

# Operating Manual Breathing Air Dryer DPS 1-8 BI/BM





# Table of contents

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1. General information .....	5
1.1 Manufacturer.....	5
1.2 Dryer data .....	6
1.3 Contact data .....	6
1.4 Additional documents .....	6
1.5 Warranty notes.....	7
1.6 About this operating manual.....	7
2. Description of application .....	9
2.1 Intended use .....	9
2.2 Technical data.....	11
3. Safety notes.....	12
3.1 Signs and instructions.....	12
3.2 Danger zones at the dryer .....	13
3.3 General safety notes.....	14
4. Technical product description .....	16
4.1 Assembly drawing.....	16
4.2 Process flow diagram.....	18
4.3 Function description.....	19
4.4 Options .....	23
5. Operating elements.....	24
5.1 Power connector .....	24
5.2 Differential pressure gauges on the filters (only DPS6...8).....	25
5.3 Pressure gauge .....	25
5.4 Control.....	26
5.5 Function keys and display.....	26
5.6 Direct indication .....	27
5.7 Menu guide.....	27
5.8 Parameter settings .....	28
5.9 Compressor synchronisation function.....	29
5.10 Dew point measurement and energy-saving function.....	29
5.11 Filters for differential pressure monitoring.....	30
5.12 Overflow monitor .....	30
5.13 Service ticket .....	31
5.14 Menu structure.....	32
6. Error analysis table .....	33
7. Transportation, setting up and storage.....	35
7.1 Transportation.....	35
7.2 Setting up.....	36
7.3 Storage.....	37
8. Installation .....	38
8.1 Installing the connecting pipelines.....	38
8.2 Installing the power supply .....	40
9. Commissioning .....	43
9.1 Requirements for initial commissioning.....	43
9.2 Commissioning the dryer.....	44

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## Table of contents

---

9.2.1	Pressurisation of the dryer .....	45
9.2.2	Opening the outlet valve .....	45
9.2.3	Starting the dryer.....	46
10.	Shutting down and restarting the dryer .....	47
10.1	Shutting down the dryer in case of emergency.....	47
10.2	Stopping the dryer.....	47
10.3	Shutting down the dryer.....	47
10.4	Depressurising the dryer .....	48
10.5	Restarting the dryer.....	48
11.	Maintenance and repair .....	49
11.1	Regular maintenance intervals.....	50
11.1.1	Visual check and function monitoring.....	50
11.1.2	Cleaning the dryer and dryer control .....	51
11.1.3	Checking if cable and terminals are securely fixed.....	51
11.1.4	Calibrating the dew point sensor.....	51
11.1.5	Replacing filter elements .....	52
11.1.6	Replacing the expansion silencer .....	52
11.1.7	Replacing the sealing set of the valves (V1-4) and the check valves (RV1-2).....	53
11.1.8	Checking and replacing the desiccant .....	53
12.	Appendix and technical documents .....	57
12.1	Manufacturer's declaration .....	57
12.2	Declaration of conformity .....	58
12.3	General arrangement drawing .....	59
12.4	Process flow diagram.....	59
12.5	Wiring diagram .....	59



## 1. General information

### 1.1 Manufacturer



FST GmbH

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Sales office: Im Teelbruch 106 – 45219 Essen, Germany

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📠 +49 (0) 2054 8735-100

✉ info@fstweb.de

***! For any questions about the product, please contact the 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)

## General information

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### 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

### 1.5 Warranty notes

For warranty information, please refer to our "General Terms of Sale and Delivery".

(→ [www.fstweb.de](http://www.fstweb.de))

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 "Target group": (→ see "target group":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.

#### Target group

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 authorised 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 selling or hiring out the dryer, also 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 and other impurities from compressed air for breathing air applications.

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 and other impurities. The compressed air is dried until only a very low residual concentration of water vapour remains in the dried compressed air. This residual moisture content is measured as the pressure dew point in °C.

DPS...BI stands for „Breathing air Industrial“, thus for Industrial use acc. EN12021, and DPS...BM stands for „Breathing air Medical“, thus medical breathing air acc. Pharmacopée Européenne, as it is demanded for hospitals.

With both systems apart from the drying process to a pressure dew point of -40°C also the components CO, CO<sub>2</sub>, hydrocarbons, nitrogen oxides and SO<sub>2</sub> are reduced so far, to residual values underneath the limit values acc. EN12021 (with series DPS..BI), respectively Pharmacopée Européenne (with series DPS..BM).

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



#### **CAUTION ! – Dry air**

Dry air is irritating to the eyes and the respiratory system.

The eyes and the respiratory system can be damaged when exposed to dry air over longer time.

Use a humidifier to add moisture to the air in case people are exposed to this air for a longer period of time or when the air is used for artificial respiration.



The dryer is exclusively designed for drying/purification 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 (e.g. 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.)

## Description of application

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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, ambient conditions).

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 subsaturated. 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.

## 2.2 Technical data

Dryer	Nominal volume flow rate	Compressed air connection	Weight "Bl"	Weight "BM"	Height	Width "Bl"	Width "BM"	Depth
	V [m³/h]*		[kg]	[kg]	[mm]	[mm]	[mm]	[mm]
<b>DPS 1</b>	8	G 3/8"	14	15	450	412	502	185
<b>DPS 2</b>	15	G 3/8"	20	21	625	412	502	185
<b>DPS 3</b>	25	G 3/8"	27	28	875	412	502	185
<b>DPS 4</b>	35	G 3/8"	35	36	1125	412	502	185
<b>DPS 6</b>	57	G 1/2"	65	66	1180	614	704	220
<b>DPS 7</b>	72	G 1/2"	78	79	1405	614	704	220
<b>DPS 8</b>	82	G 1/2"	90	91	1605	614	704	220

\* = Standardised to 1 bar(a) and 20°C as well as to the following operating conditions: 7 bar operating overpressure, 35°C inlet temperature and -40°C pressure dew point

Classification acc. to PED 97/23/EG	DPS1...2: Art.3 Par.3 / DPS3...8: I
Fluid group	2
Supply voltage	230V 50-60Hz (optional 115V 50-60Hz and 24V-DC)
Class of protection	IP65
Min. / max. allowable pressure (PS)	4 to 16 bar
Min. / max. allowable temperature (TS)	+1 to +50°C
Noise pressure level (free-field measurement in distance of 1 m)	up to 85 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.

Data on the purification performance, max. allowable inlet concentrations and further technical data and information about the product please find in the product data sheet:

→ [www.fstweb.de](http://www.fstweb.de) → „download“ → „product data sheets“

## 3. Safety notes

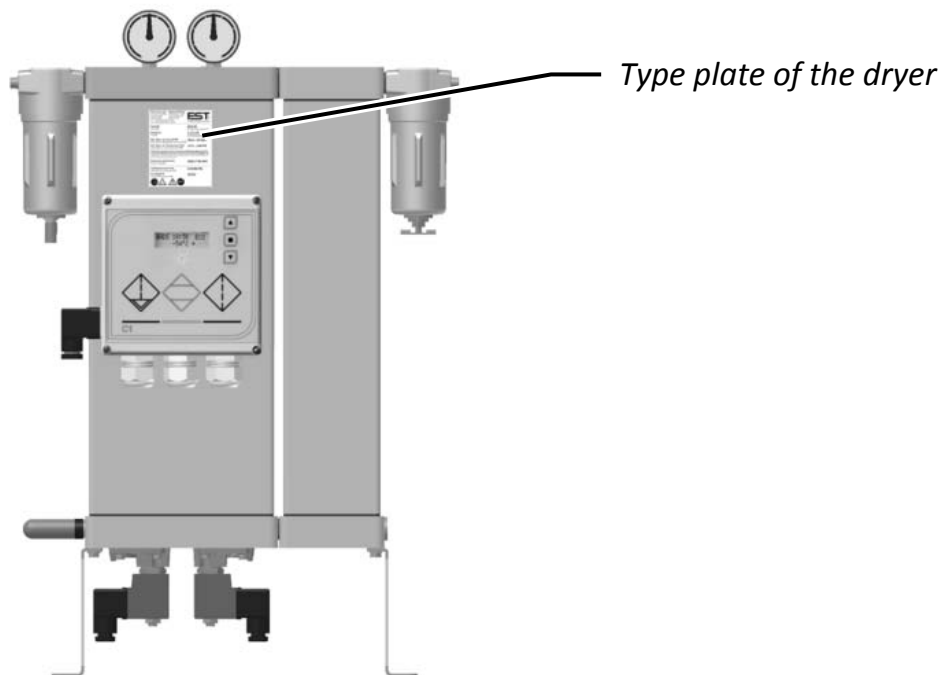
The dryer has been built according to state-of-the-art technology and recognised safety rules. However, there is a risk of danger that every person working with the dryer must be aware of. In particular, improper handling of compressed air and electricity may result in serious injury or death. If you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



