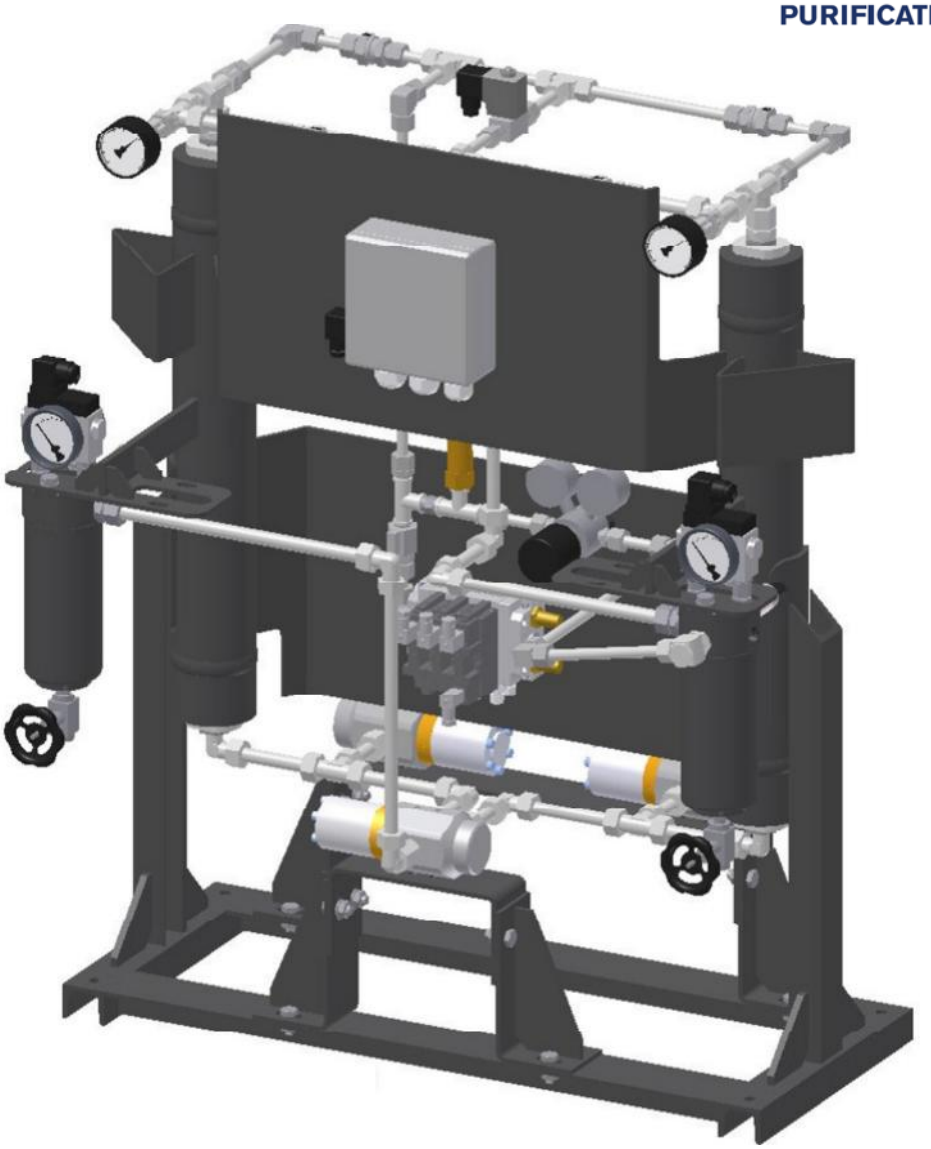

DHP - 350 (includes Filters with optional pressure differential gauges)
Designed for 5075 psig

Operating Manual Adsorption Dryer DHP 1450 – 5075 psi (100 – 350 bar)

Version: 04/2013/EN

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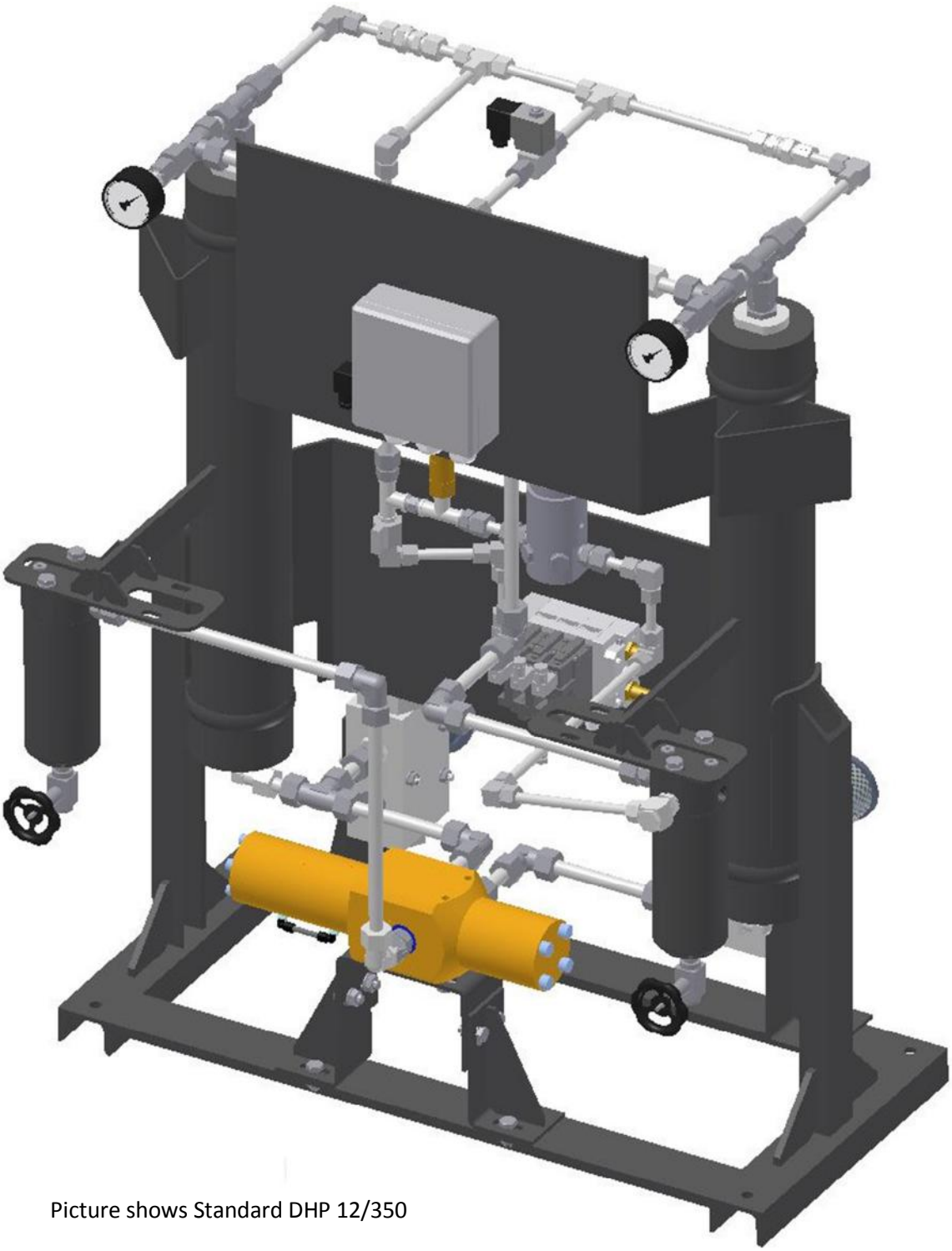
nano – purification solutions
11330 Vanstory Drive • Huntersville, NC 28078
PH 704-897-2182 • FAX 704-897-2183 • www.n-psi.com



Picture shows Standard DHP 12/350

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1. General information

1.1 Manufacturer

nano-purification solutions

Manufacturing facility: Netphen, Germany

Sales office: Huntersville, NC USA

704.897.2182

704.897.2183

Web: www.n-psi.com

Questions about the product? Please contact our sales office

In case of questions about the product, please specify the type and the manufacturing number. This information can be found on the type plate over the control box of the dryer. (→Page 12)

1.2 Dryer data

Model:	
Order no.:	
Manufacturing no.:	
Vessel no. (left/right):	
Year of manufacture:	
Date of commissioning:	

1.3 Contact data

Name:	
Company:	
Address:	
Phone / Fax:	
E-mail:	

The above dryer data differs for each dryer. Please fill in the fields according to the type plate and your contract documents. This data enables the manufacturer to clearly identify the dryer and simplifies service and provision of the proper spare parts.

Some of the information listed here and other important data can be found on the type plate of the dryer and on the type plate of the vessels. (→Page 12)

1.4 Additional documents

- General arrangement drawing
- Process flow diagram
- Wiring diagram
- CE-declaration of conformity (ASME and other codes available upon request)

Note on additional documents

Additional documents (e.g. of the components) must be adhered to. They contain additional information, e.g. on maintenance, and are therefore necessary for safe operation of the dryer.

The customer is provided with pressure vessel documents, if applicable

1.5 Warranty notes

For warranty information, please refer to our "General Terms of Sale and Delivery".
(→ www.n-psi.com)

In the following cases the warranty shall be void:

- If the safety notes and instructions of this operating manual and of the additional documents are not observed.
  - If the dryer is operated or maintained by personnel who do not have the required qualifications. (→ see "Authorized Personnel": (→ see “Authorized Personnel”: Page 7)
- If the dryer is used for anything other than its intended use. (→ Page 9)
- If aggressive substances in the compressed air or ambient air cause damage to the dryer.
- If parts other than genuine parts of the manufacturer have been used for maintenance and repair.
- If the dryer is operated although defects are evident.

1.6 About this operating manual

This operating manual contains all the technical information required for installation, operation, maintenance and disposal of the dryer.

Authorized Personnel

This operating manual is directed to all persons working on and with the dryer. We point out that these persons have to be qualified personnel who, because of their qualification and experience, are familiar with handling compressed air systems and electrical systems. If you are not experienced in using these systems, please ask the relevant experts for help. We highly recommend that commissioning and maintenance be carried out by the manufacturer or one of the authorized service partners.

Using the operating manual

Please read the operating manual and the additional documents carefully prior to installation and follow the notes and instructions. Safe and proper operation of the dryer can only be guaranteed if the instructions and notes are observed. The safety notes must be observed in particular.

The operating manual must be kept in the vicinity of the dryer and must be easily accessible.

When delivering the dryer to a customer, provide this operating manual and all the additional documents to the new user. (→Page 6)

The manufacturer accepts no liability for damages resulting from disregard of the operating manual.

All the information in this operating manual is valid at the time the manual is published. Due to component or workflow modifications at any time affecting dryer maintenance, the latest information should be available prior to maintenance work.

Signs and symbols used

- Boxes are used for bulleted lists.

1) Enumerated lists point out that the working steps are to be carried out in a specified order.

→ Cross references refer to information on a different page or in a different document.

Note!
This symbol refers to matters that should be given special attention.
Observing the notes helps to ensure safe handling of the product.

Tips and hints!
This symbol refers to matters that should be given special attention.
Observing these advisory notes helps to ensure particular efficient operation of the product.

CAUTION !
This symbol indicates a possible harmful situation.
When not avoiding this situation, there is a danger of injury or damage to the product or to adjacent system components.

WARNING !
This symbol indicates a possible dangerous situation.
When not avoiding this situation, there is a danger of serious injury or death.

DANGER !
This symbol indicates an immediate impending danger.
Not avoiding this danger results in serious injury or death.

2. Description of application

The dryer is used to remove moisture from compressed air for industrial use.

Typically, the dryer is used for drying compressed air from a compressor station.

During pre-treatment of the compressed air by means of separators and fine filters only the liquid water components can be removed from the compressed air. After this pre-treatment the dryer also removes the vaporous water components. The compressed air is dried until only a very low residual concentration of water vapor remains in the dried compressed air. This residual moisture content is measured as the pressure dew point in °F or °C.

The dryer works completely automatically and is designed for continuous operation. Thanks to numerous communication interfaces and an optionally available moisture measuring system the dryer can be operated very economically.

2.1 Intended use

The dryer is exclusively designed for drying compressed air!
Using the dryer for drying other gases (e.g. pure nitrogen) must be agreed on with the manufacturer. It may be necessary to observe special safety directives.

The dryer is designed to be set up at a site that complies with the following requirements:

- Indoors
- Protected against weather impact
- Frost-free
- Dry
- Zero to low dust laden ambient air
- No vibration via floor or connected piping
- Ambient air must be free from aggressive and corrosive substances
- Ambient air must be free from substances that damage the desiccant or influence its effectiveness
  ammonia or other alkaline-reacting substances, oil mist, water spray or drizzle)
- Free from dangers due to explosive atmospheres inside and outside the dryer. (The standard dryer version does not comply with ATEX.)

The dryer must only be operated with compressed air within the maximum allowable operating conditions.
The voltage supply must correspond to the specified values.
The maximum allowable operating conditions and the required voltage supply are specified on the type plate (→Page 12).

Modifications to the dryer or use of third-party parts may cause unpredictable danger and damage. These measures must only be carried out after previous check and approval of the manufacturer. Only use genuine spare parts of the manufacturer.

Any other use is considered improper and therefore not permissible. The manufacturer accepts no liability caused by improper use.

The values specified on the type plate are mechanical design limits.
Please note that dryer performance is not defined to these mechanical design limits. Dryer performance is guaranteed for use under the "nominal operating conditions" as well as for a certain combination of the individual operating parameters, that has been established for this dryer in the planning phase (compressed air flow rate, pressure, temperature, desired pressure dew point).

For the nominal operating conditions please refer to the following table. (→Page 11)
For a dryer designed to your individual operating conditions, please refer to your contract documents or contact the manufacturer.

Dryer performance cannot be guaranteed if the dryer is not operated within these operating conditions.

The supplied compressed air must be of the following quality:

- Free from aggressive and corrosive substances
- Filtered acc. to ISO 8573-1:2010 (1:*:3)
- Free from substances damaging the desiccant

*= The compressed air should be saturated with moisture or only be slightly sub-saturated. When using pre-dried compressed air (e.g. downstream of a fridge dryer) the dryer performance may be reduced.
During initial commissioning and after desiccant replacement in particular, pre-dried compressed air may negatively affect dryer performance.

TIPP

In the event of pre-dried compressed air
For some days, operate the dryer using moisture-saturated compressed air in order to activate the desiccant. For this activation process the dryer control system should be set as follows:

1) Select the "variable" cycle mode. (→ Page 29)
2) Select a dew point limit value that can still be tolerated, however, it must not be worse than 14°F (-10°C) (→ Page 30)

The dew point should become better within the next few days.

3) Monitor the development of the dew point measured value for several days.
4) Select a dew point limit value that is approximately 50°F (10°C) worse than the dewpoint that is usually reached, however, it must not be worse than 14°F (-10°C).

Usually, dryer performance will be adequate after this procedure even when using pre-dried compressed air. If the dew point becomes worse again at a later point in time, the procedure must be repeated.

Example:

- The dryer is to be a dew point of -40°F (-40°C.) However, in most cases it only reaches -22°F (-30°C.)
- Select the "variable" cycle mode and then a dew point limit value of -4°F (-20°C.)
- The adsorption phases of the dryer are now very long and thus the dryer is increasingly laden with moisture.
- After several days the dew point becomes better and reaches values around -67°F (-55°C.)

Now, select a dew point limit value of -40°F (-40°C.) The dryer should now permanently reach good dew point values.

