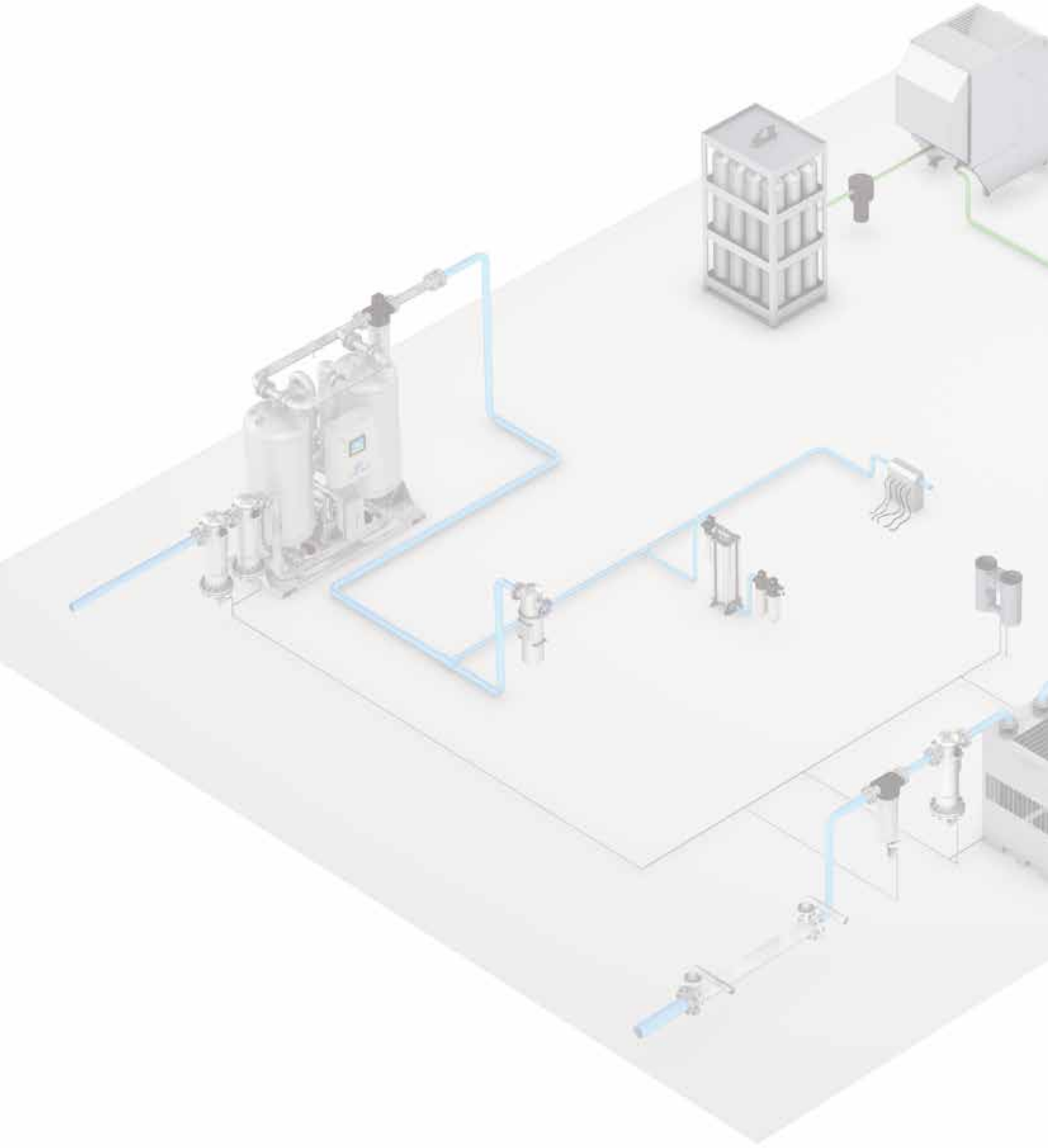
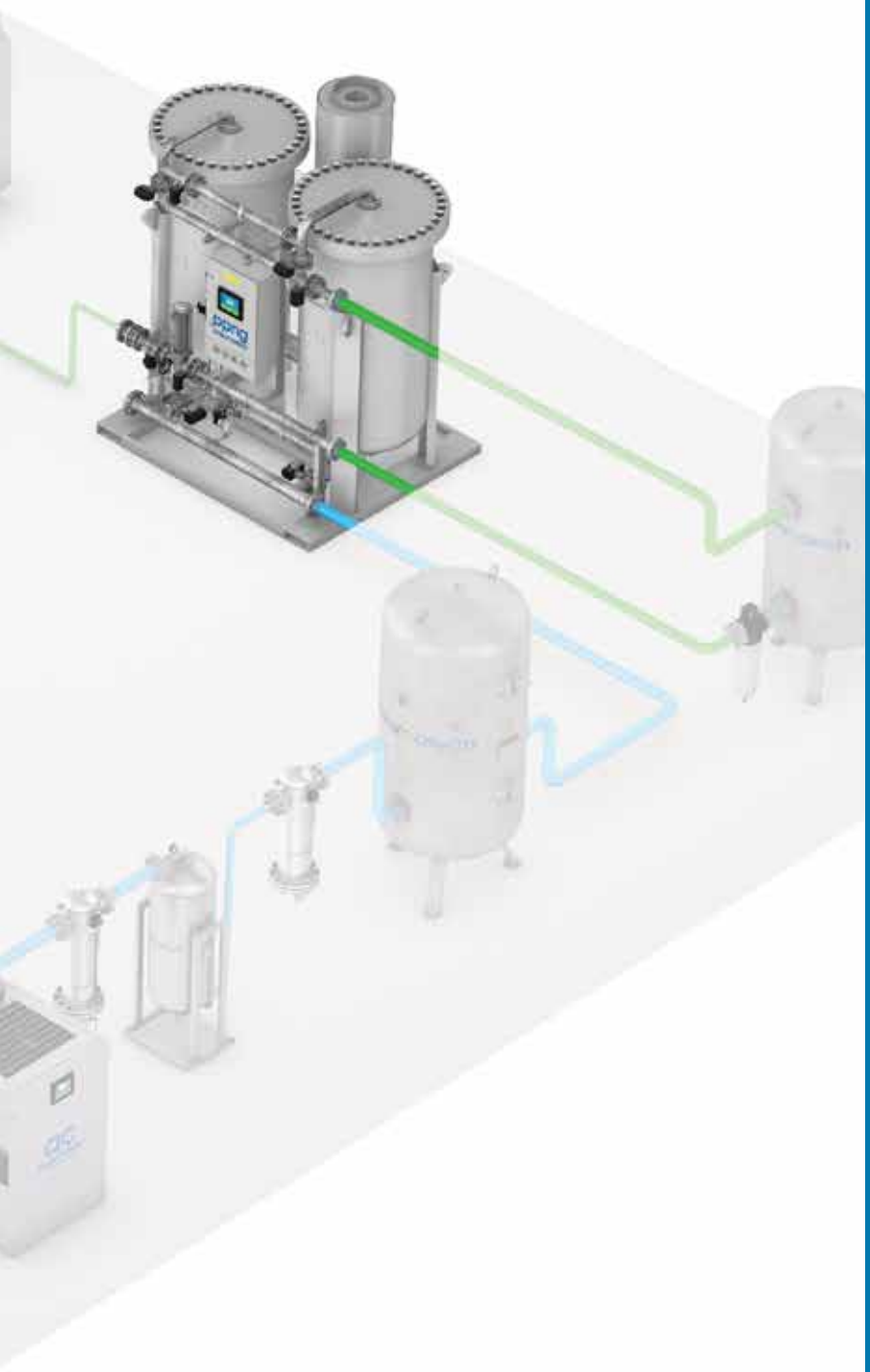

# On-site Gas Generators

pneumatech
Pure air . Pure gas

# Pneumatech Air Treatment





# Contents

# Compressed Air Treatment

Untreated compressed air always contains contaminants because of the nature of the gas and how it is produced. The need for air treatment basically results from 3 characteristics of compressed air.