### Note!

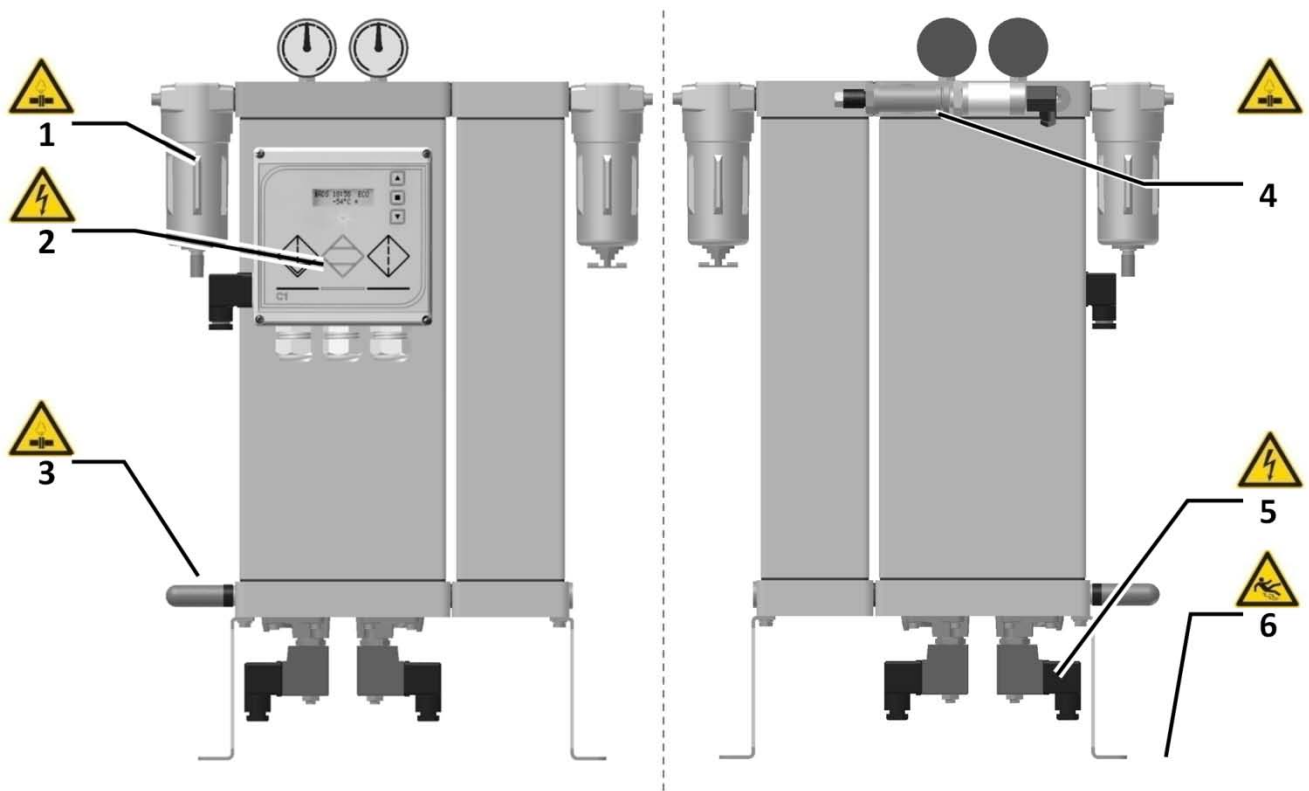
- In order to prevent personal injury or damage, the safety notes must be observed when using this dryer.
- Observe the specific safety notes in the relevant chapters.
- Observe the legal guidelines and the accident prevention regulations.
- Observe the safety notes of the local site regulations.

### 3.1 Signs and instructions



The type plates show important information. Make sure that the type plates are always clearly readable.

### 3.2 Danger zones at the dryer



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



#### **DANGER ! – Overpressure (1,4)**

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 (2;5)**

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 authorised 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.



## Safety notes

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### **WARNING ! – Suddenly escaping compressed air (3)**

The dryer is depressurised approximately every 5 minutes using a silencer. A loud and strong air-stream 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 (6)**

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 ! – Unauthorised 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.

**CAUTION ! – Dry air**

Dry air is irritating to the eyes and the respiratory system.

The eyes and the respiratory system can be damaged when exposed to dry air over longer time.

Use a humidifier to add moisture to the air in case people are exposed to this air for a longer period of time or when the air is used for artificial respiration.

