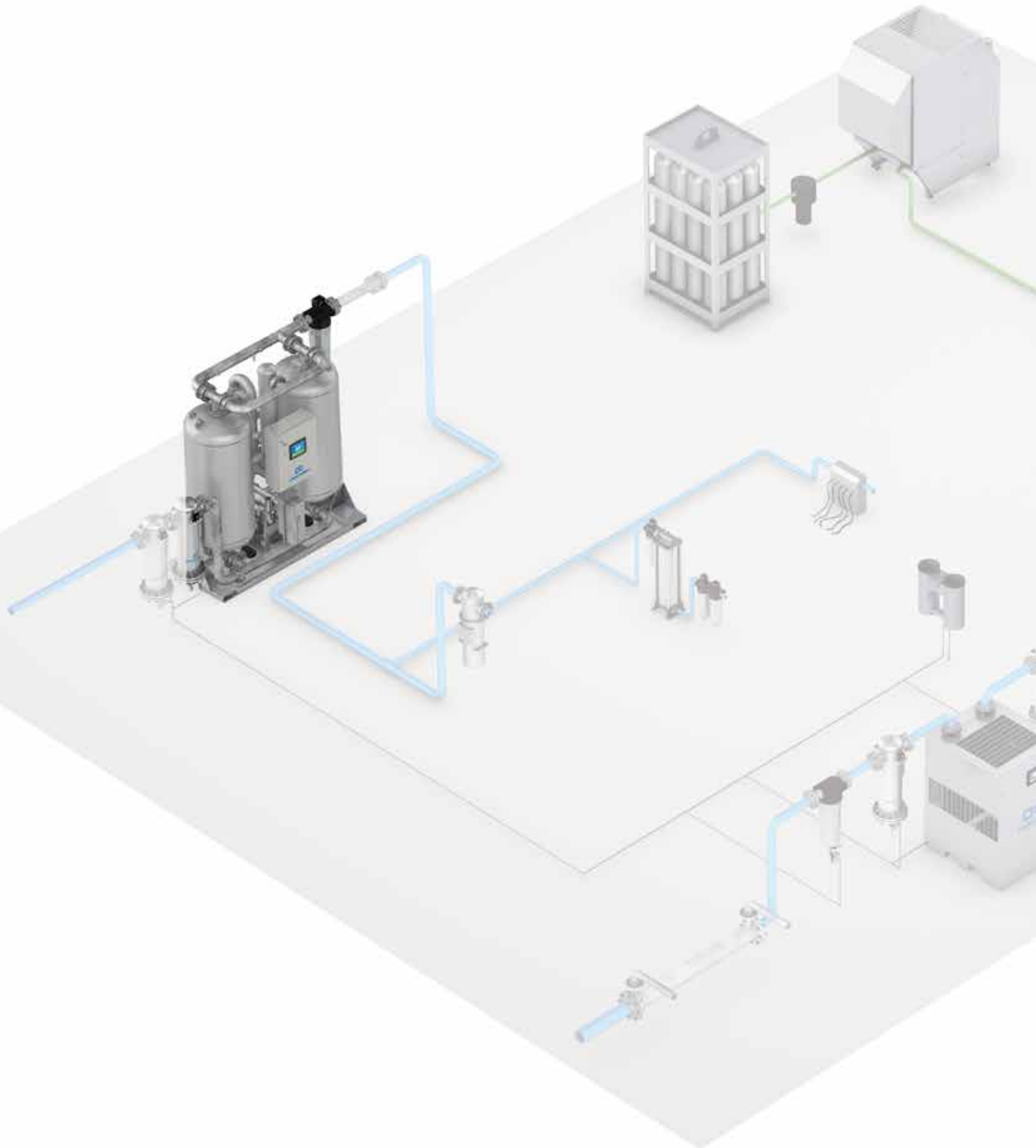




# Adsorption Dryers

# Pneumatech Air Treatment





# Contents

Compressed Air Treatment	4
Compressed Air Drying	6
Types of compressed air dryers	8
Operating Principle	10
Features and benefits explained	12-21
Compressed Air Purity	22

# 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.

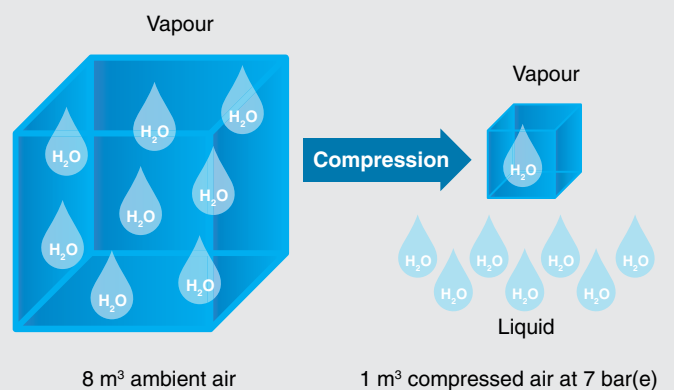
## Compressed air is always wet

### 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<sup>1</sup> is however limited for a certain temperature. Condensation will thus be formed when air is compressed.



### 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

## Compressed air is always contaminated

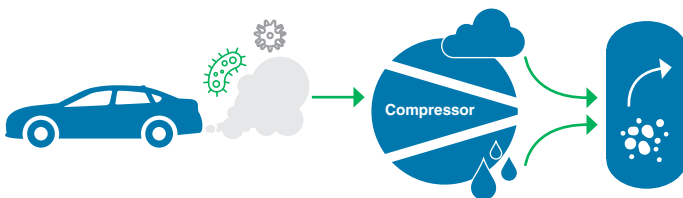
### Contaminants

- 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 microorganisms 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

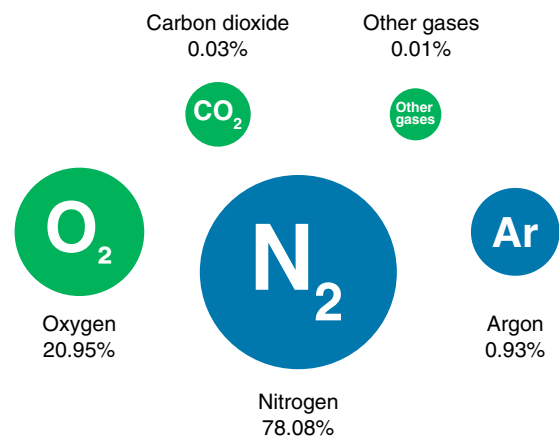
## Compressed air composes of other gases

### 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

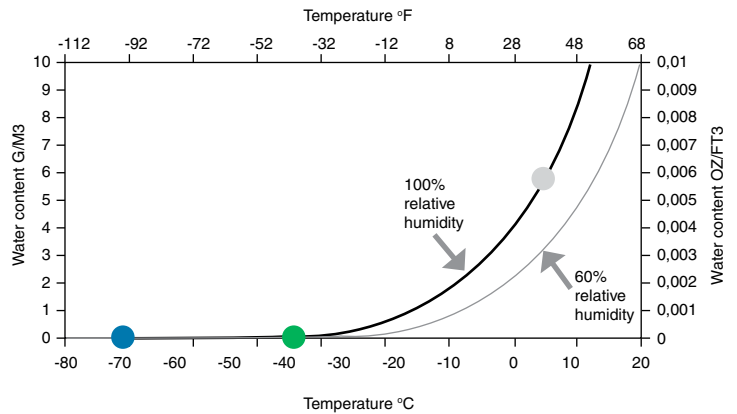
- PSA nitrogen generators
- Membrane nitrogen generators
- PSA oxygen generators

# Compressed Air Drying

Moisture is a fundamental element of atmospheric air, where it is present in the form of water vapor. The maximum moisture holding capacity of air (the maximum amount of moisture air can hold per m<sup>3</sup> / ft<sup>3</sup>) is limited for a certain temperature; and increases as the temperature increases. At and above this line the air is 100% saturated (relative humidity of 100%), meaning that the excess moisture will condense as liquid water, and will in cold environments even transform to ice.