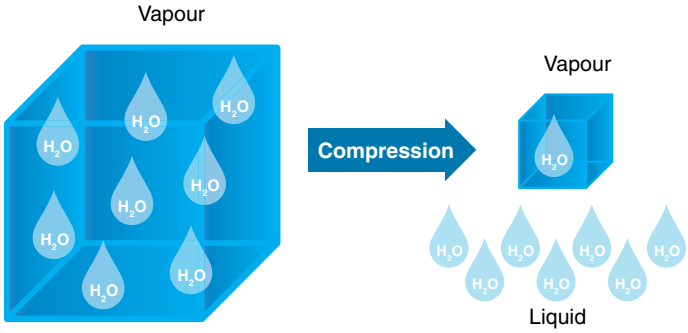
## Compressed air is always wet

### Contaminants

- Liquid water - water aerosols - water vapor

### How are the contaminants formed?

As water is incompressible, the amount of moisture per $m^3$ increases when air is compressed. The maximum amount of moisture per $m^3$ air[1] is however limited for a certain temperature. Condensation will thus be formed when air is compressed.




8 $m^3$ ambient air

1 $m^3$ compressed air at 7 bar(e)

### What problems can the contaminants cause?

- Corrosion of pipe lines
- Bad quality of the end product
- Malfunctioning of controls
- Build-up of ice
- Cultivation of micro-organisms

## The Pneumatech solution

- Water separators
- Drains
- Refrigeration dryers
- Adsorption dryers

[1] *The so-called holding capacity of moisture in air.*

## Compressed air is always contaminated

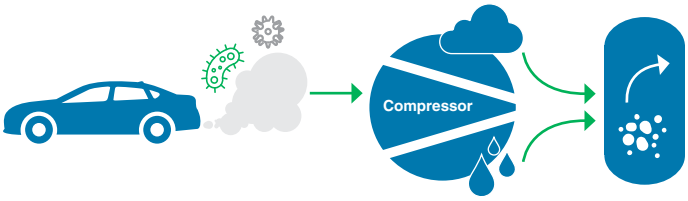
### Contaminants

- Liquid oil - oil aerosols - oil vapor
- Dirt - microorganisms - pipescale
- Trace gases: carbon monoxide, sulfur dioxide, nitrous oxide

### How are the contaminants formed?

Added by the compressor installation through oil lubricated compressors (oil), adsorption dryers and activated carbon filters (dirt), piping network and vessels (pipescale).

Trash in, trash out: oil vapors from car exhausts and industrial processes, atmospheric dirt and micro-organisms get sucked in by the compressor. As with water, their concentration – and thus importance – increases significantly after compression.




### What problems can the contaminants cause?

- Damaged production equipment, leading to inefficiencies and increased costs
- Air pollution, creating unhealthy work environments
- Pollution of the condensate

### The Pneumatech solution

- Oil coalescing filters
- Oil vapor filters
- Particulate filters
- Oil-water separators
- Breathing air units

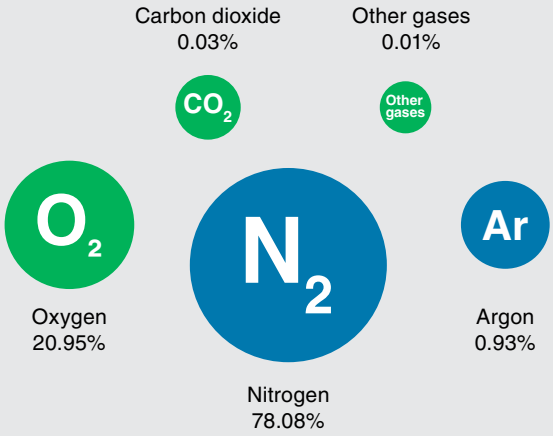
## Compressed air composes of other gases

### Contaminants

- Oxygen: contaminant if oxidation is unwanted
- Nitrogen: contaminant if oxidation is wanted

### How are the contaminants formed?

Dry air is mainly composed of nitrogen (78%) and oxygen (21%). Air will keep the same nitrogen/oxygen ratio after compression, so additional treatment is needed to change this gas mix.




### What problems can the contaminants cause?

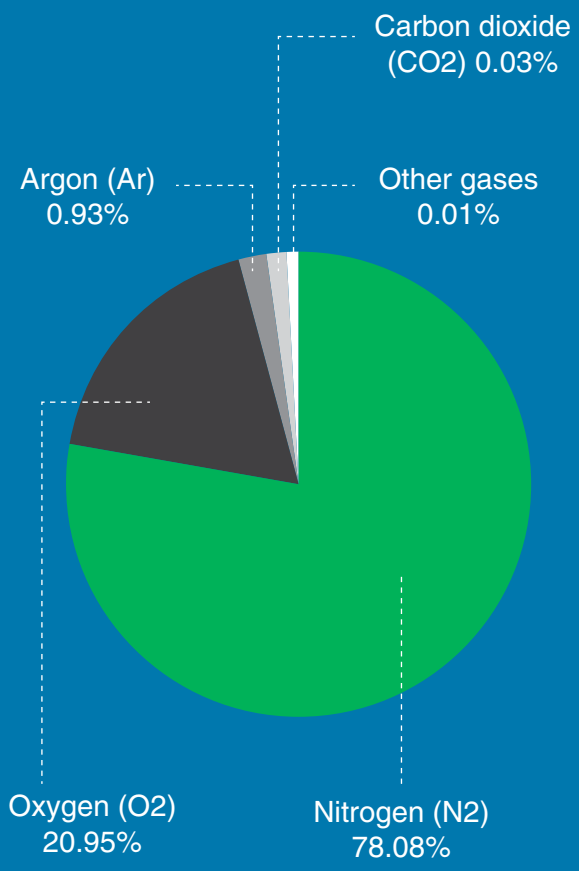
- Oxygen causes oxidation, leading to explosions or fire of flammables (fast oxidation) or to rotting processes and corrosion of metals (slow oxidation).
- Nitrogen is an inert gas that can prevent oxidation to happen.

### The Pneumatech solution

- PSA nitrogen generators
- Membrane nitrogen generators
- PSA oxygen generators

# On-site gas generation

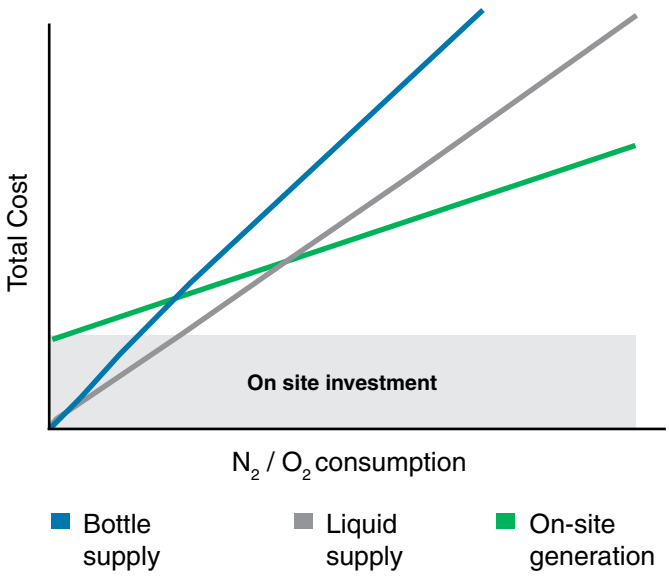
Air is a mixture of gases: 21% oxygen and 78% nitrogen - with traces of water vapor[2], carbon dioxide, argon, and various other components. Both oxygen and nitrogen are colorless, odorless and tasteless at standard conditions. Oxygen is highly reactive and supports life of any form; while nitrogen is an inert gas in which life cannot persist.These interesting characteristics and the fact that air is freely available in the atmosphere, make both oxygen and nitrogen widely used gases in various applications.




