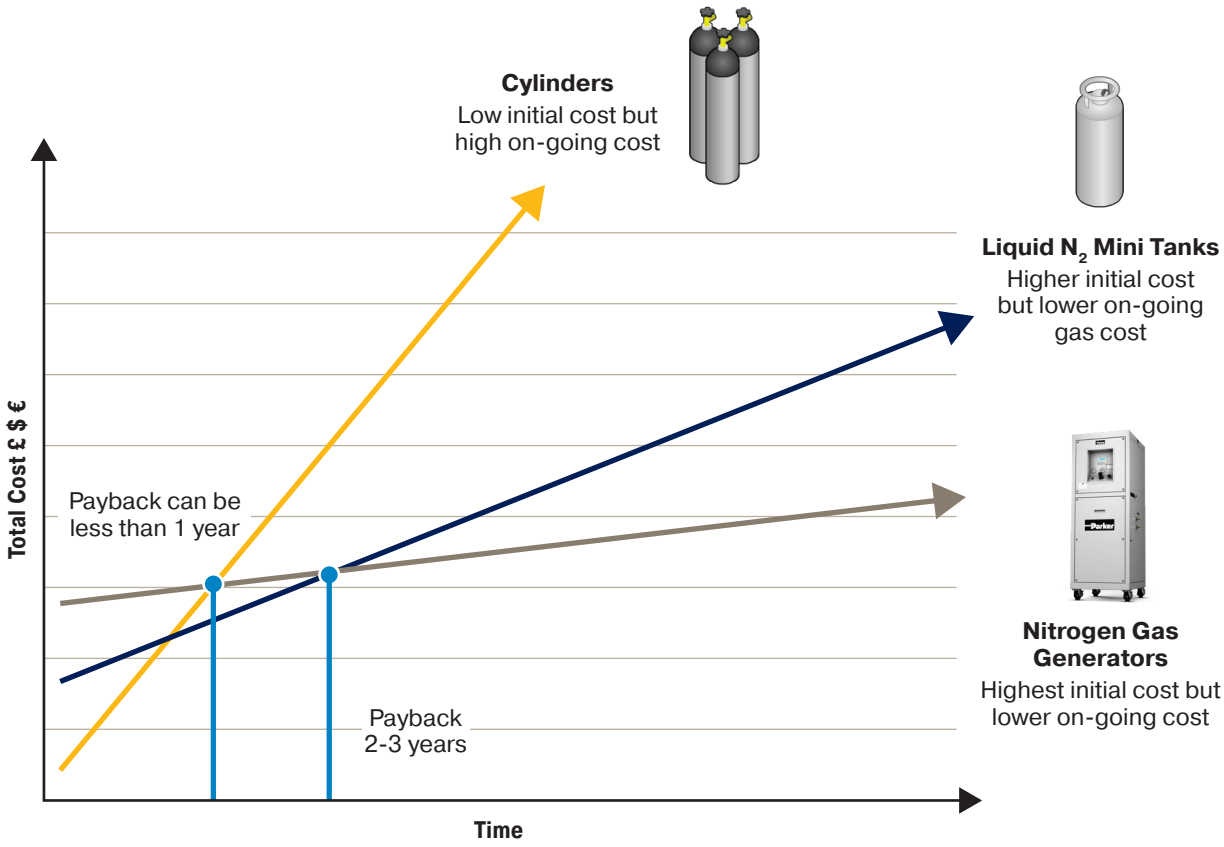
Liquid stored gas is not safer. If expelled into atmosphere, liquid nitrogen expands nearly 700 times in volume when it vaporizes and quickly displaces oxygen. If sufficient liquid nitrogen is vaporized into a confined space, there is risk of asphyxiation. The lack of properties, such as color or odor, risks significant harm with minimal warning.

The Benefits of Producing Nitrogen On-Site

Nitrogen generators allow users to produce a continuous supply of high-quality nitrogen on-site and on-demand. These gas generators take in air from a standard industrial compressor and sieve out oxygen and other trace gases, while nitrogen passes through to the application. As a result, companies can use as much or as little nitrogen as needed, at a fraction of the cost of having gas delivered by an external supplier.

