



Operating Manual Mini Adsorption Dryer DPM 2-4, DPM 2-4+

Translation from the original German to English



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1. Introduction

The FST GmbH supplies products for compressed air treatment all over the world. Without exception these are investment goods that need to be explained. They must be safety and economical operated over many years. They comprise many individual components which interact mechanical, electrical and from process point of view.

Every supplier of declarable components is obliged to also supply the respective accompanying documents together with the project or if it was contractually agreed provided by Internet. The information required in different phases and by different users can be filled in one document or in different documents depending on their extend. The accompanying documents for the projects of the FST GmbH are designated as operating instructions.

The accompanying documents on proprietary products of FST GmbH are referred to as "Operating Instructions" and are supplied in each case as a complete documentation..

2. Warning and safety references

Special action related warning references in the operation instructions draw the attention to risks that occur in a special situation or in connection with special behavior. These references are found directly before the dangerous actions.

Examples:

⚠ DANGER! indicate an immediately hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations

⚠ WARNING! – indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury

⚠ CAUTION! – indicates a potentially hazardous situation which, if not avoided may result in minor or moderate injury






NOTE! indicates a potentially hazardous situation which does not result in injury however in damage to property.

signal word

⚠ Caution! – Text describes the hazardous situation and gives behavioral notes!!

Warning and safety references

Examples for pictograms / warning signs (according to DIN EN ISO 7010) as they can be attached in the area of the product:

	Slippery surface		wear safety glasses
	Danger of falling		wear ear protection
	Crushing hazard		Wear head protection
	Hot surface		Wear safety shoes
	Toxic gases, toxic dusts		Use suitable hoist
	Sharp, pointed object		Wear respiratory protection
	Risk of explosion, risk of bursting		Caution: Do not use water to extinguish fire

NOTE! Safety references are part of a package of measures for protecting the user of the product against the risks, which can occur by the use. The operator of the plant is responsible for the consideration of the safety references. Actions on the supplied product may only be performed by qualified users. The operator is even responsible for the selection of the respective persons and to check and secure the qualification of the charged users.

Not all risks can be excluded by design measures.

2.1 Hazards on electric/pneumatic products

Electrical and pneumatic products entail risks for persons, objects or the environment e.g.:

- Risks due to supplied energy (electrical, pneumatic energy)
- Risks due to heat sources
- Mechanical with for example by bruising, shearing, cutting or stumbling
- Risks due to excessively high noise levels
- Risks due to vibrations
- Risks due to working materials and products
- Risks due to dismantling or putting out a function of safety devices and guards
- Risks due to suddenly exiting compressed air

2.2 During operation

During the operation of the plant the operator must be sure that:

- The access to the plant is prohibited for unauthorized persons
- All components are only operated in technically proper condition as required for the operation
- The product is used as directed
- No inspection doors can be opened, which can entail hazards during the operation
- Work on life parts may only be performed by persons charged and trained in this respect
- Lines and sets may not be touched if the temperature of that covers could exceed 70°
- Cleanliness and clearness of the working place and on and around the devices is ensured
- The location and the operation of fire extinguishers is known to the operating staff
- The rooms sufficiently vented and ventilated
- For the care of emergency, first aid measures to a sufficient extent must be ensured

2.3 Guards and safety systems

The device may only be operated with all guards and safety systems. This includes for example mechanical and electrical contact guards, safety valves, contact thermometers, contact switches, emergency switches etc.

Generally no guards and safety systems may be dismantled or put out of operations or modified. This also applies to the trial operation



The operating staff must be instructed by the operator to wear personal and well fitting protective clothing.

2.4 Assembly, inspection, maintenance work and repairs

2.4.1 General

Assembly, inspection, maintenance work and repairs may only be performed by qualified and experienced persons.

- The respective references in the operation instructions must be observed
- Prior to the new connection, all guards and safety systems must be mounted or rendered properly function again. Then the function check of the safety systems must be made.
- The regulation for the use of spray detergents must be observed.



WARNING! The device must not be used as climbing aids



WARNING! – Risk of intoxication and/or burns. Wear suitable protection mask.

Warning and safety references

2.4.2 Shifting, loading, transport

- For shifting, loading and transport, the respective safety measures must be taken and the applicable local accident prevention regulations be observed
- Furthermore preparatory measures must be taken such as shutting down, emptying of containers, fixing of loose parts etc.
- Depending on the instructions given in the operating instructions, prior to transport, a suitable and environmentally friendly packing should be ensured, if necessary.
- Devices and larger sub- assemblies may only be loaded or transported with approved suitable and technically proper loading systems, auxiliary equipment, lifting facilities, vehicles as well as load carrying means having a sufficient capacity.
- The slinging points for load carrying means may be taken from the respective operating instructions.
- Shifting, loading and transport of loads may only be performed by experienced and qualified persons



The stay on the suspended charges is strictly forbidden.

If necessary block the drive area

2.4.3 Electrical equipment

- Let must be made sure that only qualified persons perform works on electrically operated devices and systems or that they are supervised by responsible experts tough able to recognize possible hazard and to avoid them.
- Electric Kelly operated devices and systems are provided with touching guards, which must be by no means be removed during operation.
- Works on electrical devices may only be performed if these are standing still and secured against re-starting.




The removing of touching guards can result serious health and material damage

- Inspect the electrical equipment regularly. Eliminate deficiencies, e.g. Loose cable connections, promptly qualified.