Originally, cryogenic air separation was the only way of extracting nitrogen and oxygen gases from air. This technology relies on the differences in boiling points of the air constituents and needs temperatures down to -185°C/-300°F to get these constituents separated. The separation process takes place in big air separation plants. Pipelines, bulk containers or cylinders are needed to get the gases to the customer.

Since the 1970s gas generators are installed on-site giving customers the freedom and flexibility to provide for their own supply of industrial gases. This results in numerous advantages:

- Gases are non-stop available.
- Lower operational costs: no rental charges, transport expenses and evaporation losses.
- No safety hazards when handling high-pressure cylinders.
- Easy integration within existing compressed air installations.
- The right purity for the right application.
- This makes on-site gas generation a very attractive investment with a typical Return On Investment (ROI) often less than two years.



| Liquid/bottled gas | On-site generation |
|---|---|
| Lease tank | Capital Investment |
| Gas Consumption | Energy |
| Transport | Maintenance |
| **0.1-0.8 EUR/m³(*)** | **0.02-0.15 EUR/m³(**)** |
| ***(*) Industry average, other price settings might apply. (**) Depending on purity and electricity cost.*** | |

## DO YOU KNOW THAT?

The industrial gas market is not the first industry to go 'on-site'. More than a century ago, the refrigeration industry was in the hands of ice companies, who were cutting natural ice in the north and were transporting it around. The advent of the mechanical refrigerator in 1873 meant a disruptive innovation for this market, since ice could suddenly be produced locally. This made "cold consumers" completely independent of the sometimes unreliable and expensive ice deliveries. Despite these obvious advantages, it took several decades before mechanical refrigerators were widely adopted. One of the reasons was that many icemen spread the rumors that natural ice was better and healthier, despite the fact that their ice was often harvested in contaminated waters. They also cut their prices drastically by making the supply chain of natural ice more efficient.

*[2]Concentrations of air gases are typically provided for dry air without any water vapor. The concentration of water vapor varies significantly from around 10 ppm in the coldest portions of the atmosphere to as much as 5% by volume in hot, humid air masses.*

# Types of on-site gas generators

## Nitrogen generators

The main purpose of nitrogen is to prevent oxidation. Oxidation occurs fast in explosions or fire; or slow in a rotting process or the corrosion of metals.

On-site nitrogen can be generated by Pressure Swing Adsorption (PSA) and by membrane technology.

**Fast oxidation:** In order to start a fire you need 'the fire triangle': heat, fuel and oxygen. Below a certain oxygen concentration, the so-called Minimum Oxygen Concentration (MOC), a fire or explosion will no longer propagate.

Fire prevention

Blanketing

**DO YOU KNOW THAT?**

The concentration of nitrogen in the air is expressed as percentage of nitrogen or as residual oxygen concentration, expressed as ppm – which stands for parts per million.

## Oxygen generators

The on-site oxygen applications can also be split in two groups: at one hand there are the applications to supply oxygen enriched atmospheres to creatures, at the other hand there are the applications in which an oxidative process is fortified and accelerated.

Oxygen is produced on-site by our range of PPOG (Pneumatech PSA oxygen generators).

Medical environments are the most obvious examples of the first group: hospital supply systems, ambulant and military services and veterinary clinics might all benefit from an on-site availability of oxygen. On-site generators are also popular among fish farms where population densities increase at elevated levels of dissolved oxygen. Likewise biological processes are fortified when oxygen levels increase, which favor e.g. wastewater treatment plants, certainly in hot periods when oxygen levels in the water are low and water consumption is high.

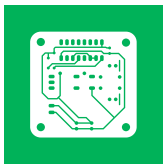
Medical

Fishing

**Slow oxidation:** Occurs for both non-organic products – like metals, polymers and chemicals – and for food. Typical non-organic applications are the use of nitrogen during metal cutting, gas-assisted injection molding and reflow soldering of electronics. Food deterioration is retarded through a reduction of the atmospheric level[3] without the need to use additives.

Food & Beverage Packaging

Plastic Molding



Electronics

| % $N_2$ | ppm $O_2$ |
|---|---|
| 90 | 100000 |
| 95 | 50000 |
| 99 | 10000 |
| 99.5 | 5000 |
| 99.9 | 1000 |
| 99.99 | 100 |
| 99.999 | 10 |


### PPNG – Pneumatech PSA Nitrogen Generators

**PPNG** produces nitrogen with purity ranging from 95% up to 99.999% and flows up to 2600 m³/hr.


### PMNG – Pneumatech Membrane Nitrogen Generators

**PMNG** is designed for purities between 95% and 99,5% and flows up to 220 m³/hr.

The second group consists of industries where the general output is highly determined by the rate of an oxidation process. Blowing extra oxygen during oxy-acetylene cutting, welding and brazing and in metallurgic processes leads to capacity increases, energy savings or reduced emissions of harmful by-products. In gold mining, waste treatment costs drop and capacities rise when dissolved oxygen concentrations are increased. Finally also the paper and glass industry make extensive use of oxygen.

Oxyacetylene cutting

Gold Mining


### PPOG – Pneumatech PSA Oxygen Generators

**PPOG** produces Oxygen with purity ranging from 90% up to 95% and flows up to 204 m³/hr.

*[3]This can be done by controlling the atmosphere over time, called Controlled Atmosphere Packaging (CAP) or by modifying the atmosphere e.g. through nitrogen injection, called Modified Atmosphere Packaging (MAP).*

# Operating Principle

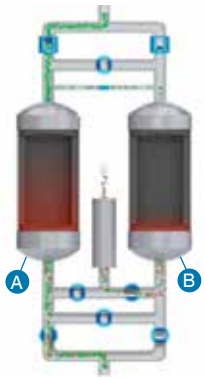
## Pressure swing adsorption technology

Just like heatless adsorption dryers, PPNG and PPOG generators are based on the Pressure Swing Adsorption (PSA) principle. The PSA process is inherently a batch process, where one of the vessels will be delivering gas by adsorbing undesired components of the air, while the other vessel is being regenerated by depressurization to atmospheric pressure. When the adsorbing vessel approaches saturation, the vessels are equalized to half the working pressure in order to save compressed air, and thus energy.

Afterwards, the adsorption and regeneration functions of the two vessels are switched. A gas receiver downstream of the generator ensures that the gas delivery is continuous.

The PSA process of a nitrogen generator is explained in 6 steps below:

**Step 1** | **A: Adsorption**
**B: Regeneration**



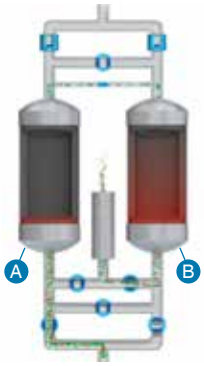

### Vessel A:

Oxygen molecules are adsorbed, while nitrogen molecules can pass. As time goes by, the adsorbent will get saturated more and more.

### Vessel B:

A fraction of the purified nitrogen will be used to purge the oxygen molecules out of vessel B to atmosphere.

**Step 6** | **A: Repressurization**
**B: Depressurization**




### Vessel A:

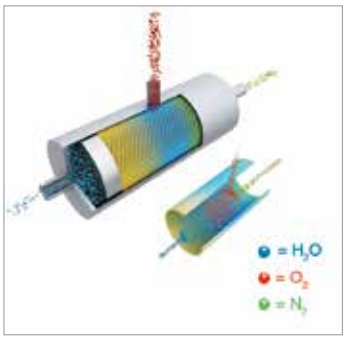
Vessel A is repressurized to full working pressure with air from the inlet (and nitrogen from the outlet in case of back-flow pressurization).