There are two core technologies that are used in the on-site generation of nitrogen: hollow fiber membrane and pressure swing adsorption (PSA). While each of these technologies offer unique value proposition, both offer companies with a reliable system to provide exactly the right quality and amount of nitrogen gas for their application.

Nitrogen gas generators offer companies with a more flexible, efficient, safe, and affordable alternative to gas delivered by a gas supply company. When the true costs are accounted for, nitrogen gas generation is the most economical source for producing nitrogen. Users who switch realize capital payback in a little as 12 months.



When the true costs are accounted for, gas generation with on-site nitrogen gas generation is the most economical source of nitrogen – making a positive contribution to the bottom line.

4

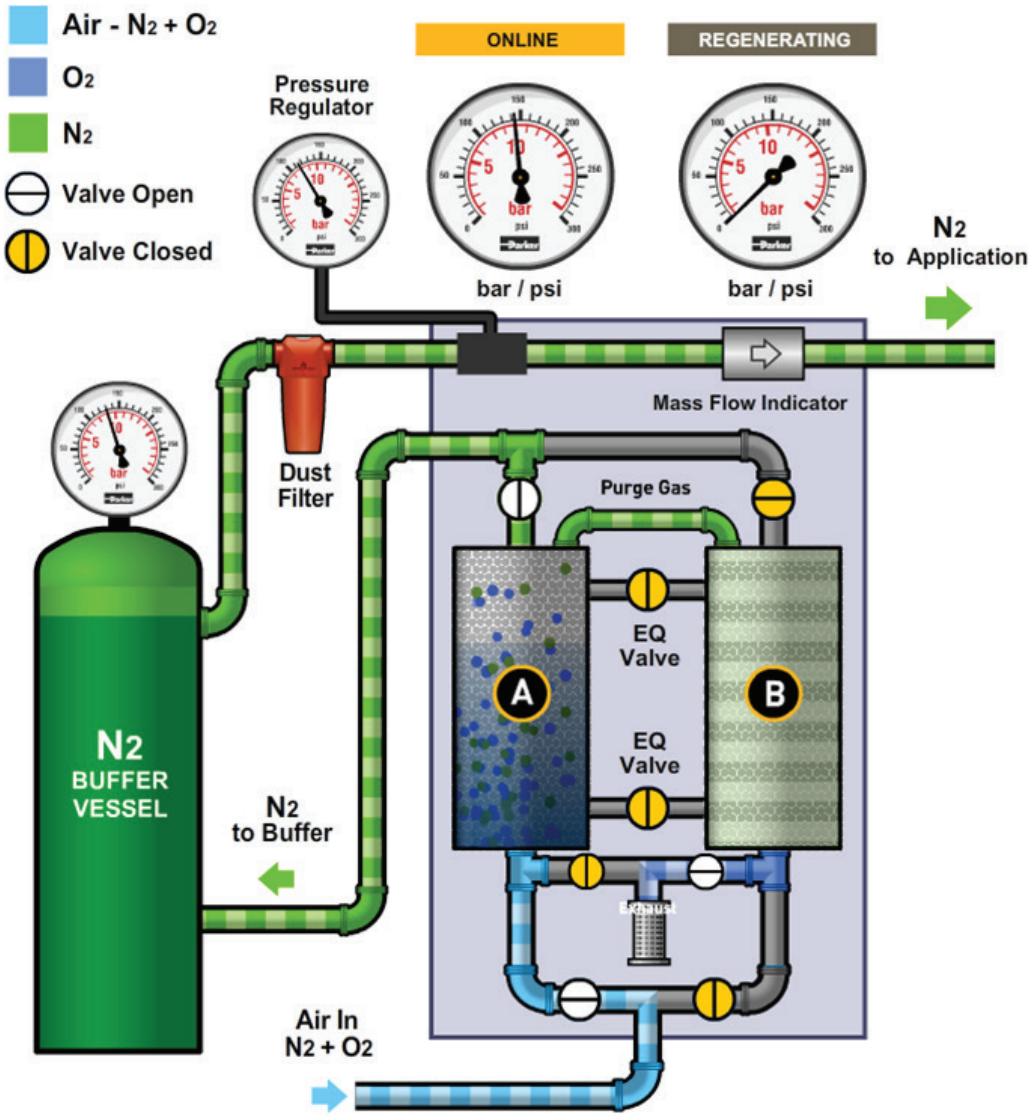
Pressure Swing Adsorption Nitrogen Generation Systems

Pressure Swing Adsorption (PSA) technology uses 2 vessels (or 2 sets of vessels) filled with carbon molecular sieve (CMS) to separate compressed air. Oxygen and other waste gases are selectively adsorbed under pressure by the CMS, allowing nitrogen to pass through to the application.

