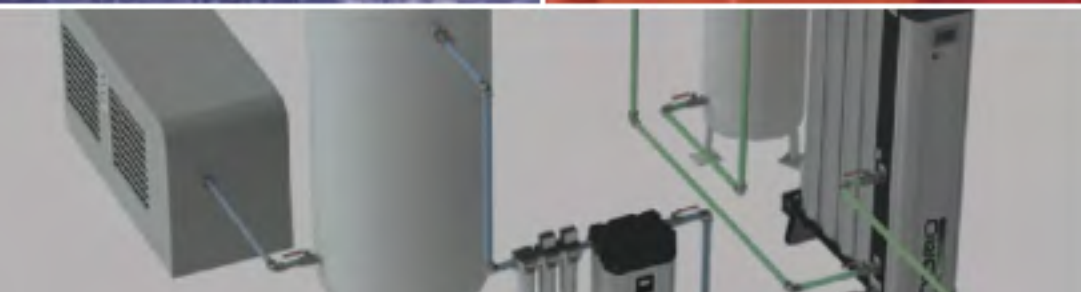
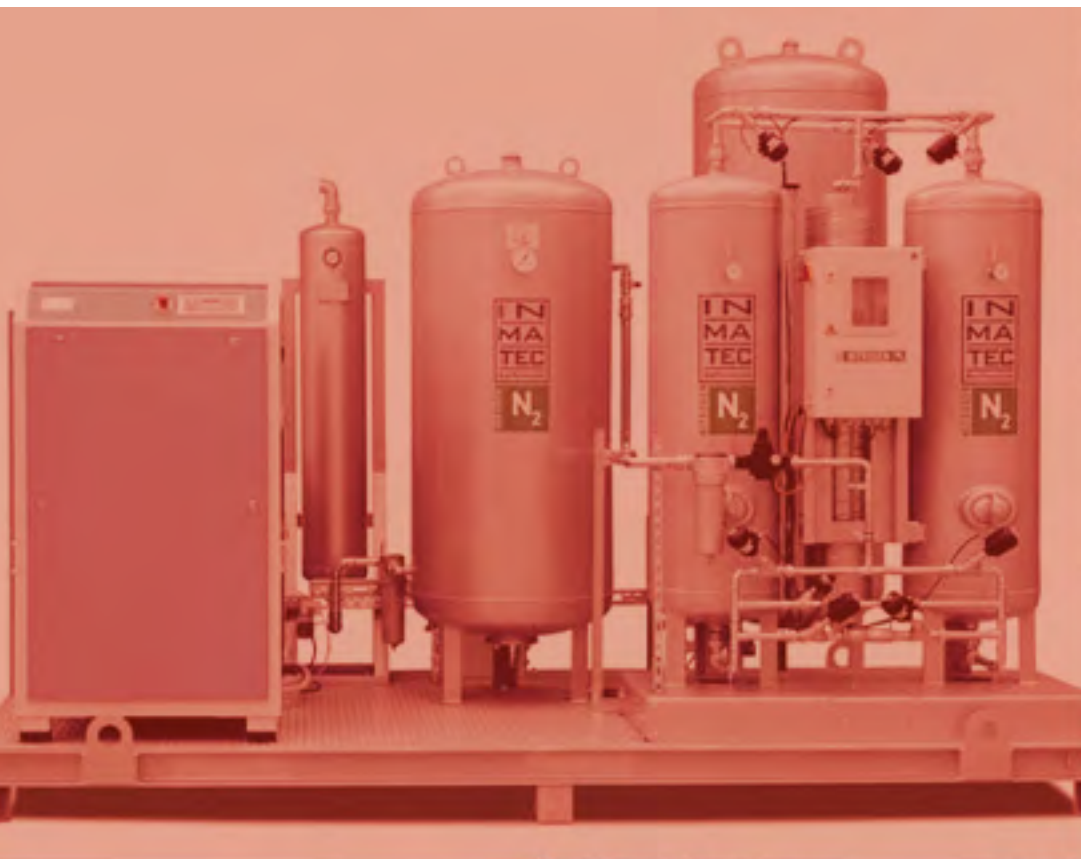


YOUR GUIDE TO NITROGEN GENERATION



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A dry and chemically inert gas, nitrogen plays a critical role in maintaining a stable environment for products and processes in a range of industrial applications. Though it occurs naturally in relative abundance — 78% of the earth's atmosphere is composed of nitrogen, compared to only 21% oxygen — the industrial applications that use it require it in high-purity form.