### Vessel B:

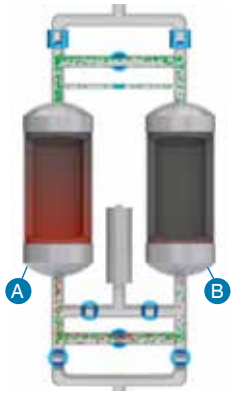
By depressurizing vessel B to atmospheric pressure, oxygen molecules are released from the adsorbent.

## Membrane technology

The PMNG membrane generator separates compressed air into component gases by passing it through semi-permeable membranes, consisting of bundles of individual hollow fibers. Each fiber has a perfectly circular cross-section and a uniform bore through its center. Because the fibers are so small, a large amount of fibers can be packed into a limited space, providing an extremely large membrane surface area that can produce a relatively high volume product stream.



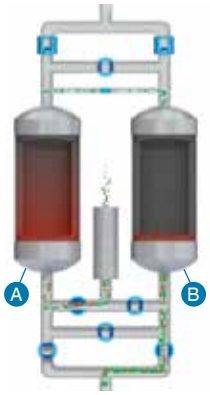
**Step 2** | **A: Equalization**
**B: Equalization**




### Vessel A & B:

During equalization, the pressure in both vessels will be equalized to the same pressure in order to save energy.

**Step 3** | **A: Depressurization**
**B: Repressurization**



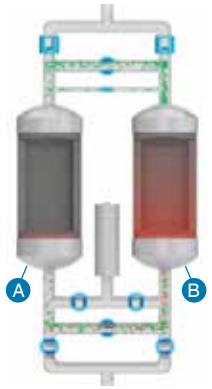

### Vessel A:

By depressurizing vessel A to atmospheric pressure, oxygen molecules are released from the adsorbent.

### Vessel B:

Vessel B is repressurized to full working pressure with air from the inlet (and nitrogen from the outlet in case of back-flow pressurization).

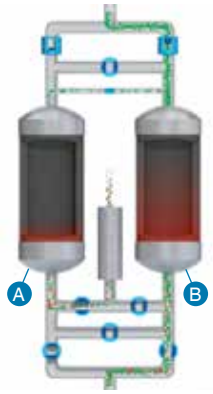
**Step 5** | **A: Equalization**
**B: Equalization**




### Vessel A & B:

During equalization, the pressure in both vessels will be equalized to the same pressure, in order to save energy.

**Step 4** | **A: Regeneration**
**B: Adsorption**



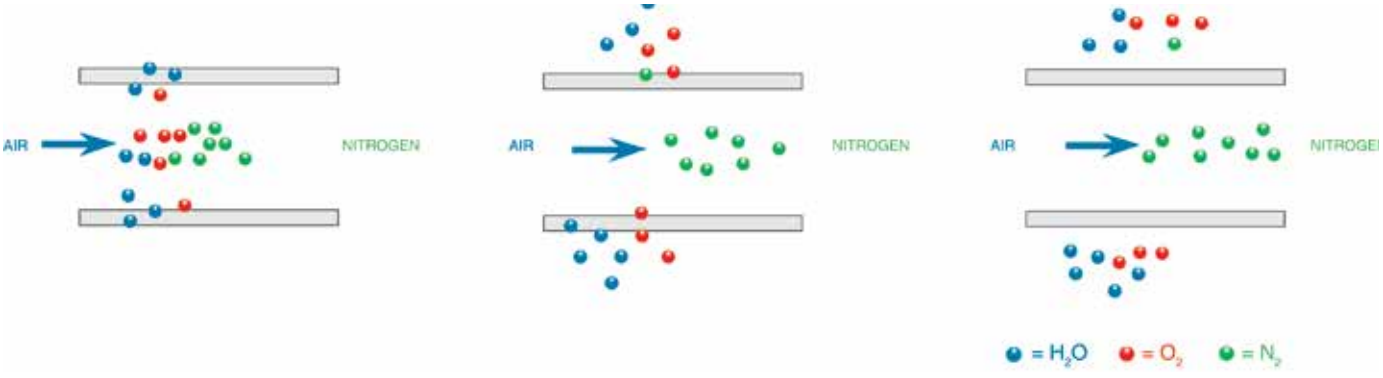

### Vessel A:

A fraction of the purified nitrogen will be used to purge the oxygen molecules out of vessel A to atmosphere.

### Vessel B:

Oxygen molecules are adsorbed, while nitrogen molecules can pass. As time goes by, the adsorbent will get saturated more and more.

Compressed air is introduced into the center of the fibers at one end of the module and contacts the membrane as it flows through the fiber bores. “Fast gases” as oxygen, carbon dioxide and water vapor[4] quickly permeate through the walls of the membrane fiber, and are discharged through a permeate port. Nitrogen, being a “slow gas” is contained within the membrane and flows through the outlet port.




[4]*Since water vapor permeates through the membrane as well, the nitrogen gas stream is very dry, with dewpoints as low as -40°C (-40°F).*

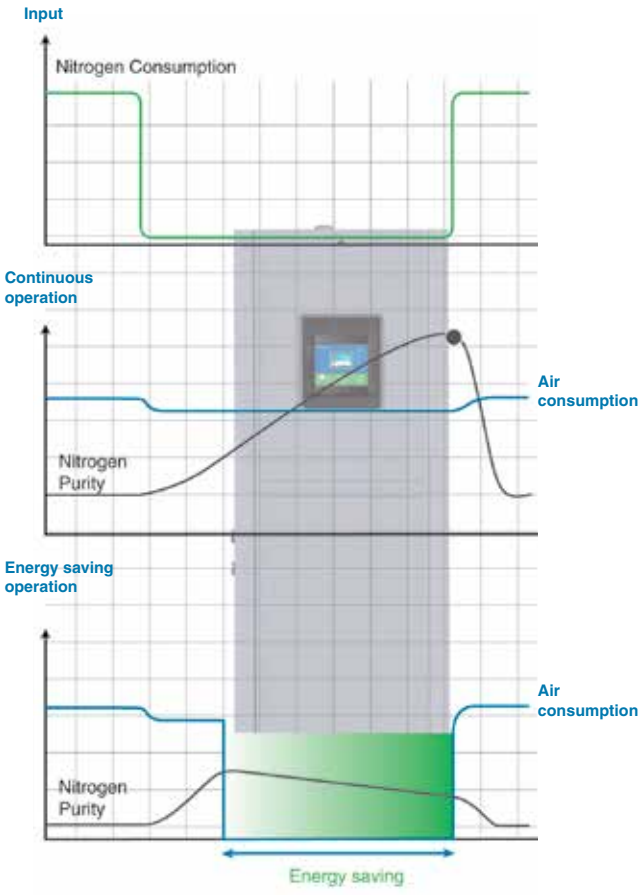
# Features and benefits explained

A. Energy saving control
- No air consumption at low gas demand

B. Back-flow pressurization
- Premium energy efficiency

## A. Energy saving control

At continuous operation the absolute air consumption of a gas generator is more or less constant[5], independent of the gas consumption. At reduced gas flow, this continuous adsorption process will lead to high gas purities, but also high air factors and thus inefficient operation.