2.4.4 Pneumatic system

- Worked on pneumatics systems may only be performed by qualified persons with special knowledge and experience in pneumatics.
- Lines, hoses and screw unions must be regularly be checked for leakages and externally visible damage
- Visible and audible damage must be eliminated immediately.
- Hose connections must be replaced at specified or reasonable intervals even if externally no safety irrelevant defect can be recognized.

 **WARNING!** Prior to works on pneumatic system the relevant parts of the system must be made pressureless

2.4.5 Materials and auxiliaries

- For proper operation, observe the correct selection of lubricants and other chemical substances and their specific safety regulations.
- When handling hot materials and auxiliaries there is a risk scalding and burning.
- The operator must ensure the secure and environment friendly disposal of materials and auxiliaries.

2.4.6 Spare parts and accessories

The operator is informed of the use of spare parts meeting the technical requirements specified by FST GmbH. This is guaranteed when using original spare parts.




The liability of the FST GmbH is excluded in case of damage due to the use of unsuitable spare parts.

2.5 Emergency shutdown

In case of danger, it must be possible to shut down the plant after the activation of an emergency of switch. After an emergency shutdown the device may only be connected again when the reason for the emergency shutdown has been eliminated.

2.6 Recognizing of operation failures

Deviations from normal operation such as increased temperatures, vibrations, noise, indicate that important functions may be affected.

 WARNING! If a direct risk for persons and plant sections is recognized, the next emergency stop must be activated without delay and/or the competent operating and maintenance staff be informed.

2.7 Storage

In case of an extended storage time please bear in mind that the storage time and the storage conditions can affect for example the efficiency of drying agents and seals.

3. About this operating manual

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

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.



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.

About this operating manual

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.



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.

⚠ DANGER! indicate an immediately hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

⚠ WARNING! – indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION! – indicates a potentially hazardous situation which, if not avoided may result in minor or moderate injury

NOTE! indicates a potentially hazardous situation which does not result in injury however in damage to property. Additionally it can be used for important information purposes.

signal word



⚠ Caution! – Text describes the hazardous situation and gives behavioral notes

4. Description of application

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

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

During pretreatment 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 pretreatment the dryer also removes the vaporous water components. 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.

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.

4.1 Intended use

The dryer is exclusively designed for drying compressed air!

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

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

- Indoors
- Protected against weather impact
- Frost-free
- Dry
- Zero to low dust-laden ambient air
- No vibration via floor or connected piping
- Ambient air must be free from aggressive and corrosive substances
- Ambient air must be free from substances that damage the desiccant or influence its effectiveness (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.)

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

Description of application

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 have been established for this dryer in the planning phase (compressed air flow rate, pressure, temperature, desired pressure dew point).

For the nominal operating conditions please refer to the table (Chapter 3.2).

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.

In the event of predried compressed air



For some days, operate the dryer using moisture-saturated compressed air in order to activate the desiccant.

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

Description of application

4.2 Technical data

Dryer	Nominal volume flow rate	Compressed air connection	Weight	Height	Width	Depth
	V [m ³ /h]*	mm	[kg]	[mm]	[mm]	[mm]
DPM 2	2	8	1,5	263	150	95
DPM 2+	2	8	1,5	263	150	95
DPM 4	4	8	2,3	403	150	95
DPM 4+	4	8	2,3	403	150	95

* = 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 2014/68/EU	DPM 2...4/ DPM 2...4+
Fluid group	2
Supply voltage	24V= DC
Class of protection	IP65
max. allowable pressure (PS)	10 bar
max. allowable temperature (TS)	+2 bis +50°C



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.

Description of application

5. Specific 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..



- 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.

5.1 Signs and instructions

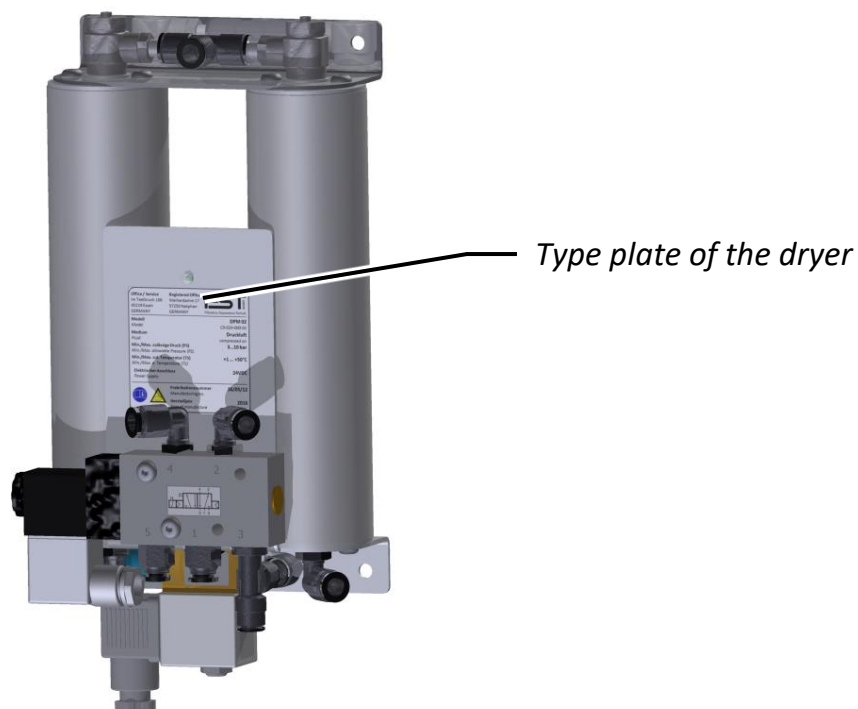


Fig 1: Type plate



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

5.2 Danger zones at the dryer



Fig 2: Dangers on the dryer

- 1;5** *Danger of pressure bearing parts*
- 2;4** *Danger due to electrical voltage*
- 3** *Danger due to suddenly escaping pressure*
- 6** *Danger by hot surface (DPM + only)*

⚠ DANGER! – Overpressure (1, 3, 5) The dryer is under pressure. Suddenly escaping compressed air may result in serious injury. Do not carry out mechanical or electrical work on the dryer as long as the dryer is under pressure.