The CMS is regenerated by releasing the pressure in one of the vessels and venting the waste gases to atmosphere, while the other vessel(s) continues to separate air and deliver a continuous supply of nitrogen.

This process is called pressure swing adsorption because the operating pressure “swings” from atmospheric pressure to line pressure to adsorb oxygen and from line pressure to atmospheric pressure to desorb and release the waste gases.

PSA nitrogen gas generators can take a supply of compressed air and deliver nitrogen with purities up to 99.999% (10 ppm remaining oxygen content).



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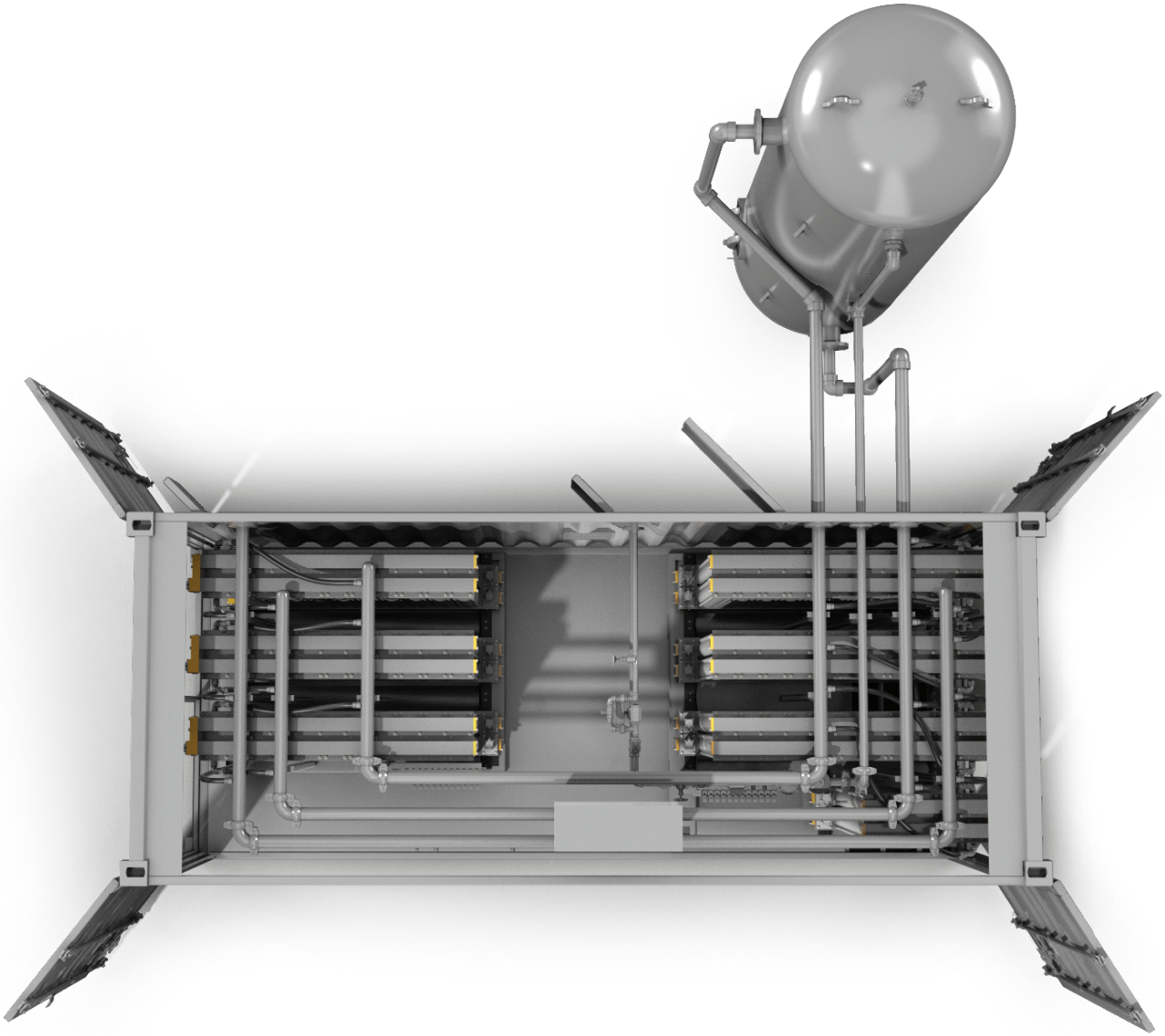
CNS Series Containerized Nitrogen Gas Generation Systems

