

NGP+ 8-100

ATLAS COPCO PSA NITROGEN GENERATOR

General description

The Nitrogen Generator makes use of Pressure Swing Adsorption (PSA) technology to produce nitrogen by passing pre-treated compressed air through a vessel containing carbon molecular sieves (CMS). The PSA process is inherently a batch process, as the adsorbent bed requires periodic desorption. In order to secure steady flow, the Nitrogen Generator PSA systems contain two adsorbent vessels to provide operational continuity. One vessel is active while the other one is inactive. At the end of each cycle, they switch roles.

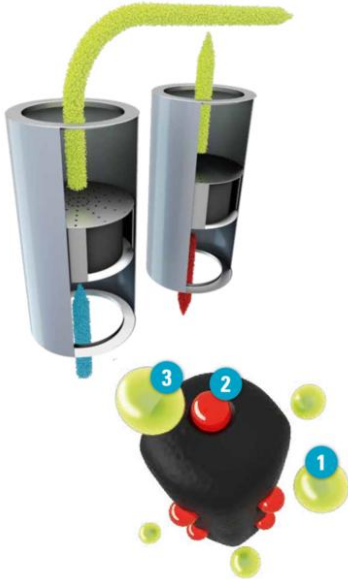


The active vessel is pressurized and pre-treated compressed air enters the active vessel and follows up through the CMS. Oxygen molecules are being adsorbed while the nitrogen molecules pass through.

When the adsorbing vessel approaches saturation, the regenerated vessel is partly re-pressurized with the compressed gas from the adsorbing vessel. This is called the equalization step, and is intended to save compressed air.

When pressure from the saturated vessel is released, the regeneration process starts. At the same time, the regenerated vessel is being pressurized up to working pressure with the compressed air from the inlet at the bottom and nitrogen from the nitrogen receiver at the top. This back flow of nitrogen also saves compressed air and as such contributes to a low air-N₂ factor. The cycle starts over again.

Working Principle



(Blue) = Clean and dry compressed air (pressurized)

(Green) = Nitrogen gas (pressurized)

(Red) = Oxygen exhaust (depressurized)

(Black) = Absorbent

1. Absorbent.
2. Nitrogen (or oxygen) molecules trapped in the absorbent.
3. Oxygen (or nitrogen) molecules passing through.

Scope of Supply

Inlet air instrumentation

The inlet air quality is constantly monitored to make sure the inlet requirement is always met. By doing this, the CMS is protected and the lifetime of the nitrogen generator guaranteed.

- Inlet PDP sensor
- Inlet temperature sensor
- Inlet pressure sensor
- Inlet pressure indicator
- Inlet air purge valve: to flush the inlet air when the inlet PDP is worse than requested.
- Pilot air connection: pilot air circuit consists of:
 - Pressure regulator and indicator
 - Pilot solenoid valve block

PSA process

The PSA process of a nitrogen generator consists mainly of two assemblies:

- The adsorbers
 - Aluminum extruded profiles filled with Carbon Molecular Sieves (CMS), which adsorb the oxygen from the incoming compressed air. The CMS is densely packed and spring-loaded to prevent fluidization.
- The valve system controlling the PSA process: pneumatic actuated angle seat valves
 - Inlet transfer valves to guide the compressed air into the adsorbers.
 - Equalization valves to allow an equalization of the adsorbers in order to save compressed air.
 - Blow-off valves to vent the adsorbers to atmospheric pressure in order to release the oxygen from the CMS.
 - Outlet transfer valves to guide the nitrogen from the adsorbers to the nitrogen receiver and to allow a back-flow from the nitrogen receiver to the adsorbers during pressurization.
 - A purge orifice to help escape the oxygen from the regenerating adsorber.

Minimum pressure valve with bypass nozzle

The minimum pressure valve allows automatic start-up, by allowing a restricted flow through a parallel orifice. The minimum pressure valve also protects the adsorbers from over-flow thus guarantees a long lifetime of the CMS.