⚠ DANGER! – Electric voltage (2;5):The dryer is operated electric voltages up to 24 V DC. 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 4 minutes using a silencer. A loud and strong airstream may carry small particles and cause injury. Do not place any equipment in the vicinity of the silencer. The silencer must not be manipulated or removed. Always wear hearing protectors when working in the vicinity of the dryer.

5.3 Safety notes

⚠ DANGER – The dryer must only be operated with compressed air within the maximum allowable operating conditions. The operating conditions are defined on the type plate. 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.

⚠ 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".

⚠ 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.

Specific Specific safety notes



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.



For additional safety notes, please refer to the relevant chapters

6. Technical product description

6.1 Assembly drawing DPM

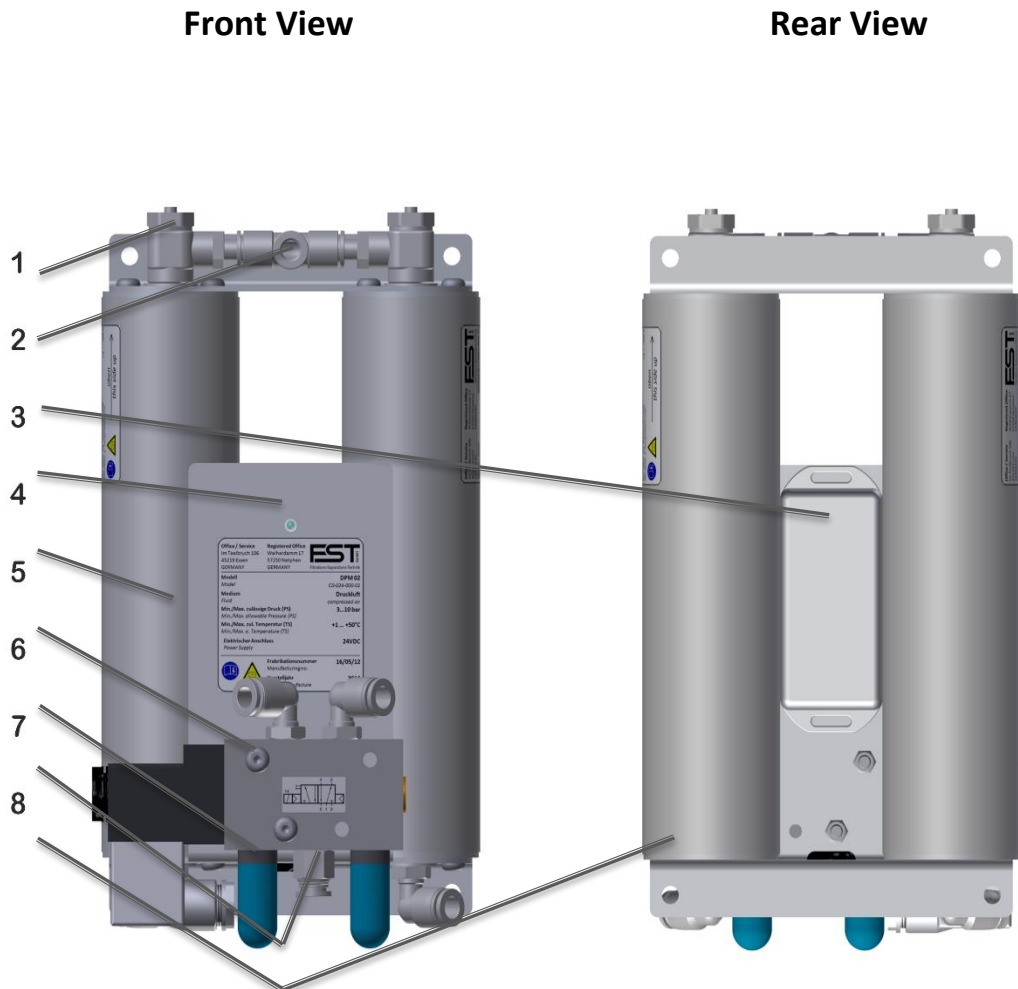


Fig 3

- | | | | |
|----------|-------------------------------|----------|---------------------------|
| 1 | <i>Throttle check valve</i> | 7 | <i>Expansion silencer</i> |
| 2 | <i>Gas outlet</i> | 8 | <i>Gas inlet</i> |
| 3 | <i>Control electronics</i> | 9 | <i>Mounting angle</i> |
| 4 | <i>Control - LED</i> | | |
| 5 | <i>Vessel</i> | | |
| 6 | <i>5-2-way solenoid valve</i> | | |