**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.

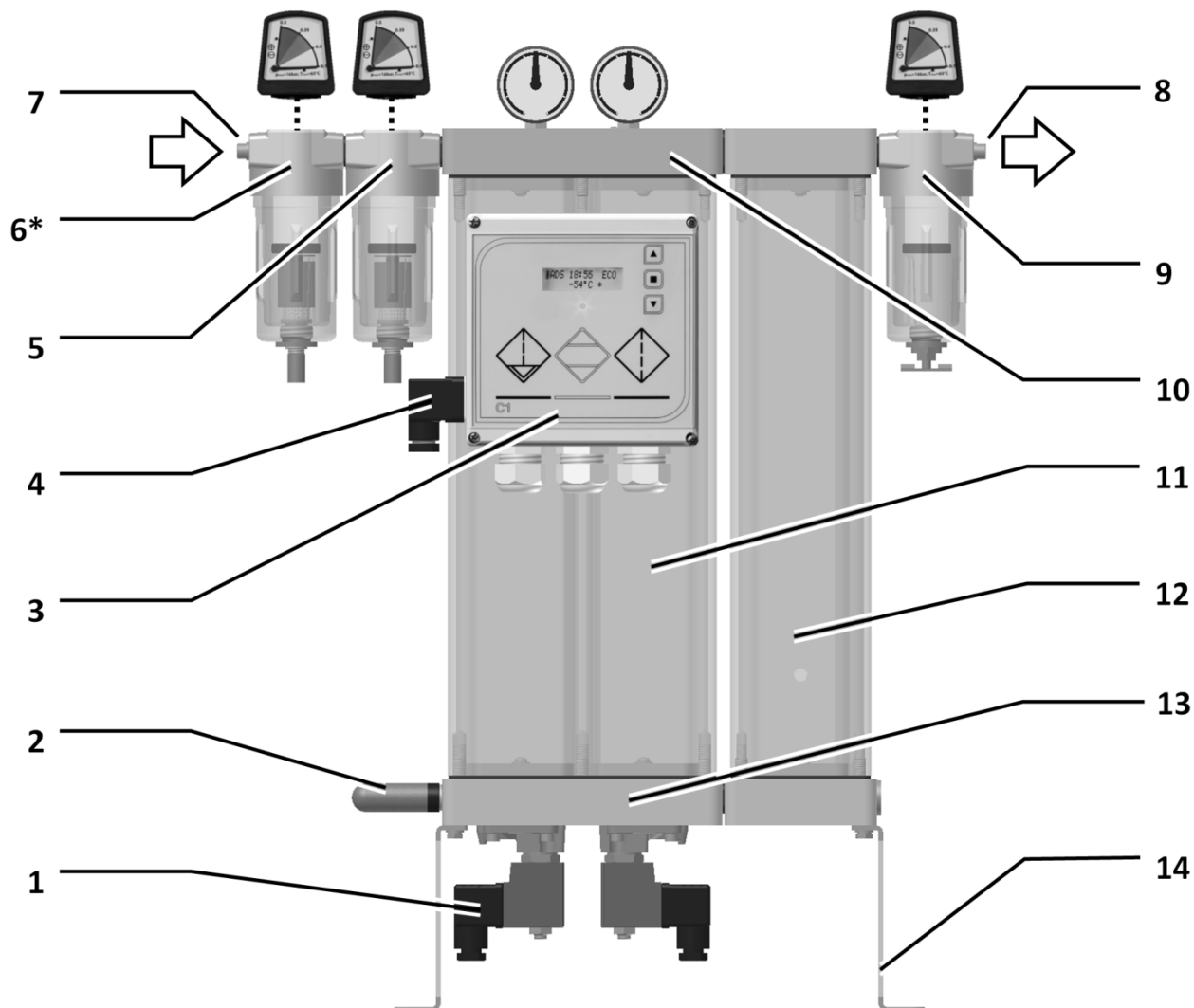
**Additional safety notes**

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

## 4. Technical product description

### 4.1 Assembly drawing

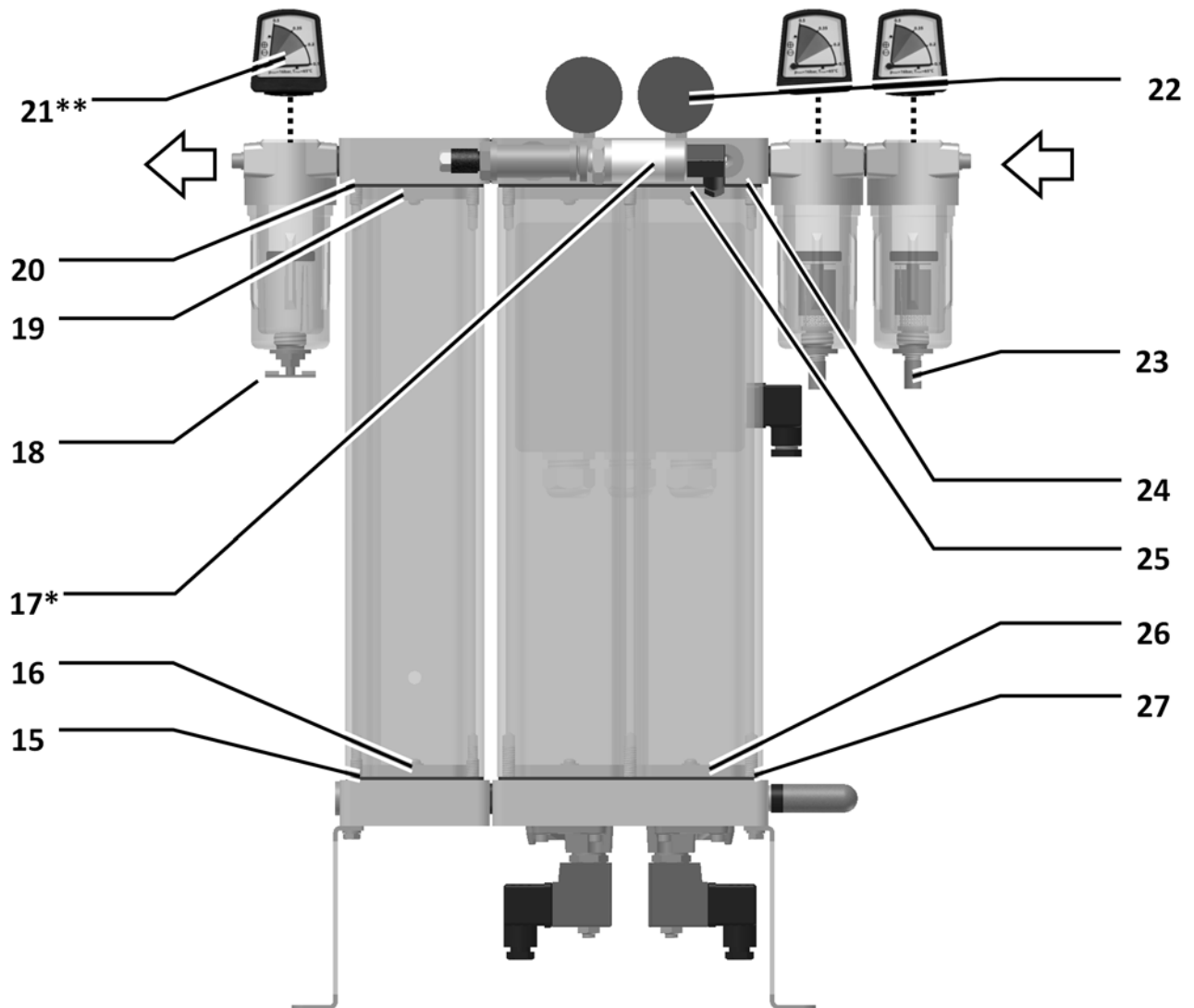
#### Front View



- |  |   |
|--|---|
| <b>1</b> Solenoid valves (solenoids: Y1, Y2, Y3, Y4)                                     | <b>8</b> Compressed air outlet (GO)                                 |
| <b>2</b> Expansion silencer (X1) with regeneration gas outlet (RO)                       | <b>9</b> After-filter (F2) with filter element                      |
| <b>3</b> Control with display and operator keys  | <b>10</b> Upper check valve block (RV1, RV2) with orifices (O1, O2) |
| <b>4</b> Power Connector (power supply)  | <b>11</b> Twin vessel (A1, A2)                                      |
| <b>5</b> Pre-filter(F1.2) "main stage" with filter element                               | <b>12</b> Third vessel (A3)   |
| <b>6</b> Pre-filter(F1.1) "pre-stage" with filter element<br>Note: * = only for DPS...BM | <b>13</b> Lower valve block (V1, V2, V3, V4)                        |
| <b>7</b> Compressed air inlet (GJ)   | <b>14</b> Dryer support legs  |



## Rear view

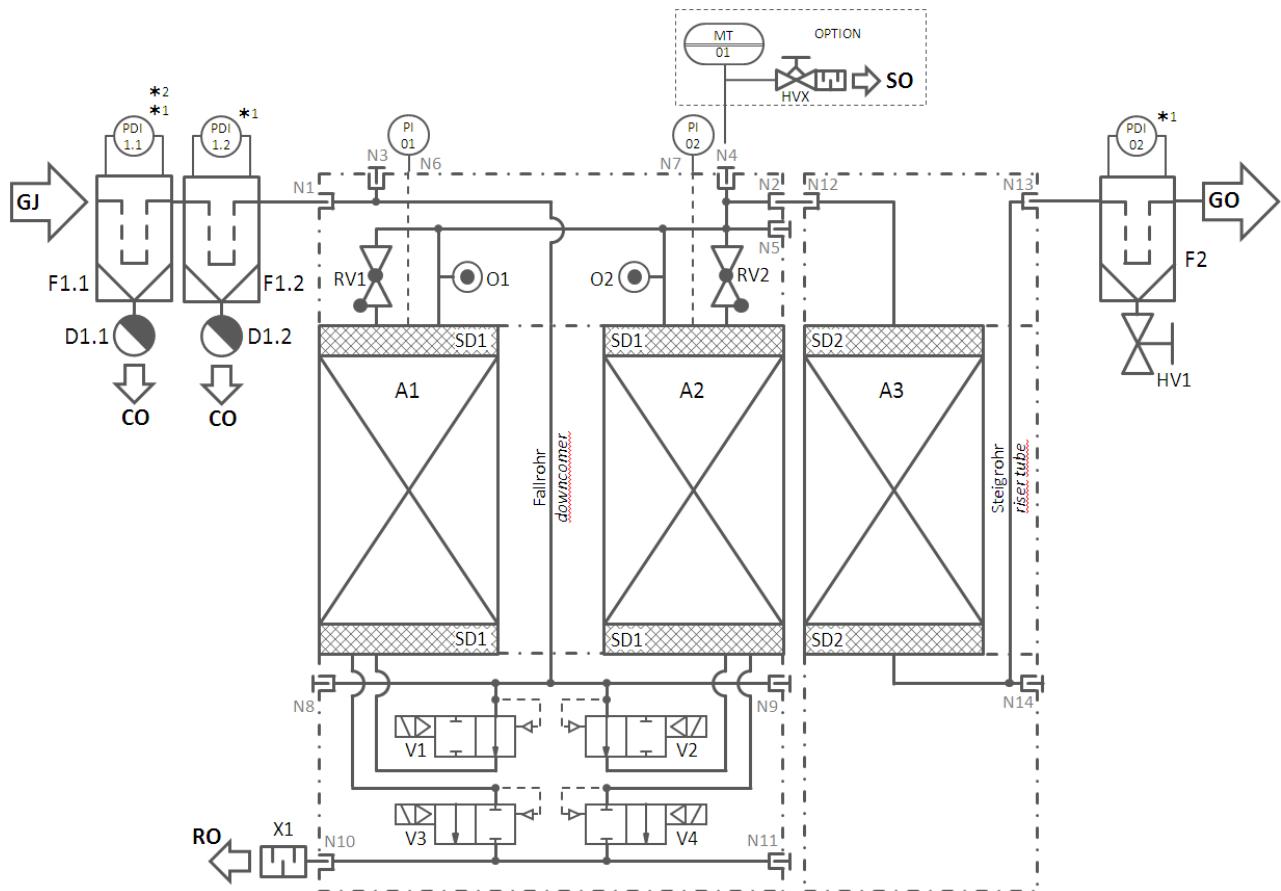


- 15; 20** Gasket for third vessel
- 16; 19** Demister-Pads (SD2) for third vessel, internal
- 17** Dew point sensor (MT01) (\*optional)
- 18** Manual drain valve (HV1) on after-filter
- 21** Differential pressure gauge (PDI1.1+PDI1.2, PDI02)  
Note: \*\* = only for DPS6-8

- 22** Pressure gauge (PI01, PI02)
- 23** Condensate drain (D1.1+D1.2) and Condensate outlet (CO)
- 24; 27** Gasket for twin vessel
- 25; 26** Demister-Pads (SD1) for twin vessel, internal

## 4.2 Process flow diagram

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



\*= DPI only for DPS 6 to 8

\*= F1.1 only for DPS...BM

A	Dryer twin vessel	O	orifice
F	Filter	PI	Pressure gauge
V	Valve	DPI	Differential pressure gauge
HV	Manual valve	MT	Dew point transmitter
RV	Check valve	GJ	Gas inlet
HVX	Throttle valve with silencer	GO	Gas outlet
SD	Sieve mesh / demister	RO	Regeneration gas outlet
X	Expansion silencer	CO	Condensate outlet
D	Condensate drain	SO	Sample air outlet

## 4.3 Function description

The operation principle of the dryer is adsorption and catalytic oxidation. 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 and purification the compressed air flow is led through a vessel containing the desiccant and brought into intensive contact with the desiccant. The desiccant removes moisture, a part of the carbon dioxide (CO<sub>2</sub>) and other gaseous components from the compressed air and stores them in its internal structure. With continuous loading of the desiccant the dryer performance is reduced until the desiccant is saturated. The saturated desiccant requires regeneration, i.e. the moisture and gaseous components stored in the inner desiccant structure is removed again. The desiccant can then be reused for drying and purification. 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 6 hours or longer.

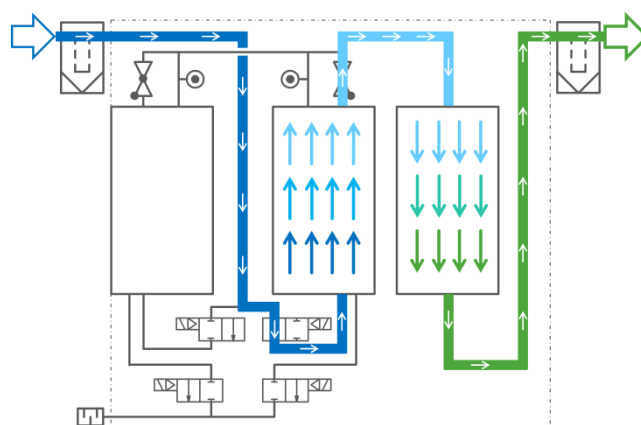
Continuous operation of an adsorption dryer requires two vessels that are operated alternately. One vessel is used for drying the compressed air (adsorption). In the other vessel the regeneration phases are carried out. The change interval between adsorption and regeneration is approx. 5 Minutes\*.

After the drying and removal of carbon dioxide the compressed air is guided through a third vessel. Here oil vapour will be removed by a activated charcoal bed and carbon monoxide (CO) will be oxidised by a catalyst bed.

### Adsorption phase

Duration approx. 3 Minutes to max. 15 min\*

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 lower valve block (V1-4) 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 demister pad (SD1) and slowly flows through the desiccant bed. The compressed air exits the vessel via a second demister pad (SD1) and is forwarded from the upper checkvalve block (RV1, RV2) to the compressed air outlet (GO).



1 Stand-by - Adsorption

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.