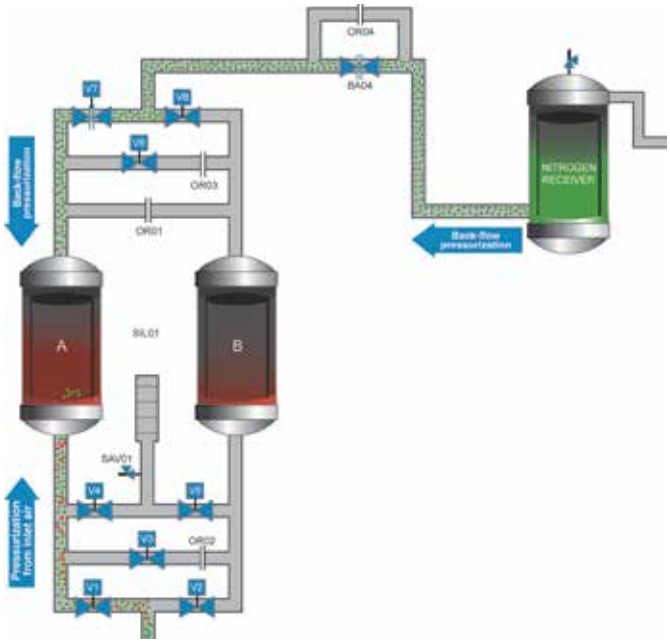

All Pneumatech gas generators are equipped with an energy saving control function, which automatically stops the gas generator – and thus the air consumption – when little or no gas is consumed. As soon as the pressure in the gas buffer tank drops below a certain level (in case of increased consumption or leaks), the generator will restart again to maintain the expected pressure.

For customers with a predictable consumption pattern, Pneumatech offers the possibility to program the generator operation in advance. The week timer menu gives the possibility to program start/stop commands and changes to the pressure settings of the energy saving control, for each moment of the week. Four difference week schemes can be programmed, and this in sequences of 10 weeks.

*[5]As the amount of air lost during purge and blow-off remains unchanged.*

## B. Outstanding air factors thanks to back-flow pressurization (for PPNG)

After the pressure equalization phase, the active vessel needs to further build up pressure before it can deliver nitrogen to the nitrogen buffer vessel. This pressurization is not only done by delivering compressed air through the bottom part of the vessel; but also by delivering nitrogen from the nitrogen buffer to the upper part of the vessel. This process is called back-flow pressurization and has several advantages:




- The high-purity CMS (Carbon Molecular Sieves) at the top side of the vessel does not get 'contaminated' with oxygen coming from compressed air. As such, the full adsorption capacity of the CMS can be used during the adsorption phase.
- The compressed air will remain at the bottom side of the vessel because of the repulsing force of the back-flowing nitrogen. Therefore the air stays longer in contact with the CMS allowing more oxygen to be removed, or nitrogen to be produced.
- The used nitrogen is not lost but will simply flow back to the nitrogen vessel as soon as the pressure in the active vessel exceeds the vessel in the nitrogen buffer vessel. The use of 'free' nitrogen makes thus that less compressed air needs to be consumed for pressurization.
- As pressurization happens from both top and bottom, it takes less time to pressurize the unit. Less time required for pressurization means more time available for adsorption.

The combination of a higher capacity, a lower air consumption and a shorter pressurization time, leads to air factor improvements up to 10% thanks to back-flow pressurization!

**DO YOU KNOW THAT?**

How can you recognize whether back-flow pressurization is used?
Pneumatech is using pressure-controlled transfer valves at the top of the units, as nitrogen flow needs to go in two directions. Without back-flow pressurization normal check valves are used. This means an additional investment, but certainly one that pays off seen the enormous savings in energy efficiency!

C. High-quality, high-efficient adsorbent or membranes, selected for the right applications

- Stable performance over the entire lifetime

## C. High-quality, high-efficient adsorbent or membranes, selected for the right application

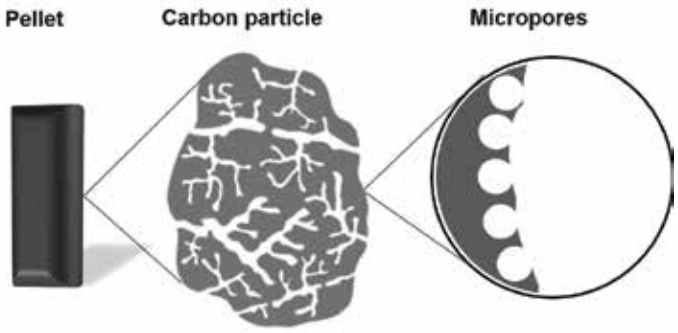
Pneumatech has selected the best adsorbent types after extensive research and development. The illustrations below focus on CMS (Carbon Molecular Sieves), but also applies to zeolite selection.

### 1. Consistent pore size distribution

CMS comes in pellets of approximately 2 to 5 mm long and 1 to 2 mm in diameter. It contains carbon particles which are porous and have a very large internal surface area.

The micropores have a pore size of approximately 0,4 nanometers, which is slightly larger than oxygen molecules (0,34nm) and nitrogen molecules (0,37nm).

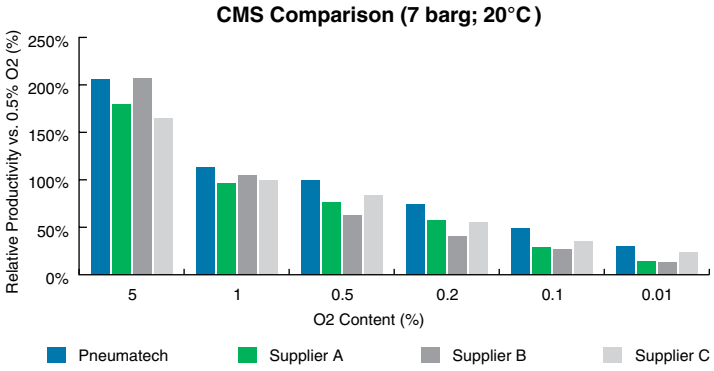
In order to ensure a consistent performance, the pore size distribution of the selected CMS is checked regularly.



## 2. Best-in class productivity

Pneumatech has tested the productivity of several CMS types at various purities, temperatures and machine configurations.

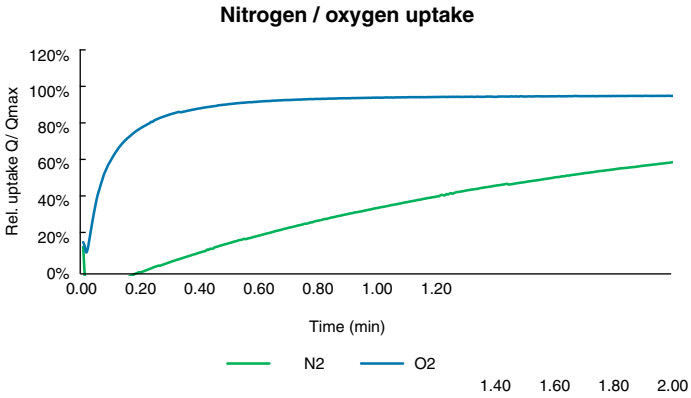
By selecting the best CMS Pneumatech can safeguard best-in-class capacities and air factors of its machines.




## 3. Optimisation of cycle times and purge nozzle flow

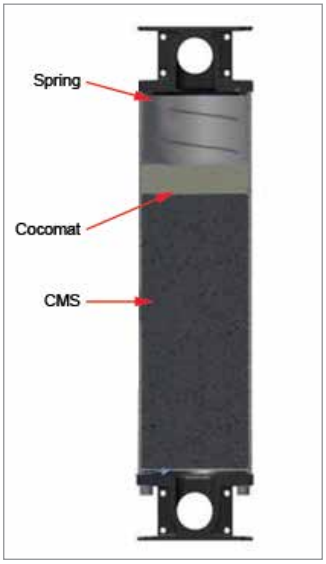
The separation of air in a nitrogen generator, relies on the kinetic selectivity of CMS.

As oxygen molecules are smaller than nitrogen molecules, it requires less energy to let oxygen diffuse into the CMS pores. The kinetic properties of the CMS have been inspected in detail to define the most optimal cycle times and purge nozzle flows of the machines.