2.2 Technical data

Dryer	Nominal volume flow rate	Max. allowable pressure (PSI)	Compressed air connection	Weight	Height	Width	Depth	Classification acc. to PED 97/23/EG
	V [scfm]*	[psi]		[Lbs]	[In]	[In]	[In]	
DHP 5/100	42	1450	G 1/2" or G 3/4" - depending on filter size, which will be selected for operating conditions acc. flow rate and operating pressure	221	44.10	26.38	24.21	II
DHP 9/100	51	1450		243	48.03	26.38	24.21	II
DHP 12/100	90	1450		276	48.03	25.59	24.21	II
DHP 24/100	167	1450		320	53.15	27.56	24.21	II
DHP 37/100	253	1450		441	54.72	29.53	24.21	III
DHP 58/100	442	1450		606	66.93	31.89	24.21	III
DHP 5/250	68	3625		243	44.10	26.38	24.21	II
DHP 9/250	82	3625		265	48.03	26.38	24.21	II
DHP 12/250	159	3625		309	48.03	25.59	24.21	II
DHP 24/250	294	3625		419	53.15	27.56	24.21	III
DHP 37/250	471	3625		540	54.72	29.53	24.21	III
DHP 58/250	824	3625		728	66.93	31.89	24.21	IV
DHP 5/350	88	5075		265	44.10	26.38	24.21	II
DHP 9/350	106	5075		287	48.03	26.38	24.21	II
DHP 12/350	177	5075		353	48.03	25.59	24.21	III
DHP 24/350	309	5075		485	53.15	27.56	24.21	III
DHP 37/350	500	5075		617	54.72	29.53	24.21	IV
DHP 58/350	918	5075		827	66.93	31.89	24.21	IV

* = Standardized to 14.5 psi (1 bar(a)) and 68°F (20°C) as well as to the following operating conditions: 1450, 3625 & 5075 psi (100, 250 & 350 bar) operating pressure, 95°F (35°C) inlet temperature and -40°F (-40°C) pressure dewpoint

Fluid group	2
Supply voltage	230V 50-60Hz (optional 115V 50-60Hz and 24V-DC)
Class of protection	IP65
Min. required operation pressure	145 psi (10 bar) required to actuate the valves)
Min. / max. allowable temperature (TS)	34°F to 140°F (1 to 60°C)
Noise pressure level Free field measurement in distance of 3.3 Ft. (1 m)	up to 125 dB(A)

Individual operating conditions
Please contact the manufacturer when your operating conditions are not within the limits stated above. Options adapting the dryer to your operating conditions can be provided for numerous special cases.

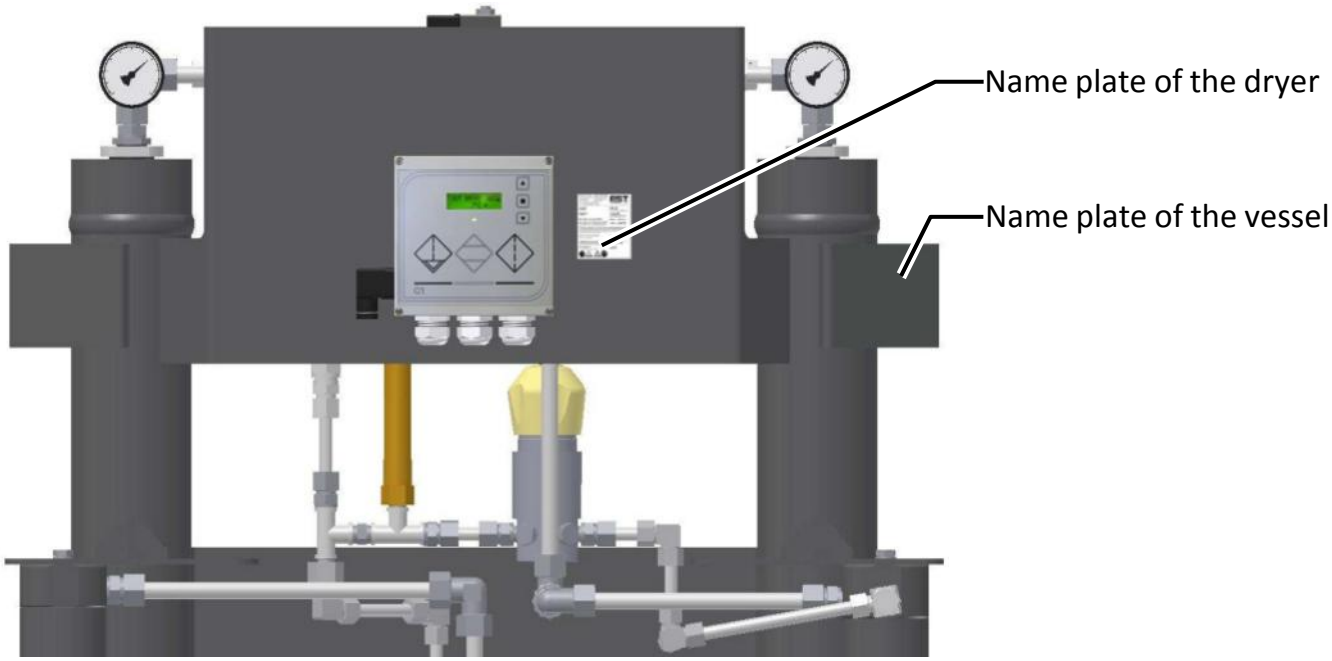
3. Safety notes

The dryer has been built according to state-of-the-art technology and recognized safety rules. However, there is a risk of danger that every person working with the dryer must be aware of. In particular, improper handling of compressed air and electricity may result in serious injury or death. If you are not experienced in using these systems, please ask the relevant experts for help..

Note!

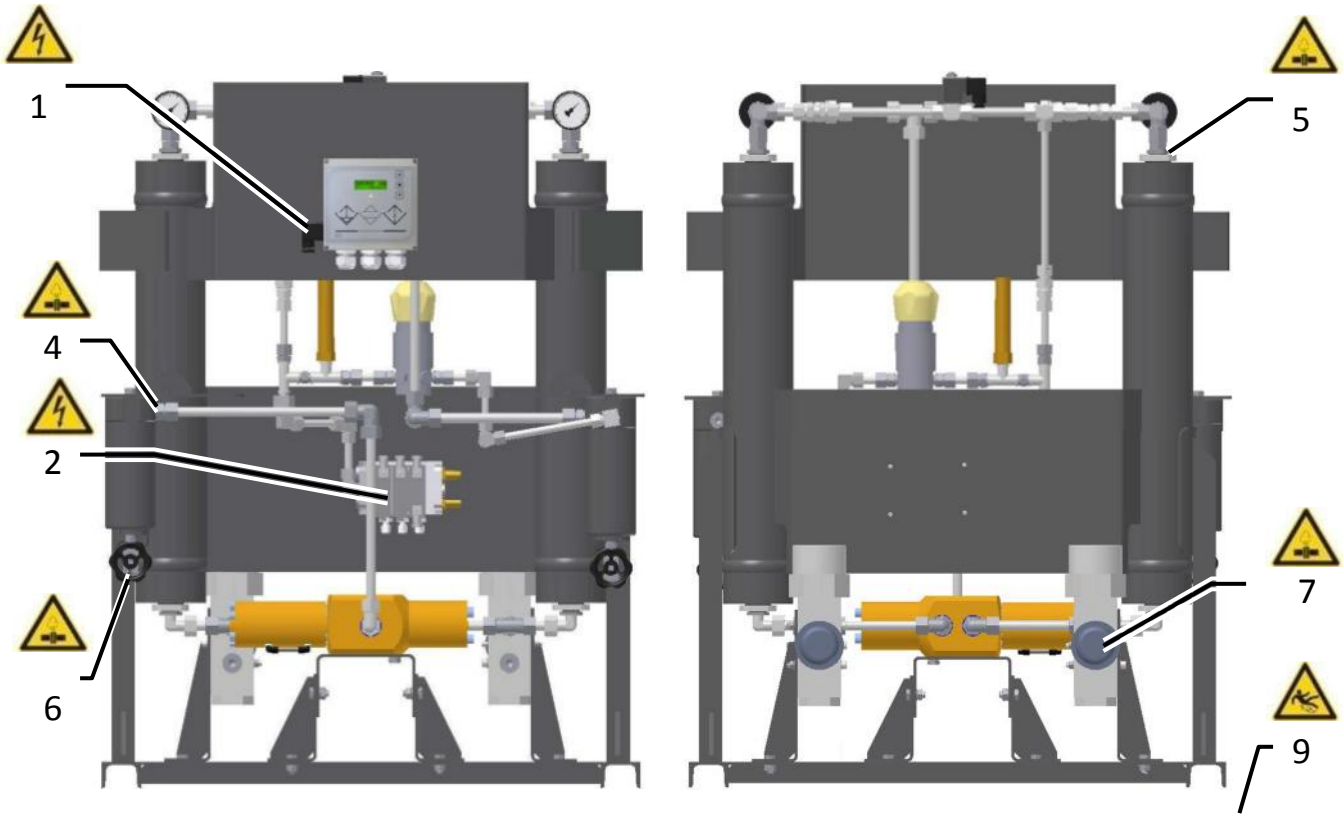
- In order to prevent personal injury or damage, the safety notes must be observed when using this dryer.
- Observe the specific safety notes in the relevant chapters.
- Observe the legal guidelines and the accident prevention regulations.
- Observe the safety notes of the local site regulations.

3.1 Signs and instructions



The name plates show important information. Make sure that the name plates are always clearly viewable.

3.2 Danger zones on the dryer



1;2	Risk of injury from electric voltage
4;5	Risk of injury from pressure-bearing parts
6;7	Risk of injury from suddenly escaping compressed air
9	Risk of slipping due to spilled desiccant

DANGER ! – Overpressure (4;5)
The dryer is under pressure.
Suddenly escaping compressed air may result in serious injury.
Do not carry out mechanical or electrical work on the dryer as long as the dryer is under pressure.

DANGER ! – Electric voltage (1;2)
The dryer is operated electric voltages up to 230 V.
Touching live parts may result in serious injury or death.
Work on electrical components must only be carried out by qualified and authorized personnel. Use a voltage detector to make sure the dryer has been disconnected from the power supply and that there are no live parts before starting maintenance work.
In the event of fire, do not extinguish the fire using water.

WARNING ! – Suddenly escaping compressed air (6;7)
The dryer is depressurized approximately every 10 Minutes using a silencer (7). A loud and strong airstream may carry small particles and cause injury.
Do not place any equipment in the vicinity of the silencer. The silencer must not be manipulated or removed. Always wear hearing protectors when working in the vicinity of the dryer.

WARNING ! – Risk of slipping (9)
After desiccant replacement some amounts of desiccant may still remain on the floor.
The desiccant is very slippery and may result in serious fall injury.
Immediately remove residual desiccant properly from the floor.

3.3 General safety notes

DANGER ! – Overload
The dryer must only be operated with compressed air within the maximum allowable operating conditions. The operating conditions are defined on the type plate (→ page 12).
Exceeding the maximum allowable operating conditions may result in serious injury or death.
It is the duty of the operator to ensure that the connected pressure source is safe-guarded such that the maximum allowable operating pressure (PS) and the maximum allowable temperature (TS) are not exceeded.
Please also refer to section "Intended use" (→ page 9).

DANGER ! – Unauthorized modifications
Modifications to the dryer or the dryer control system may result in dangerous operating states. Violations may cause serious injury or death.
Never modify the dryer function by means of conversions.
Never carry out welding work on pressure-bearing parts.
Never change the control program of the dryer.

Any modifications of the dryer must be agreed on with the manufacturer and confirmed in writing.

DANGER ! – Suspected misuse
Using the dryer for unintended purposes may result in dangerous situations. Violations may cause serious injury or death.
Never use the dryer as a climbing aid.
Never use the dryer as a support for external weight loads.
Never use dryer components for unintended application purposes.

Please also refer to section "Intended use" (→ page 9).

WARNING ! – Risk of falls
The dryer must never be used as a climbing aid. The dryer components will not provide adequate support and parts of the dryer may break off. Disregard may lead to dryer damages and falls with serious injuries.
When working at height only use approved climb assist systems.

CAUTION ! – Desiccant dust
Using the desiccant may lead to mineral dust formation.
Desiccant dust may cause eye and respiratory tract irritations.
Wear eye protection and a dust mask when handling the desiccant.

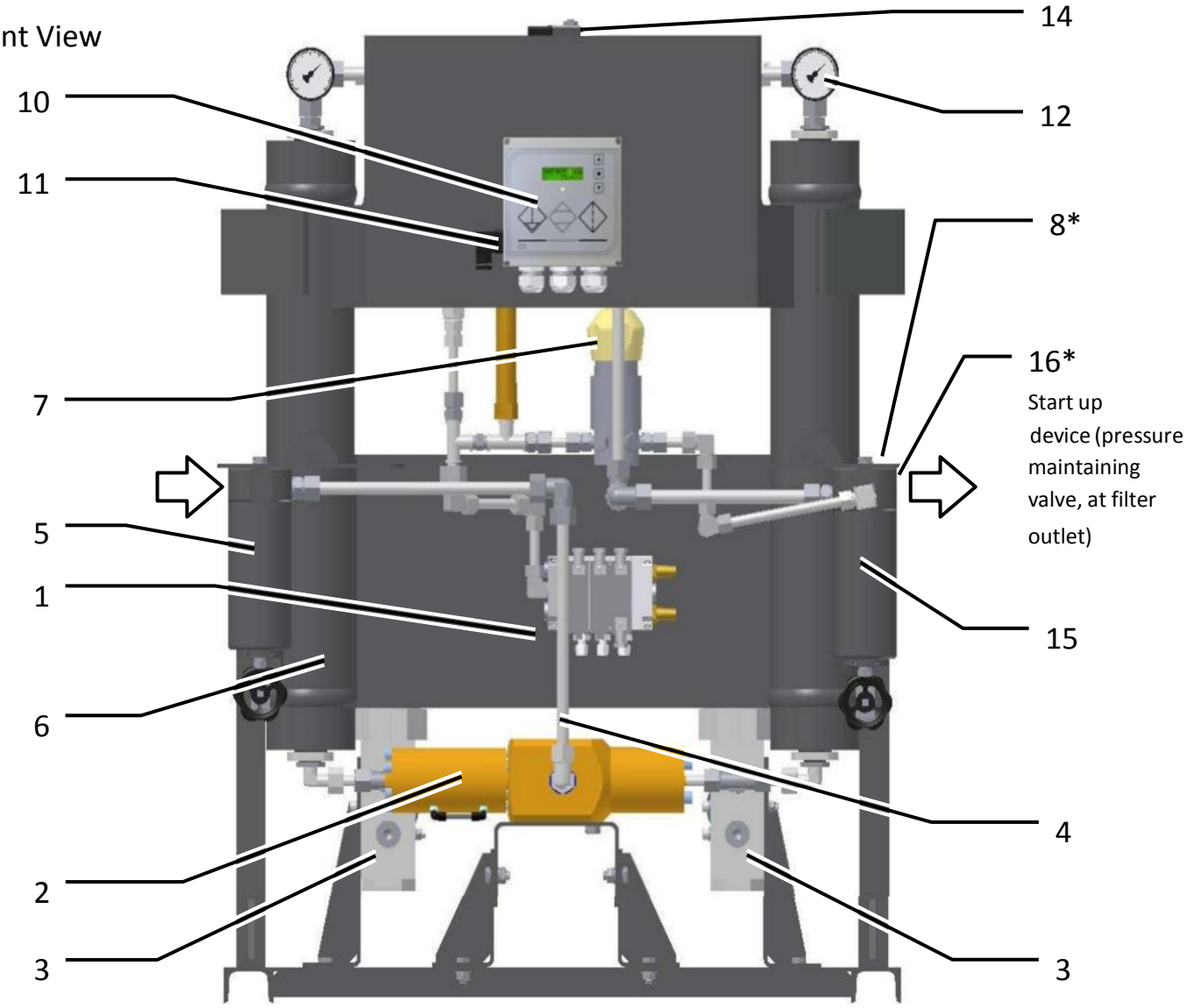
Desiccant
The desiccant used is not subject to labeling requirements according to the Hazardous Substances Ordinance. Nevertheless, the common safety measures with regard to using chemicals apply.
The manufacturer will provide safety data sheets on request.
The desiccant may accumulate contaminants from the compressed air. Depending on the type of contamination there may be a risk of injury or damage when using the desiccant. As the type of contamination is not known to the manufacturer, the resulting risks cannot be evaluated in this operating manual.