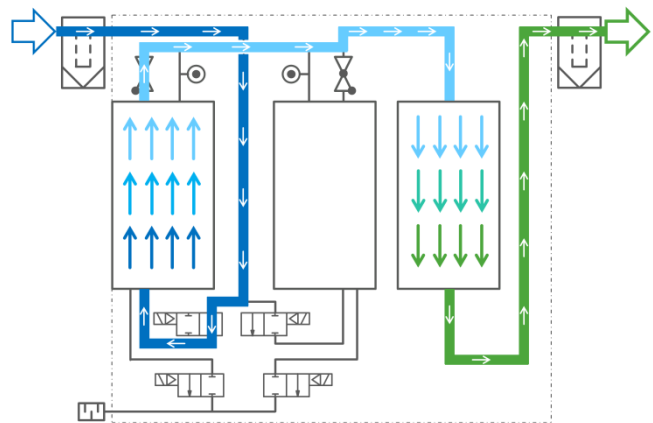
The adsorption phase is completed and the vessels are switched over if...

- ... the cycle mode **"CYCLE MODE – FIX"** has been pre-selected and a time of 5 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 compulsorily after 15 minutes at the latest.

# Technical product description

For vessel switch-over the main valves (V1) is opened and shortly later the main valve (V2) is closed. The compressed air flow changes 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".



2 Adsorption - Stand-by

## Regeneration

Duration approx. 5 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.

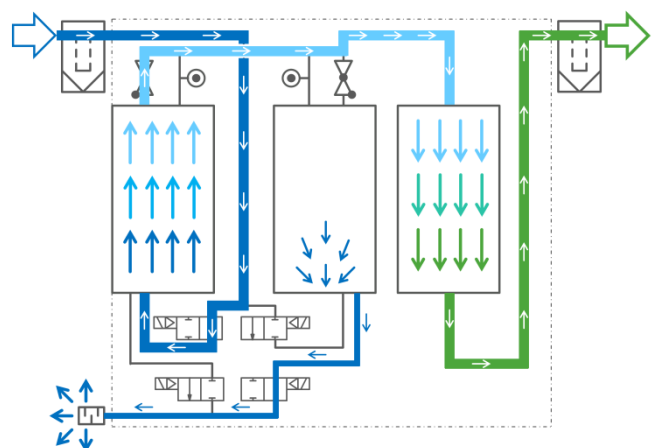
Regeneration is divided into the following phases:

- Expansion
- Purging (regeneration)
- Pressurisation
- Standby

## Expansion phase

Duration a few seconds\*

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



3 Adsorption - Expansion

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

### Purging (regeneration)

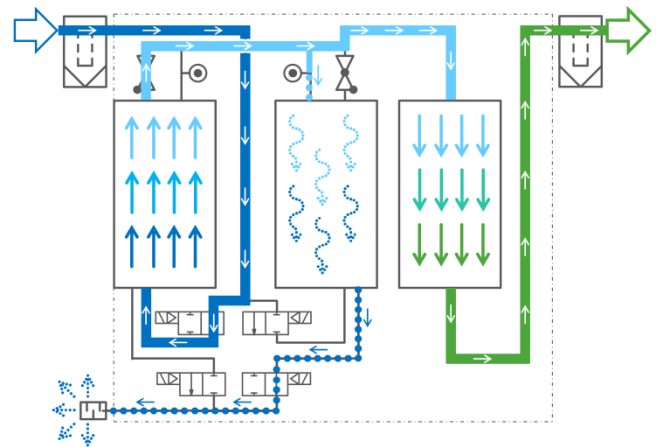
Duration approx. 4 min\*

When the vessel pressure drops, dry air (regeneration gas) from vessel (A1) flows through the orifice (O2) into vessel (A2).

The dry and pressureless regeneration gas is distributed throughout the vessel cross-section and led through the desiccant. The dry regeneration air vaporises the water and removes the carbon dioxide stored in the desiccant. In the form of steam the water, together with the carbon dioxide and 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)

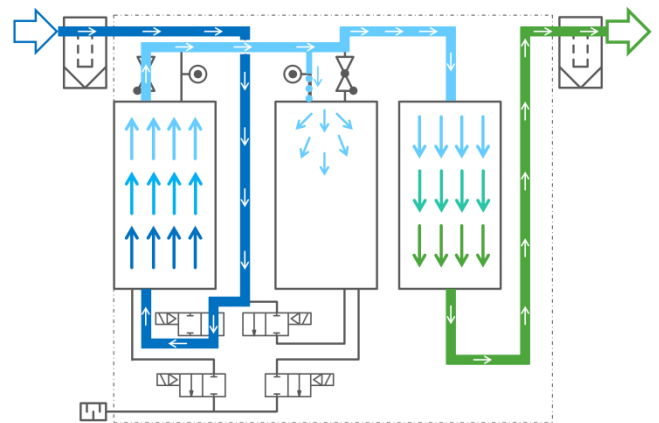
### Pressurisation phase

Duration approx. 1 min

The pressurisation phase ensures that the two vessels have the same vessel pressure prior to vessel switch-over.

The regeneration air valve (V4) is closed and dry compressed air continues to flow through orifice (O2) into vessel (A2) gradually equalising the pressure in both vessels.

The next phase begins when the vessel pressure is almost the same in both vessels.



5 Adsorption - Pressurisation

After a preset time of app. 1 minute\* has expired the pressurisation phase is ended and the next phase begins.

# Technical product description

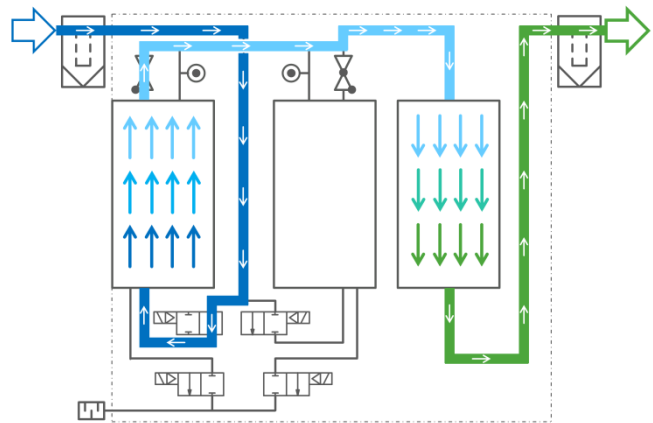
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## Standby

Duration approx. 0 minutes to max. 10 minutes\*

Vessel regeneration is now complete and the vessel is immediately ready to operate. During this phase the both vessels stay connected via the orifice (O1) and (O2). 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.

### **Automatic start-up device (pressure maintaining valve)**

The dryer must always be operated with an adequately high pressure in order to avoid excessive flow velocities in the dryer. There is a danger of damage to the dryer. (→ Page 45)

If the dryer is started against a pressureless 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 pressureless 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
- Wall-mounting supports
- Heated frost protection housing
- Differential pressure gauges with electric alarm contact (only for DPS6-8)
- Multistage pre- or after-filtration
- Oil adsorber as third vessel flanged to the dryer. (can be added to an existing 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 pressureless vessel in regeneration mode will be pressurised via the main valve with a sudden pressure blow.

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 “pressurisation phase” or during “stand-by”



#### **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 29)



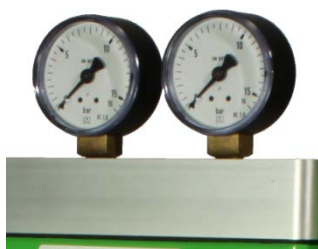
### 5.2 Differential pressure gauges on the filters (only DPS6...8)



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.

### 5.3 Pressure gauge



The vessel pressure of each vessel is shown on their respective pressure gauge PI01 / PI02.

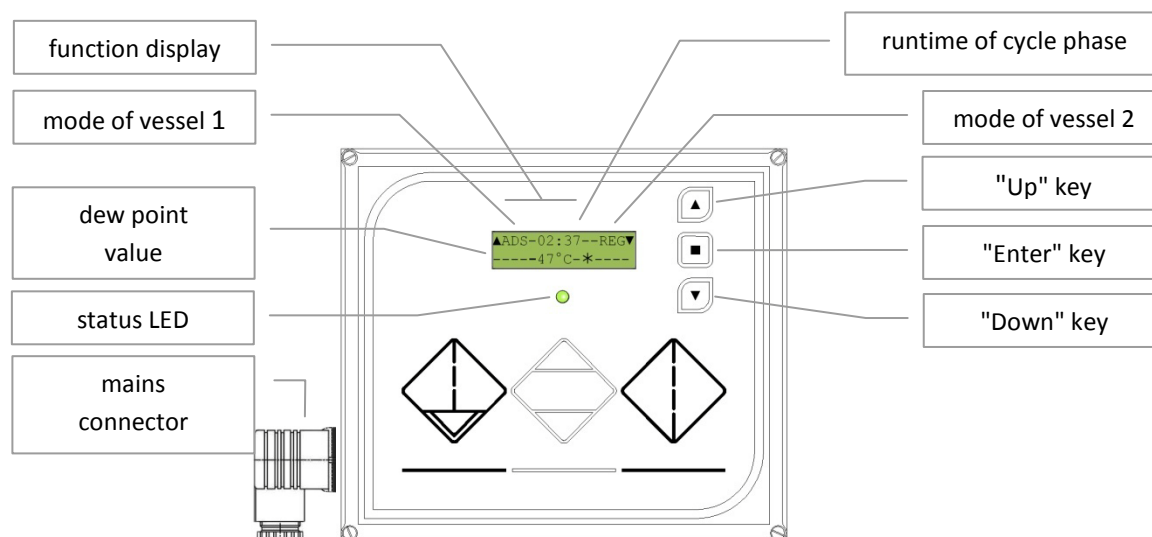
The pressure gauges allow to monitor the proper function of the dryer. When the display shows “**REG**” the corresponding pressure gauge should indicate a pressureless vessel.

# Operating elements

## 5.4 Control

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

## 5.5 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 "easy" 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	repressurisation 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

## 5.6 Direct indication

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

CYCLE MODE  
VAR ECO 00:15:00



NEXT-SERVICE  
82%

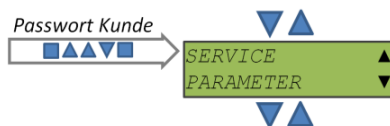
"Cycle Mode" indicates the VAR or FIX operating modes as well as the number of days, hours and minutes the dryer was in economy mode.