6.2 Assembly drawing DPM+

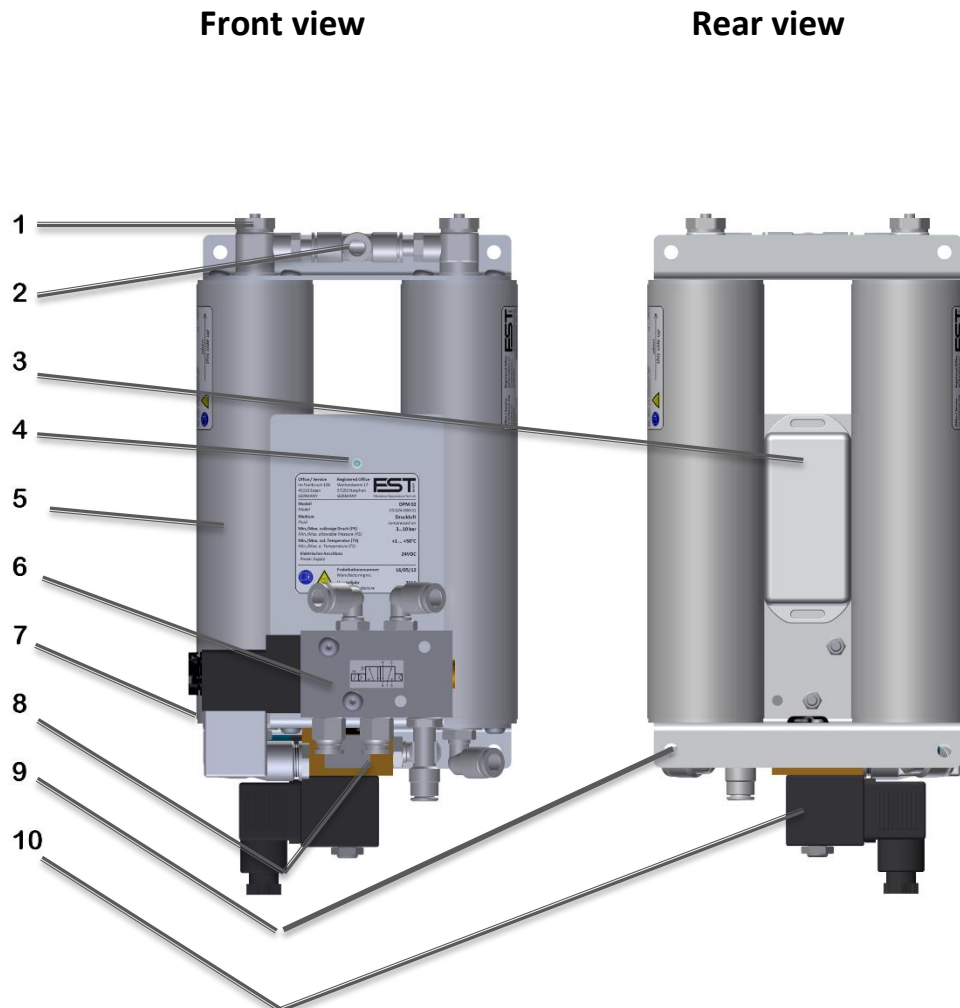


Fig 4

- | | | | |
|----------|-------------------------------|-----------|-------------------------------|
| 1 | <i>Throttle check valve</i> | 7 | <i>Expansion silencer</i> |
| 2 | <i>Gas outlet</i> | 8 | <i>Gas inlet</i> |
| 3 | <i>Control electronics</i> | 9 | <i>Mounting angle</i> |
| 4 | <i>Control - LED</i> | 10 | <i>2-2-way solenoid valve</i> |
| 5 | <i>Vessel</i> | | |
| 6 | <i>5-2-way solenoid valve</i> | | |