As industries evolve and technologies advance, several different methods have been developed for creating and refining high-purity nitrogen at a lower overall cost. Prefilled cylinders of high-purity nitrogen, either in liquid or gaseous form, are typically what the industry has been using but costs and safety has always been a concern. Getting it delivered means having someone to inspect and sign off on the delivery and a missed or delayed delivery could mean lost production. Leasing, rental, and delivery fees can be expected to increase costs, and the price of N₂ can often fluctuate. Additionally liability insurance is usually needed as the continued handling and rotating of the cylinders is considered dangerous and potentially hazardous.



For large-scale industrial applications, nitrogen generators are ideal. Taking in ambient air and separating the oxygen and other gases from the nitrogen, these generators then compress the nitrogen, allowing for a steady, consistent supply.

Nitrogen generator systems are capable of creating nitrogen with purity levels as high as 99.999%, and levels can be adjusted according to specific application requirements. N₂ generators use regular compressed air to deliver continuous supply of high purity nitrogen. These sophisticated systems are safer and more cost-effective than cylinders or bulk liquid delivery to a rented large storage system. These systems typically pay back in less than 24 months.



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Types of Nitrogen Generators

There are two primary processes — and, therefore, two primary types of generators — for generating high-purity nitrogen for industrial use: pressure swing adsorption (PSA) nitrogen generation and membrane nitrogen generation.

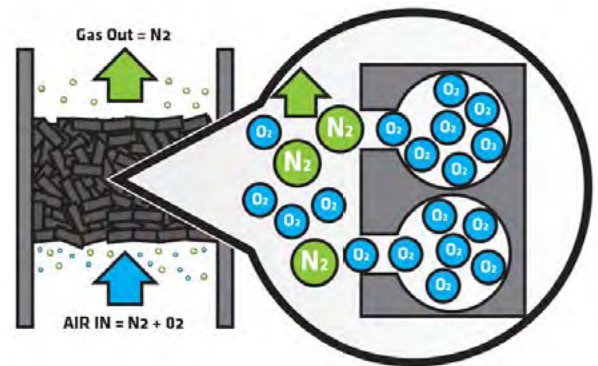


Pressure Swing Adsorption Generators

Comprised of two individual towers, pressure swing adsorption nitrogen generators use what's known as a carbon molecular sieve — a material whose molecules attract the molecules of a particular gas. (A 3A zeolite, for instance, typically an aluminosilicate mineral, is a common type of molecular sieve used in ethanol distillation.)

For nitrogen generation, carbon molecular sieves are used. Carbon molecular sieves are created when polymeric precursors are pyrolyzed, leaving behind a skeletal framework of porous carbon. This porous carbon absorbs oxygen, carbon dioxide, water, and other molecules, but does not adsorb nitrogen.