"Next Service" indicates the time (as a percentage value) remaining for the next service message to be shown. This value depends on the actual utilisation 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.

## 5.7 Menu guide

Access to the menu structure and thus to the parameter settings is generally password-protected against unauthorised 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 parameterisation section.

Pressing the "Down" key selects the corresponding menu item. Pressing the "Enter" key opens the parameterisation 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.

## 5.8 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 synchronisation 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! <i>See also compressor synchronisation.</i>
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 simultaneously 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.

## 5.9 Compressor synchronisation function

The CYCLE STOP menu item is used to select the control system behaviour 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:

CYCLE STOP ▲  
DIRECT STOP ▼

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).

CYCLE STOP ▲  
FINISH CYCLE ▼

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 synchronises the dryer with the compressor. The dryer only regenerates with compressed air being produced. The influencing compressor synchronisation contact does not affect the input valves. The compressor synchronisation contact can also be used as a remote switch and can, for example, be connected to higher-level time or emergency control systems.

## 5.10 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.

PARAMETER ▲▼  
PDP SENSOR ■

PDP SENSOR ▲  
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°C \*.

PARAMETER ▲▼  
PDP SET ■

PDP SET ▲  
-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.

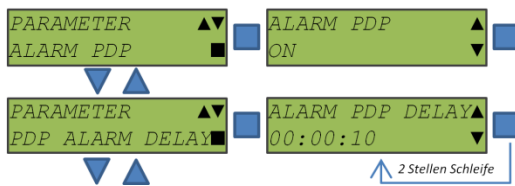
PARAMETER ▲▼  
PDP ALARM SET ■

PDP ALARM SET ▲  
-25°C \* ▼

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.

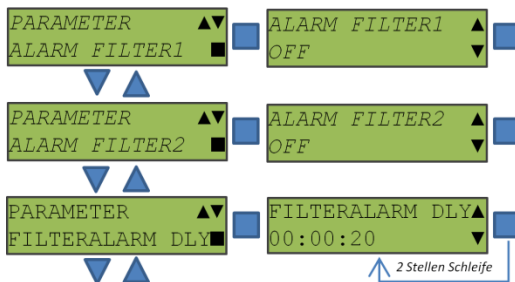
## Operating elements

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.



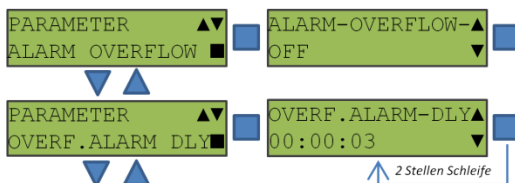
### 5.11 Filters for differential pressure monitoring

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.



### 5.12 Overflow monitor

If the pre- and afterfilters 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.



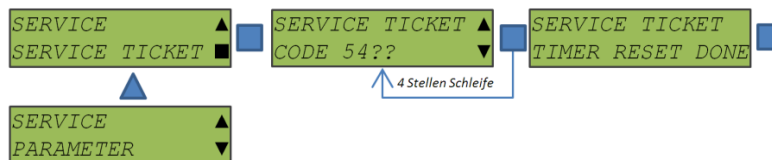
The ALARM-OVERFLOW monitor is switched off by default. The delay time should always be shorter than the delay time of the separate differential pressure monitor on the filters.

## 5.13 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 utilisation 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. Every time buying 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.

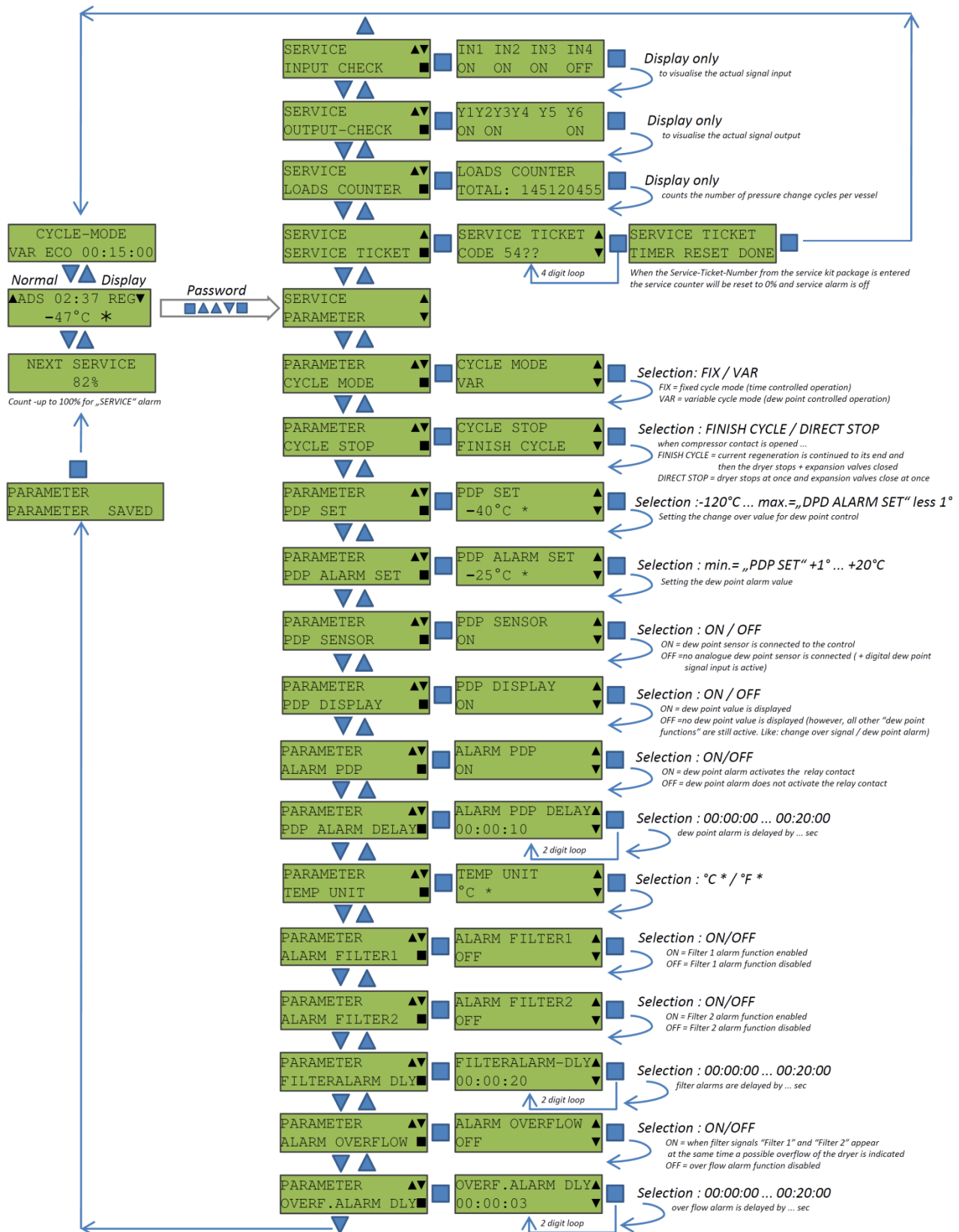


The number of the ticket code is entered digit by digit using the arrow keys. The cursor moves to the next digit by pressing the "Enter" key.

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.

## 5.14 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 reinstall, 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 dewpoint transmitter below 4 mA	Indicates heavy dirt accumulation on the active sensor surface. The sensor has to be replaced.
	Signal of dewpoint transmitter below 4 mA	4-20 mA signal adjusted incorrectly during connection of external dew point measuring instruments.
Dew point indication +++°C *	Signal of dewpoint transmitter above 20 mA	Active sensor surface is very moist and must be dried carefully.
	Signal of dewpoint 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.

## Operating elements

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<i>Error</i>	<i>Cause</i>	<i>Measure</i>
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 centre 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 haulage 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 Setting up

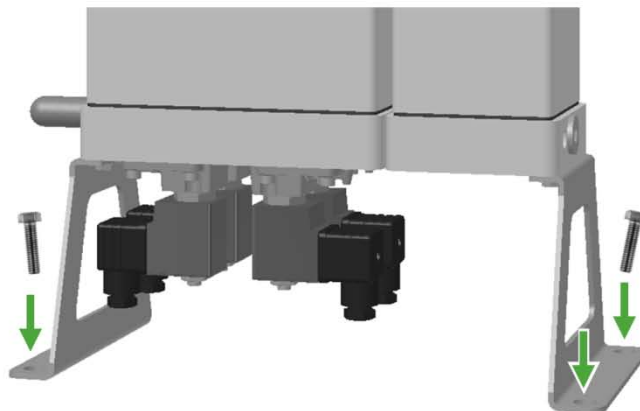
Please refer to section "Description of application" (→ page 9). Here, you will find a list of requirements on the installation site.

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.
- 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 0,1 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.



### 7.3 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 29)
- 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 47)
- 5) Depressurise the dryer. (→ Page 48)
- 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 plugs.
- 9) Place a desiccant bag in the control box.
- 10) Protect the dryer against dust using a cover.