As it is not possible to compress water, the moisture content of compressed air increases in relation to the pressure of the compressed air. As a result the moisture content will exceed the maximum moisture holding capacity of air (which is only dependent on temperature) and the excess amount of moisture will condense into liquid water. We can thus state that **compressed air will normally always be 100% saturated**.

Water Content v/s Temperature Curve



The saturated, hot air at the outlet of the compressor – typically 80°C/ 176°F – will cool down along the cold piping network to around ambient temperature. This causes condensate to form that can result in the a number of problems:

**DO YOU KNOW THAT?**

For every 12°C/ 22°F increase in air temperature the maximum water holding capacity doubles. In other words: saturated air at 30°C/ 86°F holds twice as many water than saturated air at 18°C/ 64°F.



Corrosion in pipe



Bad product quality



Process malfunctioning



Bacterial environments



Ice formation

In order to avoid any of these things from happening **compressed air dryers** need to be added to your compressed air network. Dryers remove moisture to well below the saturation point, so that no condensation can be formed downstream. This in contrast to coolers, which also remove moisture by cooling the air but where the air always remains 100% saturated at the outlet. The required degree of dryness is usually expressed with

the term **dew point temperature**. It is the temperature at which condensation (dew) occurs. A lower dew point temperature means a lower presence of moisture in the air. For compressed air applications the term **Pressure Dew Point (PDP)** is used. It is the temperature at which water vapor condenses into water at the current working pressure, and corresponds thus to the amount of moisture air can hold per m<sup>3</sup> / ft<sup>3</sup> **compressed air**.

*Note: There is a substantial difference between Atmospheric Dew Point (ADP) and PDP, as can be seen from the example below: What is the Atmospheric Dew point (ADP), when you have a Pressure Dew Point (PDP) of +3°C / 37.4°F at a pressure of 7 bar(g) / 102 psi(g) or 8 Bar(a) / 116 psi(a)?*

- A PDP of +3°C / 37.4°F corresponds to a water content of 5.94 g per m<sup>3</sup> compressed air.
- If the air got expanded to atmosphere, the same moisture content got spread over 8 m<sup>3</sup>.
- The corresponding moisture holding capacity is 8 times lower: 5.94 g/m<sup>3</sup> / 8 = 0,74 g/m<sup>3</sup>, which equals an Atmospheric Dew Point (ADP) of -22°C / -7.6°F

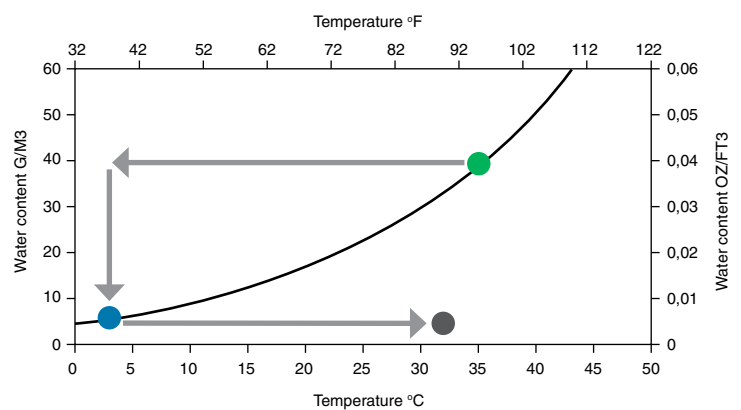
# Types of compressed air dryers

## Refrigeration dryers

Refrigeration dryers are used for PDPs between +3°C/37.4°F to +10°C/50°F with the freezing point of water (0°C/ 32°F) as the lower limit.

By cooling the compressed air with a closed refrigeration system a large amount of water condenses and can be separated. Afterwards the compressed air is reheated with the incoming air to around room temperature. In this way the moisture content of the air stays well below the maximum moisture holding capacity at normal (non-freezing) ambient temperatures, meaning that the relative humidity stays below 100%. It is recommended to stay below 50% relative humidity to avoid any condensation to happen on local cold spots of the piping network.

Refrigeration Cycle

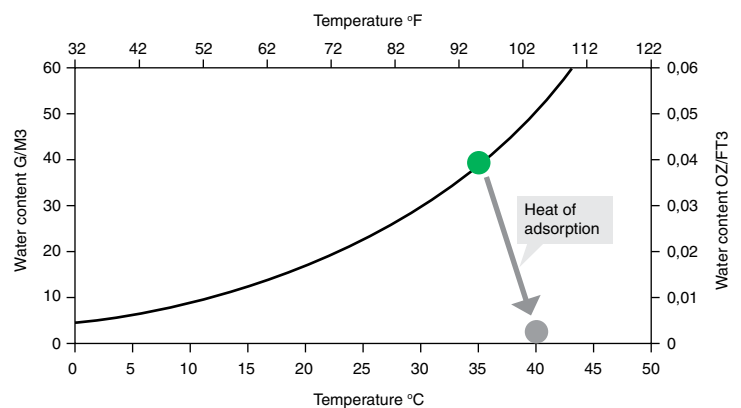


## Adsorption dryers

Adsorption dryers are used when PDPs from -10°C/14°F down to -70°C/-94°F are to be achieved.

They make use of a material which has a high affinity to attract moisture, so called hygroscopic material or desiccant. The adsorption of moisture causes the desiccant to be gradually saturated with water.

Adsorption Cycle



Therefore, the desiccant needs to be regenerated regularly to regain its drying capacity. Adsorption dryers are typically built with two drying vessels ("towers") for that purpose: the first tower will dry the incoming compressed air while the second one is being regenerated. To ensure continuity, each vessel switches tasks when the other one is completely regenerated.



Smart steering of the refrigerant compressor via intelligent control algorithms can significantly reduce the power consumption of modern refrigeration dryers.

Refrigeration dryers are mainly suitable for compressed air applications with **standard dry air demands**; and are mostly installed as central protection in the compressor room. They provide the right air dryness for pneumatic

tools, blast air and instrument air; and for a frost-free piping and distribution system. For critical applications and applications below 5°C/ 41°F ambient temperature, an adsorption dryer is recommended.

**Please consult the Pneumatech Refrigeration dryer catalogue for further information.**

### AD refrigeration dryers



### AC refrigeration dryers



### PH heatless adsorption dryers



### PE heated purge adsorption dryers



### PB blower purge adsorption dryers



*Note: Dry air comes with a cost, both in terms of initial investment as well as running costs. The required dryness of the compressed air network should be chosen based on the largest compressed air consumers, while more critical applications can be covered with a low PDP dryer at point of use. As Pneumatech adsorption dryers exist in all possible sizes, they can be used both centralized (in the compressor room) and decentralized (close to the point-of-use), dependent on the needs.*



### DO YOU KNOW THAT?

If compressed air with PDP of -70°C/-94°F is being supplied to a normal living room of 20m<sup>3</sup> in volume, it will contain half a gram of water by weight inside it.