Parker's CNS Series Containerized Nitrogen Gas Generation Systems were developed through extensive research and design to deliver the highest efficiency nitrogen generation system for high flow applications. Using less compressed air than conventional twin tower PSA systems, CNS Series generators match compressed air flow with nitrogen gas outlet flow and purity to produce nitrogen at the lowest unit cost.

Together with substantially lower servicing costs, reduced downtime and a longer working life, it adds up to the most cost-efficient nitrogen supply available. Users can expect payback within 12 to 24 months, depending on agreed gas delivery terms and consumption. So after the initial investment, CNS generator costs reduce dramatically, while the costs of traditional methods of gas supply continue to grow year after year.

With over 20 years experience in the market, and over 50,000 nitrogen generators installed globally, Parker is first choice for innovative and reliable gas generation technology. And with the most dependable, lowest cost nitrogen generation safely in place, you're free to concentrate on what matters to you: creating value for your customers and building profit for your business.



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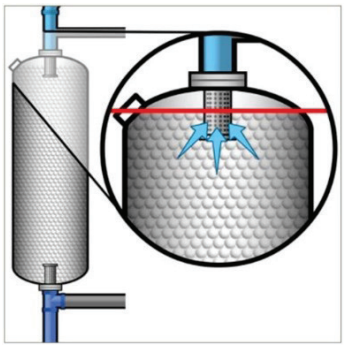
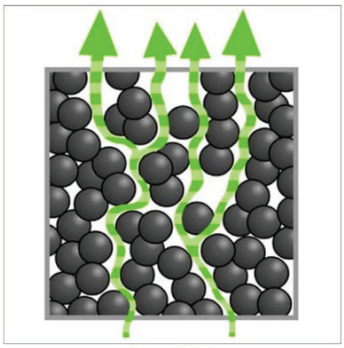
Twin Tower Nitrogen Generators



Due to the welded construction and their large size, tanks on most twin tower nitrogen generators do not allow access to the full cross sectional area of the vessel, preventing the vessels from being snowstorm filled. CMS material is therefore poured in through a small fill port, located on the size of the tank head, until it reaches the height of the port. As the CMS cannot be filled to the top of the vessel, a void will exist.

When compressed air is applied, the void allows the CMS to move about inside the vessel. Compressed air will take the path of least resistance through the CMS material and this results in air channelling through the adsorbent bed.



Loose Filled

Channeling in the CMS columns result in:

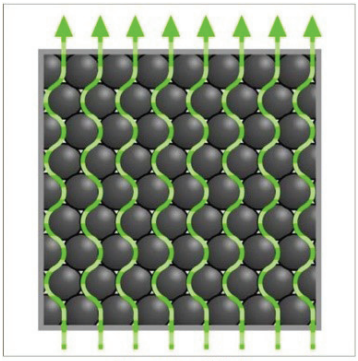
- Bypass of the CMS material
- Oversized CMS beds to provide the required contact time between air and adsorbent
- Oversized vessels to hold the extra CMS material
- CMS attrition (dusting) which leads to premature blockage of downstream filtration & pnuematics and loss of performance
- Inconsistent outlet purity due to inconsistent oxygen adsorption

Snowstorm Filling Method

Advantages of this unique filling method:

All of Parker's modular nitrogen gas generation systems use the 'snowstorm filling' method to fill the adsorption columns with carbon molecular sieve material. This special filling method achieves maximum packing density for the CMS, utilizes all space available in each column and allows more CMS to be filled versus loose filling. The media is held in the column between two mesh gasket plates so that no void exists, and the CMS is fully retained and unable to move.