To recommission the dryer after storage, please proceed as described for initial commissioning. (→ Page 44)



#### **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.

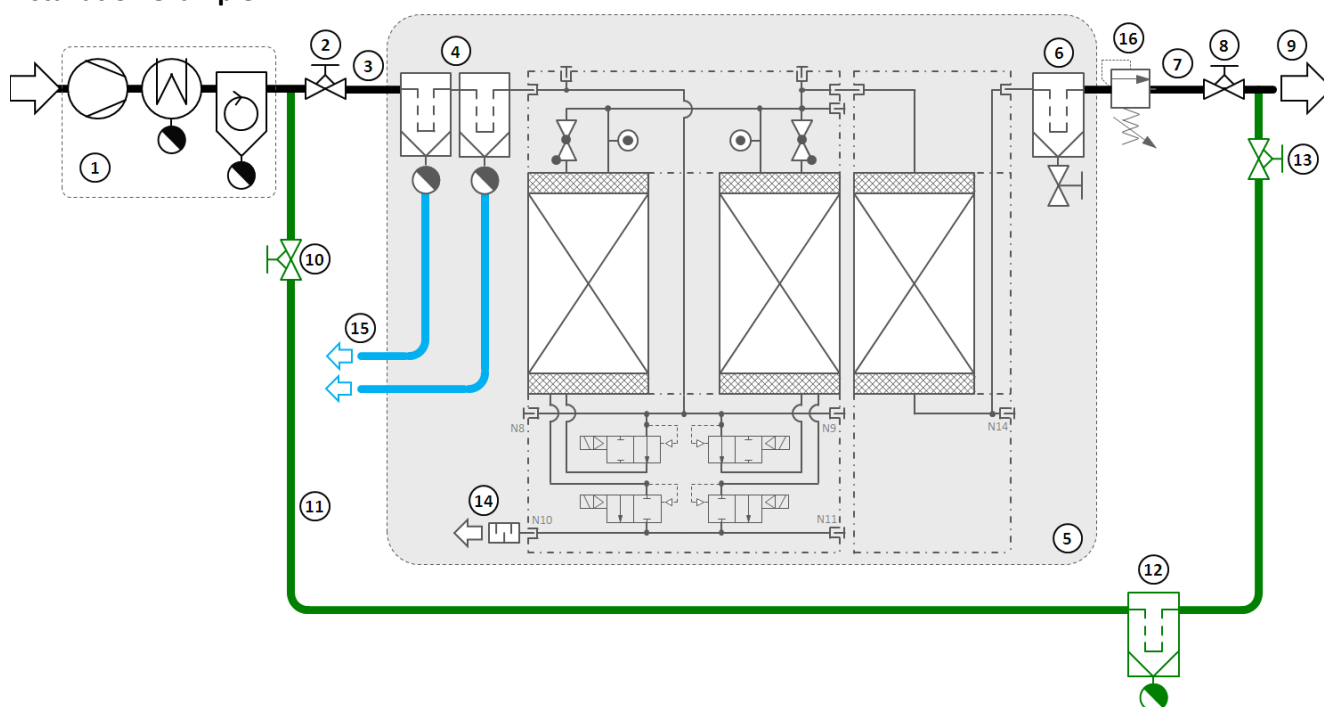
Proper installation is required for safe and error-free operation of the dryer.

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 behaviour avoids sudden pressure equalisation 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 supply <u>with water separator!</u> | 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          |
|  | 17 Regeneration back-feed-line         |

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

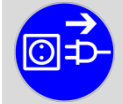
## 8.2 Installing the power supply



### **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 authorised 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 authorised 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.

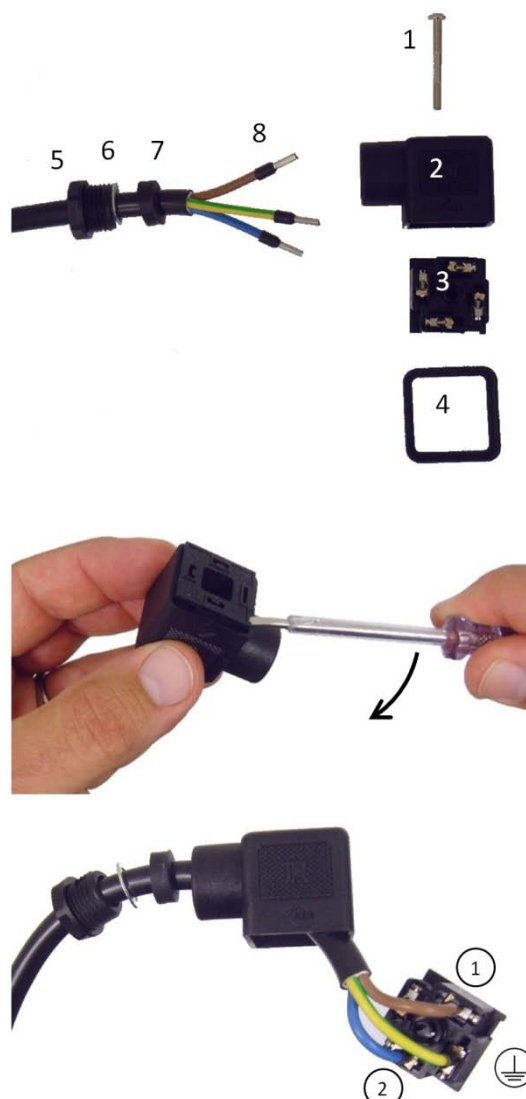
For the data required for connecting and securing the voltage supply, please refer to the wiring diagram (→ see appendix: wiring diagram)

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 reclosing.
- 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 feedthrough.
- 6) Connect the leads of the signal cable according to the information in the wiring diagram.

## Installation

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The standard scope of the dryer includes the most frequently used connector plugs and cable feedtroughs. 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 authorised 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 personal.

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.
- Neighbouring construction sites do not affect commissioning.
- The dryer is connected to the compressed air system using pipelines. (→ Page 38)
- The dryer is connected electrically and voltage supply is ensured. (→ Page 40)
- 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 led 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.

## Commissioning

---

- 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 authorised 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.

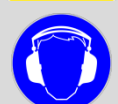


In the event of fire, do not extinguish the fire using water.



### **WARNING ! – Suddenly escaping compressed air (3)**

The dryer is depressurised approximately every 5 minutes using a silencer. A loud and strong air-stream 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 Pressurisation 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.

Pressurise 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. Pressurisation can be monitored on one of the two pressure gauges. Make sure the pressure is only rising slowly.
- 4) Check the system for leaks during pressurisation. In the event of leaks, pressurisation must be stopped and the leaks must be repaired. To repair the leaks the dryer has to be depressurised again. (→ Page 48)
- 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 pressureless compressed air system, we recommend using an automatic start-up device. (→ Page 23)

The automatic start-up device prevents pressure blows and increased flow speeds 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 33)
- 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 ...

- Disconnecting the power supply.
- Pulling the power connector off the control box.
- Opening the “compressor contact”. . (→Page 29)

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. (→ Page 24)
- 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 depressurised.

## Shutting down and restarting the dryer

---

### 10.4 Depressurising 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 valve on the after-filter or the condensate drain at the pre-filter, respectively.
- 3) Monitor the pressure on the pressure gauges of the dryer.
- 4) Wait until the pressure has dropped to 0 bar on both pressure gauges.

### 10.5 Restarting the dryer

Please proceed as described in chapter "Commissioning". (→ Page 44)

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 authorised 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 authorised 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 44.



### **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 next to 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
<b>Dryer and dryer control</b>	Visual check and function monitoring	■				50
<b>Dryer</b>	Clean		■			51
<b>Control box</b>	Check if cable and terminals are securely fixed			■		51
<b>Dew point sensor (MT01)</b>	Calibration required			■		51
<b>Pre- and after-filter</b>	Replace filter element			■		52
<b>Expansion silencer (X1)</b>	Replace			■ *		52
<b>valves (V1-V4 + RV1-2)</b>	Replace sealing set				■	53
<b>Demister (SD1)</b>	Replace			■ *		
<b>desiccant</b>	Check/replace			■ *		53
* = 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". (→ Page 33)
- 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 47)
- 2) Depressurise the dryer. (→ Page 48)
- 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 recommissioned again.

### 11.1.4 Calibrating the dew point sensor

The dew point sensor (MT01) is subject to ageing which leads to inaccurate measurements over time. Oil vapour 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 47)
- 2) Depressurise the dryer. (→ Page 48)
- 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 47)



### 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) Depressurise the filter. (→Page 48)
- 2) For filter replacement please proceed as described in the operating manual of the filter.

### 11.1.6 Replacing the expansion 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 47)
- 2) Depressurise the dryer. (→ Page 48)
- 3) Unscrew the old expansion silencer (X1) from the connecting part using your hands or an appropriate tool.
- 4) Screw the new expansion silencer (X1) in the connecting part and tighten it using your hands or an appropriate tool and some sealing tape.
- 5) Pressurise the dryer and commission the dryer again. (→ Page 47)

### 11.1.7 Replacing the sealing set of the valves (V1-4) and the check valves (RV1-2)

The valves and check valves are subject to wear. 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



#### **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 and the catalyst are subject to ageing and its drying performance is reduced over time. The service life of the desiccant depends on numerous operating parameters and cannot be exactly predicted. Under favourable conditions (e.g. oil-free compressed air) the service life may be several years. However, we recommend an exchange of the desiccant every year as a precautionary measure to maintain full performance of the dryer at any time.



#### **WARNING ! – Risk of falls**

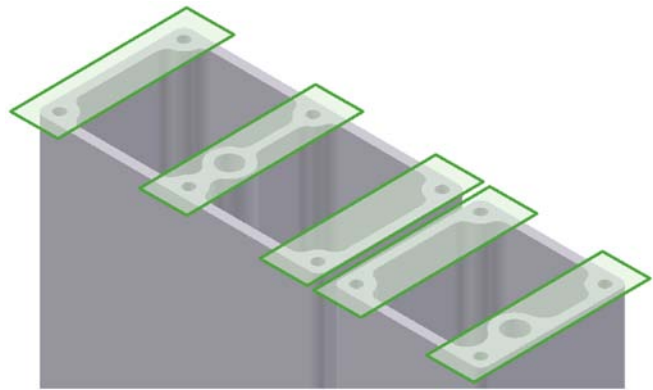
The dryer must never be used as a climbing aid. The dryer components will not provide adequate support and parts of the dryer may break off. Disregard may lead to dryer damages and falls with serious injuries.  
When working at height only use approved climb assist systems.