# Operating Principle

## Adsorption Dryers

All materials can adsorb and desorb water, only the degree of adsorption is different per material. Desiccant used in adsorption dryers is specifically designed to adsorb moisture. Desiccants can release the water particles by adding some form of energy to them. This is called **regeneration**.

Pneumatech adsorption dryers consist of two towers, both filled with desiccant, which alternatively operate in adsorption or regeneration cycle via a controlled switching mechanism. Once the desiccant is saturated in one vessel the process is reversed, and the second vessel starts adsorbing.

The four types of adsorption dryers differ from each other in the way regeneration (and cooling) is done.

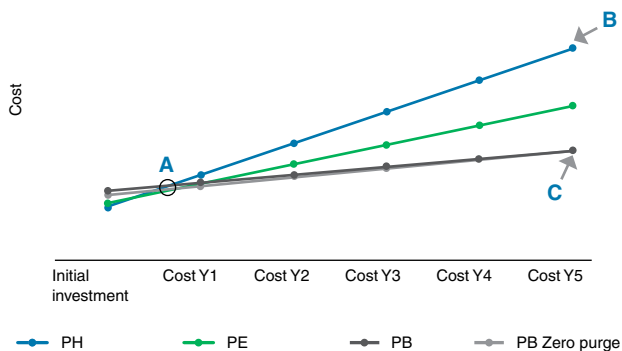


One desiccant granule contains more pores to capture water vapour than a football field contains blades of grass.

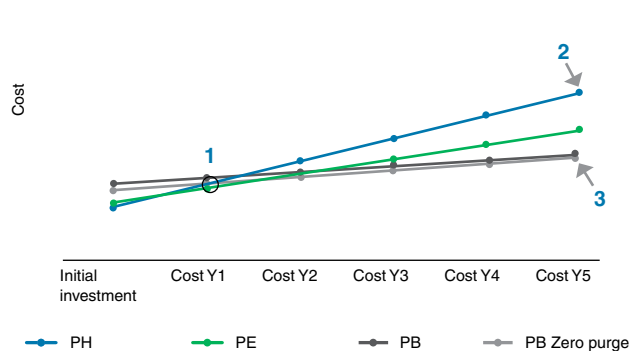
	PH Heatless Adsorption Dryers	PE Heated Purge Adsorption Dryers	PB Blower Purge Adsorption Dryers	PB ZP Zero Purge Adsorption Dryers
<b>Regeneration principle</b>	Regeneration by adding dry air: moisture is attracted to the dry purge air and separates /detaches from the desiccant.  This is the Pressure Swing Adsorption (PSA) principle.	Regeneration by adding heat: heat causes the water molecules in the desiccant to vibrate, which triggers the reverse physical action of adsorption. The water retaining forces are broken, and water is discharged in the form of vapor.  This is the Temperature Swing Adsorption (TSA) principle.		
<b>Drying phase</b>	Compressed wet air is passed through one tower filled with desiccant from the bottom. The desiccant removes the moisture from the air as it travels upwards. The dry air leaves the dryer through a filter and is ready to be used in sensitive applications.			
<b>Regeneration phase</b>	<b>A. Heatless purge</b>  A small amount of dried air controlled via a small nozzle is passed to the regenerating tower. This is called purge air.	<b>B. Heated purge</b>  A small amount of dried air controlled via a small nozzle is passed to the regenerating tower. This is called purge air. Purge air is heated and sent through the saturated desiccant forcing the moisture out from top to bottom.	<b>C. Heated blower purge</b>  The blower takes ambient air and blows it over the external heater. The heated air is then sent through the saturated desiccant, forcing the adsorbed moisture out, from top to bottom.	
<b>Cooling phase</b>	NA	<b>1. Cooling from purge:</b>  After the heating, the hot tower desiccant is cooled. Cooling is done by expanding dry compressed air from the outlet of the adsorbing vessel over the hot reactivated tower, from top to bottom.		<b>2. Zero purge:</b>  After the heating, the hot tower desiccant is cooled. Cooling is done by sending air from the hot vessel over a cooler and back into the hot tower, from bottom to top.
<b>Standard half-cycle time (if no energy saving control)</b>	3-4 minutes regeneration	4 hours: 3 hours regeneration – 1 hour cooling – 20 seconds pressurization/ depressurization		
<b>Energy consumption</b>	High purge consumption	Medium purge consumption + heater	Small purge consumption Blower + heater	No purge consumption Blower + heater

The **PB (ZP) dryer has the highest initial investment cost but the lowest life cycle cost**, as can be seen in the following typical lifecycle cost calculations.

Typical lifecycle cost calculation based on 8760 running hours per year



Typical lifecycle cost calculation based on 4000 running hours per year



- A. Payback time PB versus PH less than 1 year
- B. Total cost: 6.5 times the initial investment after 5 years
- C. Total cost: 2 times the initial investment after 5 years

- 1. Payback time PB versus PH slightly higher than 1 year
- 2. Total cost: 3.5 times the initial investment after 5 years
- 3. Total cost: 1.5 times the initial investment after 5 years

The choice for PH, PE or PB is typically based on the following selection criteria.

#### Select PH

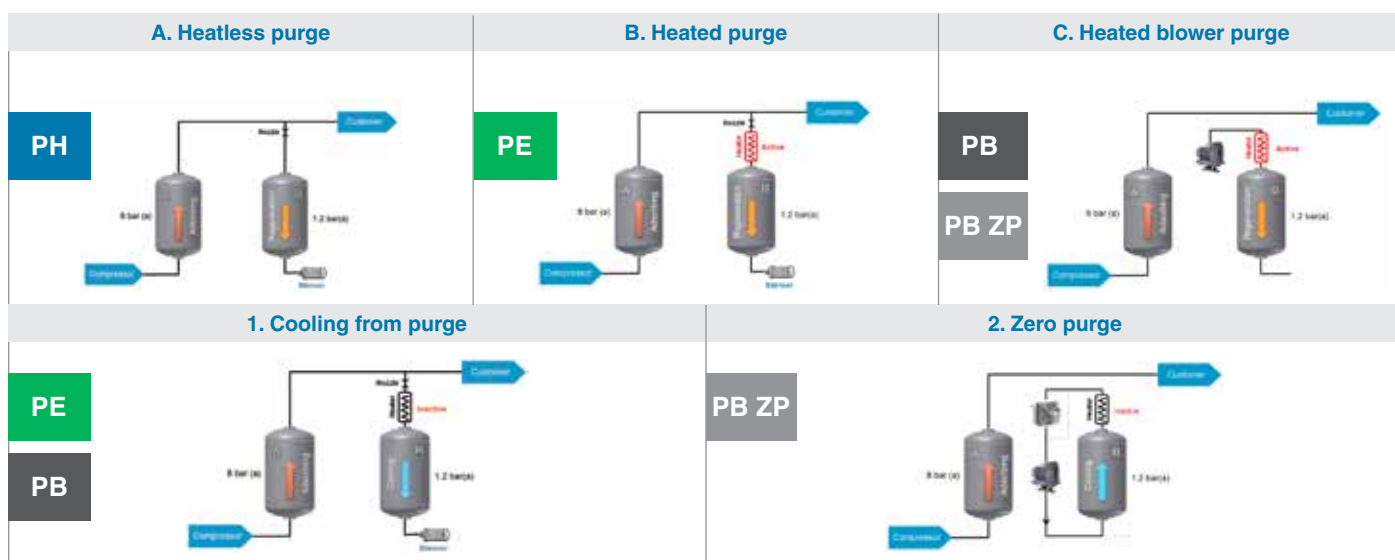
- Choice for lowest investment cost
- Limited number of running hours
- Load time below 4 hours
- High humidity environments
- Highly polluted atmosphere

#### Select PE

- Balance between lowest investment cost and lowest lifecycle cost
- Most efficient solution in case of high humidity environments or highly polluted atmosphere
- Customer requirement; e.g. in the semiconductor industry

#### Select PB (ZP)

- Choice for lowest lifecycle cost
- High number of running hours



# Features and benefits explained

## A. Advanced energy management systems

- ▶ Lowest operating costs
- ▶ Optimal control & monitoring

## A. Advanced energy management systems for lowest operating costs

Adsorption dryers are sized for full-load operation, with extra margin to cope with the aging effect of the desiccant. In reality full-load operating conditions will rarely occur, due to fluctuations in the demand, seasonal and meteorological fluctuations and over-specification of the entire compressed air system.