6.3 Process flow diagram

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

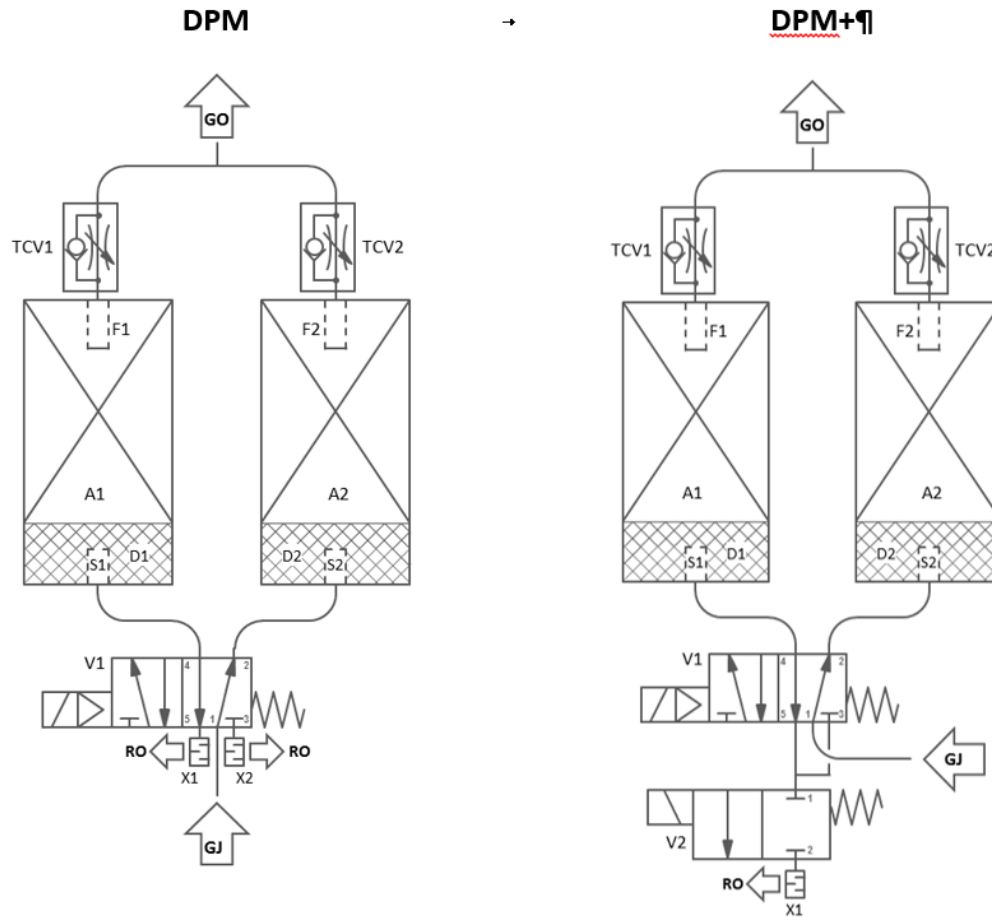


Fig.5

A	Dryer twin vessel
F	Filter
S	Flow distributor
D	Demister tissue
V1	5-2-way solenoid valve
V2	2-2-way solenoid valve
TCV	Throttle check valve
X	Expansion silencer
GJ	Gas inlet
GO	Gas outlet
RO	Regeneration gas outlet

6.4 Function description

Function

For drying the compressed air, i.e. "adsorption", the compressed air flow is led through a vessel filled with desiccant. The desiccant extracts moisture from the compressed air and stores it in its structure until the desiccant is saturated with moisture. The saturated desiccant then has to be regenerated, i.e. the moisture stored in the structure has to be "removed" before the desiccant can be used for drying again. Continuous operation of an adsorption dryer therefore requires two vessels that are operated alternately. One vessel is used for drying the compressed air (adsorption) and the other vessel for regenerating the desiccant.

For the DPM series a certain quantity of dried compressed air is drawn off at the dryer outlet. This amount of compressed air is expanded to atmospheric pressure and is led through the vessel to regenerate the desiccant. The dried, decompressed air is extremely dry and thus extracts the moisture stored in the desiccant and discharges it to the atmosphere via a silencer (heatless regeneration). An afterfilter is integrated into the dryer vessels, which cleans the dry compressed air from dust.

Features DPM

The desiccant has a high drying capacity for moisture and a long service life. This ensures permanently low and stable pressure dew points.

A combination of coarse separator and demister is installed on the inlet side of the adsorber vessel. This separator combination effectively removes liquid impurities and thus reduces the service life of the desiccant.

A fine filter element is installed on the outlet side of the adsorber vessel. This integrated after-filter eliminates dust particles in the compressed air flow exiting the dryer. A complex after-filtration and its piping is no longer required.

The change-over of the vessels is carried out by one single valve. This valve falls into a safe normal position in the event of a power failure. This makes an unintentional interruption of the compressed air flow impossible. This integrated design avoids complicated piping and minimizes the leakage potential. Generously sized flow cross sections minimize the pressure losses.

The quantity of regeneration air can be individually adjusted via needle valves, thus optimizing the compressed air consumption to the operating conditions. Two silencers ensure an effective reduction of the expansion noise.

The DPM series is controlled by a programmable microcontroller. The interchange intervals of the vessels can be adapted individually to the needs.