Outlet gas instrumentation

To guarantee the quality of the outlet gas, the outlet gas parameters are constantly monitored:

- Outlet pressure sensor
- Outlet pressure indicator
- Outlet PDP sensor (optional)
- Outlet flow meter
- Nitrogen purity sensor

Outlet circuit

After the nitrogen receiver, two valves are foreseen to control the flow of the nitrogen:

- Consumer valve: opens when the requested purity of the nitrogen is available in the nitrogen receiver
- Flushing valve: opens when the requested purity of the nitrogen is not reached. This way, bad purity nitrogen is flushed to atmosphere through the silencer
- Pressure regulator: to reduce the nitrogen pressure to the requested pressure at the point of use.

Electrical control system

NGP+ nitrogen generators are controlled by the Atlas Copco Mk5 graphic controller. They control the PSA cycle of the generator, the regulation of the nitrogen quality and the protection of the CMS bed:

- PSA cycle control:
 - Manual mode: The PSA cycle will operate independent from the consumed nitrogen flow.
 - Automatic mode: The PSA cycle algorithm will be altered depending on the level of consumed nitrogen. This way, less compressed air is needed to feed the generator and energy is saved when the generator is not running at full load. This algorithm also compensates for altering ambient conditions (thus the generator uses less compressed air at lower temperatures) and altering purity settings (the generator will use less compressed air at lower purity settings). When no nitrogen is consumed, the generator will enter stand-by mode and not use any compressed air at all.
- Automatic start-up:
 - Automatic start-up enables the user to start the generator with the push of a button. The generator will fill the nitrogen receiver with a specific flow which will result in the fastest start-up procedure possible.
- Guaranteed purity:
 - When the nitrogen purity is less than requested, the flushing mode will shut off the nitrogen flow to the user and direct it over the flushing nozzle. This way, the purity will be recovered as fast as possible.

Warnings & alarms

The following diagnostics are foreseen:

- Indications:
 - Operation mode indication
 - Running state
 - Running time
 - Inputs:
 - Nitrogen purity level
 - Outlet flow
 - Inlet pressure
 - Inlet temperature
 - Inlet PDP
 - Pressure inside adsorber A
 - Pressure inside adsorber B
 - Outlet temperature
 - Outlet PDP (optional)
- Alarms:
 - Low purity alarm
 - Failed to blow off vessel A
 - Failed to blow off vessel B
 - Failed to pressurize
 - High inlet pressure
 - High inlet temperature
 - High inlet dew point
 - High outlet flow
- Retransmitting signals (4-20mA):
 - Inlet PDP
 - Nitrogen purity level
 - Outlet flow
- Other:
 - Service indication
 - Password protected administrator settings
 - Changeable settings for alarm levels

Features & Benefits

Self-protective monitoring of the feed air quality

- Temperature
- Pressure
- Pressure Dew Point
- Automatic feed air blow-off in case of contamination

Premium energy efficiency

- Air-to-nitrogen ratio from 1.8 (95% N₂) up to only 5.5 for high purity N₂ (99.999%)

Automatic start-up

- Minimum pressure valve with bypass nozzle for fast start-up
- Eliminates risk of overflow and CMS damage

Highest quality CMS

- High density
- Compact spring loaded
- Top/bottom equalization
- Protected by dedicated pressure sensor

The most complete scope of supply

- Nitrogen flow meter as standard
- Zirconia oxygen sensor with a long lifetime
- Outlet pressure reducing valve

Self-regulation and stable purity

- Automatically regulates to the requested nitrogen pressure and purity
- Extremely easy to change purity
- Off-spec nitrogen flushing

Control and monitoring

- Remote start-stop
- Modbus, Profibus and Ethernet
- SMARTLINK

Back flow pressurization

- In the pressurization phase nitrogen is used instead of air
- No oxygen contamination of the CMS before adsorption phase starts

The ultimate energy saver

- Stand-by mode in vase no nitrogen is consumed
- Cycle time modulation algorithm = extended cycle time at low nitrogen demand = reduced air consumption at low nitrogen demand.