- Delivers a low, equal resistance to air flow allowing multiple CMS chambers and multiple generator banks to be used.
- Prevents channeling of air through the CMS as seen on loose-filled twin tower designs.
- Utilizes 100% of the available CMS material providing consistent purity and flow.
- Reduces the amount of CMS required to achieve purity.
- Significantly reduces CMS attrition, which leads to dusting, blocked filters, and loss of purity.
- Provides consistent regeneration of the CMS material as the exhaust gas back-flow and purge is contact with 100% of the CMS.
- Supplies a low and equal resistance to the air flow, allowing multiple CMS chambers and multiple nitrogen generator banks to be used without preferential flow.



Snowstorm Filled

7

Bringing together advanced energy-efficient technologies, Parker engineering know-how, and in-depth understanding of customer needs, CNS Series Nitrogen Gas Generation Systems set a new level of specification for on-site nitrogen gas generation:

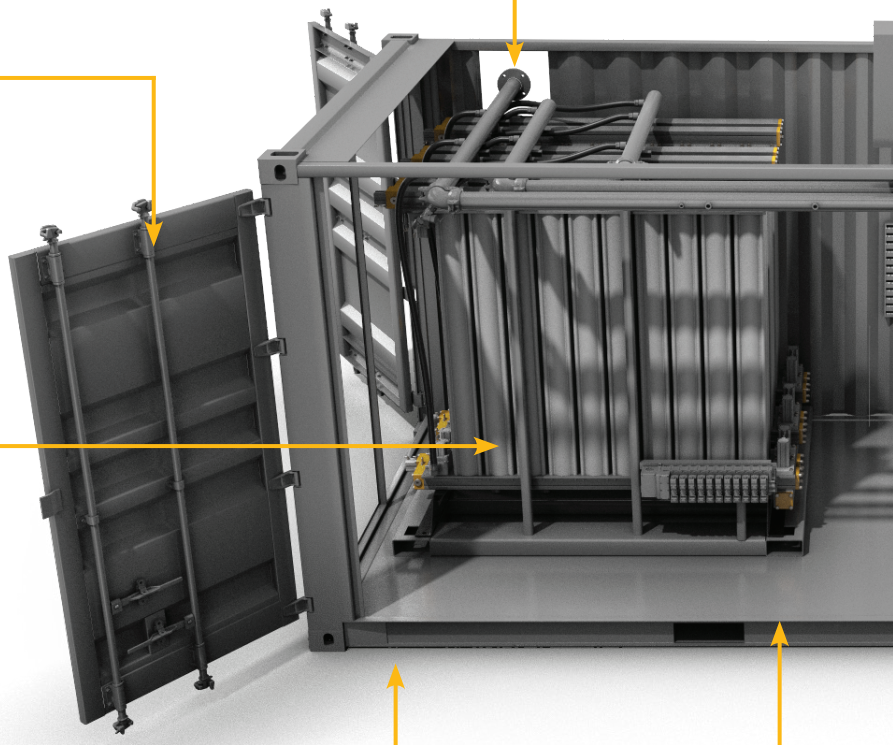
Note: Front and top panels are hidden to show system interior. CNS generators come in a completely enclosed container.

Plug & Play

CNS Series generators come completely assembled, except for the nitrogen buffer tank. Simply connect in the buffer tank to the container, pipe in air and pipe out nitrogen.

Access Doors

Double swing doors at both ends allow for easy access to the nitrogen generators when it comes time for service.



Multi-Bank Modular Design

Each container consists of multiple modular nitrogen generation banks which work together to deliver peak flow and purity. During times of low demand, CNS Series generators automatically shut down individual banks to reduce air consumption and deliver consistent, low air to nitrogen ratios.

Containerized Package

Nitrogen generators are installed inside of an industrial shipping container and manifolded together, which allows for installation outdoors, saving valuable floor space, and significantly simplified installation.