Prozess-diagramm DPM

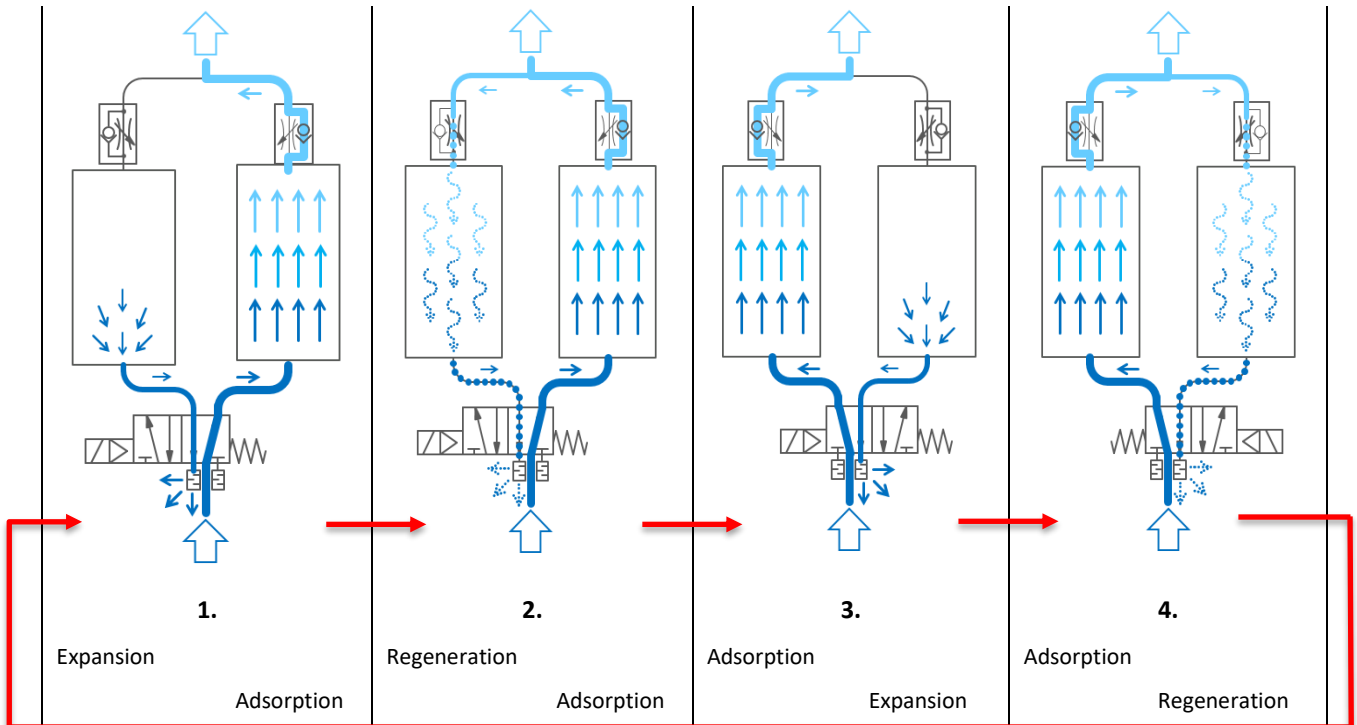


Fig. 6

The DPM performs the pressure build-up abruptly because the compressed-air stream is suddenly switched over from the adsorbing vessel to the still regenerating vessel. This is possible because the desiccant is pretensioned by the flexible demister.

The DPM can never stop regeneration. Regardless of whether the dryer is stopped by compressor contact or whether the voltage is switched off, the DPM always uses regeneration air and is a permanent leakage. The compressor contact is therefore not required for the DPM.

Process diagram DPM+

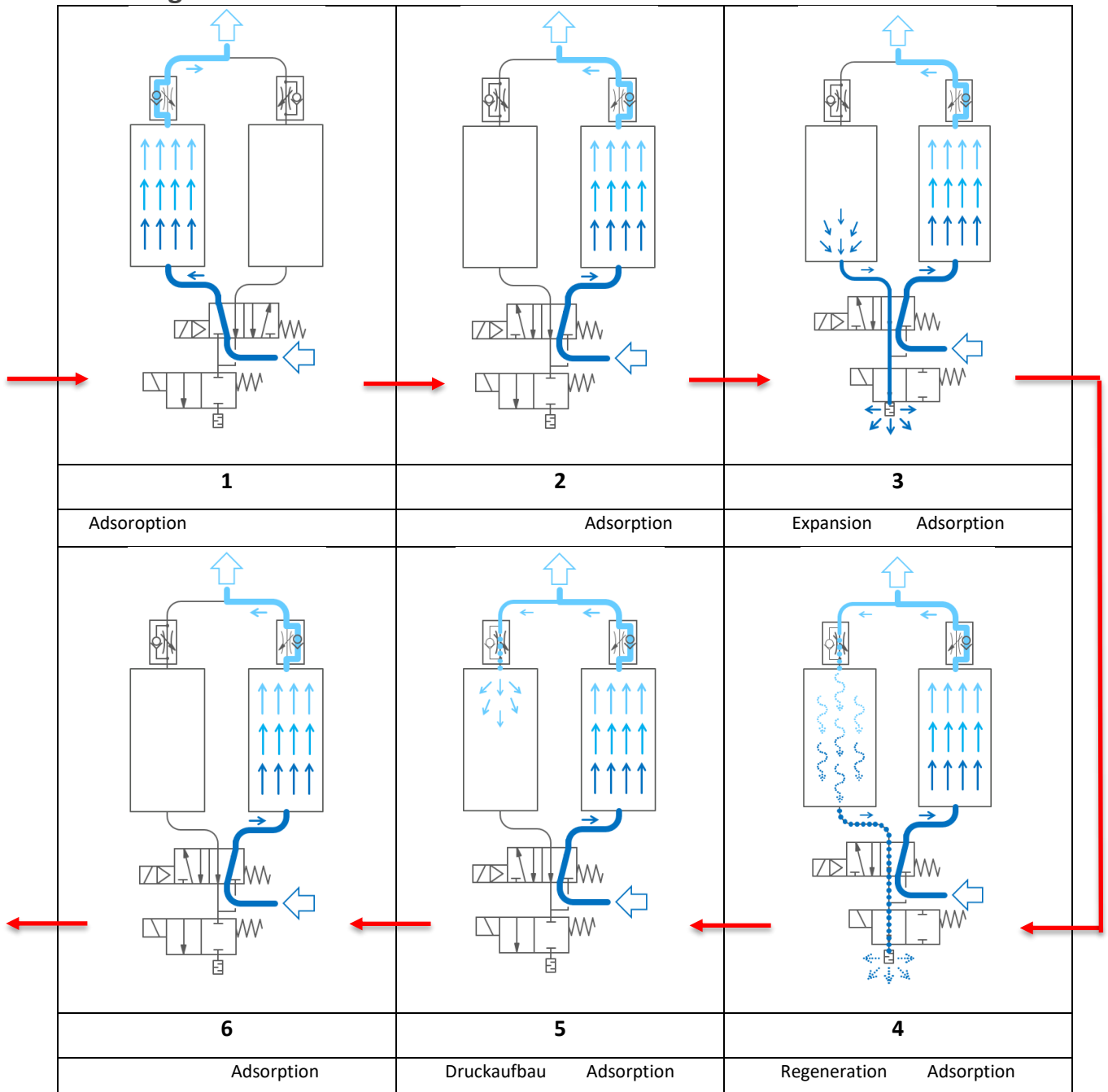


Fig 7

The DPM + has an additional 2-2-way valve and can stop the regeneration. Thus it is free of leakage when switched off. Pressure fluctuations are also reduced.