### Heatless Regeneration

Adsorption	Regeneration
Regeneration	Adsorption

### Heated Regeneration

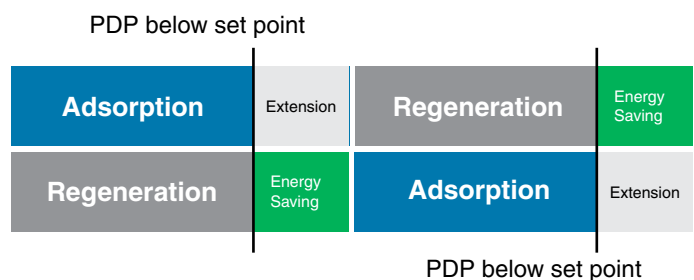
Adsorption	Regeneration by heat	Cooling
Regeneration by heat	Cooling	Adsorption

Pneumatech adsorption dryers use 4 smart measures to cope with this reality; resulting in **tremendous energy savings**.

### 1. Pressure Dew Point (PDP) control (PH, PE, PB)

The PDP sensor constantly measures the pressure dew point (PDP) of the air leaving the drying tower. Once the pre-set time has elapsed, regeneration of the non-drying tower is stopped if the PDP temperature is below the set point. As a result, the number of regeneration cycles is reduced over the lifetime of the adsorption dryer, leading to significant energy savings.

Additionally, varying Pressure Dew Point (PDP) requirements can easily be anticipated. When changing the PDP setting, e.g. from -40°C/-40°F to -30°C/ -22°F the energy saving mode will be extended, leading to additional energy savings.

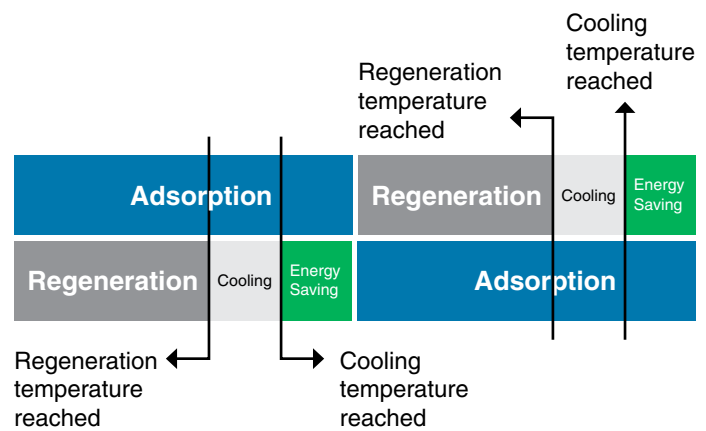


*Note: The maximal standby time is 24 hours for heat regenerated dryers and 4 hours for heatless dryers. This prevents the desiccant from capturing moisture for too long time, which would accelerate aging.*

## 2. Regeneration & cooling temperature control (for heat regenerated dryers only) (PE, PB)

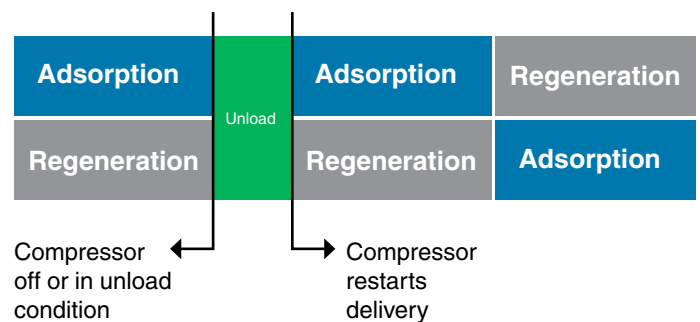
Temperature sensors at the bottom of the vessel constantly monitor the regeneration temperatures and will stop the regeneration cycle when the vessel has been properly regenerated. As a consequence, the heaters will be switched off irrespective of the pre-set cycle time<sup>4</sup> and the program will switch to the cooling step. After pressurization the tower will go in idle mode until the other tower has finished its adsorption cycle. It is clear that switching off the heaters will lead to **significant energy savings**.

The same energy saving algorithm is implemented for the cooling cycle, resulting in **additional energy savings**.



## 3. Compressor load/unload synchronization (PH, PE, PB)

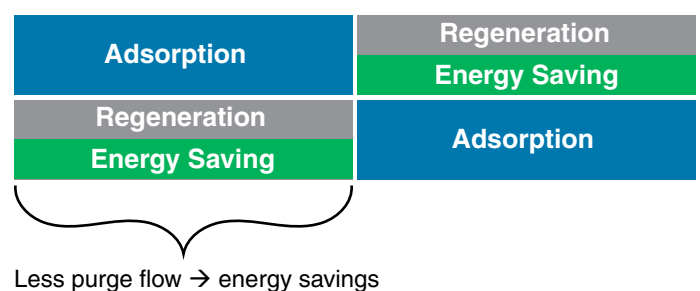
When the compressor switches off or goes in standby mode, no compressed air needs to be dried. By connecting a simple wire from the compressor to the compressor synchronization port of the dryer controller, the adsorption dryer will go in standby mode together with the compressor. No regeneration energy is required in the standby phase, leading to **substantial energy savings**.



## 4. Purge nozzle optimization (PH, PB)

The purge nozzle guarantees that a small amount of dried air is passed into the regenerating tower, for the purpose of regeneration (heatless dryers and purge heated dryers) or cooling (purge and blower heated dryers) purposes. This nozzle has a fixed orifice. The higher the operating pressure, the higher the purge flow will be. This purge - and thus energy-loss - is however unwanted, especially considering that the required purge is lower at the higher pressure.

Pneumatech offers **optimized purge nozzles** for higher pressure applications as standard with the PH55-310; and as option for all other PH variants and for PB dryers.



<sup>4</sup>As long as the minimum regeneration time of 30 minutes has passed. This prevents the real regeneration temperature being confused with a temporary temperature increase.