Desiccant replacement is part of a large inspection run. At the same time, other maintenance activities should be carried out. (See maintenance table → page 50)

- 1) Decommission the dryer. (→ Page 47)
- 2) Depressurise the dryer. (→ Page 48)
- 3) Remove the upper check valve block. (RV1, RV2)
- 4) Replace the demister-pads (SD1 and SD2)
- 5) Provide an adequately sized container for the used desiccant.
- 6) Remove the used desiccant from the vessel using a suction device (e.g. vacuum cleaner).
- 7) Remove the used desiccant from the construction site.

## Maintenance and repair

- 8) Cover the down-comer tube, the riser tube and the bolt holes with tape. No desiccant shall drop into these openings to avoid damage to the valves or bolt holes.



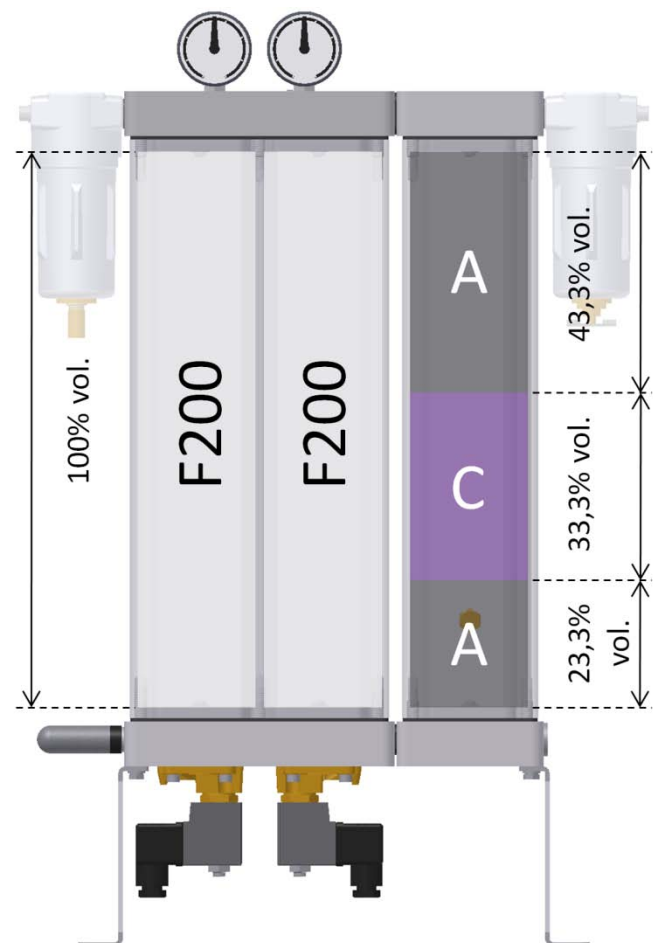
Cover tubes and bolt holes!

- 9) Provide the new desiccant.  
Please note that the third vessel is filled with two different types of granules that form three different layers. 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.

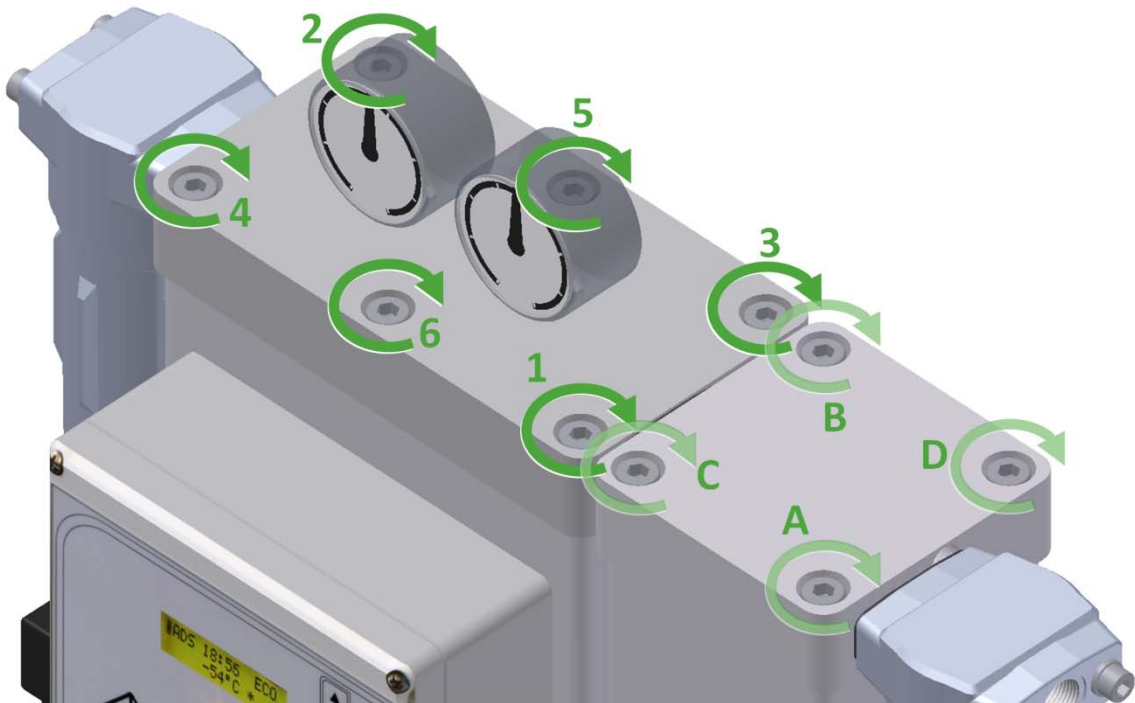
In the event you are unsure which desiccant to fill in first, please contact the manufacturer.

- 10) Fill the vessel with the different types of granules as shown in the picture.  
11) Fill up the vessel almost to its full extent. Make sure that the demister-pads (SD1; SD2) can still be inserted into the vessel.  
12) Place the upper check valve block back onto the vessel using new flat gasket.



Filling of twin vessel: F200 aluminagel  
Filling of third vessel: A = activated charcoal  
C = catalyst

- 13) Close the twin vessel with the upper check valve block. First tighten the screws only lightly. Then tighten completely in a crosswise manner. Use a torque wrench to tighten the screws. Apply a torque as state below!



Torque DPS1...4 = 25 Nm

Torque DPS6...8 = 40 Nm

- 14) Clean the floor thoroughly from desiccant residues.
- 15) Slowly pressurise the dryer again. (→ Page 45) Carry out a leak test using a leak detection spray. In the event of leaks the dryer will have to be depressurised 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 **Fehler! Textmarke nicht definiert.**)



### 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 Catalogue 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 Manufacturer's declaration

# Manufacturer's Declaration

Herewith we declare that the below mentioned products in their conception and design in which we placed them on the market comply with the standards and directives mentioned below.

<b>Manufacturer/authorised representative:</b>	FST GmbH Weiherdamm 17 57250 Netphen, Germany
<b>Description of the assembly:</b>	Dryer Type DPS1(BI/BM) to DPS2(BI/BM)
<b>Description of the pressure equipment constituting the assembly:</b>	The dryer is described in the operating manual in detail.
<b>Harmonised standards applied:</b>	DIN EN ISO 12100-1; DIN EN ISO 12100-2; DIN EN ISO 14121-1; DIN EN 55011; DIN EN 61000-6-2; DIN EN 61000-3-2; DIN EN 61000-3-3
<b>Other European Commission directives applied:</b>	97/23/EC annex I 2004/108/EG 2006/95/EG

In case changes are made to the product without prior consultation and written approval of the manufacturer this declaration will become void.

Signature



Norbert Hannen, General Manager

### 12.2 Declaration of conformity

# EC – Declaration of Conformity

## acc. to the pressure equipment directive 97/23/EG

Herewith we declare that the below mentioned products in their conception and design in which we placed them on the market have undergone the procedures of conformity assessment acc. to annex III of the above mentioned directive and are in conformity with this directive.

<b>Manufacturer/authorised representative:</b>	FST GmbH Weiherdamm 17 57250 Netphen, Germany
<b>Description of the assembly:</b>	Dryer Type DPS3(BI/BM) to DPS8(BI/BM)
<b>Description of the pressure equipment constituting the assembly:</b>	The dryer is described in the operating manual in detail.
<b>Conformity assessment procedure followed:</b>	Module A
<b>Harmonised standards applied:</b>	DIN EN ISO 12100-1; DIN EN ISO 12100-2; DIN EN ISO 14121-1; DIN EN 55011; DIN EN 61000-6-2; DIN EN 61000-3-2; DIN EN 61000-3-3
<b>Other Community Directives applied:</b>	97/23/EC annex I 2004/108/EG 2006/95/EG

In case changes are made to the product without prior consultation and written approval by the manufacturer this declaration will become void.