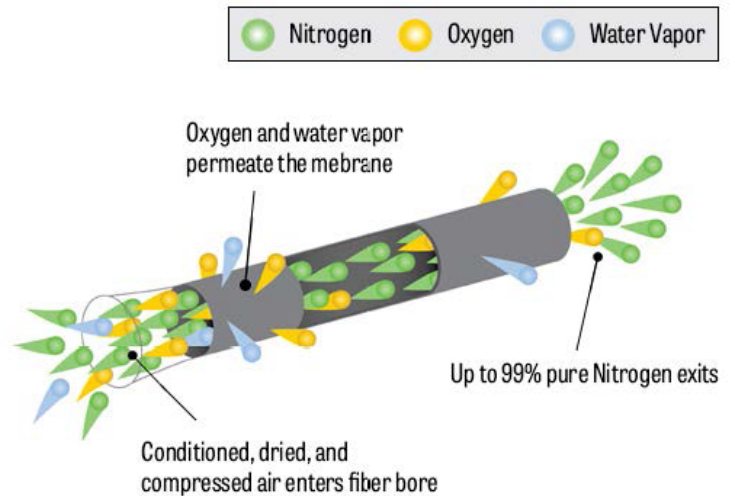
In PSA systems, two carbon molecular sieves, one in each tower, are used to filter all non-nitrogen molecules, resulting in clean, dry, and high-purity nitrogen. With proper pretreatment filtration, thorough drying, and standard maintenance, PSA nitrogen generators can have up to a decade in life span.



Membrane Nitrogen Generators

Membrane nitrogen generators use a more physical, rather than chemical, reaction to generate nitrogen — they rely on hollow membrane fibers bundled together to physically separate molecules. As separation occurs, oxygen is allowed to vent into the atmosphere, while nitrogen is directed to a separate distribution system.

Membrane bundles can be sensitive to contaminants and oil carryover, and these systems typically show wear over time, degrading the nitrogen output. Membrane generators are more effective than PSA generators for smaller applications.



Selecting a Nitrogen Generator

Required purity level is the most important factor to keep in mind when selecting a nitrogen generator for your specific application; higher purity levels require more compressed air at the inlet, meaning a larger generator system will be needed. This is why selecting the correct purity level is important for the application to achieve an acceptable return on investment (ROI).

Membrane nitrogen generators can achieve nitrogen purity levels within a small range, around 90-95%. Pressure swing adsorption nitrogen generators, on the other hand, can generate nitrogen with purity levels between 95% and a nearly perfect 99.999%.

It's also important to consider how often the system will be used: Pressure swing adsorption systems are ideal for applications that require consistent levels of nitrogen on a regular basis, whereas membrane systems are more suitable for small, point-of-use applications.

Caring For Your Nitrogen Generator

In order to make sure that your nitrogen generator is working as effectively as possible, it is important to properly care for and maintain your unit. Some of the best maintenance practices are as follows:

- Consistently review & replace pre-filters
- Purge exhaust mufflers & calibrate O2 sensors annually
- Replace valves for pre-treatment dryer and N2 generators every 2-3 years
- Create a written plan for your floor managers to maintain this process

The Nitrogen Generation Process

Nitrogen generation — pressure swing adsorption nitrogen generation, in particular — is a complex, dynamic process, so it's important to have a solid understanding of each step to ensure optimal performance and value.

PSA nitrogen generation involves two major stages, a purification process and a regeneration process, each of which contains multiple steps. Nitrogen generators are typically programmed to alternate between these two processes at predetermined intervals, helping to maximize nitrogen production during the purification stage and maximize contaminant removal during the regeneration stage.



Step 1: Purification

Air is drawn into the generation system and immediately filtered of oils, solid particulates, and any other impurities. Next, air dryers are used to remove water vapor from the airstream.