A silencer provides an effective reduction of the expansion noise.

The DPM series is controlled by programmable microelectronics. The exchange intervals of the containers are adjusted individually to the needs at the factory.

NOTE! A prefilter is absolutely essential for oil-lubricated compressors at least.

a cyclone does not suffice as a pre-filtration.


7. Transportation, setting up and storage

7.1 Transportation

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.

- 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

 DANGER 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.

7.2 Setting up

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 wall 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.).
- The wall 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.
- The place of installation should not be in the vicinity of hallways in order to avoid risks to inexperienced persons.

Transportation, setting up and storage



We recommend anchoring the dryer into the wall using the holes in the mounting brackets.



To remove the dryer for maintenance, anchors the dryer with screws. (Rivets and other unsolvable connections are not suitable).

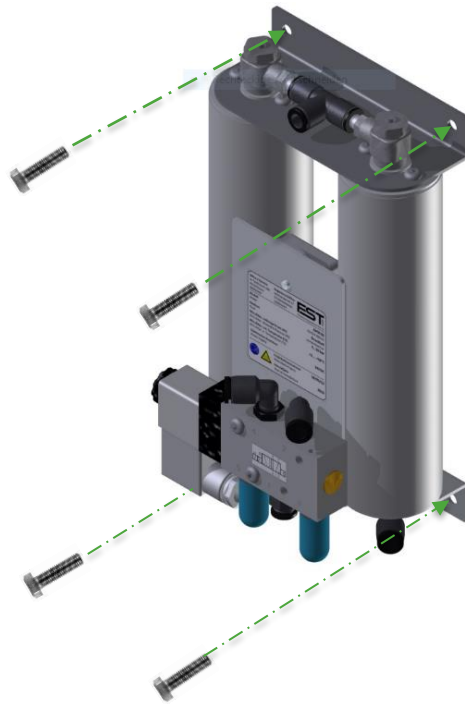


Fig.8

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
- Dust free

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) 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.
- 3) Decommission the dryer.
- 4) Depressurise the dryer
- 5) Disconnect the dryer from the electrical supply.
- 6) Disconnect the dryer from the compressed air system.
- 7) Close the inlets and outlets of the dryer using flange covers.
- 8) Protect the dryer against dust using a cover.


Transportation, setting up and storage


To recommission the dryer after storage, please proceed as described for initial commissioning. (Chapter 9)


⚠ CAUTION 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!** 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!** The dryer must only be operated with compressed air within the maximum allowable operating conditions. The operating conditions are defined on the type plate. 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” (→ Chapter 4.1).

 **DANGER!** 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.

Installation

Please observe the following steps when installing the compressed air pipeline (Fig 9):

- 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.
- 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.
- 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. 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.
- Prior to closing the connected pipelines, please check that there are no objects or contaminations left in the pipelines.
- When checking the installation for leaks the maximum allowable operating pressure of the dryer must not be exceeded.
- Never fill the dryer with water when performing a pressure test. Liquids will destroy the desiccant!