## Features and benefits explained

### B. High-quality, high-efficient desiccant, selected for the right application

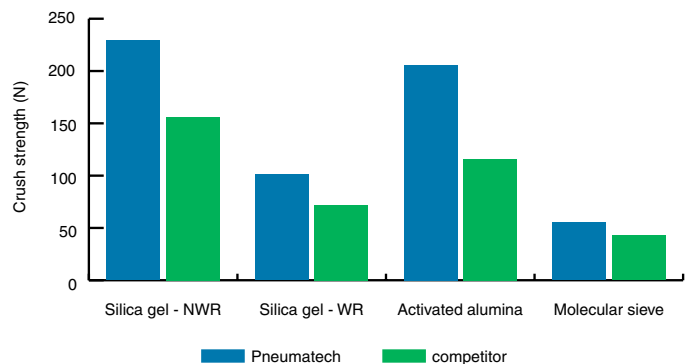
- ▶ Lowest operating costs
- ▶ Stable performance over the entire lifetime
- ▶ Guaranteed dry air
- ▶ Low maintenance costs

### B. High-quality, high-efficient desiccant, selected for the right application (PH, PE, PB)

Adsorption dryers can only be energy efficient if they contain **premium desiccant material**. The desiccant used in Pneumatech adsorption dryers is carefully selected from a wide range of European and North-American suppliers, based on following key selection criteria:

#### 1. Crushing strength

Desiccant is subject to continuous cyclic load. Due to this load, low-quality desiccant will easily break up resulting in small dust particles, hereby quickly losing its water attraction capabilities, blocking valves or clogging the downstream dust filter and silencer.



#### 2. Water resistance

Standard desiccant will degrade when it comes in contact with liquid water. Although a water separator should be installed upstream of an adsorption dryer, some water carry-over to the lower part of the adsorption dryer can never be excluded. All Pneumatech adsorption dryers are therefore equipped with water-resistant desiccant material in the bottom part of the vessel.

#### Silica gel – Not Water Resistant



#### Silica gel – Water Resistant



### 3. Lowest total cost of ownership

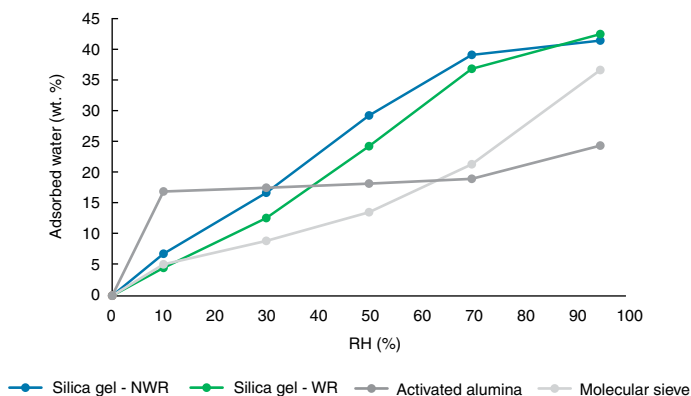
We carefully balance initial capital investment with ongoing running cost. Silica gel has the highest adsorption capacity and is therefore used in heat regenerated adsorption dryers (PE & PB). In the dynamic operation conditions of heatless adsorption dryers (PH) only a small percentage of the total static adsorption capacity is used because of the relatively short cycle

times. The use of silica gel in the case of -40°C/-40°F PDP applications would increase the initial investment significantly, but would not bring any purge loss reduction or other benefits. Heatless adsorption dryers are therefore filled with activated alumina<sup>3</sup> which provide equal dew point requirements (-40°C/-40°F PDP) and energy efficiency at lower investment costs.

	Activated alumina	Silica gel – WR <sup>5</sup>	Silica gel – NWR	Molecular sieves
	Heatless regenerated dryers (-40°C/-40°F PDP)	Heat regenerated dryers (protective layer against liquid water)	Heat regenerated dryers (-40°C/-40°F PDP)	<ul style="list-style-type: none"> <li>Heat &amp; heatless regenerated dryers (-70°C/-94°F PDP)</li> <li>High air inlet temperatures</li> </ul>
Used in	PH	PE PB	PE PB	PH PE PB
Specific surface area	335 m <sup>2</sup> /g	650 m <sup>2</sup> /g	750 m <sup>2</sup> /g	750 m <sup>2</sup> /g
Equilibrium capacity (25°C)	10 % RH: 5 wt.% 80 % RH: 27.5 wt. %	10 % RH: 4 wt.% 80 % RH: 39 wt. %	10 % RH: 6.5 wt.% 80 % RH: 40 wt. %	10 % RH: 17 wt.% 80 % RH: 24 wt. %
Crush strength	206 N	100 N	229 N	55 N

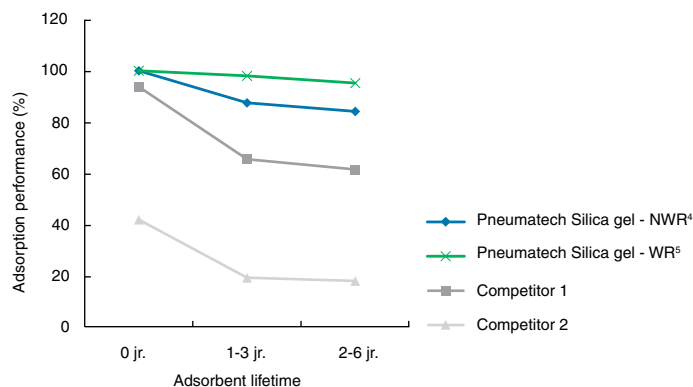
### 4. The right desiccant for the right application

Different desiccants have different levels of water attraction. The greater the attraction, the lower pressure dew point is possible. However, the greater the level of water attraction of the desiccant, the more purge is required to regenerate it. Therefore we use molecular sieves at the top of the vessels in our -70°C/-94°F variants, while using silica gel (heat regenerated) or activated alumina (heatless) in our -40°C/-40°F variants. Molecular sieves have the tendency to adsorb moisture at low relative humidity and have thus the best performance at the low PDPs.



### 5. Anti-aging effect

Some desiccants show fantastic static performance, but have a bad dynamic performance; meaning that they degrade after a couple of months because of pressure, temperature or air humidity variations. Pneumatech adsorption dryers are not only equipped with the **most durable** desiccant material in the market, they are also **overfilled** to cope with this aging affect or with temporary overloads.



<sup>3</sup>Exception is the PH2-45 which makes use of molecular sieves. <sup>4</sup>NWR: non water resistant <sup>5</sup>WR: water resistant



## Features and benefits explained

C. Minimized risk of crushed desiccant thanks to spring-loaded desiccant and sonic nozzles (PH, PE, PB)

- ▶ Stable performance over the entire lifetime
- ▶ Low maintenance costs

D. Counter-current regeneration

- ▶ Lowest operating costs
- ▶ Stable performance over the entire lifetime
- ▶ Guaranteed dry air

C. Minimized risk of crushed desiccant thanks to spring-loaded desiccant and sonic nozzles (PH, PE, PB)

A high air speed through the vessels of the adsorption dryer can have a detrimental effect, even on high-quality desiccant.

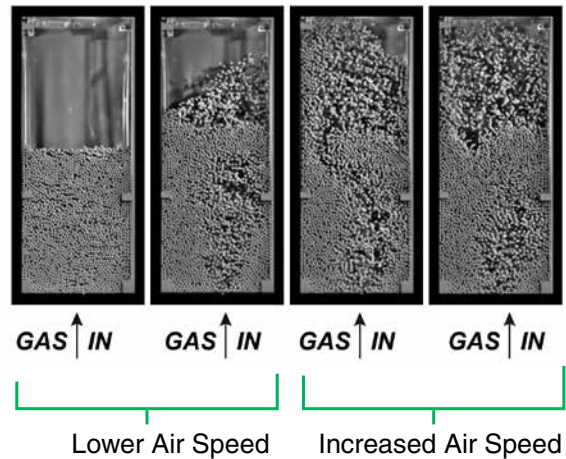
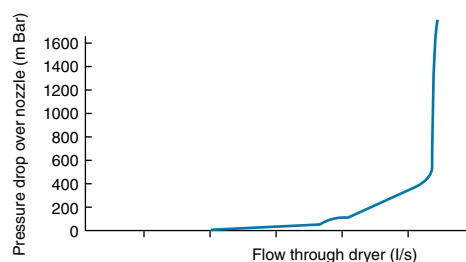


Image Source: <https://www.youtube.com/watch?v=IFhrpSJZzck>

Pneumatech has built inherent protection measures into the design of its adsorption dryers:

1. The desiccant of the PH2-310 extruded profile dryers is spring-loaded, keeping the desiccant within the confined volume at all times. This is in contrast to loose desiccant filling which can move and thus crush the desiccant.
2. Sonic nozzles are delivered with welded vessel PH-dryers (optional) and all PE- and PB-dryers. The sonic nozzle limits the air flow speed through the dryer to a safe level of maximum 0,25m/s / 0,8ft/s inside the vessels, so that no damage is caused to the desiccant. If for any reason more air is passing through the dryer, the pressure drop over the nozzle increases so dramatically that the air speed is limited again.