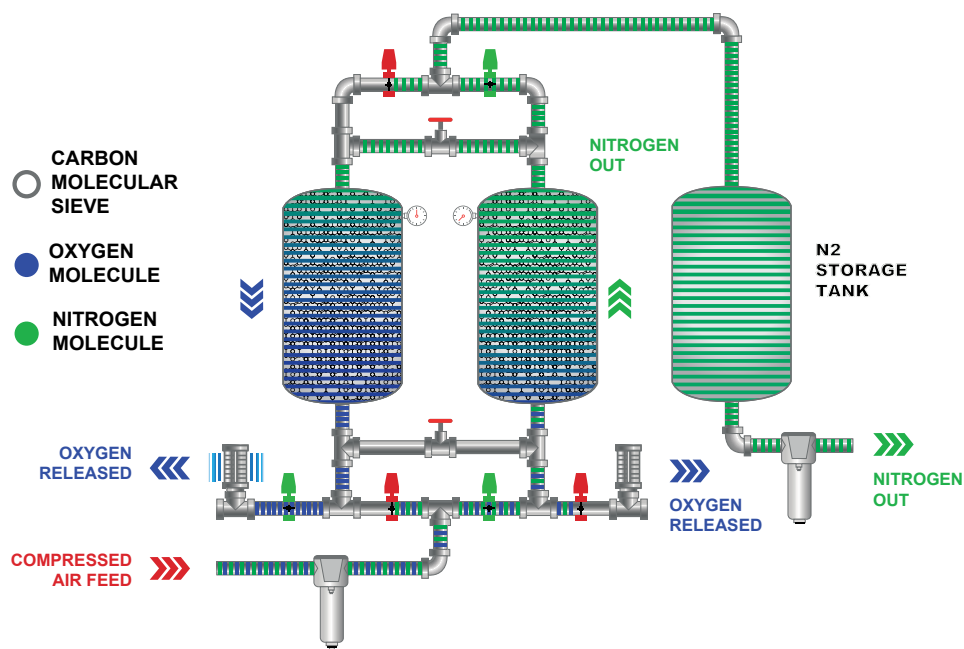
Next is the particulate filtering process, in which any remaining water molecules and oxygen molecules are adsorbed by the carbon molecular sieve media, leaving behind clean, dry nitrogen. This nitrogen is delivered to a buffer vessel, where nitrogen purity-level adjustments are made as dictated by the application for which it will be used.

The nitrogen is then filtered and returned to the instrumentation compartment of the nitrogen generation system: Here, the nitrogen is regulated for pressure and flow, and an oxygen analyzer checks the purity level. The nitrogen is routed to a storage tank, where pressure is allowed to build to usable levels, thus creating a steady nitrogen supply for the end application. The nitrogen is then passed through a final particulate filter.

Step 2: Regeneration

For the pressure swing adsorption process to continue smoothly, adsorbed oxygen must be off-gassed into the atmosphere – this helps increase the efficacy and life span of the carbon molecular sieve.

In order to properly off-gas the oxygen, a small amount of high-purity nitrogen must be diverted from the buffer vessel and expanded back to near-regular atmospheric pressure levels. Removed oxygen is then added to the nitrogen, forcing the oxygen molecules to desorb into the nitrogen. This mix is then expelled from the system via an exhaust valve.



Common Nitrogen Generation Applications

Extremely versatile, nitrogen is used in many different applications and industries, including:

- Beer and wine manufacturing and storage
- Chemical processing
- Electronics
- Food processing and packaging
- Injection molding
- Metal production
- Metal fabrication
- Petroleum refining
- Pharmaceuticals
- Rubber manufacturing



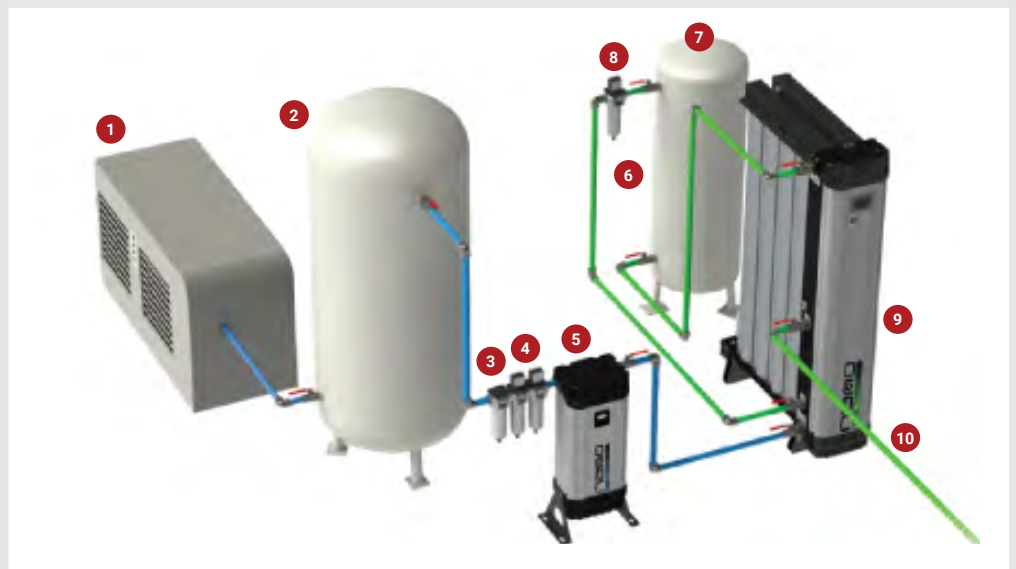
The food processing and packaging industry, in particular, makes extensive use of nitrogen for modified atmosphere packaging (MAP) processes.