Additional safety notes
For additional safety notes, please refer to the relevant chapters.

4. Technical product description

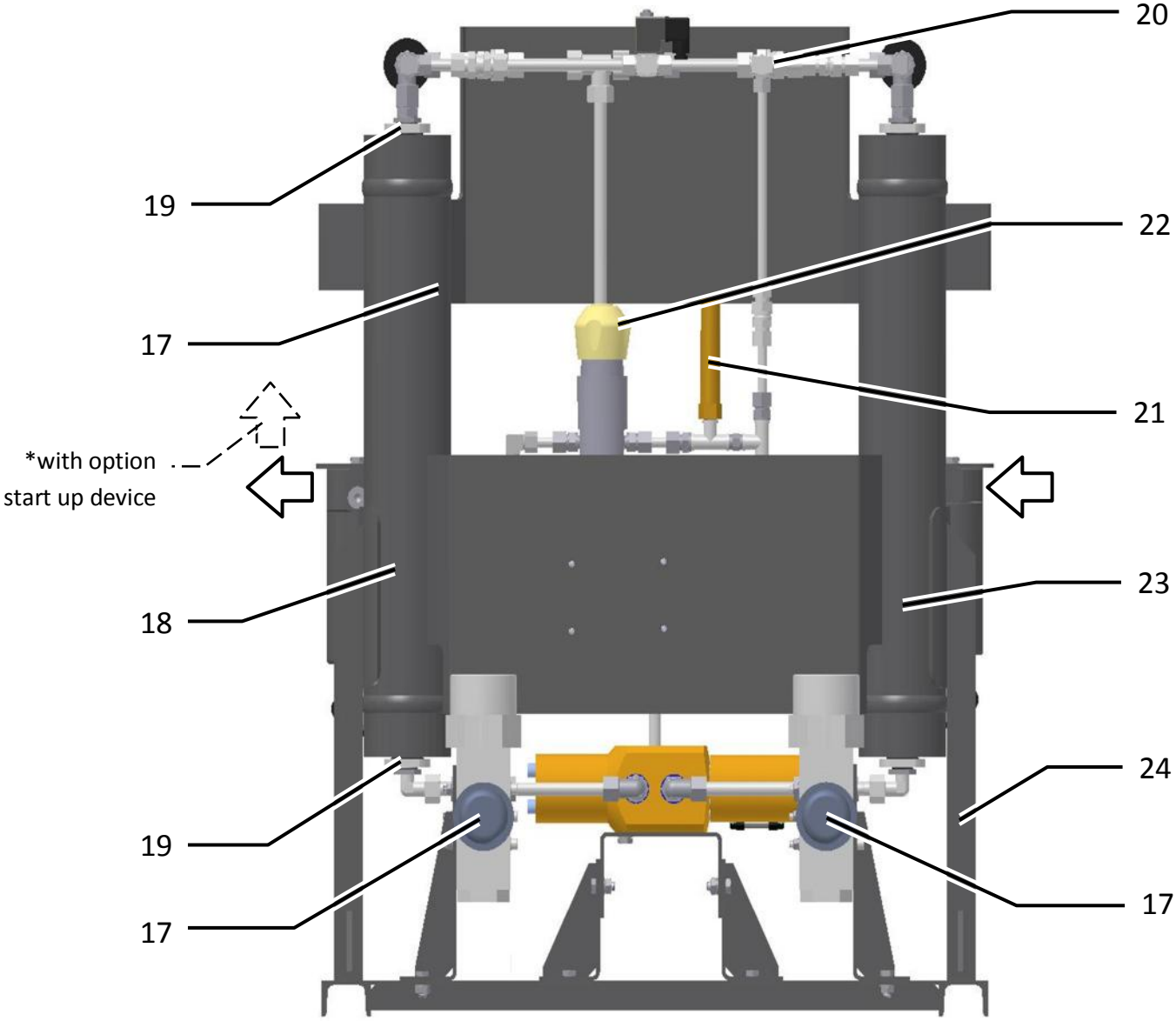
4.1 Assembly drawing

Front View



1	Solenoid pilot valves (Y1-Y3)	10	Control with display and operator keys
2	Main inlet valve with pneumatic actuator	11	Power Connector (power supply)
3	Exhaust and regeneration valves (V3/V4)	12	Pressure gauge (PI01, PI02)
4	Inlet piping	13	Pressure gauge (PI03) for regeneration and control air
5	Pre-filter (F1) incl. filter element	14	Pressurization valve (V5)
		15	After-filter (F2) incl. filter element and compressed air outlet (GO)
7	Control air (pressure regulator)		
8	Dew-point sensor (MT01) (*Optional) built into the head of after filter	16	Start-up device (*Optional)

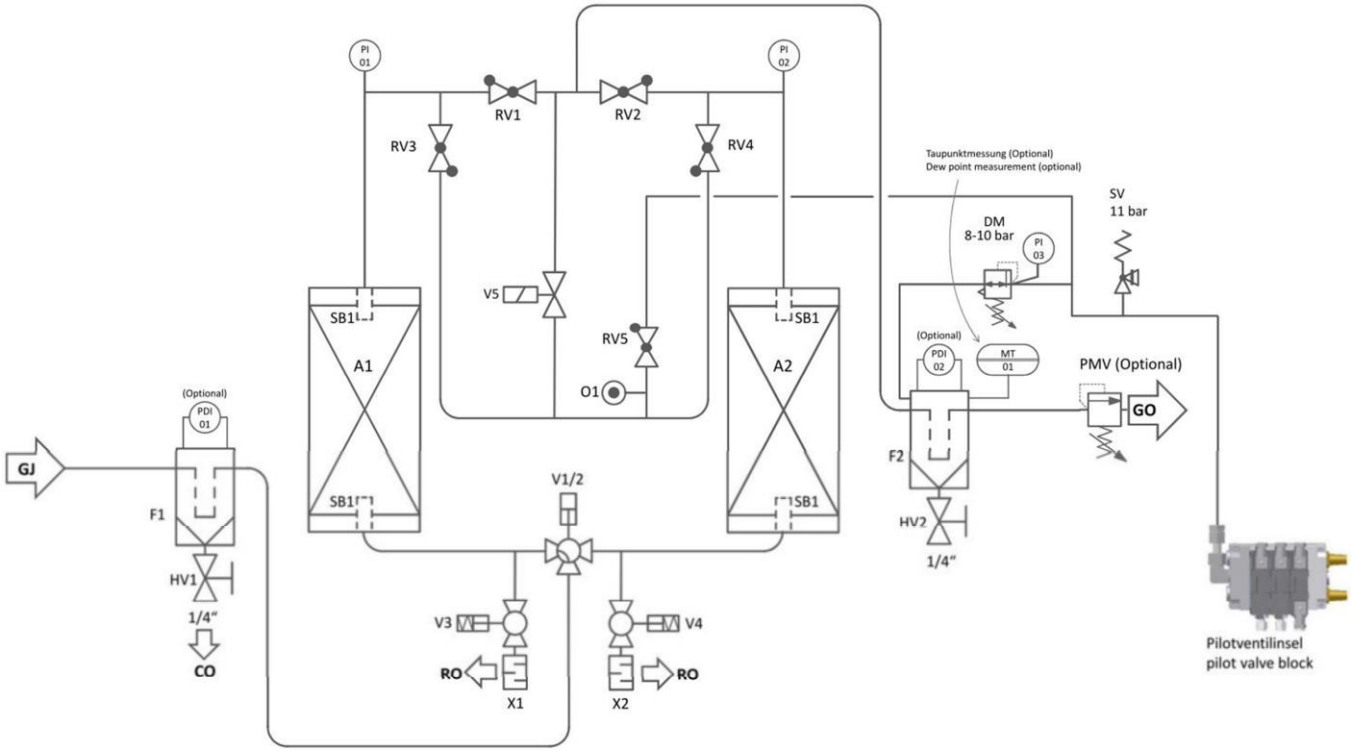
Rear view



17	Regeneration gas outlet (RO) with expansion silencer (X1)
18	Adsorber vessel 1
19	Flow distributor
20	Non return valves (RV1 – RV5)
21	Safety valve for control air
22	Outlet piping
23	Adsorber vessel 2
24	Dryer support legs

4.2 Process flow diagram

Symbolic diagram of the dryer components, their locations and interconnections.



A	Dryer vessel	O	orifice
F	Filter	X	Expansion silencer
V	Main valves		
HV	Manual Valve	SB	Flow distributor
NV	Needle valve		
RV	Check valve	GJ	Gas inlet
PMV	Pressure maintaining valve	GO	Gas outlet
PI	Pressure gauge	RO	Regeneration gas outlet
SV	Safety valve	CO	Condensate outlet
MT	Dew point sensor		

4.3 Function description

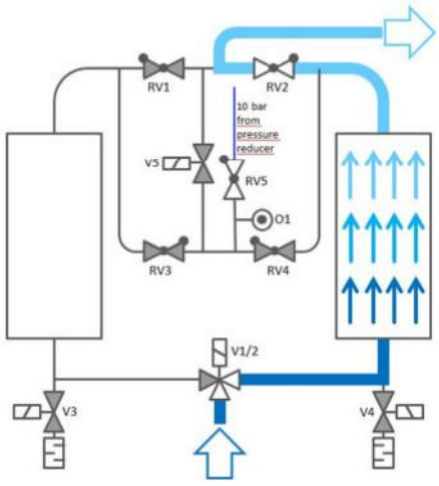
The operation principle of the dryer is adsorption. The principle of moisture adsorption is water molecules being attracted to a hygroscopic solid material (desiccant). This process is reversible and, after a regeneration phase, the desiccant can be reused for drying.

For compressed air drying the compressed air flow is led through a vessel containing the desiccant and brought into intensive contact with the desiccant. The desiccant removes moisture from the compressed air and stores it in its internal structure. With continuous moisture loading of the desiccant the dryer performance is reduced until the desiccant is saturated with moisture. The saturated desiccant then requires regeneration, i.e. he moisture stored in the inner desiccant structure is removed again. The desiccant can then be reused for drying.

Continuous operation of an adsorption dryer requires two vessels that are operated alternately. One vessel is used for drying the compressed air (adsorption). In the other vessel the regeneration phases are carried out. The change interval between adsorption and regeneration is approx. 10 Minutes*.

Adsorption phase
Duration approx. 10 Minutes to max. 2 hours*

The moist compressed air is supplied from a compressed air source (e.g. compressor) to the compressed air inlet (GJ) of the dryer. The pre-filter (F1) removes dust and liquids from the compressed air flow. The valve (V1/2) forwards the compressed air to the vessel which is in "adsorption" mode (here A2). In the lower part of the vessel the compressed air is decelerated and distributed over the vessel cross section. The compressed air passes the lower sieve tray (ST) and slowly flows through the desiccant bed. The compressed air exits the vessel via upper sieve tray (ST) and is forwarded from the upper check valve block (RV1, RV2) to the compressed air outlet (GO).



The optional dew point sensor (MT01) checks the dryer performance at the compressed air outlet.

During this time the second vessel is in standby mode and waits for operation.

The adsorption phase is completed and the vessels are switched over if...

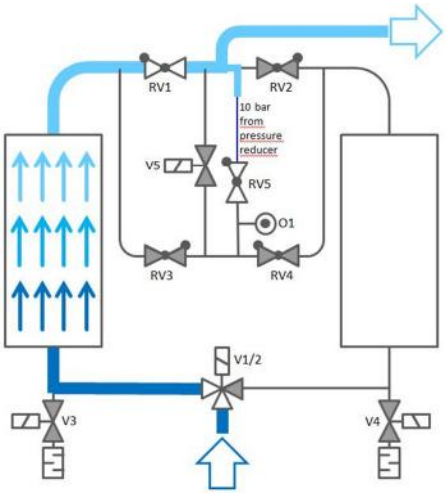
- ... the cycle mode “CYCLE MODE – FIX“ has been pre-selected and a time of 10 minutes has expired.
- ... cycle mode “CYCLE MODE – VAR“ has been pre-selected and optional dew point measurement has reached the selected limit value. The maximum allowable duration of the adsorption time is gradually increased as long as the dew point stays good. Switch-over of the vessels is carried out automatically after 2 hours at the latest.

For vessel switch-over the main valve (V1/2) turns now for opening to the left vessel. The compressed air flows from one vessel to the other. A free flow path through the dryer is available at any time during switch over. As a result, the task of drying is passed on to the other vessel without interruption.

Now vessel (A2) has gone “offline” and vessel (A1) has gone “online”.

Regeneration
Duration approx. 10 min*

After the "wet" vessel (A2) has completed the adsorption phase and passed on the task to the second vessel (A1), the first vessel (offline vessel) runs the regeneration phases.



1 adsorption – switch-over

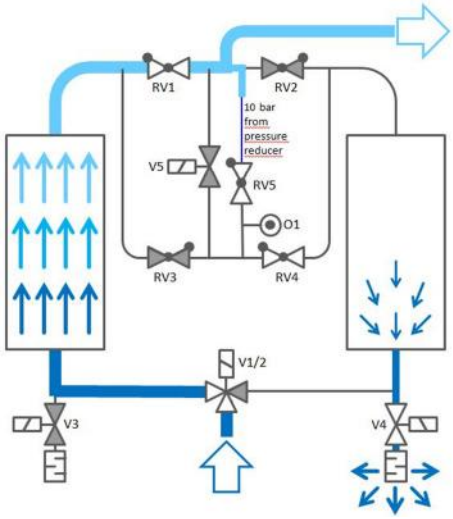
Regeneration is divided into the following phases:

- Expansion
- Purging (regeneration)
- Pressurization
- Standby

Expansion phase
Duration a few seconds*

After vessel switch-over the expansion valve (V4) is opened and the "wet" vessel is depressurized. Via the silencer (X1) the compressed air flows to the outside.

The next phase begins a after the vessel pressure has almost reached atmospheric pressure.

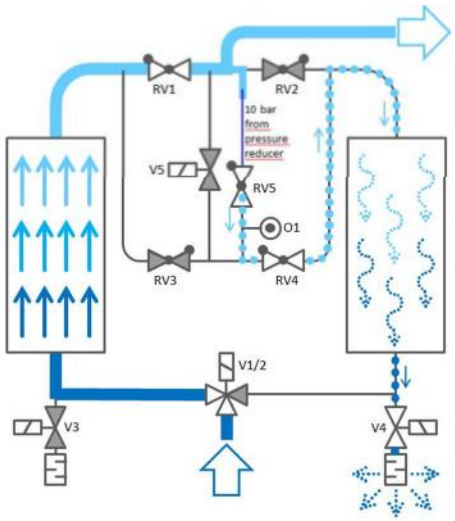


2 adsorption - expansion

Purging (regeneration)
Duration approx. 8 min*

When the vessel pressure drops, dry air (regeneration gas) from vessel (A1) flows through the non-return valve (RV5) and orifice (O1) into vessel (A2).