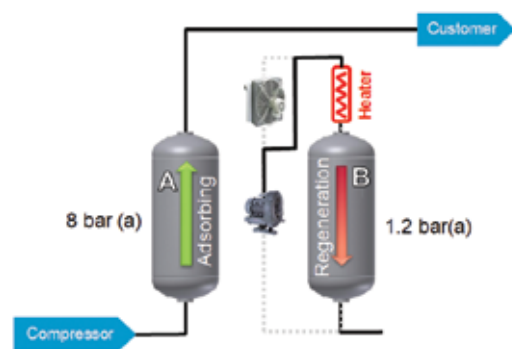
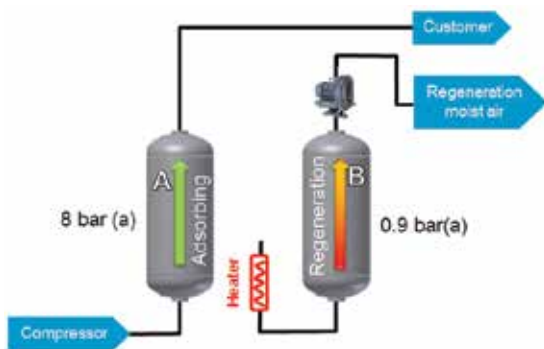
3. Pneumatech vessels typically have larger diameters than the competition. This results in a lower air speed, therefore reducing the risk of desiccant crushing.



#### D. Counter-current regeneration for optimal energy efficiency and guaranteed dry air (PH, PE, PB)

Counter-current regeneration is regeneration from the top to the bottom of the vessel; meaning opposite to the drying direction. Counter-current regeneration saves approximately 50% in required regeneration energy compared to co-current regeneration (i.e. regeneration in the same direction as drying).

The reason is simple: in an adsorption dryer, the bulk of the moisture is stored at the inlet side of the drying vessel.



During regeneration in a co-current way all this moisture will have to be transported through the entire vessel. Because the outlet end of the vessel is still relatively dry, the moisture that is transported from the bottom side will be re-adsorbed at the outlet and the regeneration air will leave the vessel hot but still dry. This means a loss of energy.

In a counter-current regeneration, the regeneration air will always leave the vessel at the wet side, and will always be in equilibrium with the wet inlet side, i.e. completely saturated, transporting the maximum amount of moisture out of the vessel. In other words: every Joule of regeneration energy that is put into the vessel during regeneration is used to its full extent, which is not the case in a co-current regeneration.

Counter-current regeneration is a guarantee of a good dewpoint performance of the dryer, whatever the working conditions are. Under severe working conditions (i.e. high ambient temperature or high humidity) the regeneration will inevitably be slower, both in co-current as in counter-current designs, and there is a risk that it is not completely finished within the regeneration time frame. In those cases, for a co-current regeneration dryer, the top layer (that is also the dewpoint determining layer) will remain wet. For a counter-current dryer it is the bottom layer that will remain wet, which will cause no problems at all for the dewpoint.

Additionally, counter-current regeneration is the safest choice, as there is no risk of accidentally igniting oil polluted desiccant (at the bottom) with hot regeneration air (coming in from the top). Desiccant material can become polluted with oil, if inlet filters have not been serviced properly.



#### DO YOU KNOW THAT?

High air speeds typically occur in the following situations:

- Wrong start up procedure: without pressurization of the dryer vessel
- Buffer vessel installed between compressor and dryer
- Installations with multiple compressors/dryers; not 1-to-1 setup
- Applications where air is used at low pressure after the dryer (e.g. pipe line drying)
- Installations with regular start/stop
- Applications with high fluctuating air demands
- Wrong selection of dryer size: too high air flow / too low working pressure
- Installations with standby compressor but no standby dryer, where dryer is only sized for standard load

## Features and benefits explained

### E. Robust vessel and piping design

- ▶ Stable performance over the entire lifetime
- ▶ Safe operation

### F. Highly reliable valve selection

- ▶ Stable performance over the entire lifetime
- ▶ Low maintenance costs

### G. Carefully selected silencers

- ▶ Lowest noise levels
- ▶ Lowest operating costs
- ▶ Safe operation

### H. Designed for transportability & mountability

- ▶ Easy handling

### I. High efficiency heaters

- ▶ Lowest operating costs
- ▶ Safe operation

### J. Compact, efficient and reliable side channel centrifugal blowers

- ▶ Lowest operating costs
- ▶ Low maintenance costs

### E. Robust vessel and piping design (PH, PE, PB)

All pressure vessels are made in Europe and are designed, manufactured and inspected according to recognized regulations and standards (ASME VIII div 1, ISPEL VSR). This ensures that all vessels are **designed for continuous fatigue load** from 0 bar up to the design pressure for a minimum lifetime of 10 years.

International approvals such as ASME (USA), CRN (Canada), MOL (China), MOM (Singapore), AS1210 (Australia) are available on request.

All piping is completely hot-dip galvanized and makes use of flanged connections for easy maintenance and maximum leak tightness. All piping is sufficiently sized to ensure low pressure drop and maximum energy efficiency.



### F. Highly reliable valve selection (PH, PE, PB)

The vessel designs are equipped with reliable two-way carbon steel butterfly valves, with stainless steel disks. The valves are individually controlled by a pneumatic actuator. This avoids high torque requirements on the actuators.



Each valve of the large PB range is equipped with limit switches, which return an alarm to the Purelogic™ controller in the unlikely event that a valve does not open or close.

*Note: In case of loss of supply voltage the regeneration valves will close down but the active vessel will continue to supply high-purity air to the downstream network.*

### G. Carefully selected silencers guarantee high energy efficiency, low noise levels and maximum safety (PH, PE, PB)

The pressure drop over the silencer (and by extension the entire exhaust system including valves) has an important influence on the purge rate; and therefore the energy efficiency of the adsorption dryer. 100mbar / 1.45 PSI additional pressure drop over the silencer results in 8% increase in purge loss! Thanks to their up-sized silencers with advanced mufflers, Pneumatech adsorption dryers have the ideal balance between noise level reduction and energy efficiency.

*Note: In order to avoid inefficient operation, the Purelogic™ controller gives a service warning when the regeneration pressure drop exceeds 250 mbar/ 3.63 PSI.*

To guarantee safety, all silencers are designed for 100% working pressure and are equipped with integrated safety valves which open when the silencers get clogged.