**Signature:**



Norbert Hannen, General manager

### **12.3 General arrangement drawing**

Separate document

### **12.4 Process flow diagram**

### **12.5 Wiring diagram**



# Stromlaufplan für Trocknersteuerung C1

## Wiring Diagram for Dryer Control C1

Elektrische Anschlussdaten : 230 V / 115V (+/-10%) 50/60 Hz  
(= Ventil-Spannung)  
L1 / N / PE

power supply  
(= solenoid valve voltage)

Schutzart:  
protection class  
IP 65

Leistungsaufnahme :  
(abh. vom Trocknertyp)  
power consumption  
(depending on dryer type)  
DPS1-8 : < 50 VA  
DPS10-100 : < 35 VA  
DPS120-630 : < 10 VA  
DHM 8-66 : < 80 VA  
DTC 45-1100 : < 10 VA

Sicherung intern :  
internal fuse  
0,5 A träge / slow-blow

Angewandte Richtlinieien  
und Normen :  
applied guidelines  
and standards  
2009/95/EG  
EN 55011  
EN 61000-3-2  
EN 61000-3-3  
EN 61000-6-2

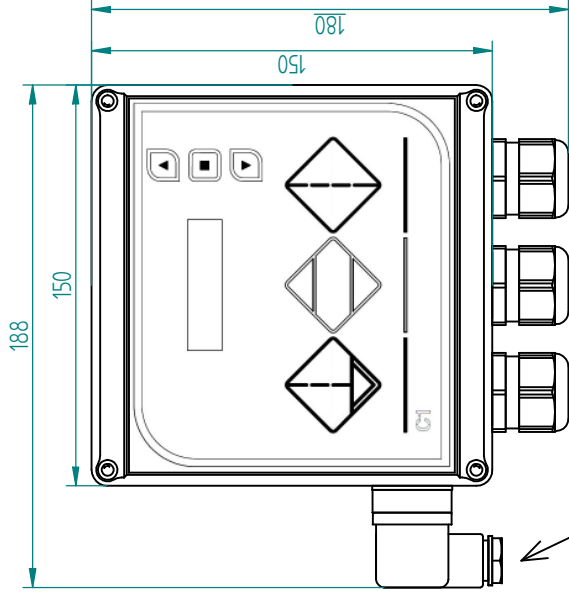
EMV Prüfbericht:  
EMV test report  
2010-2536-3871-RDE

Anmerkung:  
Note  
Nicht geeignet für Ventilstecker mit Gleichrichter.  
Hierfür bitte Sonderplatine anfordern.  
Not suitable for valve connectors with rectifier. In this  
case please ask for a special circuit board.

Inhaltsverzeichnis  
list of content  
1 Deckblatt  
cover sheet  
2 Aufbauplan  
general arrangement  
3 Platine / Klemmenbelegung  
circuit board / wire terminal  
4 Stückliste  
parts list

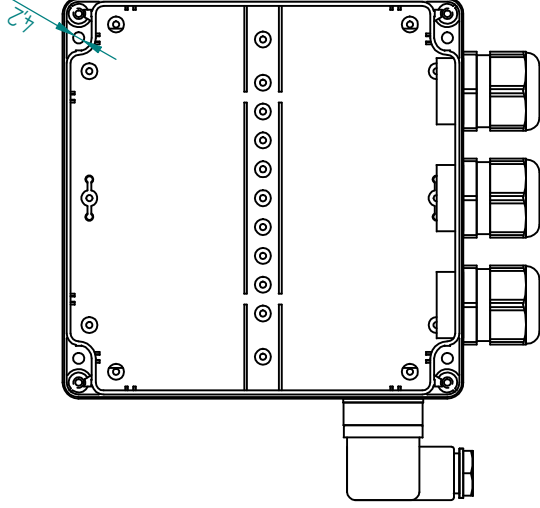
Rev.		Änderung / change	Datum/date	Name	Druck	Name		Datum/date		Bemerkung / title	
A		Filterkontakt = Öffner (NC)	08.08.11	CR		bear./design		07.09.10		C1 Stromlaufplan 230/115V-AC	
						gepr./check		07.09.10		C1 wiring diagram 230/115V-AC	
										Deckblatt / cover sheet	
										Zeichnungsnummer / drawing no.	
										ZEP-S-100064	
										Blatt/sheet	
										1	
										von/of	
										4	
										(Ers.f / repl.for: - - )	
										(Ers.d / rep.by: - - )	
										A3	

Vorderansicht  
front view



Gerätesteckdose DIN EN 175301-803,  
niedriges Gehäuse, für 6-8mm Kabel  
female power connector DIN EN 175301-803,  
low housing, for 6-8mm cable

Gehäuse (innen)  
box (inside)



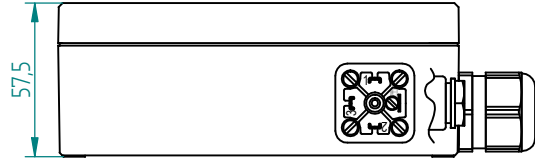
4-fach Kabelverschraubungen M25x1,5,  
für Kabel 6-8mm

(Die Anzahl der Verschraubungen variiert je nach Anwendung.  
Ggf. werden freie Öffnungen durch Blindstopfen verschlossen.)

4-port cable glands M25x1,5,  
for cable 6-8mm

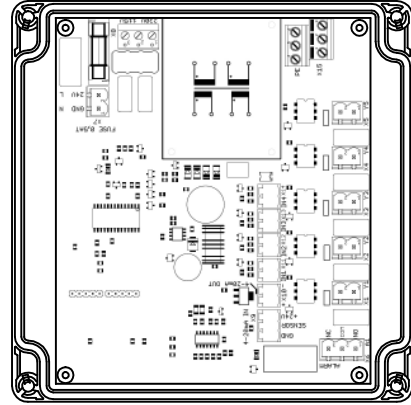
(The number of glands varies with the application.  
Free openings might be closed using blind plugs.)

Seitenansicht  
side view



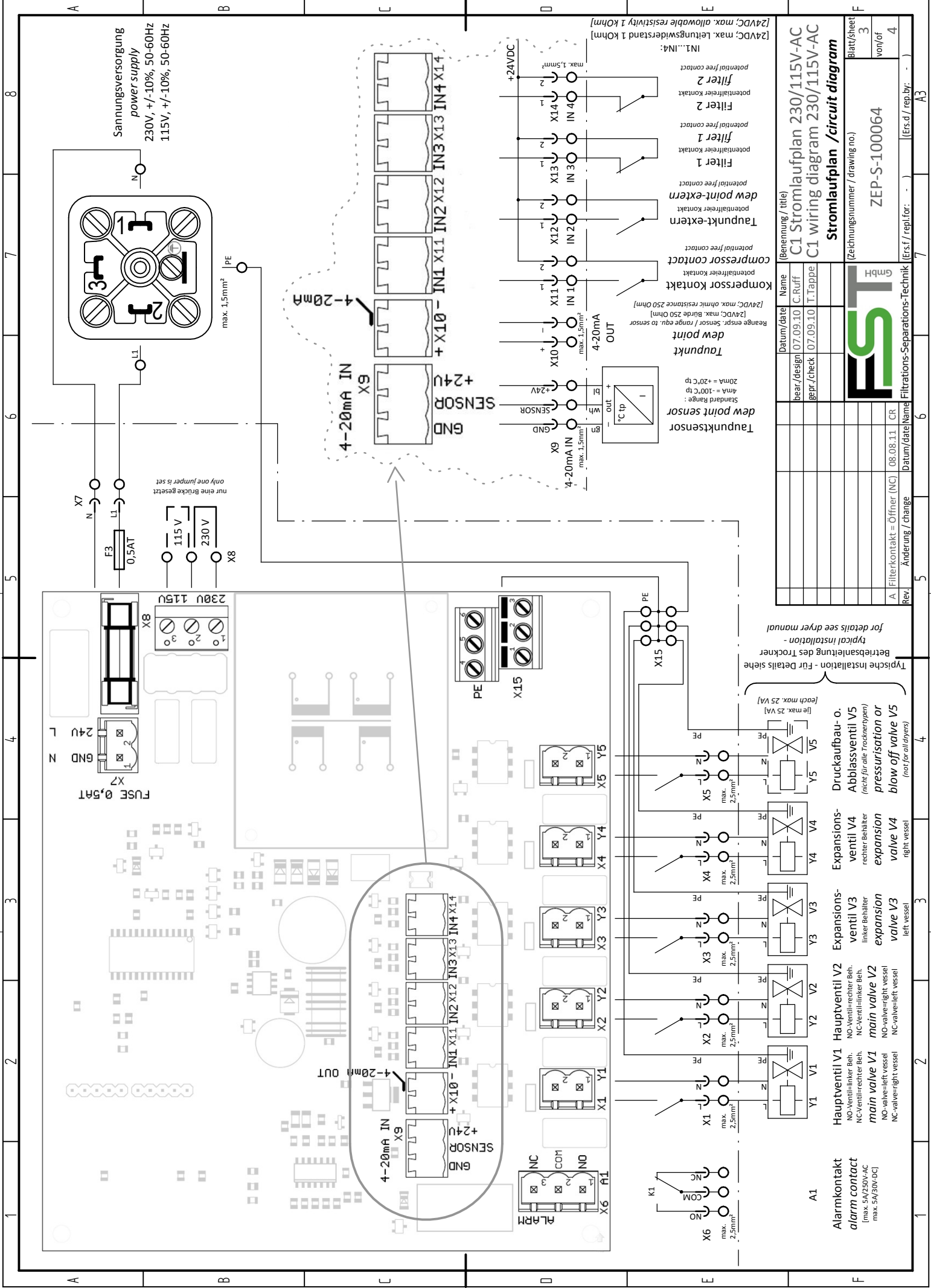
120

Deckel mit Steuerung (innen)  
box lid with control (inside)



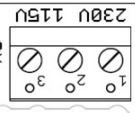
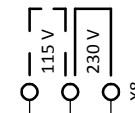
max. Durchmesser des Schraubenkopfes = 7mm  
max. diameter of bolt head = 7mm

Datum/date	Name	(Benennung / title)
bear./design 07.09.10	C. Ruff	C1 Stromlaufplan 230/115V-AC
gepr./check 07.09.10	T. Tappe	C1 wiring diagram 230/115V-AC
Aufbauplan / gen. arrangement		
Zeichnungsnummer / drawing no.		
ZEP-S-100064		
Blatt/sheet 2		
von/of 4		
Rev.		
A	Filterkontakt = Öffner (NC)	08.08.11 CR
Änderung / change		
Filtrations-Separations-Technik		
GmbH		
Erst.f. / repl. for: - - -		
Ers.d. / rep. by: - - -		
7		
A3		



Sonnensversorgung  
power supply  
230V, +/-10%, 50-60Hz  
115V, +/-10%, 50-60Hz

nur eine Brücke gesetzt  
only one jumper is set



FUSE 0,5AT