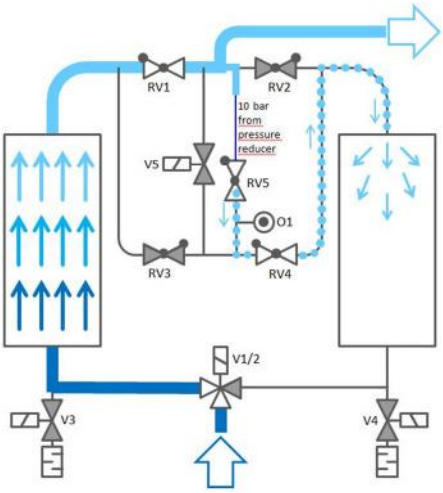
The dry and pressure free regeneration gas is distributed throughout the vessel cross-section and fed through the desiccant. The dry regeneration air vaporizes the water stored in the desiccant. In the form of vapor the water, together with the regeneration air flow, is then led via valve (V4) to the regeneration outlet (RO).
The wet regeneration gas is led via the expansion silencer (X1) to the outside
After a preset time of app. 4 minutes* has expired the purge phase is ended and the next phase begins.



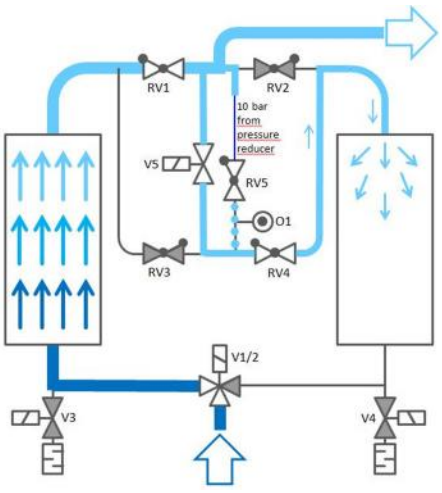
4 adsorption – purging (regeneration)

Pressurization phase
Duration approx. 2 min

The pressurization phase ensures that the two vessels have the same vessel pressure prior to vessel switch over. The pressure is build up in two steps.
In the first step the regeneration air valve (V4) is closed and dry compressed air continues to flow through the non-return valve (RV5) and orifice (O1) into vessel (A2) until the initial pressure have built up.
In the second step the valve (V5) is opened and now a higher volume of air flows into vessel (A2) gradually equalizing the pressure in both vessels.
The next phase begins when the vessel pressure is almost the same in both vessels.
After a preset time of app. 2 minute* has expired the pressurization phase is ended and the next phase begins.



5 adsorption – pressurization 1

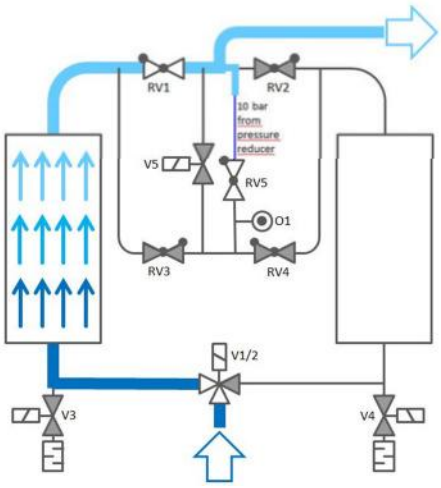


5 adsorption – pressurization 2

Standby
Duration approx. 0 minutes to max. 2 hours

Vessel regeneration is now complete and the vessel is immediately ready to operate. During this phase the both vessels stay connected via the non-return valve (RV5) and orifice (O1) and the valve (V5). Thus the pressure in both vessels stays equal throughout the complete stand-by phase.

When the current adsorption phase has been completed, the vessels are switched over and the process is restarted.



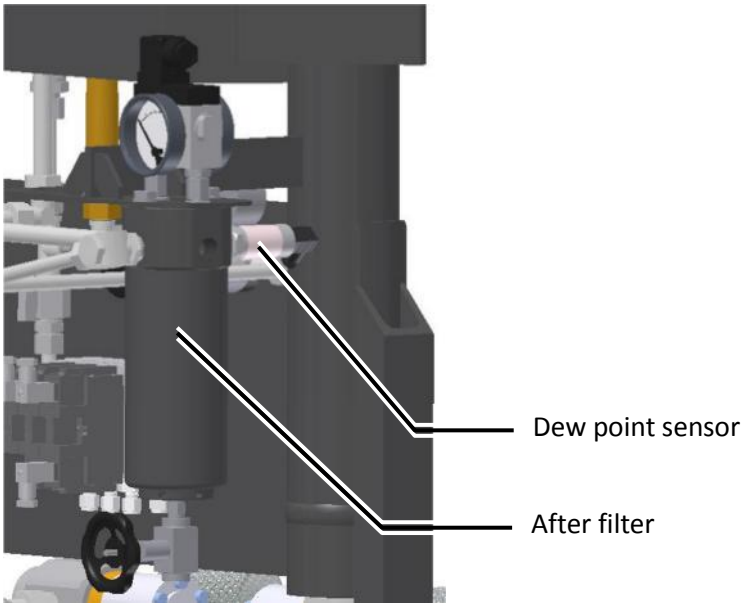
6 adsorption - stand-by

* : Note
The above time values are variables which can be pre-set individually for each dryer. Therefore, deviations from the above mentioned values are possible

4.4 Options

Various options are available for improved operation and special installation site conditions. For detailed information on the options or dryer modification to meet your operating and installation site requirements, please contact the manufacturer or the responsible sales partner

Dew point sensor
Control of the adsorption phases changes from purely time-dependent vessel switch-over to load-dependent operation when using the dew point sensor. The dew point sensor allows for considerable energy savings and increased dryer performance.
Use of a dew point sensor is highly recommended.
The dew point sensor will be (if ordered) installed into the after filter head as shown on next picture.



Automatic start-up device (pressure maintaining valve)
The dryer must always be operated with an adequate high pressure in order to avoid excessive flow velocities in the dryer. There is a danger of damage to the dryer. (→ Page 46)
If the dryer is started against a pressure free compressed air network, the compressed air network must be filled through the dryer. To ensure adequate operating pressure in the dryer the manual valve behind the dryer must be throttled and only be opened very slowly.
In the event the dryer is frequently started against pressure free compressed air networks (e.g. after the weekend) or if there is no personnel available for the start-up procedure, an automatic start-up device is useful. It ensures that there is an adequately high pressure in the dryer at any time during operation.

Further options include:

- Special voltages: 115V – 50-60Hz , 24V-DC
- Heated frost protection housing
- Differential pressure gauges with electric alarm contact for filters
- Multistage pre or after filtration
- Oil adsorber as third vessel flanged to the dryer.

5. Operating elements

The following sections describe the dryer components used for dryer monitoring and dryer operation.

5.1 Power connector

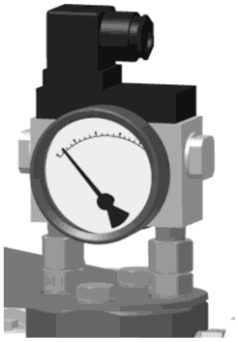
The power supply is connected via a female power connector (1) (part of the dryer scope)
Loosen the mounting screw of the power connector and pull the power connector off the male power connector (2).
Now the control (3) is disconnected for the power supply.

The main valves open when the power supply is interrupted
Please note that both main valves will open instantly when the power supply is interrupted. I.e. a pressure free vessel in regeneration mode will be pressurized via the main valve with a sudden pressure surge.
We recommend to wait until both vessels have reached equal pressure before you remove the female connector (e.g. when the cycle is close to the end of the “pressurization phase” or during “stand-by”

TIPP

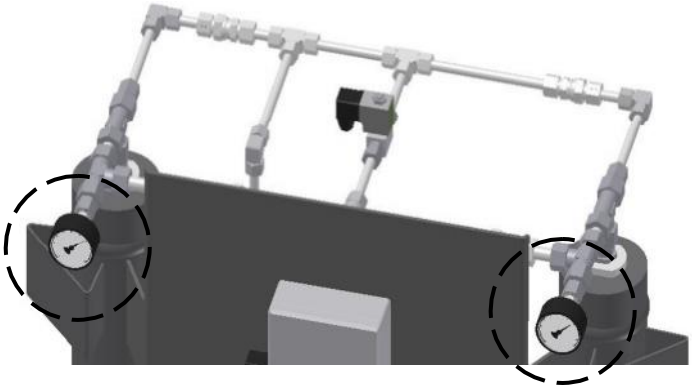
Switch off the dryer from remote
The dryer consumes only little power. Therefore the dryer can be switched off by externally interrupting the power supply.
A standard line switch installed in the power supply line is sufficient to switch off the dryer.
The dryer control is fitted with a digital input port (“compressor contact”). The dryer program can be stopped and restarted via this “compressor contact” without interrupting the power supply. (→ Seite 30)

Differential pressure gauges on the filters (optional)



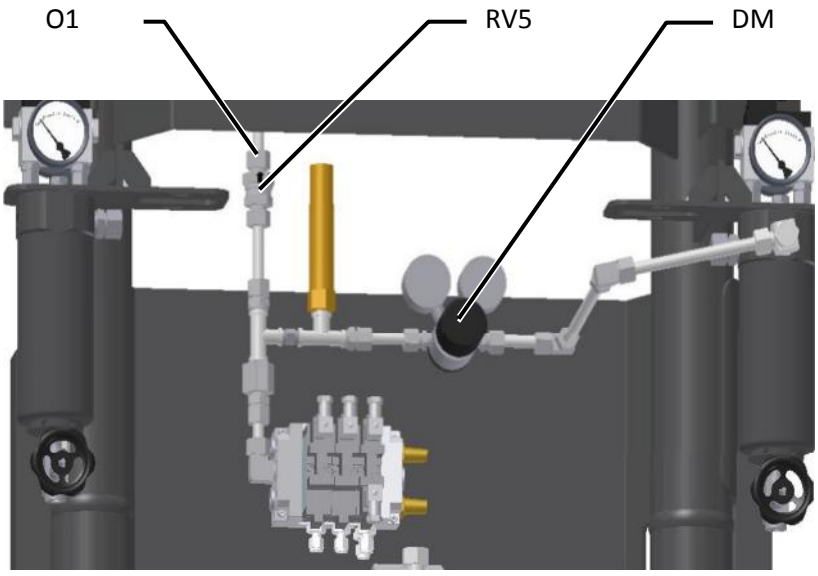
The pre- and after-filter of some dryers are fitted with differential pressure gauges. The differential pressure gauge gives evidence of the condition and the degree of contamination of filter element.
For further information and instructions please refer to the manual of the filter and the differential pressure gauge.

5.2 Pressure gauge



The vessel pressure of each vessel is shown on their respective pressure gauge PI01 / PI02.
The pressure gauges allow to monitor the proper function of the dryer. When the display shows "REG" the corresponding pressure gauge should indicate a pressure less vessel.

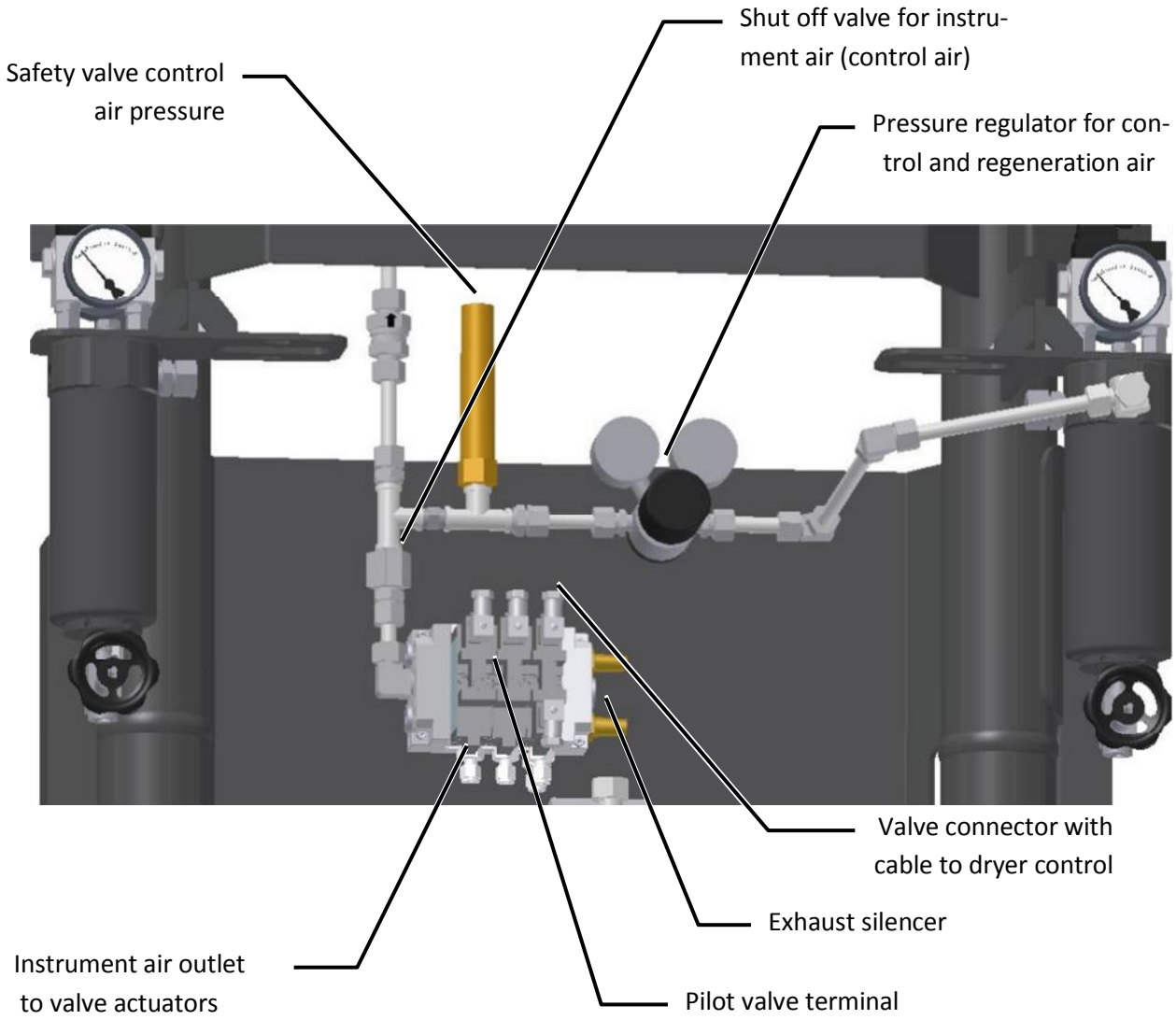
5.3 Pressure reducer with pressure gauges, non-return valve (RV5) and orifice (O1)



Via the combination of pressure reducer (DM), with pressure gauges non-return valve (RV5) and orifice (O1) the regeneration air flow will be adjusted for the purge phase. Pressure after pressure reducer should be 145 psi (10 bar). NOT MORE ! Orifice is sized to have exact calculated purge flow if pressure is 145 psi (10 bar(g) in front of the orifice.

The air for the regeneration, and for control air is taken from the after filter (Dried and filtered air)

5.4 Instrument air supply and pilot valve terminal



The instrument air is supplied internally, i.e. from the after filter at dryer outlet, and forwarded to the pilot valve terminal via pressure reducer. The electrical control signals from the dryer control system are pneumatically amplified using the pilot valve terminal and transferred to the valve actuators.