Service-Friendly Walkway

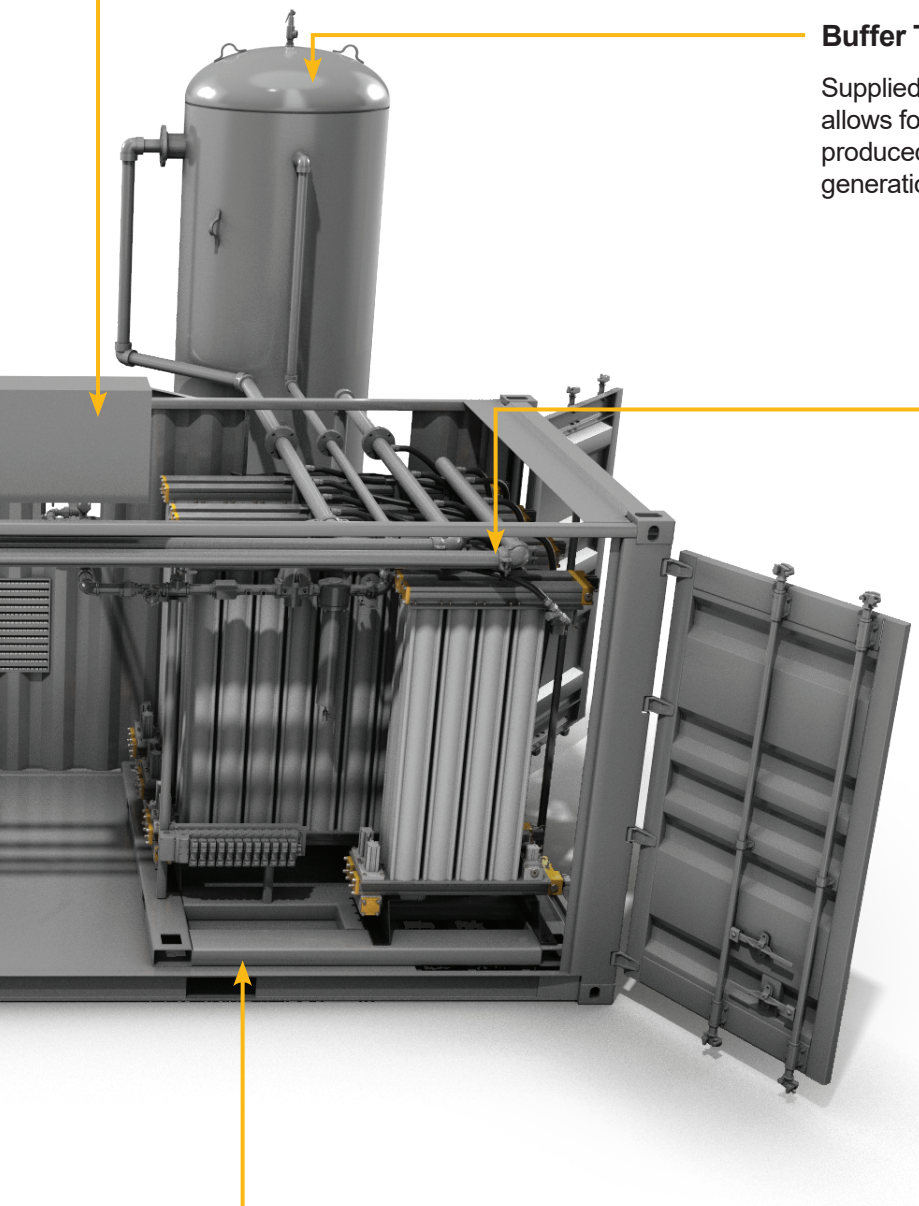
Every CNS generator is designed with ease of service in mind. Adequate space is left available for a technician to easily perform service on nearly any system component.

Climate Control System

CNS Series generators can be fitted with a climate control system that maintains ideal ambient temperatures within the container to optimize performance of the nitrogen generation systems.

Buffer Tank Included

Supplied as standard, a nitrogen buffer tank allows for a continuous supply of nitrogen to be produced at all times throughout the nitrogen generation cycle.



Partial Capacity

Each modular nitrogen generator bank is fitted with isolation valves. In the event that a single generator bank requires servicing, that bank can be isolated while the system continues to run at partial capacity.

Skid Mounted Generators

Modular nitrogen generation systems are installed on a common skid, which can be easily disconnected and removed from the container through the access doors if required.