When free oxygen in the atmosphere is captured inside of a food package containing minimally processed foods such as fish, fruits, meat, or vegetables, it hastens spoilage, promotes microbial growth, oxidizes foods, and so on. With MAP, nitrogen is injected into the packaging, helping to keep the food fresher longer. MAP nitrogen purity requirements, and those for many other food applications, fall around 99.5% – a high-performance sweet spot for PSA nitrogen generators.

As a result of the rising popularity of laser cutting, nitrogen is also increasingly important in the metal fabrication industry. In laser cutting applications, nitrogen is used as a gain medium and as a shielding gas when cutting stainless steel and aluminum to achieve an excellent quality cut. With no oxygen present, it stops the burning process and allows the laser to vaporize the material. Also, high pressure is needed usually 300-400psi, so the supply of compressed air will need to be in this range and generally a high pressure booster compressor will need to be added to the compressor system.

Nano GEN2 Installation

1. Compressor
2. Wet Air Receiver
3. Water Separator
4. Pre Filters
5. Dryer with Integrated Dust Filter
6. Buffer Vessel
7. Pressure Relief Valves
8. Buffer Vessel Filter
9. Nitrogen Generator
10. Nitrogen Outlet



Nitrogen Generator Maintenance

Many companies considering investing in a nitrogen generator are primarily concerned with maintenance requirements, and assume that costs will be much higher than those required by canistered nitrogen. But, in reality, nitrogen generators require only minimal, easy-to-perform preventative maintenance measures to ensure optimal performance. The following maintenance procedures should be conducted:

- Regular pre-filter replacement
- Regular exhaust muffler purging
- Annual O2 sensor calibration
- Pretreatment dryer and nitrogen generator valve replacement (every two to three years)
- Carbon molecular sieve replacement (every seven to 10 years, on average)

With over 55 years of experience working with all manner of air systems, the Compressed Air Systems team is proud to supply high-quality, reliable nitrogen generators from leading manufacturers.

Our skilled compressed air technicians are available to help you throughout every step of the process, from nitrogen generator selection to installation and maintenance. For help in selecting a nitrogen generator that's ideal for your needs, or for assistance with a current installation, **contact the team today.**



OVER 55 YEARS OF OUTSTANDING SERVICE

Compressed Air Systems, Inc. began doing business in 1963 with only five employees. Over the years, we have steadily grown and now employ over 50 people. Our thriving business operates out of our 30,000 square foot facility in Tampa, FL, with a 4,000 square foot facility in Orlando, FL.

We carry a wide range of products and specialize in air compressors, blower, and vacuum systems. Our sales department is backed by our own in-house service, installation, and rental departments to make an unbeatable team. We sell, service, and rent all types of pneumatic tools and equipment. Whether working with pumps or tools, our complete repair facility ensures quick turnaround for your convenience.

If you're considering the purchase of a complete air system or need diagnosis and repair of an old system, we're ready to put over 55 years of experience to work for you.

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