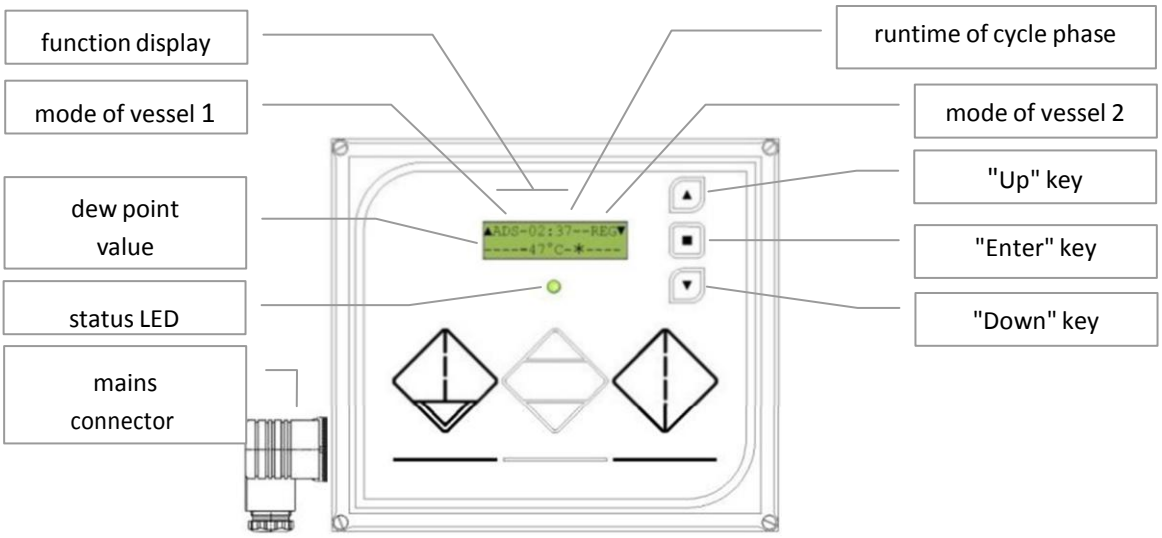
1) For maintenance of the instrument air supply cut off the instrument air at the small shut-off valve.
2) Lift the safety valve in order to depressurize the pilot valve terminal and the valve actuators
3) After maintenance work the shut-off valve must be reopened.

For a schematic diagram of the instrument air supply, please refer to the pneumatic diagram in the → appendix.

5.5 Control

The dryer is operated via the display and tree function key on the dryer control.

5.6 Function keys and display



The appliance connector is used to supply the C1 control system with the operating voltage. Following voltage connection the display will indicate the software version number for approximately 5 seconds.

The control system then immediately changes to the operating mode and starts in the program step at which it was last shut down. As a rule, all the operating states and settings are memory-resident, i.e. the control system will automatically continue the control program after a power failure.

The function display indicates all the relevant operating situations and the associated residual runtime and the pressure dew point*. After pressing a key the display backlight is on for 2 minutes. The status LED additionally informs you about the energy-saving mode and the alarm states.

Operation and entry of the setting values is carried out using the 3 keys. For further information, please refer to the menu structure. The language used for the control system is English.

Mode	Function	Display	Status
ADS	vessel adsorption	5:00 min - cannot be read	Input valves at vessel 1 or 2 opened
REG	regeneration	3:59 min - residual time indication	Expansion valves at vessel 1 or 2 opened
REP	Re-pressurization phase	0:59 min - residual time indication	Expansion valves at vessel 1 or 2 closed
CHG	vessel changeover	0:03 min - residual time indication	no valve activated
ECO	economy mode	xx:xx min - time indication	Expansion valves at vessel 1 or 2 closed
STB	standby mode	no time indication	Expansion valves at vessel 1 or 2 closed
LED	status indication		
Green	normal operation		
Orange	economy mode		ECO is indicated for one vessel
Red	alarm, flashing	message/dew point value	Acknowledge alarm manually via "Enter" key

5.7 Direct indication

Pressing the arrow keys allows for directly accessing additional information on the operating mode, energy savings and service monitor.

"Cycle Mode" indicates the VAR or FIX operating modes as well as the number of days, hours and minutes the dryer was in economy mode.

"Next Service" indicates the time (as a percentage value) remaining for the next service message to be shown. This value depends on the actual utilization of the dryer. For this value, the pure operating hours are counted which the dryer used for regeneration. Depending on the operation intensity the time for the percentage value = 0 and the service message to be shown may be different.

5.8 Menu guide

Access to the menu structure and thus to the parameter settings is generally password protected against unauthorized access. Keep this operating manual in a safe place and make sure it is available for maintenance.

The password is:

The menu is structured in two paths. Pressing the "Up" arrow key selects the service section. Pressing the "Down" key selects the parameterization section.

Pressing the "Down" key selects the corresponding menu item. Pressing the "Enter" key opens the parameterization level. On this level, the setting value can be changed using the "Up" and "Down" keys. Confirm the settings entered using the "Enter" key. The display returns to the menu item.

The numeric codes in the service section are also set using the arrow keys. When entering a digit the cursor jumps to the next position until the code has been entered completely.

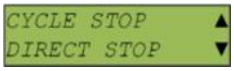
5.9 Parameter settings

The table shows all the parameters, their default settings and their function.

Menu	Default settings	Value range	Function
CYCLE MODE	VAR	FIX VAR	In FIX mode the control time program is executed without being affected. VAR mode provides the energy-saving function. Internal dew point measurement or an external signal (IN2) will affect the control time.
CYCLE STOP	FINISH CY-CLE	FINISH CYCLE DIRECT STOP	When opening the compressor synchronization contact in DIRECT STOP mode the expansion valves open immediately and vessel change will be prepared. In FINISH CYCLE mode the regeneration cycle started will be completed. Please note that the dryer still requires compressed air for this purpose! See also compressor synchronization.
PDP SET	-40°C *	20°C * to -100°C*	Threshold value for dew point control.
PDP ALARM SET	-25°C *	20°C * to PDP SET	Threshold value for dew point alarm.
PDP SENSOR	ON	ON OFF	Switches internal dew point measurement on/off.
PDP DISPLAY	ON	ON OFF	Switches dew point value indication on/off (4-20 mA signal at X10 is not affected).
ALARM PDP	ON	ON OFF	When ON, the dew point alarm controls the alarm relay. When OFF, the relay is not controlled.
PDP ALARM DELAY	00:10 s	00:00 .. 20:00	Alarm relay control can be delayed for up to 20 minutes. In the event the dew point alarm falls again within the delay time, the alarm relay will not be switched.
TEMP UNIT	°C	°C (degrees Celsius) °F (degrees Fahrenheit)	Changes the temperature indication.
ALARM FILTER1	OFF	ON OFF	Input IN3 can be used to evaluate the threshold switch of a differential pressure gauge on the upstream filter. The result can be indicated in the form of an alarm.
ALARM FILTER2	OFF	ON OFF	Input IN4 can be used to evaluate the threshold switch of a differential pressure gauge on the downstream filter. The result can be indicated in the form of an alarm.
FILTERALARM DLY	00:20 s	00:00 .. 20:00	Delay time for the filter alarm up to 20 minutes. This function can be used to suppress alarm activation caused by rapid volume flow changes (peaks).
ALARM OVERFLOW	OFF	ON OFF	"Overload" of the dryer can be detected by simul-taneously monitoring the differential pressure monitors on the upstream and downstream filters. An overflow alarm is activated when the signals from IN3 and IN4 are present during the alarm delay time.

5.10 Compressor synchronization function

The CYCLE STOP menu item is used to select the control system behavior for the signal at the digital input IN1. By default, IN1 is provided with a jumper. If the jumper is opened, the control program is set to the standby mode. There are two options:



In DIRECT STOP mode the control system is stopped immediately and outputs Y3 and Y4 are not (no longer) controlled. All the time values expired until then will be "frozen" (stored).

In FINISH CYCLE mode the control system will only be stopped after completing the regeneration cycle, and outputs Y3 and Y4 are not (no longer) controlled. All the count values will also be "frozen".

Independent of the type of cycle completion "STB" is indicated for both vessels on the display.

Example: IN1 can be connected to the auxiliary contacts of a compressor. This synchronizes the dryer with the compressor. The dryer only regenerates with compressed air being produced. The influencing compressor synchronization contact does not affect the input valves. The compressor synchronization contact can also be used as a remote switch and can, for example, be connected to higher level device or emergency control systems.

5.11 Dew point measurement and energy-saving function

If the internal dew point measuring system is used with a pressure dew point sensor or if an external measuring instrument is used with a 4-20 mA signal output, it must be registered to the control system. For this purpose the option in the PDP SENSOR menu must be set to ON.

The working point of the dryer is specified by the dew point threshold value. It can be set in the PDP SET menu using the arrow keys. The default setting is -40°F (-40°C)*.

Every time the dryer is not operating at the performance limit (i.e. at maximum volume flow rate), a better (lower) pressure dew point value can be achieved than specified by the threshold value set. The dryer then switches to the ECO mode and delays the next vessel change or regeneration phase until the measured dew point value exceeds the threshold value. For information on the total time the dryer was in ECO mode, please use the direct indication method and refer to 3.2.

The dew point alarm is preferably set with a distance of 10° to 20° to the dew point threshold value. This prevents hypersensitive reactions of the alarm messages from occurring. Spontaneous fluctuations of

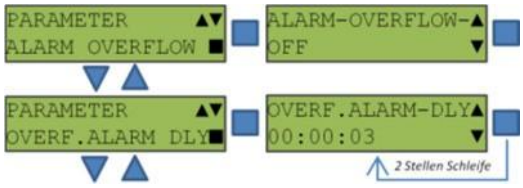
the measured dew point value caused by pressure or load variations within the system are inevitable. Direct activation of the dew point alarm sensor in the event of dew point peaks can also be suppressed by setting a longer delay time. This rule applies: For the entire delay time the measured dew point must be worse than the alarm value set.

5.12 Filters for differential pressure monitoring

The pre- and afterfilters of an adsorption dryer can optionally be provided with differential pressure gauges with an integrated differential pressure monitoring contact. Using the C1 control system the contact signals can be separately evaluated and indicated for the upstream and downstream filters. The connections are provided via switching inputs IN3 and IN4. You can individually switch the alarms on or off and delay their evaluation.

5.13 Overflow monitor

If the pre- and after filters are provided with differential pressure monitors (as described in 3.7), the overflow can be evaluated by means of common interrogation of both contacts. It can be assumed that the dryer will be strongly overloaded (internal flow rates too high), if the differential pressure monitors on the upstream and downstream filters are activated simultaneously.



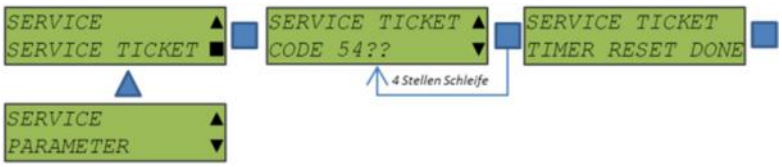
The ALARM-OVERFLOW monitor is switched off by default. The delay time should always be shorter than the delay time of the separate differential pressure monitor on the filters.

5.14 Service ticket

The control system program counts the switching cycles of the dryer. This allows for representing the vessel load changes on the one hand and for calculating the actual capacity utilization or the desiccant and upstream/downstream filter wear using the count values in relation to the duty cycle on the other hand. After reaching a threshold value (66,400 complete load changes (corresponds to approx. 1 year) under normal operating conditions) a service warning message is indicated.

To acknowledge the service warning message a 4-digit numeric code ("service ticket") must be entered. When procuring service parts and filter elements the customer is provided with a new service ticket including the numeric code. Once a numeric code has been used it cannot be entered again. Upon indication of the next service warning message the control system expects a new code to be entered.

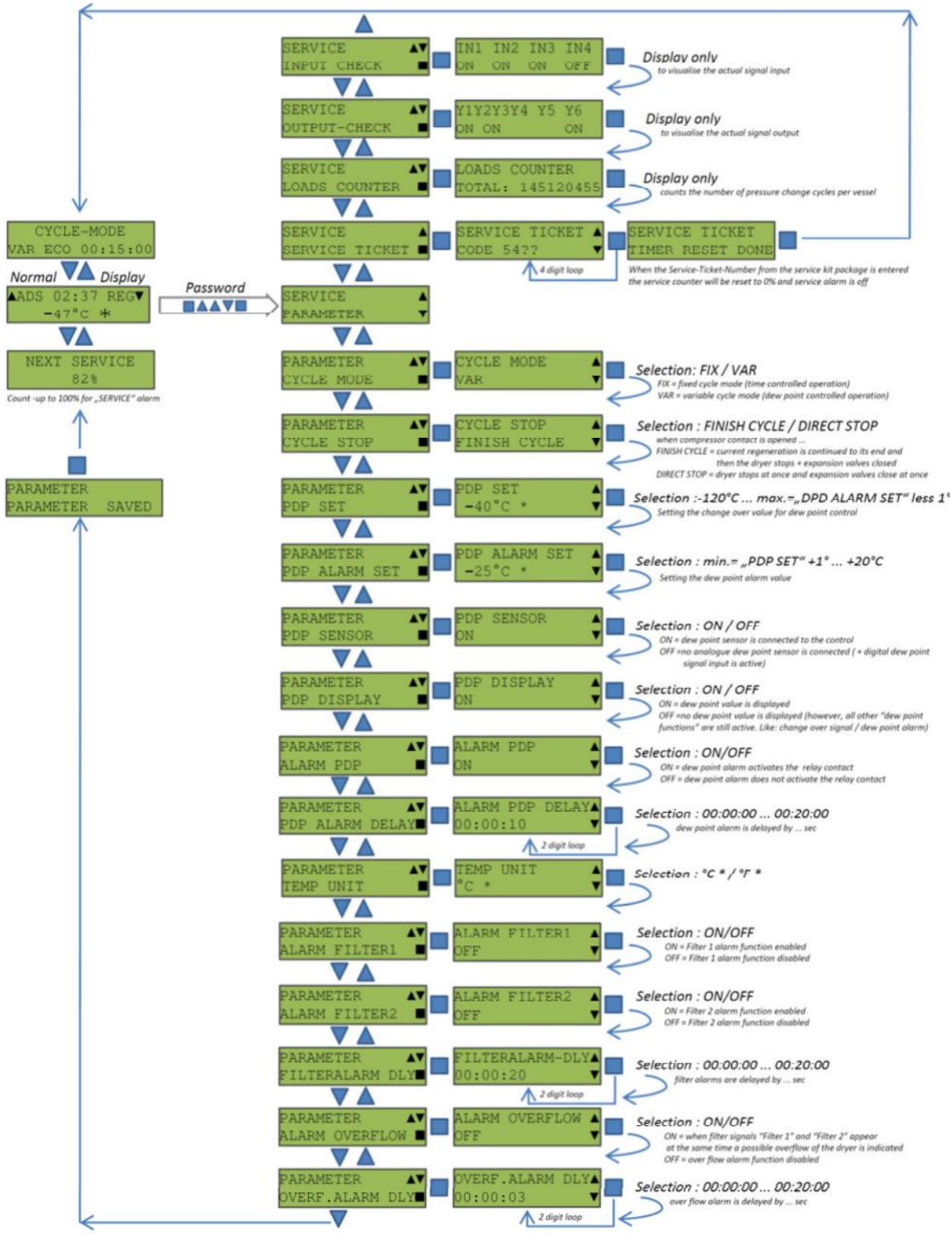
The path for entering the service parameters and monitoring functions can be accessed by entering the password and pressing the "Up" arrow key.



The number of the ticket code is entered digit by digit using the arrow keys. The cursor moves to the next digit by pressing the "Enter" key.
When the correct ticket code has been entered TIMER RESET DONE is indicated. When the wrong code has been entered TIMER RESET FAIL is indicated.

If the ticket code has not been entered correctly, it can be entered again after approximately 2 minutes. If, after this try, the ticket code is not entered correctly again and again, the waiting time for the next try doubles each time until the correct code is entered.