*Note: Dust release is inevitable for adsorption dryers. Adsorption dryer variants made out of extruded profile design have filter mats included in order to minimize dust release. However, it is recommended to replace the downstream filter cartridges once a year to avoid clogging.*

### H. Designed for transportability & mountability (PH, PE, PB)

All dryers feature forklift slots and lifting eyes for **easy handling**. The lifting eyes are designed to carry the full dryer weight. The center of gravity has been carefully considered during the design phase to avoid any risk of tilting during transportation.



To minimize the total unit height, all flange connections are integrated into the top and bottom shells of the vessels.

### I. Heaters: High efficiency and maximum safety (for heat regenerated dryers only) (PE, PB)

The heater is integrated in an insulated heater pipe to **avoid energy losses**. The heater can easily be accessed for maintenance without any height restriction for disassembly, this is in contrast to heaters integrated in the vessels.

Furthermore, the heaters are designed for **maximum lifetime and minimal risk**:

- The heaters are made out of stainless steel and integrated in a nickel-plated heater pipe, to protect against corrosion.
- Large heaters are selected with a relatively low heat density (W/cm<sup>2</sup>) to guarantee the longest lifetime.
- They are equipped with a mechanical thermostat. This thermostat interrupts the electrical current through the heater when the temperature gets too high.
- If the heater becomes damaged, the heatless backup mode can be activated, a simplified sequence with only purge cooling as regeneration step and with adapted timing settings.

*Note: Optionally the vessels can also be insulated for further increase of the overall efficiency.*

### J. Blower: Compact, efficient and reliable side channel centrifugal blowers (for blower purge dryers only) (PB)

For the PB dryers a blower is used to transfer the atmospheric air over the external heater to the saturated desiccant during the regeneration phase of PB dryers. For PB Zero Purge dryers the blower is also used during the cooling phase.

To ensure the **lowest life cycle cost**, Pneumatech has opted for a side-channel centrifugal blower. This does not only result in a high efficiency level, it also guarantees maintenance-free operation for more than 24,000 operating hours.



The side-channel principle makes the blower very **compact and silent**. The motors comply with DIN EN 60034 and have IP 55 protection. The blowers are also UL/CSA approved and can be used without further testing all over the world.

## Features and benefits explained

### K. Purelogic™ controller

- ▶ Lowest operating costs
- ▶ Stable performance over the entire lifetime
- ▶ Guaranteed dry air
- ▶ Safe operation
- ▶ Optimal control & monitoring

### K. Purelogic™ controller

The Purelogic™ controller ensures increased reliability, lowest operating costs and optimal control and monitoring of the dryer.

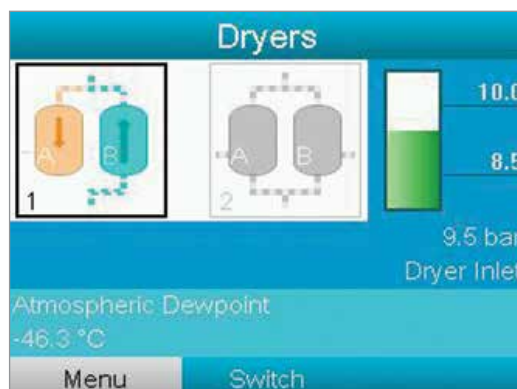
#### 1. User-friendly interface

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 within an IP54 protected cabinet. IP65 protected cabinets are also available on certain variants as an option. The keyboard is durable to resist tough treatment in demanding environments.



#### 2. Increased reliability

The Purelogic™ ensures safe and reliable operation by monitoring pressures, temperatures and digital switches. Warning and alarm levels are set for each of these parameters, as are service indicators. This ensures the customer can react to these warnings before any losses to production.



### 3. Lowest operating costs

The Purelogic™ controller incorporates all energy management systems described in section A of the Features and benefits chapter: Pressure Dew Point control, regeneration & cooling temperature control and compressor load/unload synchronization. Each function is clearly indicated through pictograms and LED indicators. All set-points can be easily altered through the user friendly interface.

Regulation	
PDP Extended Cycle	Not Activated
PDP Switching Temperature	-40 °C
PDP Alarm Offset	5 °C
Modify	

### 4. Optimal control and monitoring






The Purelogic™ can communicate with industrial protocols such as Modbus, Profibus or Ethernet/IP. Visualization via Ethernet/IP can be easily achieved by connecting the Ethernet port of the Purelogic™ to the local area network and then entering the corresponding

IP address into your web browser. A screen shot of this is shown below.

Additionally the Purelogic™ features remote start/stop capabilities.