## 4. Best-in class productivity

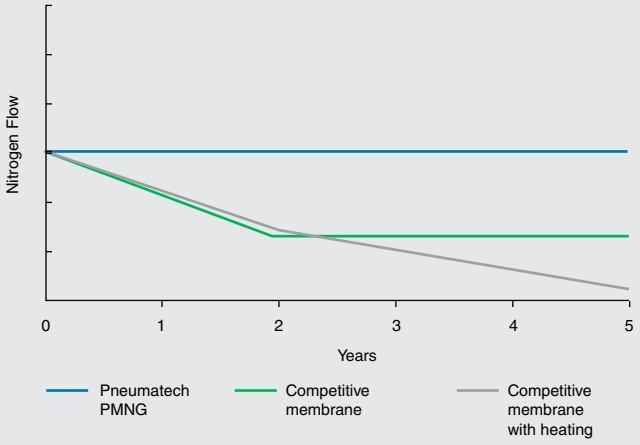
A high air speed through the adsorbent bed can have a detrimental effect, even on high-quality CMS. The CMS inside the PPNG6-68 is spring-loaded, keeping the CMS within the confined volume at all times. The coconut mat between CMS and spring, prevents CMS dusting.




The PMNG membrane generators are equipped with high-performing membranes, which are not subject to aging effects.

Several competitor membranes show similar performance at start-up, but experience a drastic performance drop after a couple of years.

This is certainly true for membranes with integrated heaters, where the initial membrane performance is boosted by increasing the compressed air temperature above 50°C / 122°F. These high temperatures cause additional membrane aging.



# Features and benefits explained

D. Zirconia oxygen sensor, high-purity variants & purity certificates

- Guaranteed purity
- Low maintenance costs

## D. Guaranteed purity

Pneumatech guarantees peace-of-mind, thanks to reliable measurement, optimized generator settings and external purity certificates:

### 1. Zirconia sensors for reliable purity measurement

All PPNG and PPOG gas generators are installed with zirconia oxygen sensors as standard. Zirconia sensors are not subject to drift over time, meaning that a yearly calibration check is sufficient to guarantee absolute accuracy. They have a guaranteed lifetime of minimum 5 years. This in contrast to the electrochemical sensors, which typically show inaccurate readings after a couple of weeks already; and are quickly consumed when coming in contact with ambient air.

To guarantee stable measurement conditions, oxygen sensors are equipped with a pressure regulator and flow restrictor. Additionally a solenoid valve is foreseen to avoid nitrogen consumption through the oxygen sensor when the generator is not working.

The oxygen analyzer is located in the electrical cabinet to ensure maximum protection against dust and water (IP54).


### 2. Dedicated high-purity variants

Critical applications like laser cutting and electronics soldering require purity levels up to 99.999%. Pneumatech has developed dedicated PPM variants,

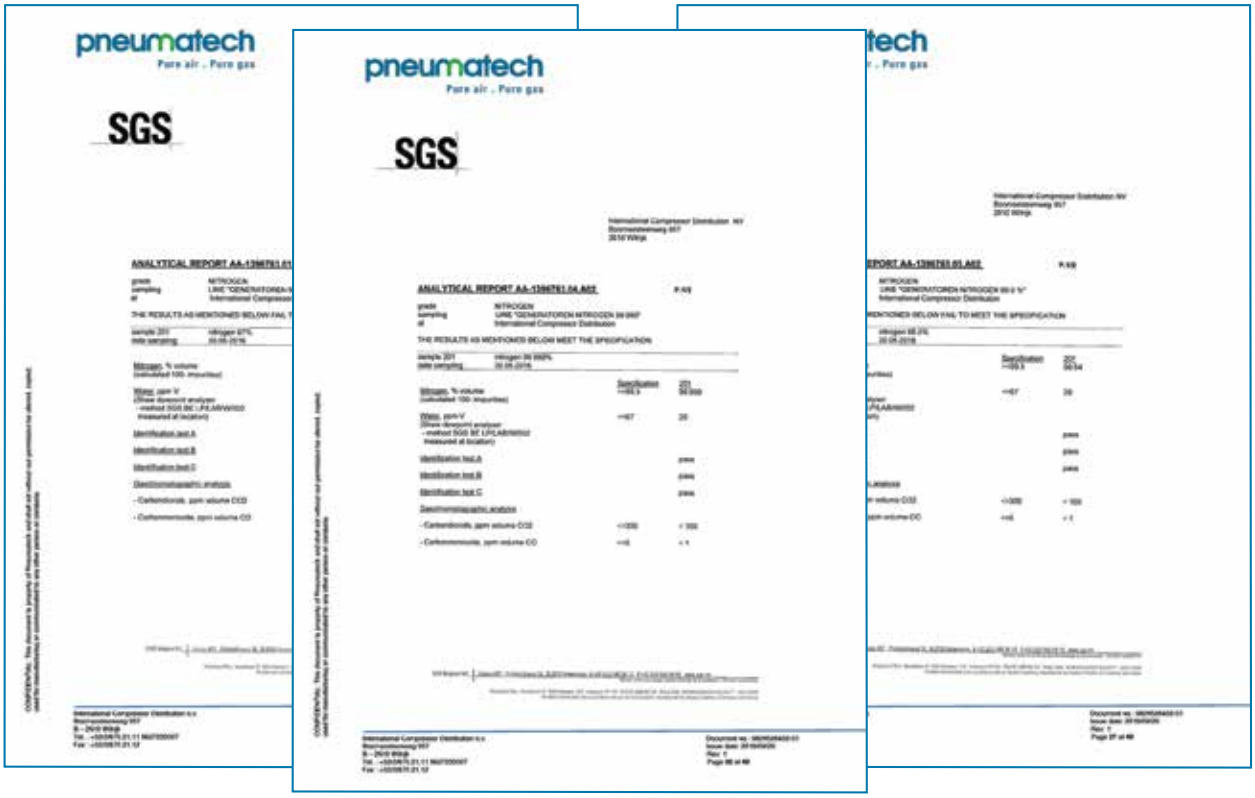
fine-tuned for purity levels from 99.95% (500ppm) up to 99.999% (10ppm). By improving the nozzle sizing and the time settings of the generator, three-digit purity levels are always met and this in the most energy efficient way. This becomes clear when comparing the air factors of our PPNG PPM units to those of our competitors at high purity levels.

| | 99.95% (500 ppm) | 99.99% (100 ppm) | 99.999% (10 ppm) |
|---|---|---|---|
| Pneumatech PPNG | 3.7 | 4.6 | 6.7 |
| Competitor 1 | 4.5 | 6.3 | 10.8 |
| Competitor 2 | 3.8 | 5.5 | NA |
| Competitor 3 | NA | 7.0 | 12.0 |

## 3. Purity certificates

The purity of the nitrogen coming out of the PPNG6-68 units has been validated by an external laboratory, as this is often requested for applications in the food & beverage; and pharmaceutical industries. Compliance reports are available at 97%, 99%, 99.5% and 99.999% purity levels:

- from purity levels of 99% and higher, the outlet sample is below limitations set by '2008/84/EC grade 99.0% N2 – Food Safety – Purity criteria on food additives other than colours and sweeteners (August 27th, 2008)'.
- from purity levels of 99,5% and higher, the outlet sample is below limitations set by 'EU pharmacopoeia 01/2008 12470 M grade 99.5% N2'.
- for purity levels of 99,999%, the outlet sample is below limitations set by 'USP-NF33 (7727-37-9) – United States Pharmacopoeia – 01/12/2015'.