5.15 Menu structure



6. Error analysis table

Error	Cause	Measure
Control system not ready to operate / LED not on	Voltage supply missing	Check voltage supply and switch on, if necessary.
	Appliance connector installed incorrectly	Check cable connections on appliance connector.
	Fine-wire fuse defective	Replace fine-wire fuse (500 mA, slow-blowing).
Valve not working	Cable connection to magnetic coil defective	Check cable connection and re-install, if necessary.
	Magnetic coil defective	Check magnetic coil using ohmmeter.
	No voltage at valve output	Switching transistor of output may be defective.
No dew point value on display	Sensor not registered	Register pressure dew point sensor to control system, see 3.6.
Indication ALARM SENSOR	Sensor cable connected incorrectly	Remove contact problems and check wiring, see table 2.6, X9.
	Sensor defective	Check dew point sensor and send it back to be inspected, if necessary.
	Too much moisture in sensor	The sensor was in contact with splash water. Dry the sensor slowly. Never dry the sensor using compressed air!
Dew point indication ---°C *	Signal of dew point transmitter below 4 mA	Indicates heavy dirt accumulation on the active sensor surface. The sensor has to be replaced.
	Signal of dew point transmitter below 4 mA	4-20 mA signal adjusted incorrectly during connection of external dew point measuring instruments.
Dew point indication +++°C *	Signal of dew point transmitter above 20 mA	Active sensor surface is very moist and must be dried carefully.
	Signal of dew point transmitter above 20 mA	4-20 mA signal adjusted incorrectly during connection of external dew point measuring instruments.
Dew point indication incorrect	Possible only if external dew point measuring instruments are connected. Default scaling of 4-20 mA signal not matching.	Adjust 4-20 mA scaling (by manufacturer service only). Set 4-20 mA output of external measurement system.
Indication ALARM FILTER	Differential pressure monitor has been triggered	Acknowledge alarm using "Enter" key.
	Cable connection from/to differential pressure monitor defective (open)	Check cable connection from control system using a continuity tester. In normal state the contact loop needs to be closed.
Indication ALARM OVERFLOW	Differential pressure monitor has been triggered. The upstream and downstream filters have been triggered simultaneously. Dryer has been overloaded.	Acknowledge alarm using "Enter" key. Frequent overloading of the dryer considerably damages the desiccant.
Indication ALARM DEWPOINT	Dew point value above the alarm value	Acknowledge alarm using "Enter" key. Dew point alarms occurring more frequently after some years of operation indicate that the desiccant capacity is exhausted.
Indication ALARM 24VDC	Internal monitoring function of the control system has been triggered	Disconnect control system from voltage and restart after approx. 30 seconds. Contact manufacturer service in the event the control system fails to restart.

Error	Cause	Measure
Dryer switches over without pressurisation phase (one side or two sides)	Supply lines of input valves and expansion valves mixed up	Check installation according to table in 2.6 and diagram in 2.5.
Expansion noise of dryer is too loud and, at the same time, there is pressure loss in the system	Supply lines of input valves V1 and V2 mixed up	Check installation according to table in 2.6 and diagram in 2.5. Try to change the connections, if necessary.

7. Transportation, setting up and storage

7.1 Transportation

DANGER ! – Damage
Damages of the dryer may lead to unpredictable hazardous situations.
Operating a damaged dryer may result in serious injury or death.
Never start to operate a damaged dryer.

DANGER ! – Risk of tilting
The center of gravity is in the upper part of the dryer.
Tilting of the dryer may result in serious injury or death.
During transport and during loading and unloading secure the dryer against tilting using the lifting lugs.

Although great care is taken damages caused by transportation cannot be ruled out. Therefore, always check the dryer for possible damages after transportation and packaging removal.
The hauling contractor and the manufacturer or the sales partner must immediately be informed about any damage.

- Make sure to provide adequate lifting equipment when transporting and loading or unloading the dryer.
- Persons responsible for transportation must be appropriately qualified.
- The dryer must only be lifted at the appropriate points using lifting equipment. (Transport pallet; base frame; support feet) (→ see Figure).
- Take the dryer weight and the maximum allowable load of the lifting and transport equipment used into account.
- Do not remove the packaging material until the dryer is moved to its final place of installation.
- The national regulations for accident prevention must be adhered to.

7.2 Set
7.3 up

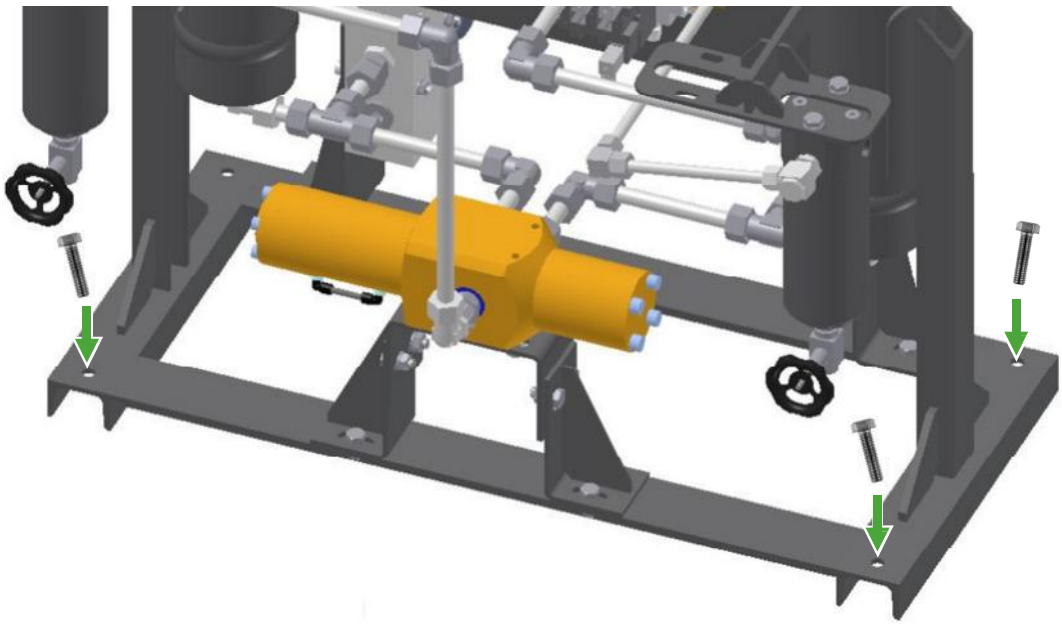
Please refer to section "Description of application" (→ page 9). Here, you will find a list of requirements on the installation site.

Important data of the dryer can be found in section "Technical data" (→ page 11).

Additional requirements on the installation site:

- The ground for dryer installation must be level and capable to carry heavy loads. Ground irregularities must be levelled in order for tensional forces not to occur in the piping of the dryer.
- Because of noise emissions the installation site should not be in the vicinity of stationary workplaces.
- Keep a service distance to walls and other systems around the dryer of 1 m, minimum.
- During maintenance of the dryer components lifting equipment with adequate load capacity should be available and access of this equipment to the dryer must be ensured.
- The place of installation should not be in the vicinity of hallways in order to avoid risks to inexperienced persons.
- Set up the dryer such that the pressure gauge and the control are clearly visible and can be operated properly.

We recommend anchoring the dryer into the ground using the holes in the vessel supports.



7.4 Storage

To maintain the dryer quality the dryer must be stored at a suitable location and properly prepared for storage.

The place of storage has to fulfil the following requirements:

- Indoors
- Protected against weather impact
- Frost-free
- Dry

If the dryer is to be stored immediately after delivery, it must only be protected against dust using an additional cover.

If the dryer has already been used for drying compressed air, please proceed as follows:

1) Disconnect the compressed air flow from the dryer by closing the valves up- and downstream of the dryer.
2) Change the setting of the control to „CYCLE MODE – FIX“.(→ Page 30)
3) Operate the dryer for at least 4 more hours without compressed air flowing through the dryer. This ensures the dryer to be stored with dry vessels. The more regeneration cycles are performed, the dryer the desiccant.
4) Decommission the dryer. (→ Page 48)
5) Depressurize the dryer. (→ Page 49)
6) Disconnect the dryer from the electrical supply. (→ Page 24)
7) Disconnect the dryer from the compressed air system.
8) Close the inlets and outlets of the dryer using flange covers.
9) Place a desiccant bag in the control box.
10) Protect the dryer against dust using a cover.

To re-commission the dryer after storage, please proceed as described for initial commissioning. (→ Page 45)

CAUTION ! – Moisture in electrical components
Long-term storage may lead to penetration of moisture into electrical components. This may result in short circuits or damages to these components.
Check the electrical dryer components for internal moisture.
The necessary actions (insulation resistance test) must only be performed by a qualified electrician.

8. Installation

8.1 Installing the connecting pipelines

DANGER ! – Overpressure
The dryer is under pressure.
Suddenly escaping compressed air may result in serious injury.
Do not carry out mechanical or electrical work on the dryer as long as the dryer is under pressure.

DANGER ! – Overload
The dryer must only be operated with compressed air within the maximum allowable operating conditions. The operating conditions are defined on the type plate (→ page 12).
Exceeding the maximum allowable operating conditions may result in serious injury or death.
It is the duty of the operator to ensure that the connected pressure source is safe-guarded such that the maximum allowable operating pressure (PS) and the maximum allowable temperature (TS) are not exceeded.
Please also refer to section “Intended use” (→ page 9).

DANGER ! – Bursting components due to external forces
The dryer components are not designed for externally applied forces and may burst due to additional load impact.
Bursting, pressure-bearing components may result in serious injury or death.
The support required for the connected pipelines has to be provided by the customer. Transmission of loads or stress into the connection flanges of the dryer is not permissible.

Proper installation is required for safe and error-free operation of the dryer.

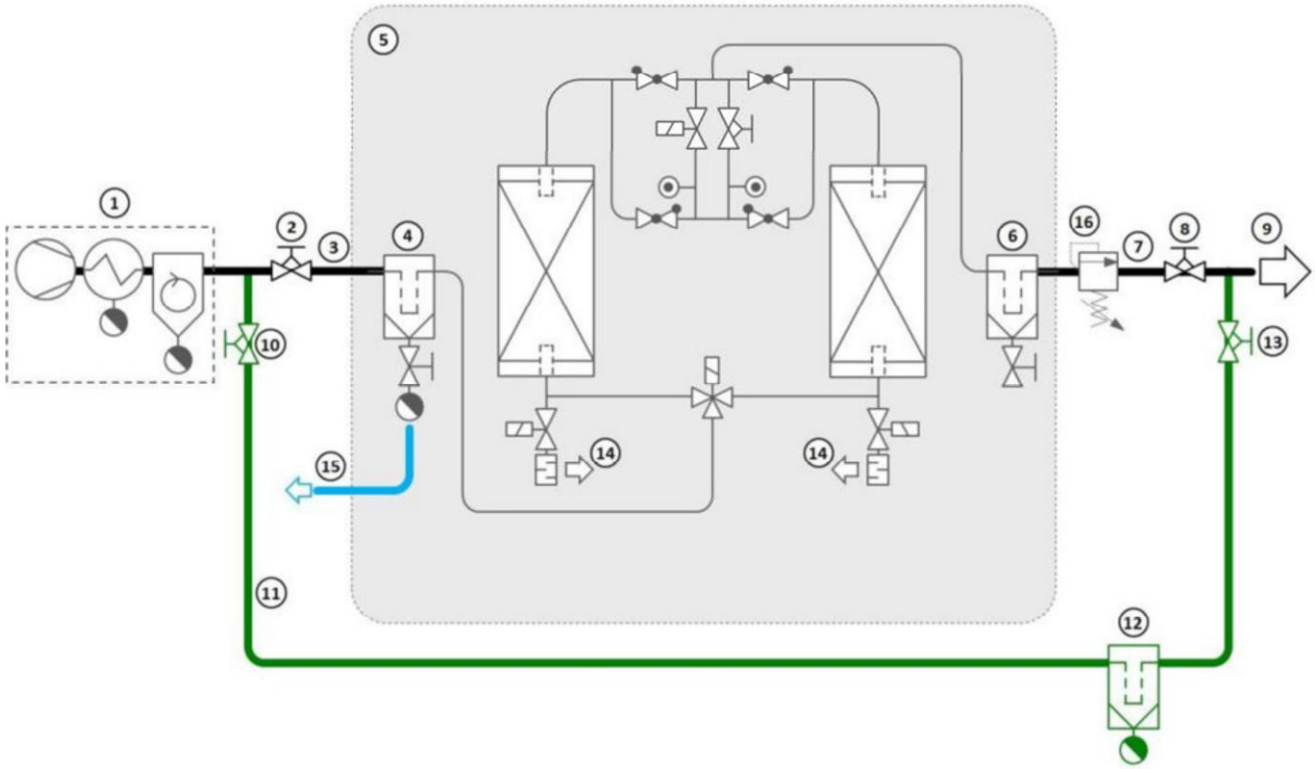
Please observe the following steps when installing the compressed air pipeline (4) + (6):

- Make sure that the dryer and the compressed air system are free from pressure. If the compressed air system has to remain under pressure during installation, the shut-off valves have to be protected against unintentional opening. (2) + (8)
- The compressed air source (e.g. compressor) must be safe-guarded against exceeding of the maximum allowable operating pressure using safety equipment.
- The compressed air pipelines must be provided with shut-off valves used for disconnecting the dryer from the piping system (2) + (8). We recommend using shut-off valves with continuous opening behaviour (e.g. shut-off valves with stem or gear handwheel). This valve behavior avoids sudden pressure equalization between the piping sections.
- We recommend using a bypass line (11) around the dryer.
- The pipelines must be suitable for use with the maximum possible operating pressure.
- The transfer points (threaded connectors) have to be compatible to the dryer inlet and outlet with regard to nominal width, nominal pressure and type. (→ See general arrangement drawing in the appendix)
- Any vibrations or pulsation must not be transmitted to the dryer via the piping. This may damage the desiccant, the dryer control system or other components. If required, install compensators or pulsation absorbers in the pipelines to be connected.

- Wet pipelines upstream of the dryer (4) should be installed at a slope in order for condensate (water and oil) in the line to be discharged in flow direction. If installation of an upright pipeline is inevitable, a condensate drain must be provided at the lowest point of the pipeline. This avoids condensate from being accumulated in the pipeline and suddenly being swept away by the compressed air flow. These kinds of water shocks may damage the filter and dryer and must be avoided.
- Prior to closing the connected pipelines, please check that there are no objects or contaminations left in the pipelines.
- Remove the end caps from the dryer inlet and outlet.
- When checking the installation for leaks the maximum allowable operating pressure of the dryer must not be exceeded. (→ See specification on the type plate, page 12)

  Never fill the dryer with water when performing a pressure test. Liquids will destroy the desiccant!

Installation example



1	Compressed air inlet	9	Compressed air outlet
2	Valve at compressed air inlet	10	Bypass valve at inlet
3	Compressed air pipeline at inlet	11	Bypass line
4	Pre-filter with condensate drain	12	Bypass filter with condensate drain
5	Dryer	13	Bypass valve at outlet
6	After-filter with manual drain	14	Expansion silencer
7	Compressed air pipeline at outlet	15	Condensate line
8	Valve at compressed air outlet	16	Pressure maintaining valve

Please note that the standard scope of supply only comprises the dryer (5) in the grey outline.

8.2 Installing the power supply

DANGER ! – Electric voltage
The dryer is operated at electric voltages up to 230 V.
Touching live parts may result in serious injury or death.
Work on electrical components must only be carried out by qualified and authorized personnel. Use a voltage detector to make sure the dryer has been disconnected from the power supply and that there are no live parts before starting maintenance work.
In the event of fire, do not extinguish the fire using water.

CAUTION ! – Qualification and experience required
Persons working on and with the dryer have to be qualified personnel who, because of their qualification and experience, are familiar with handling compressed air systems and electrical systems. If you are not experienced in using these systems, please ask the relevant experts for help. We highly recommend that commissioning and maintenance be carried out by the manufacturer or one of the authorized service partners.

DANGER ! – Moisture and contamination in electrical components
Moisture and contamination in electrical components may lead to damages resulting in unpredictable dangers for the operating personnel. As a consequence, short circuits and faulty circuits may occur.
Always keep the control box and the terminal box dry and free from contamination and foreign bodies.
Make sure the control box and the terminal box are securely closed during operation.