Machine Preferences	Analog Inputs	Counters	Digital Inputs	Digital Outputs																																																																																												
	Special Protections	Service Plan																																																																																														
	<table border="1"> <thead> <tr> <th>Analog Inputs</th> <th>Value</th> </tr> </thead> <tbody> <tr><td>Pressure Vessel A</td><td>0.3 bar</td></tr> <tr><td>Pressure Vessel B</td><td>0.0 bar</td></tr> <tr><td>Heater Out</td><td>20.0 °C</td></tr> <tr><td>Temperature Bottom Vessel A</td><td>43.6 °C</td></tr> <tr><td>Temperature Bottom Vessel B</td><td>45.1 °C</td></tr> </tbody> </table>	Analog Inputs	Value	Pressure Vessel A	0.3 bar	Pressure Vessel B	0.0 bar	Heater Out	20.0 °C	Temperature Bottom Vessel A	43.6 °C	Temperature Bottom Vessel B	45.1 °C	<table border="1"> <thead> <tr> <th>Counters</th> <th>Value</th> </tr> </thead> <tbody> <tr><td>Running Hours Dryer</td><td>0 hrs</td></tr> <tr><td>Loaded Hours Dryer</td><td>0 hrs</td></tr> <tr><td>Standby Time</td><td>0 hrs</td></tr> <tr><td>Actual State Time</td><td>00:01:05</td></tr> <tr><td>Programmed State Time</td><td>03:00:00</td></tr> <tr><td>Actual Half Cycle Time</td><td>00:01:06</td></tr> <tr><td>Programmed Half Cycle Time</td><td>04:00:00</td></tr> <tr><td>Regeneration Cycles Vessel A</td><td>0</td></tr> <tr><td>Regeneration Cycles Vessel B</td><td>0</td></tr> <tr><td>Regeneration Cycles After Restart</td><td>0</td></tr> <tr><td>Heating Time</td><td>00:01:05</td></tr> <tr><td>Energy Saving PDP Sensor</td><td>0 %</td></tr> <tr><td>Average Heating Power</td><td>0.0 kW</td></tr> <tr><td>Module Hours</td><td>1 hr</td></tr> </tbody> </table>	Counters	Value	Running Hours Dryer	0 hrs	Loaded Hours Dryer	0 hrs	Standby Time	0 hrs	Actual State Time	00:01:05	Programmed State Time	03:00:00	Actual Half Cycle Time	00:01:06	Programmed Half Cycle Time	04:00:00	Regeneration Cycles Vessel A	0	Regeneration Cycles Vessel B	0	Regeneration Cycles After Restart	0	Heating Time	00:01:05	Energy Saving PDP Sensor	0 %	Average Heating Power	0.0 kW	Module Hours	1 hr	<table border="1"> <thead> <tr> <th>Info.</th> <th>Value</th> </tr> </thead> <tbody> <tr><td>Machine Status</td><td>A: Regeneration</td></tr> <tr> <th>Digital Inputs</th> <th>Value</th> </tr> <tr><td>Emergency Stop</td><td>Not Triggered</td></tr> <tr><td>Remote Start Stop</td><td>Triggered</td></tr> <tr><td>Heater Fuses</td><td>Not Triggered</td></tr> <tr><td>Overheating Switch</td><td>Not Triggered</td></tr> <tr> <th>Digital Outputs</th> <th>Value</th> </tr> <tr><td>Dryer Motor</td><td>Triggered</td></tr> <tr><td>General Shutdown</td><td>Not Triggered</td></tr> <tr><td>General Warning</td><td>Not Triggered</td></tr> <tr><td>Low Pressure Alarm</td><td>Not Triggered</td></tr> <tr><td>Pressure Relief Valve A</td><td>Triggered</td></tr> <tr><td>Pressure Relief Valve B</td><td>Not Triggered</td></tr> <tr><td>Main Heaters</td><td>Triggered</td></tr> <tr> <th>Special Protections</th> <th>Level</th> </tr> <tr><td>Low Inlet Pressure</td><td>A</td></tr> <tr><td>Failed To Pressurize</td><td>A</td></tr> <tr><td>Expansion Module Communication</td><td>A</td></tr> <tr><td>Dryer Unloaded</td><td>A</td></tr> <tr> <th>Service Plan</th> <th>Level</th> </tr> <tr><td>4000</td><td>A</td></tr> <tr><td>4350</td><td>A</td></tr> <tr><td>5000</td><td>B</td></tr> <tr><td>5760</td><td>B</td></tr> </tbody> </table>	Info.	Value	Machine Status	A: Regeneration	Digital Inputs	Value	Emergency Stop	Not Triggered	Remote Start Stop	Triggered	Heater Fuses	Not Triggered	Overheating Switch	Not Triggered	Digital Outputs	Value	Dryer Motor	Triggered	General Shutdown	Not Triggered	General Warning	Not Triggered	Low Pressure Alarm	Not Triggered	Pressure Relief Valve A	Triggered	Pressure Relief Valve B	Not Triggered	Main Heaters	Triggered	Special Protections	Level	Low Inlet Pressure	A	Failed To Pressurize	A	Expansion Module Communication	A	Dryer Unloaded	A	Service Plan	Level	4000	A	4350	A	5000	B	5760	B	
Analog Inputs	Value																																																																																															
Pressure Vessel A	0.3 bar																																																																																															
Pressure Vessel B	0.0 bar																																																																																															
Heater Out	20.0 °C																																																																																															
Temperature Bottom Vessel A	43.6 °C																																																																																															
Temperature Bottom Vessel B	45.1 °C																																																																																															
Counters	Value																																																																																															
Running Hours Dryer	0 hrs																																																																																															
Loaded Hours Dryer	0 hrs																																																																																															
Standby Time	0 hrs																																																																																															
Actual State Time	00:01:05																																																																																															
Programmed State Time	03:00:00																																																																																															
Actual Half Cycle Time	00:01:06																																																																																															
Programmed Half Cycle Time	04:00:00																																																																																															
Regeneration Cycles Vessel A	0																																																																																															
Regeneration Cycles Vessel B	0																																																																																															
Regeneration Cycles After Restart	0																																																																																															
Heating Time	00:01:05																																																																																															
Energy Saving PDP Sensor	0 %																																																																																															
Average Heating Power	0.0 kW																																																																																															
Module Hours	1 hr																																																																																															
Info.	Value																																																																																															
Machine Status	A: Regeneration																																																																																															
Digital Inputs	Value																																																																																															
Emergency Stop	Not Triggered																																																																																															
Remote Start Stop	Triggered																																																																																															
Heater Fuses	Not Triggered																																																																																															
Overheating Switch	Not Triggered																																																																																															
Digital Outputs	Value																																																																																															
Dryer Motor	Triggered																																																																																															
General Shutdown	Not Triggered																																																																																															
General Warning	Not Triggered																																																																																															
Low Pressure Alarm	Not Triggered																																																																																															
Pressure Relief Valve A	Triggered																																																																																															
Pressure Relief Valve B	Not Triggered																																																																																															
Main Heaters	Triggered																																																																																															
Special Protections	Level																																																																																															
Low Inlet Pressure	A																																																																																															
Failed To Pressurize	A																																																																																															
Expansion Module Communication	A																																																																																															
Dryer Unloaded	A																																																																																															
Service Plan	Level																																																																																															
4000	A																																																																																															
4350	A																																																																																															
5000	B																																																																																															
5760	B																																																																																															

# Compressed air purity




Product	Compressor	Water separator	Coalescing filter – general protection	Coalescing filter – high efficiency	Adsorption dryer	
						
Contaminant		Water aerosol	Oil aerosol & wet dust	Oil aerosol & wet dust	Water vapor	
Pneumatech reference		SW	G	C	PB/PE/PH	
	Oil-injected	•	•	•	•	
		•	•	•	•	
		•	•	•	•	
	Oil-free without oil vapors at inlet	•			•	•
		•			•	•
		•			•	•
	Oil-free with oil vapors at inlet	•			•	•
		•			•	•
		•			•	•




At different points of use, different compressed air purities might be needed, depending on the application. ISO8573-1:2010 is the latest international standard for compressed air purity specification and defines purity classes for compressed air with respect to solid particles, water and oil.

The table specifies which ISO8573-1:2010 purity classes are reached for certain combinations of Pneumatech adsorption dryers and filters.

## General guidelines

- You always need to install a water separating device in front of a coalescing filter. This can be either a freestanding version (SW) or an integrated water separating device in the after cooler.
- You always need to install a dryer in front of an oil vapor removal filter (VT/V).
- It is recommended to install a G - C combination in front of an adsorption dryer, in case of oil-injected compressors.
- It is recommended to install an additional P pre-filter upstream the G filter in case of heavy contamination.
- In case of critical applications, it is better to install air treatment products at point of use, in order to make sure that pipeline contamination is removed.

Activated carbon tower	Particulate filter – general protection	Particulate filter – high efficiency
		
Oil vapor	Dry dust	Dry dust
VT/V	S	D
•	•	•
•	•	
	•	
	•	•
	•	
•	•	•
•	•	
•		

ISO8573-1:2010 class		
		
Solid	Water	Total oil
1	1-3	≤ 1
2	1-3	≤ 1
2	1-3	2
–	1-3	2
1	1-3	0
2	1-3	0
–	1-3	0
1	1-3	0
2	1-3	0
–	1-3	0

### ISO8573-1:2010 purity classes

Purity Class	Solid particles			Water		Total Oil*
	Number of particles per m <sup>3</sup>			Pressure dewpoint		Concentration
	0.1 < d ≤ 0.5 μm**	0.5 < d ≤ 1.0 μm**	1.0 < d ≤ 5.0 μm**	°C	°F	mg/m <sup>3</sup>
0	As specified by the equipment user or supplier and more stringent than Class 1.					
1	≤ 20.000	≤ 400	≤ 10	≤ -70	≤ -94	≤ 0.01
2	≤ 400.00	≤ 6.000	≤ 100	≤ -40	≤ -40	≤ 0.1
3	–	≤ 90.000	≤ 1.000	≤ -20	≤ -4	≤ 1
4	–	–	≤ 10.000	≤ 3	≤ 37.4	≤ 5
5	–	–	≤ 100.000	≤ 7	≤ 44.6	–
6	≤ 5 mg/m <sup>3</sup>			≤ 10	≤ 50	–

\* Liquid, aerosol and vapor    \*\* d= diameter of the particle





Pneumatech reserves the right to change or revise specifications and product design in connection with any features of our products. Such changes do not entitle the buyer to corresponding changes, improvements, additions or replacements for equipment previously sold or shipped.

© 2017 Pneumatech. All rights reserved.