**DO YOU KNOW THAT?**

Purity has a substantial impact on the sizing and the energy efficiency of a gas generator. In order to increase purity, air needs to stay longer in contact with the adsorbent, meaning that the outlet flow needs to be reduced substantially. For example: to increase nitrogen purity from 95% to 99,999%, outlet flow needs to be reduced by almost a tenfold. This flow reduction will however also lead to an increased adsorption of nitrogen molecules, which makes the air factor increase with a factor of 4. It is thus very important to define the right purity for the right application. High purity levels are often recommended by gas companies to make the business case for on-site gas generators look worse and to defend their own business. There are however few applications requiring purity levels above 99,9% nitrogen purity.

# Features and benefits explained

E. All components designed & tested for cyclic load
- Safe operation

F. Reliable, efficient and low maintenance angle seat valves
- Premium energy efficiency
- Stable performance over the entire lifetime
- Low maintenance costs

G. Carefully designed exhaust silencer
- Safe operation
- Low noise levels

H. PDP sensor
- Protection against misuse
- Advanced control and monitoring

## E. Designed & tested for cyclic load

As safety is our first priority, all Pneumatech generators are designed for high dynamic load. This can be seen from the data plate of our extrusions and welded vessels and in our declarations of conformity.



**DO YOU KNOW THAT?**

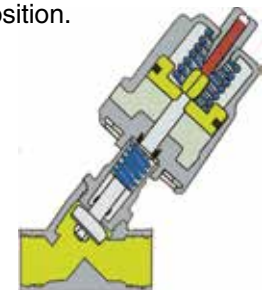
All PSA gas generators are subject to very high dynamic load. With a typical half cycle time of 60 seconds, one vessel will go from atmospheric to full and back to atmospheric pressure in 120 seconds. This corresponds to almost 4 million pressure cycles after 15 years of operations!

## F. Reliable, efficient and low maintenance angle seat valves (for PPNG6-68)

The regular switching between vessels also implies that the eight valves of the PPNG are heavily loaded. Pneumatech has therefore opted for angle seat valves, which prove to be robust for a number of reasons:

- Extremely insensitive to contamination, as controlling is not based on small diameter holes;
- Guaranteed closing of the valves, also in the event of a pressure drop in the control circuit;
- Operation possible up to pressures of 13 bar(g)/189 PSI and temperatures up to 60°C/140°F;
- Maintenance friendly, as the actuator can be taken out, while keeping the valve body in position.

This results in a very beneficial maintenance plan, whereby the actuators of two equalization valves need to be replaced after 8000 hours; and the other valves only after 16000 hours.



## G. Carefully designed exhaust silencers resulting in quiet and safe operation (for PPNG6-68)

The silencers of the PPNG range have been carefully selected for low noise levels, while keeping the pressure drop over the exhaust system to a minimum. After all, every mbar pressure drop over the exhaust system has a large impact on the overall efficiency of the gas generator.

Silencers are also pressure tested up to 15 bar(g) to guarantee safe operation in case of a blocked exhaust. Additionally a safety valve has been installed on the exhaust to ensure maximum safety.
The exhaust has been routed to the top of the units to facilitate easy ducting.

## H. PDP sensor

The outlet pressure dew point (PDP) of a gas generator is at least -40°C/-40°F. In a PSA generator the water vapor gets adsorbed by the CMS (Carbon Molecular Sieves) or zeolite; in a membrane generator the water vapor permeates through the fiber walls.

The inlet pressure dew point of a gas generator should however not exceed 3°C/37°F, to prevent liquid water from entering the adsorbent or the membranes.

Pneumatech is therefore offering the inlet PDP sensor as standard with the PPNG150-800, and as option with the other units. The PDP sensor is connected to the Purelogic™ controller which will shut down the generator or flush the inlet air, if PDP is too high.

Also oil and dust contamination should be avoided at the inlet of the generator. Therefore the following filter – dryer combination is recommended in front of a gas generator:


This results in a required inlet air purity of class 1-4-1, according to ISO 8573-1:2010. Using a lower quality of compressed air will cause irreversible damage to the generator.

*[6]In contrast to water vapor, liquid water cannot be regenerated and will damage the adsorbent irrevocably.*

# Features and benefits explained

I. Purelogic™ controller

- Advanced control and monitoring
- Premium energy efficiency
- Guaranteed purity
- Protection against misuse
- No air consumption at low gas demand

## I. Purelogic™ controller

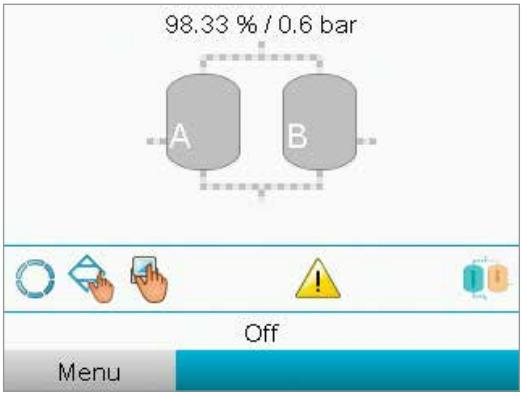
The Purelogic™ controller solution ensures increased reliability, lowest operating costs and optimal control and monitoring of the gas generators. Purelogic™ is standard on all PPNG, PMNG and PPOG gas generators.

### 1. User-friendly interface

The Purelogic™ controller incorporates a 3.5 inch high-definition color display with a multilingual user interface and clear icon indications. It is always provided with an IP54 protected cabinet. The keyboard is durable to resist tough treatment in demanding environments.


### 2. Lowest operating costs

The Purelogic™ controller incorporates the energy saving control and the week timer menu, which was described earlier. These energy saving functions are clearly indicated through pictograms and LED indicators. Set points can be altered through the user friendly interface.