High Flow and Purity Ranges

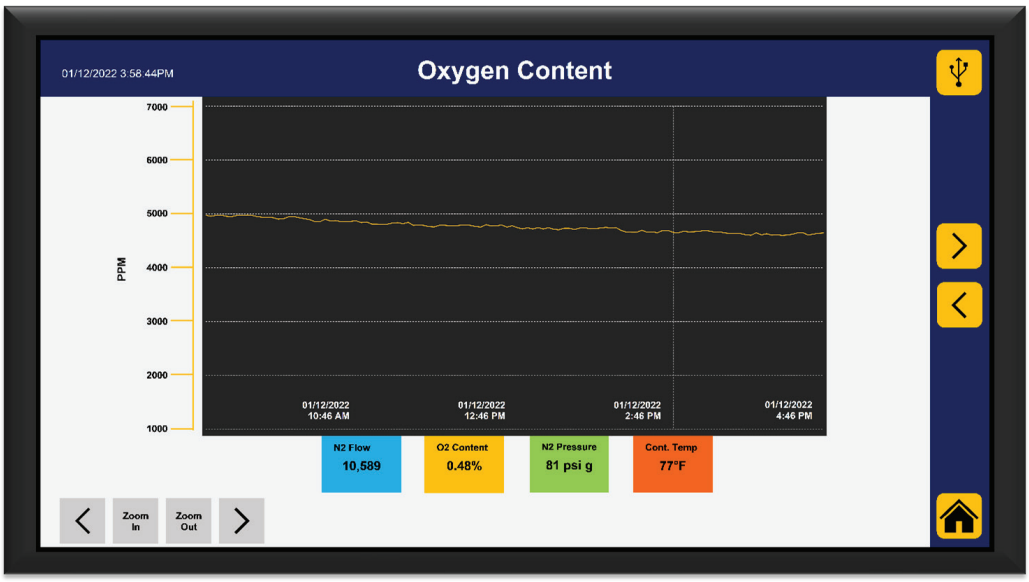
Generate high nitrogen flow rates with purities of 95 to 99.999% (5% to 10 ppm remaining oxygen).

A single CNS Series container can provide up to 19,000 scfh @ 99.5% purity. Higher flows can be achieved at lower purities, higher inlet air pressures and/or a dual container system. Consult Parker for details.

Advanced User Controls

CNS Series generators utilize an Allen Bradley™ programmable logics controller (PLC) paired with a full-color touchscreen for operator input. This advanced control system has been tailored to enhance user friendliness while offering a wide range of control and monitoring features that aid in hassle-free maintenance, improve performance, and increase reliability of your nitrogen generation system.

State-of-the-art data trending screens deliver graphical representation of sensor values which are continuously logged during system runtime. Together with 24/7 data logging capability, the operator can view both real-time and historical data points that provide important insight system efficiency, changes in operations, cause of alarm states and much more.