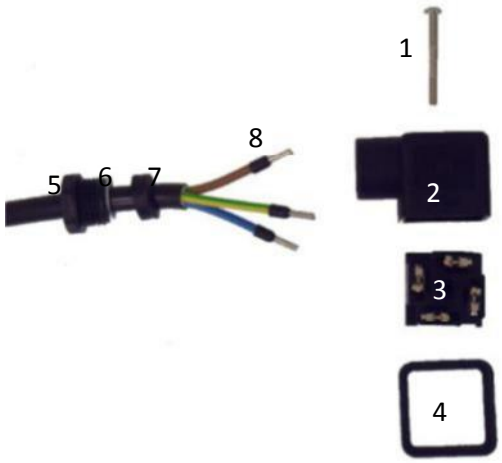
Qualified electrician required
Electrical connection of the dryer must only be carried out by a qualified electrician who is familiar with reading electro-technical documentation.

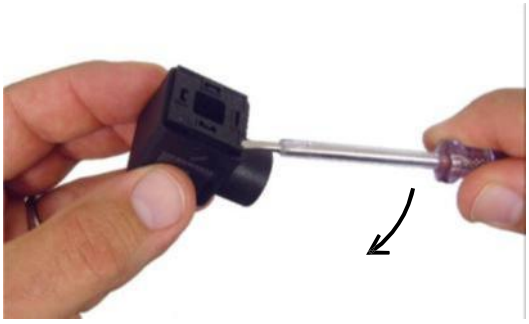
For the data required for connecting and securing the voltage supply, please refer to the wiring diagram (→ see appendix: wiring diagram)

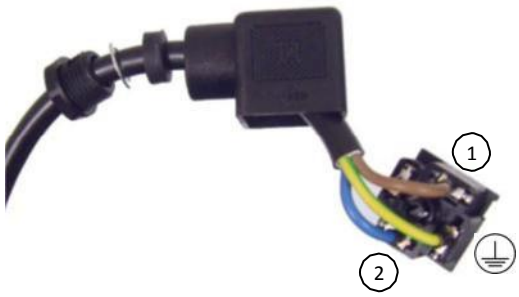
The power supply is connected via a female power connector on the dryer control box (part of the dryer scope):

1) Use a cable that is sufficiently sized for the voltage and power consumption of the dryer when connecting the dryer to the power supply. (→ see appendix: wiring diagram)
2) Make sure the power supply is switched OFF and secure it against unintentional activation.
3) Pull the female power connector off the male power connector on the control box. (→Page 24)

4) Remove the mounting screw (1) from the connector housing (2) first.
   (The mounting screw serves as locking device for the connector insert (3). The connector insert cannot be removed from the housing of the power connector before the mounting screw has been removed.)
5) Carefully lift the connector insert (3) out of the connector housing using a small screw driver.
6) Lead the cable (8) through the various components of the cable gland:
   (5) gland plug
   (6) washer
   (7) rubber seal
   Now lead the cable through the gland opening in the connector housing (2).
7) Connect the leads of the cable according to the information in the wiring diagram.
8) Put the connector insert (3) back into the connector housing (2). Put the connector seal (4) back onto the female power connector and tighten the cable gland (5).







Communication interfaces
The dryer is provided with different signal inputs and outputs for dryer control and dryer monitoring. These communication interfaces are used to implement improved monitoring and economical operation of the dryer. For the interfaces, please refer to the wiring diagram (→ see appendix).

The connection of the signal cables is done via the cable glands on the bottom side of the control box:

1) Pull the female power connector off the male power connector on the control box in order to disconnect the dryer control from the power supply. (→Page 24)
2) Open the housing of the control box.
3) Individual ports for each IN and OUT signal are available on the circuit board. The allocation of these ports is shown in the wiring diagram.
4) Choose the cable type according to the details stated in the wiring diagram.

5) Loosen a cable gland with free cable ports and remove the blind plug from the cable feed trough.
6) Connect the leads of the signal cable according to the information in the wiring diagram.

The standard scope of the dryer includes the most frequently used connector plugs and cable feed troughs. Additional connector plugs and cable glands are required when all signal ports are used. Details of the connector plugs and cable glands can be found in the parts list of the wiring diagram.

9. Commissioning

CAUTION ! – Qualification and experience required
Persons working on and with the dryer have to be qualified personnel who, because of their qualification and experience, are familiar with handling compressed air systems and electrical systems. If you are not experienced in using these systems, please ask the relevant experts for help. We highly recommend that commissioning and maintenance be carried out by the manufacturer or one of the authorized service partners.

9.1 Requirements for initial commissioning

All the requirements for unhindered commissioning must be fulfilled, especially when commissioning is carried out by external qualified personnel.

Make sure the following requirements for initial commissioning have been fulfilled:

- External qualified personnel have been informed about the commissioning date in good time (2 weeks in advance, minimum).
- External qualified personnel have been informed about the following in good time: special local conditions; site-specific safety guidelines; required safety instructions, if necessary; specially required qualifications, if necessary; special personal protective equipment.
- The place of installation can be freely accessed and entered without any risks.
- Neighboring construction sites do not affect commissioning.
- The dryer is connected to the compressed air system using pipelines. (→ Page 39)
- The dryer is connected electrically and voltage supply is ensured. (→ Page 41)
- The compressor is ready to operate and personnel for starting and operating the compressor are present.
- Compressed air can be delivered to the downstream system. A volume flow rate of at least 40% of the nominal dryer performance can be fed through the dryer.
- The dryer is classified pressure equipment (see declaration of conformity in the appendix). Prior to commissioning the dryer has to be approved by the local authorities according to the applicable national regulations. In the EU, the Pressure Equipment Directive 97/23/EC has to be observed.

Please check the following directly before commissioning:

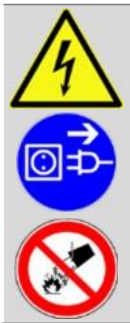
- The operating limits must not be exceeded. (→ Page 9)
- The female power connector is pulled off and the control box is disconnected from the voltage supply. (→ Page 24)
- The shut-off valves provided by the customer and located upstream and downstream of the dryer are closed.
- The connections may have become loose due to dryer transportation. Make sure the piping connections, screwed joints and pneumatic lines are tightly secured. Tighten loose connections using the appropriate tools.

- Make sure the cable clamps in the control box are tightly secured. Tighten all the screw connections using the appropriate tools.
- Check all the components for visible damages. If there are defective components, commissioning of the dryer is not permitted!

DANGER ! – Moisture and contamination in electrical components
Moisture and contamination in electrical components may lead to damages resulting in unpredictable dangers for the operating personnel. As a consequence, short circuits and faulty circuits may occur.
Always keep the control box and the terminal box dry and free from contamination and foreign bodies.
Make sure the control box and the terminal box are securely closed during operation.

9.2 Commissioning the dryer

DANGER ! – Overpressure
The dryer is under pressure.
Suddenly escaping compressed air may result in serious injury.
Do not carry out mechanical or electrical work on the dryer as long as the dryer is under pressure.



DANGER ! – Electric voltage
The dryer is operated at electric voltages up to 230 V.
Touching live parts may result in serious injury or death.
Work on electrical components must only be carried out by qualified and authorized personnel. Use a voltage detector to make sure the dryer has been disconnected from the power supply and that there are no live parts before starting maintenance work.
In the event of fire, do not extinguish the fire using water.

WARNING ! – Suddenly escaping compressed air (3)
The dryer is depressurised approximately every 6 hours using a silencer. A loud and strong airstream may carry small particles and cause injury.
Do not place any equipment in the vicinity of the silencer. The silencer must not be manipulated or removed. Always wear hearing protectors when working in the vicinity of the dryer.

If all conditions required for commissioning are fulfilled, the commissioning procedure can be started. Perform the following steps in the listed order.

9.2.1 Pressurization of the dryer

CAUTION ! – Pressure blows and overload
Rapid opening of the valves may cause pressure blows and increased flow rates in the dryer. Pressure blows and increased flow rates may lead to damages of the dryer.
Open the valves very slowly and make sure that the flow noise does not become too loud. Pay special attention when opening valves that can be opened rapidly by means of a pivoting movement.

The dryer valves are internally controlled by compressed air which is supplied from inside the dryer. For this reason the first requirement for commissioning is reaching a minimum pressure of 4 bar in the dryer. Pressurize the dryer as follows:

1) Make sure the compressed air system upstream of the dryer inlet is under pressure. If necessary, the compressor must be started.
2) Open the valve upstream of the dryer inlet very slowly until hearing the first clear flow noise. Stop the procedure when the flow noise becomes loud.
3) Observe the vessel pressure gauges. Pressurization can be monitored on one of the two pressure gauges. Make sure the pressure is only rising slowly. Pressurization speed may not exceed 2 bar/min.
4) Check the system for leaks during pressurization. In the event of leaks, pressurization must be stopped and the leaks must be repaired. To repair the leaks the dryer has to be depressurised again. (→ Page 49)
5) If flow noise and a pressure increase is no longer present when further opening the valve, it can be opened completely.

9.2.2 Opening the outlet valve

Special attention must be paid if the compressed air system downstream of the dryer is free from pressure.

1) Open the valve downstream of the dryer outlet very slowly until hearing the first clear flow noise.
2) Observe the vessel pressure gauges. Make sure there is no sudden pressure drop in the vessel. The vessel pressure may not drop for more than 1 bar.
3) If flow noise is no longer present when further opening the valve, it can be opened completely.
4) Air can now freely flow through the dryer. If a volume flow is to be transferred via the dryer, commissioning should be performed quickly or the valve downstream of the dryer outlet should be closed again, in order for the dryer not to be overladen with moisture during standstill.

Automatic start-up device
In the event the dryer is frequently started against a pressure free compressed air system, we recommend using an automatic start-up device. (→ Page 23)
The automatic start-up device prevents pressure surges and increased flow velocities from occurring even when the compressor is started automatically.

9.2.3 Starting the dryer

1) Make sure the dryer is under pressure and that all the valves upstream and downstream of the dryer are opened in order for the compressed air to be able to flow through the dryer.
2) Put the female power connector onto the male power connector on the control box. (→Page 24) Now the display is illuminated and the software version of the control appears on the display for a few seconds. The dryer programs starts up. The start of the program is accompanied by a notable clicking of the valves (V1-4)
3) Acknowledge any alarm messages, if required.
4) If any alarm messages are present that cannot be acknowledged, please proceed as described in section "Error messages and measures". (→ Page 34)
5) If there are no additional alarm messages, the dryer has been commissioned properly.

Monitor dryer operation. The dryer now performs the phases described in section "Function description". (→ Page 19)

10. Shutting down and restarting the dryer

10.1 Shutting down the dryer in case of emergency

1) Disconnect the power supply to the dryer. (e.g. by pulling the power connector off the control box. (→ Page 24)
2) Close the valves upstream and downstream of the dryer.
3) The dryer has now been shut down.

10.2 Stopping the dryer

The dryer can be stopped by ...

1) Disconnecting the power supply.
2) Pulling the power connector off the control box.
3) Opening the “compressor contact”. . (→Page 30)

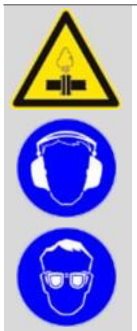
Compressed air must no longer flow through the dryer. Otherwise, it is overladen with moisture.

Please note that the dew point becomes worse after a certain standstill period. Worsening of the dew point is not a dryer error but is caused by external moisture slowly penetrating the static volume in the piping. As soon as the compressed air flows again, the dew point will also become better again

10.3 Shutting down the dryer

1) Stop the dryer as described in the above section.
2) Pull the power connector off the control box.
3) Close the valves upstream and downstream of the dryer.
4) The dryer has now been shut down.
5) Prior to working on the dryer it has to be depressurized.

10.4 Depressurizing the dryer



WARNING ! – Exhausting pressure
Compressed air exhausting to the outside is very loud and may carry small particles.
This may cause hearing damage as well as injuries of the eyes and of the skin.
Close the openings used for releasing the pressure by means of a silencer suitable for the pressure.
Open the valves for releasing the pressure only very slowly.
Always wear eye and hearing protectors when working in the vicinity of the dryer.

1) Close the valves upstream and downstream of the dryer.
2) Open the condensate drain valves (HV1, HV2) on the pre- and after-filter (F1 and F2).
3) Monitor the pressure on the pressure gauges of the dryer.
4) Wait until the pressure has dropped to 0 psi (0 bar) on both pressure gauges.

10.5 Restarting the dryer

Please proceed as described in chapter "Commissioning". (→ Page 45)
If the relevant requirements have already been fulfilled, the corresponding steps of the chapter can be skipped.

11. Maintenance and repair

DANGER ! – Overpressure
The dryer is under pressure.
Suddenly escaping compressed air may result in serious injury.
Do not carry out mechanical or electrical work on the dryer as long as the dryer is under pressure.

DANGER ! – Electric voltage
The dryer is operated at electric voltages up to 230 V.
Touching live parts may result in serious injury or death.
Work on electrical components must only be carried out by qualified and authorized personnel.
Use a voltage detector to make sure the dryer has been disconnected from the power supply and that there are no live parts before starting maintenance work.
In the event of fire, do not extinguish the fire using water.

CAUTION ! – Qualification and experience required
Persons working on and with the dryer have to be qualified personnel who, because of their qualification and experience, are familiar with handling compressed air systems and electrical systems. If you are not experienced in using these systems, please ask the relevant experts for help. We highly recommend that commissioning and maintenance be carried out by the manufacturer or one of the authorized service partners.

Please observe the following requirements for maintenance:

- Observe the notes in section "Intended use". (→ Page 9)
- Observe the "Safety notes" and the "General safety notes" in particular. (→ Pages 12, 14)
- Provide the required spare parts. Only use genuine spare parts of the manufacturer.
  The manufacture provides prepared spare part packets. (→ Page 5)
- Maintenance must only be carried out if the dryer is depressurised and disconnected from the power supply.

Please observe the following when completing maintenance work:

- Make sure that all the flange connections and screwed joints are tight and sealed.
- Carry out a leak test.
- Make sure not to forget any tools, detergents or other objects in and around the dryer.
- Commission the dryer as described on → page 45.

Maintenance contract
It is possible to conclude a maintenance contract with the manufacturer or one of their service partners. A maintenance contract guarantees that the dryer has been maintained regularly by qualified personnel and that only genuine spare parts are being used.
For contact data, please refer to → page 5.
For communication purposes, please specify the type and the manufacturing number. This information can be found on the type plate on the control box of the dryer. (→ Page 12)

11.1 Regular maintenance intervals

The following table gives an overview of routine maintenance tasks. The required activities are described on the following pages.

Component	Maintenance activity	Every day	Every month	Every year	Every 2 years	See page
Dryer and dryer control	Visual check and function monitoring	●				51
Dryer	Clean		●			52
Control box	Check if cable and terminals are securely fixed			●		52
Dew point sensor (MT01)	Calibration required			●		52
Pre- and after-filter	Replace filter element			●		53
Expansion silencer (X1)	Replace			●		53
valves (V1-V5 + RV1-5)	Replace sealing set				●*	54
desiccant	Check/replace				●*	54

* = These activities should be carried out at the same time.

11.1.1 Visual check and function monitoring

1) Check the dryer for external damages.
2) Check the operating parameters of the incoming compressed air (pressure and temperature in particular). (→ Page 11)
3) Check the individual components for unusual noise development and leaks.
4) Check the error messages on the touch panel and, if required, proceed as described in section "Alarm messages". (→ Page34)
5) Check if the condensate drains on the compressor and on the upstream filters are working properly.
6) Check the dew point.

11.1.2 Cleaning the dryer and dryer control

Make sure the surroundings are clean and tidy.

1) Clean the dryer surface using a slightly moist cloth. Do not use detergents containing acids or solvents.
2) Make sure the operating elements and the type plates can always be clearly read.
3) Keep water and metallic dust away from the electrical components.