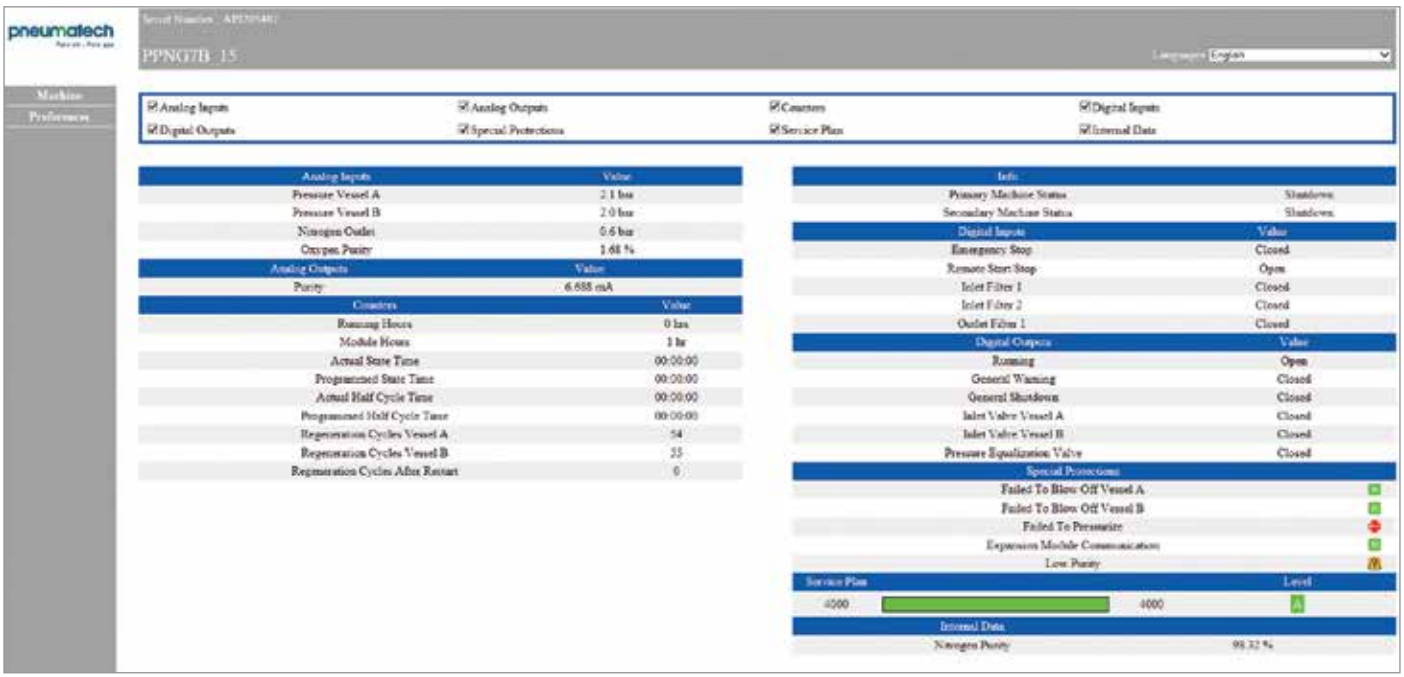
## 3. Increased reliability

The Purelogic™ ensures safe and reliable operation by monitoring several parameters: vessel pressures, outlet pressure, outlet purity, valve switching, inlet pressure dew point and outlet flow. Warning and alarm levels are set for each of these parameters. Also the service plan and preventive maintenance indications contribute to the customer's peace of mind.



## 4. Optimal control and monitoring

The Purelogic™ can communicate with most widely used industrial protocols like Modbus, Profibus or Ethernet/IP. The latter makes it possible to visualize the complete dryer performance over internet, as can be seen on the screen shot below. The Purelogic™ has moreover remote start/stop capabilities.



# Packaged oxygen solutions

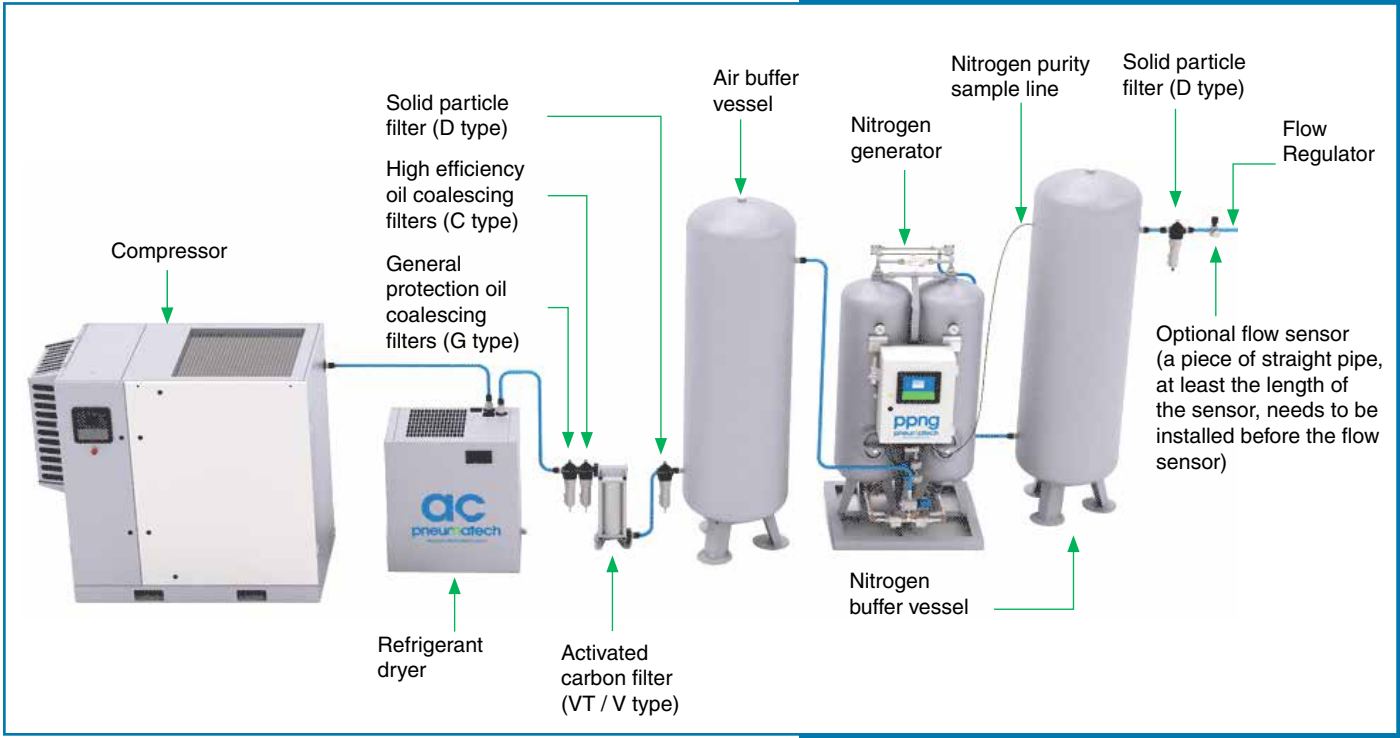
Pneumatech offers packaged solutions for on-site oxygen generation, which guarantee peace of mind and quick returns compared to traditional oxygen supply.

A typical lineup consists of a compressor, a refrigeration dryer, filters, buffer vessels and a PPOG oxygen generator; and can be completed with a high-pressure oxygen booster and a bottle filling station. These can be containerized or skid-mounted, depending on the application and the needs.

Pneumatech's on-site oxygen systems generate oxygen from 90% up to 95% purity, and are thus compliant with European pharmacopeia and United States Pharmacopeia (USP). Our production locations are moreover certified according to ISO 13485, the international quality management system for medical devices.

Our boosters are available in 3 kW to 15 kW models and can safely and reliably boost oxygen, nitrogen, helium or argon up to 200 bar(g) / 2900 PSI. By boosting a gas to these high pressures, you can bottle the gas you generate. This is particularly interesting to cover peak demand or as emergency back-up.

# Installation guidelines




## Safety

- Proper ventilation of the generator room is a must. If natural ventilation is not sufficient, at least 4 air changes/hour are required.
- A room oxygen level detection with an audible/visual alarm is advisable. When working in rooms where the oxygen content can rise to a dangerous level, a continuous measurement system is necessary. Alarm levels should be set below 19.5% and above 22.5%.
- If exposed to an oxygen enriched atmosphere, make sure to ventilate your clothing for at least 15 minutes in normal atmosphere. Do not come near open flames or do not smoke.

## Compressor

- Variable speed compressors are preferred to avoid pressure fluctuations at the inlet and thus instable purities.
- When connecting a gas generator to an existing compressed air installation: install a check valve and pressure regulator before the air receiver.

## Refrigerant dryer & filters

- Class 1-4-1, according to ISO 8573-1:2010, should be reached at all times to ensure long lifetime of the adsorbent material or membranes.

## Air buffer

- Oversize the air vessel by a factor 1,5 in case of load/unload compressors. This allows the compressor pressure band to be set at 0,5bar / 7,3psi.

## Gas generator

- Purity and outlet flow are directly correlated.
- Do not specify a higher purity than needed. This has a large impact on the energy efficiency of the system.
- Install a flow sensor (optional) in case the flow pattern is not stable.

## Gas buffer

- Proper sizing of the buffer vessels is crucial to reach the required performance.
- If the gas buffer is too big, start-up times will be too long.
- If the gas buffer is too small, flow over the adsorbent might become too big.
- To allow peak consumption a second buffer vessel should be installed downstream the flow regulator.

## Others

- Install a flow regulator downstream the gas buffer to avoid excessive gas demand.
- Use PTFE flexibles in your nitrogen sampling lines to avoid that oxygen molecules would enter the flexibles hose.

pneumatech

Pure air . Pure gas



LLOYD'S REGISTER · LRQA

ISO 9001 - ISO 14001
OHSAS 18001