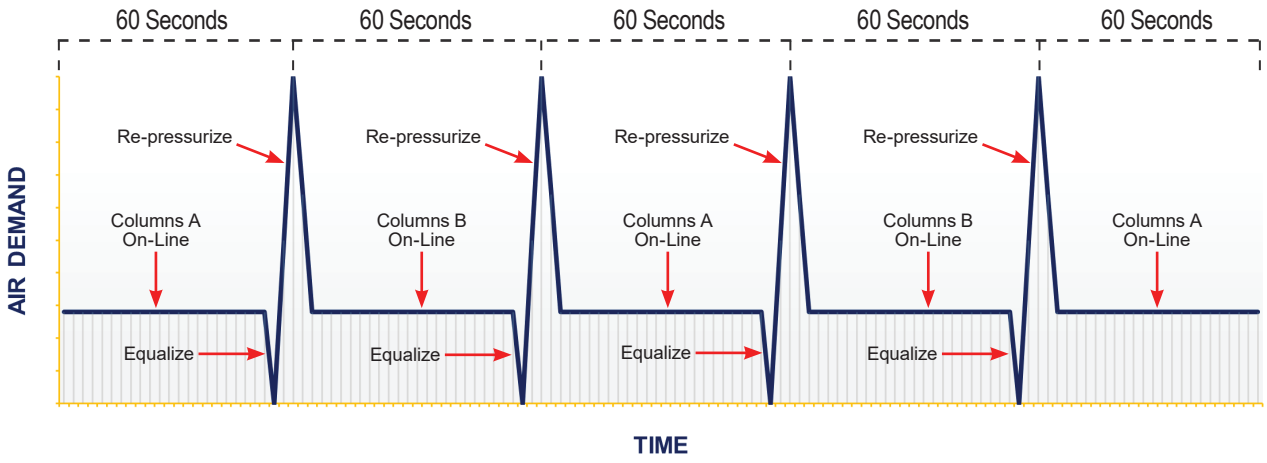
Comprehensive Instrumentation

- **Integral Oxygen Analyzer** – constantly measures the oxygen content in the output gas stream
- **Zirconia Oxygen Sensor** – provides 5 years of life and requires no calibration
- **Auto Block and Vent** – eliminates off-spec nitrogen gas from being sent downstream
- **Mass Flow Meter** – provides real-time measurement of nitrogen flow rate
- **Outlet Pressure Regulator** – allows users to control the pressure of nitrogen sent downstream
- **Remote Monitoring** – equipped with MODBUS as standard, CNS Series generators can be connected to proprietary remote management systems
- **Key system parameter sensors, including:**
  - ✓ Nitrogen outlet pressure sensor
  - ✓ Container ambient temperature
  - ✓ Inlet air dewpoint sensor

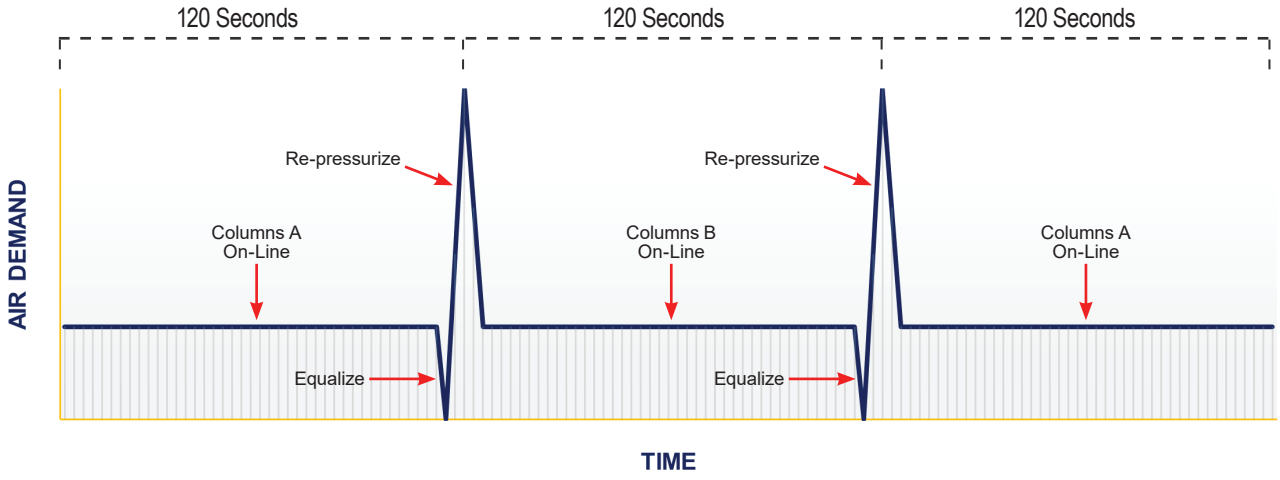
Energy Saving Technology

Peak air consumption for a PSA nitrogen generator comes at the point of changeover and re-pressurization phase. Therefore, by reducing the number of changeovers over a period of time we can reduce the average compressed air requirement for producing nitrogen.

Traditional PSA nitrogen generators typically operate on a fixed time cycle. This means that the generator will endlessly cycle, based on time, regardless of nitrogen demand downstream. If the generator is not operating at full capacity, it is unlikely that the CMS in the on-line (generating) chamber will be fully saturated at the point of changeover.



CNS Series generators come equipped with Parker's Advanced Energy Efficiency Control System (AEECS) which monitors key operating parameters of the system and will extend the time cycle to delay changeover and/or shutdown individual modular nitrogen generator banks within the container during times of low demand, while ensuring oxygen content within the generated nitrogen gas remains to specification. Reducing the air consumption peak flows (changeovers) per hour will reduce the overall average air consumption and hence energy.



By reducing the number of changeovers with AEECS, users will:

- ✓ Minimize energy consumption
- ✓ Reduce compressed air costs
- ✓ Elongate valve life
- ✓ Maximize CMS life

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