11.1.3 Checking if cable and terminals are securely fixed

The cable connections may be loosened due to transportation or vibrations. To prevent malfunctions from occurring, all the cable connections must be checked to ensure that they are securely fixed. In the event of heavy vibrations, inspection must be carried out more frequently. The necessary actions must only be performed by a qualified electrician.

1) Decommission the dryer. (→ Page 48)
2) Depressurize the dryer. (→ Page 49)
3) Disconnect the electrical power supply from the dryer and protect it against unintentional reconnection.
4) Make sure the cables and terminals are securely fixed by tightening them, if required.
   Only use tools approved for electrical work.
5) Replace any damaged or corroded components.
6) After the control box has been reclosed, the dryer can be re-commissioned again.

11.1.4 Calibrating the dew point sensor

The dew point sensor (MT01) is subject to age which leads to inaccurate measurements over time. Oil vapor and other contamination may render the sensor unusable over time. To prevent operating errors from occurring the dew point sensor must be calibrated regularly.

Delicate dew point sensor
The dew point sensor contains a very delicate electronic system. Vibrations and shocks may lead to sensor damage. Handle the sensor with particular care.

1) Decommission the dryer. (→ Page 48)
2) Depressurize the dryer. (→ Page 49)
3) Loosen the screw at the sensor cable socket and remove the cable socket. The cable socket is kept at the dryer and will be reused.
4) Unscrew the sensor from the measuring socket using an appropriate wrench. Only hold the sensor at the hexagon of the sensor housing!
5) Insert a calibrated sensor of the same type in the measuring socket.
6) Plug the cable socket onto the calibrated sensor and tighten the cable socket.
7) Pressurise the dryer and commission the dryer again. (→ Page 48)

Replacement program
The manufacturer provides a replacement program for old dew point sensors.

1) Order a new dew point sensor.
2) Exchange the sensors upon receipt of the new sensor.
3) Send the old sensor back to the manufacturer. For this purpose, use the protective packaging of the new sensor. Only sensors that are undamaged can be recalibrated!
4) After receipt of the old, undamaged sensor the price difference of the new sensor and calibration will be credited. The old sensor remains at the manufacturer.

11.1.5 Replacing filter elements

The filter elements in the filters prevent particles and aerosols in the compressed air flow from entering the system. The filter elements in the filters will be clogged over time and thus the compressed air flow is throttled. To prevent operating errors from occurring, the filter elements have to be replaced regularly. Check the differential pressure gauge at the filter (if available). When exceeding approximately 350 mbar, the elements should be replaced. Replacement is due after one year at the latest.

1) Depressurize the filter. (→Page 49)
2) For filter replacement please proceed as described in the operating manual of the filter.

11.1.6 Replacing the expansion silencer

WARNING ! – Suddenly escaping compressed air (7)
The dryer is depressurized approximately every 10 Minutes using a silencer. A loud and strong airstream may carry small particles and cause injury.
Do not place any equipment in the vicinity of the silencer. The silencer must not be manipulated or removed. Always wear hearing protectors when working in the vicinity of the dryer.
Never change the silencer on a pressurized dryer! Never
operate the dyer without silencer!

The expansion silencer (X1) is contaminated by dust and condensate over time and thus the expansion air flow is throttled. To prevent operating errors from occurring, the expansion silencer has to be replaced regularly.

1) Decommission the dryer. (→ Page 48)
2) Depressurize the dryer. (→ Page 49)
3) Lock the connecting part between valve V5 and expansion silencer (X1) using an appropriate tool in order for valve (V5) not to turn.
4) Unscrew the old expansion silencer (X1) from the connecting part using your hands or an appropriate tool.
5) Screw the new expansion silencer (X1) in the connecting part and tighten it using your hands or an appropriate tool and some sealing tape.
6) Pressurise the dryer and commission the dryer again. (→ Page 48)

11.1.7 Replacing the sealing set of the valves (V1-5) and the check valves (RV1-5)

The valves and check valves are subject to ware. The seals must be replaced in regular intervals.
Spare part kits containing all parts required for proper maintenance can be purchased from the manufacturer or one of his service partners

11.1.8 Checking and replacing the desiccant / cleaning the sieve tray

CAUTION ! – Desiccant dust
Using the desiccant may lead to mineral dust formation.
Desiccant dust may cause eye and respiratory tract irritations.
Wear eye protection and a dust mask when handling the desiccant.

WARNING ! – Risk of slipping
After desiccant replacement some amounts of desiccant may still remain on the floor.
The desiccant is very slippery and may result in serious fall injury.
Immediately remove residual desiccant properly from the floor.

The desiccant is subject to age and its drying performance is reduced over time. The service life of the desiccant depends on numerous operating parameters and cannot be exactly predicted. The service life is approximately 2 to 3 years. Under very favorable conditions (e.g. oil-free compressed air) the service life may be considerably longer. The quality of the desiccant can be assessed quite well when monitoring the operating phases. If the adsorption phase is reduced significantly during operation in the „CYCLE MODE - VAR“ mode, the desiccant should be replaced. Desiccant replacement is generally useful as a preventive maintenance measure in conjunction with other repair work. (See advisory note below)

WARNING ! – Risk of falls
The dryer must never be used as a climbing aid. The dryer components will not provide adequate support and parts of the dryer may break off. Disregard may lead to dryer damages and falls with serious injuries.
When working at height only use approved climb assist systems.

Desiccant replacement is part of a large inspection run. At the same time, other maintenance activities should be carried out. (See maintenance table → page 51)

1) Decommission the dryer. (→ Page 48)
2) Depressurize the dryer. (→ Page 49)
3) Remove pipe work directly on the upper connection of the vessel and remove reduction
4) Screw sieve cylinder (SB1) out, and remove desiccant from it, if desiccant is on the surface.
5) Clean threads from old sealants

Picture 1 : taking off the upper valve block

6) Provide an adequately sized container for the used desiccant (see data of volume on the vessel name plate)
7) Remove the used desiccant from the vessel using a suction device (e.g. vacuum cleaner).
8) Provide the new desiccant. In case two different desiccants shall be used, make sure that the two different desiccant types create two separate layers in the vessel.
   Distribute the different desiccant types equally to the two vessels.
   In the event you are unsure which desiccant to fill in first, please contact the manufacturer.
9) Fill in the liquid waterproof desiccant (silica gel WS) first. It is the lower layer in the vessel.
10) Fill in the desiccant (molecular sieve) last. It is the upper layer in the vessel. Fill it so far, that sieve cylinder could easily insert with a slight hand pressure into vessel. During operation the desiccant will compress a little bit and will reduce its volume a little bit.
11) Screw in the sieve cylinder with new O-ring
12) Clean and grease the sealing surfaces and the thread of the upper closing plug (G).
13) Fit new O-rings to the upper closing plug (G).
14) Connect upper pipe work
15) Clean the floor thoroughly from desiccant residues.
16) Slowly pressurise the dryer again. (→ Page 46) Carry out a leak test using a leak detection spray. In the event of leaks the dryer will have to be depressurized prior to repairing the leaks.

Please note that, directly after desiccant replacement, the dew point may become worse. The new desiccant will reach the full drying performance only after a longer operation period.
For the time directly after desiccant replacement it may be useful to select a dew point limit value as described in the "Properly selecting the dew point limit value" advisory note. (→ Page 10)

Increased dust contents after desiccant replacement
Filling the new desiccant in the dryer results in increased dust contents in the vessels. In the first weeks after recommissioning the dust is forwarded to the downstream filter and the filter elements will deteriorate faster than during later operation. We therefore recommend to recommission the dryer using the old filter elements and to use the new filter elements and the new expansion silencer only after some weeks.

Desiccant

The desiccant used is not subject to labelling requirements according to the Hazardous Substances Ordinance. Nevertheless, the common safety measures with regard to using chemicals apply.
The manufacturer will provide safety data sheets on request.
The desiccant may accumulate contaminants from the compressed air. Depending on the type of contamination there may be a risk of injury or damage when using the desiccant. As the type of contamination is not known to the manufacturer, the resulting risks cannot be evaluated in this operating manual.

Disposal

Dispose of the desiccant according to the local regulations.
Waste codes according to the Waste Catalog Ordinance:

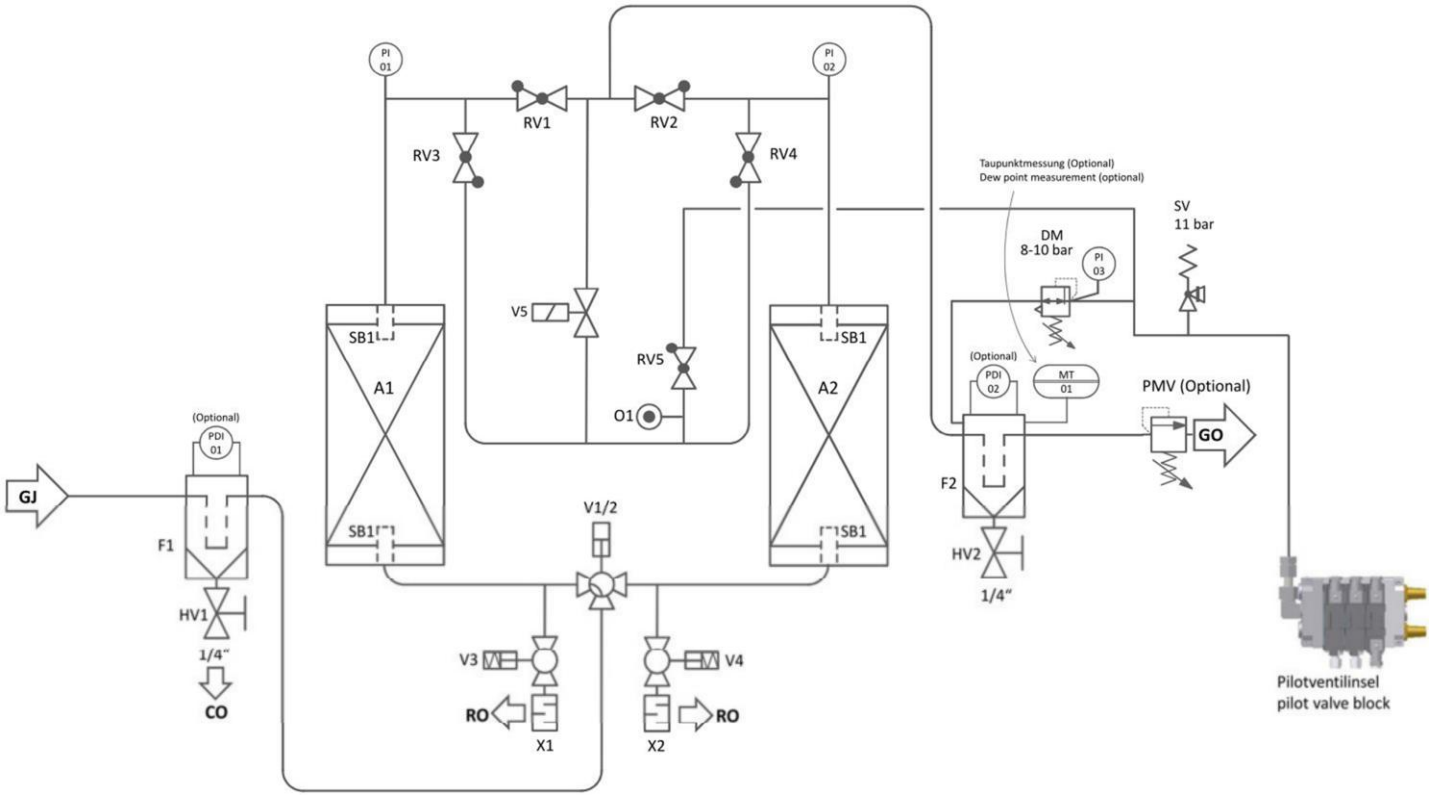
- Non-contaminated desiccant: 06 08 99
- Contaminated desiccant: The waste code will have to be determined by the waste producer taking the type of contamination into consideration. The desiccant must be disposed of in an appropriate disposal plant.

12. Appendix and technical documents

12.1 General arrangement drawing

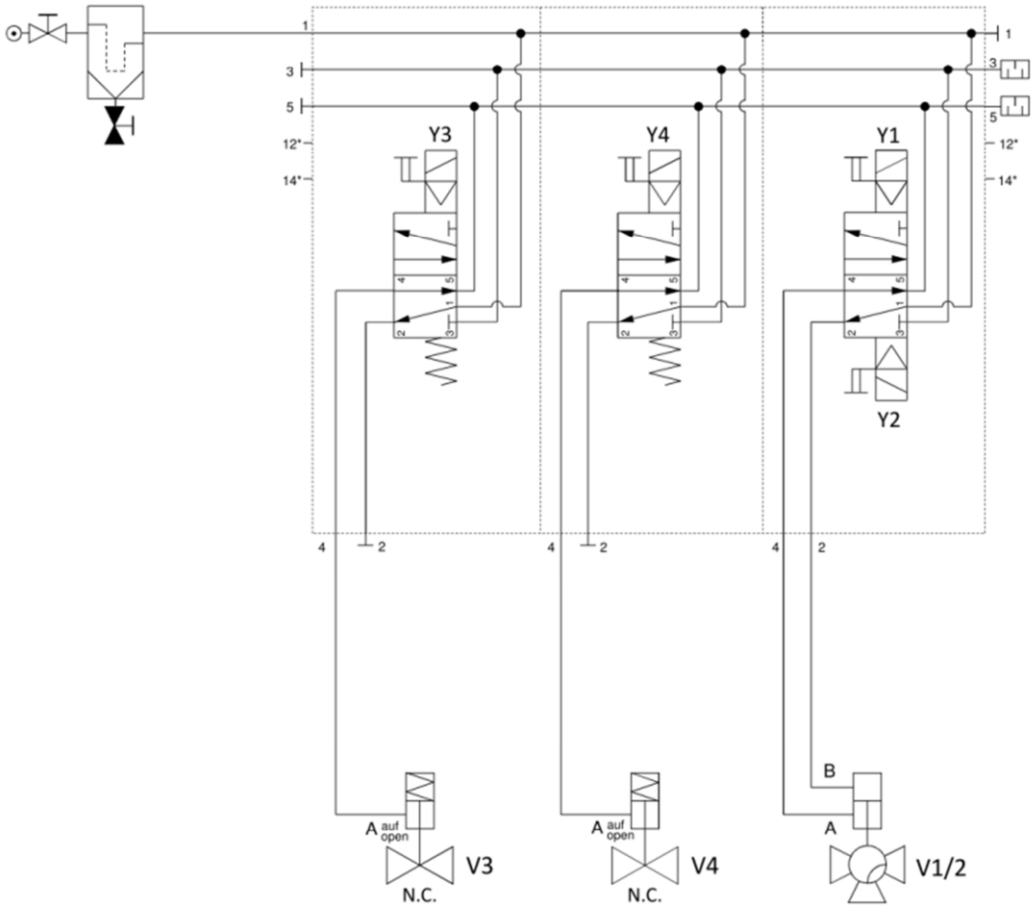
Separate document

12.2 Process flow diagram PID



A	*adsorber vessel*		
F	*filter*		
V	*Shut off or 3-2-way valve*		
HV	*manual shut off valve*		
RV	*non-return valve*		
NV	*needle vlave*		
SB	*sieve basket*		
PMV	*pressure maintaining valve*		
O	*orifice / throttle*		
X	*silencer*	GJ	*gas inlet*
PI	*pressure gauge*	GO	*gas outlet*
DPI	*differential pressure gauge*	RO	*regeneration gas outlet*
MT	*pressure dew point transmitter*	CO	condensate outlet

12.3 Pneumatic plan



Wenn Y1 angesteuert ist,
dann ist der Trocknereintritt (GJ) auf
Behälter A1 (links) verbunden.

When Y1 is energised vessel A1 (left)
is connected to the dryer inlet (GJ)

12.4 Wiring diagram

See next pages