8.2 Installation examples

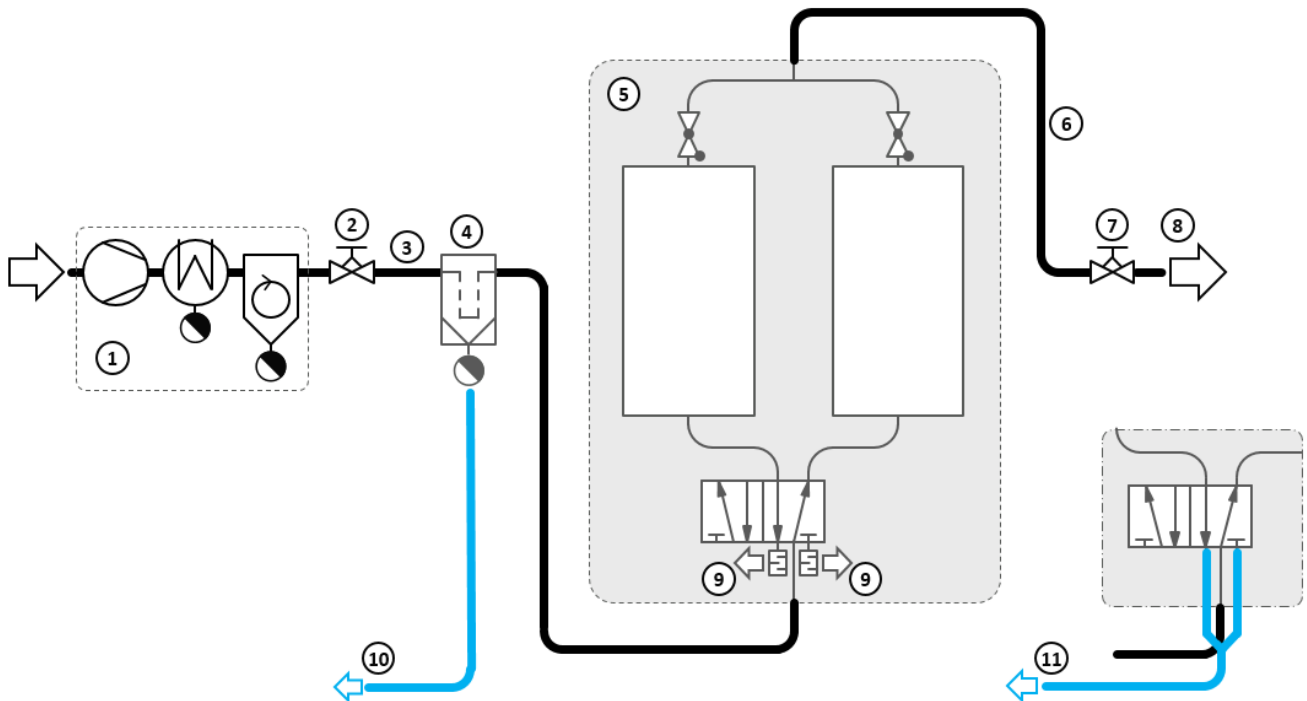


Fig 9: DPM

- | | | | |
|---|---|----|--|
| 1 | Compressor | 9 | Regeneration gas outlet / silencer |
| 2 | Valve at compressed air inlet | 10 | Condensate line |
| 3 | Compressed air pipeline at inlet | 11 | Alternate regeneration gas outlet e.g. via a pressure line into a condensate collecting tank |
| 4 | Pre-filter with condensate drain | | |
| 5 | Dryer (<i>standard scope of supply</i>) | | |
| 6 | Compressed air pipeline at outlet | | |
| 7 | Valve at compressed air outlet | | |
| 8 | Gas outlet | | |

Installation

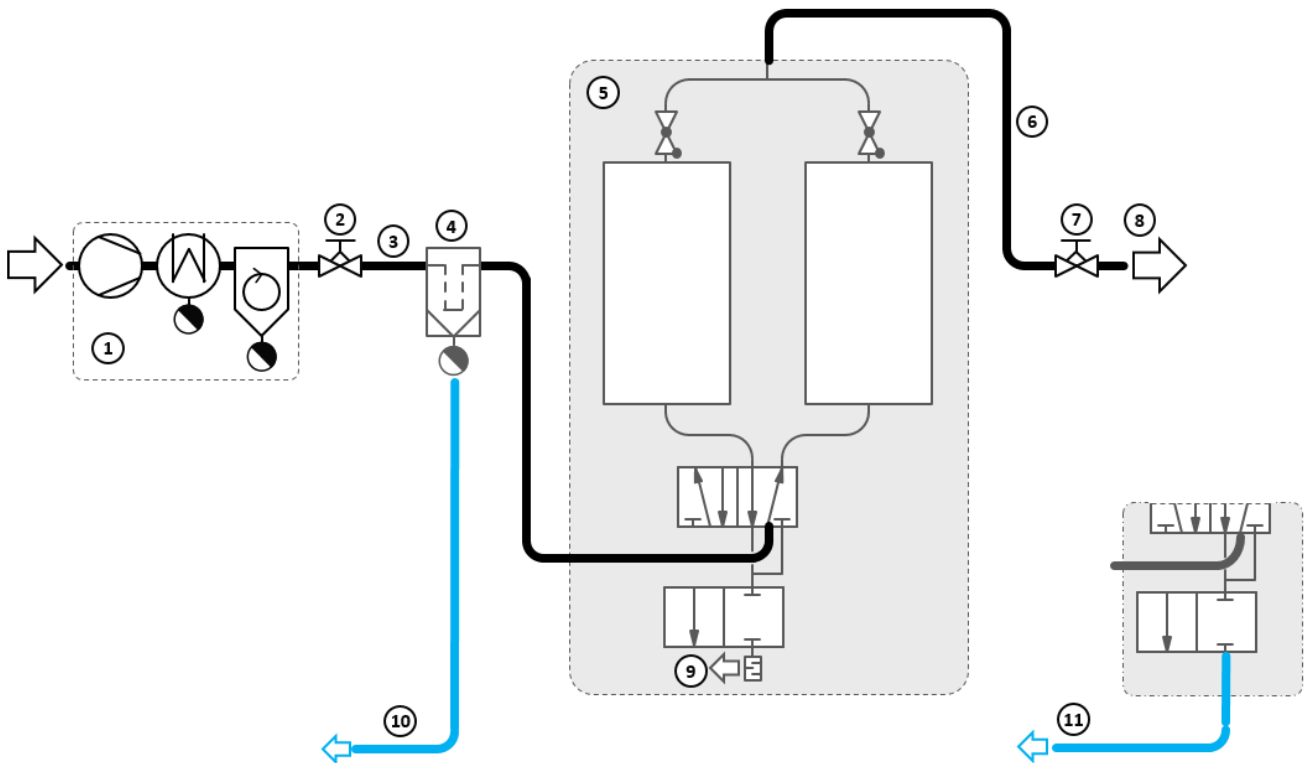


Fig. 10: DPM+

- | | | | |
|---|---|----|--|
| 1 | Compressor | 9 | Regeneration gas outlet / silencer |
| 2 | Valve at compressed air inlet | 10 | Condensate line |
| 3 | Compressed air pipeline at inlet | 11 | Alternate regeneration gas outlet e.g. Via a pressure line into a condensate collecting tank |
| 4 | Pre-filter with condensate drain | | |
| 5 | Dryer (<i>standard scope of supply</i>) | | |
| 6 | Compressed air pipeline at outlet | | |
| 7 | Valve at compressed air outlet | | |
| 8 | Gas outlet | | |

8.3 Installing the power supply

⚠ CAUTION! The dryer is operated at electric voltages up to 24V=. 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! 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 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.

Installation



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

The voltage supply is connected, for example, via a **customer-specific power supply unit with 24V DC output voltage**. The dryer is supplied with a single-ended 3-lead connection cable.

Depending on the installation location, the cable must be laid in a plastic or steel armored pipe or cable duct.

Connection table

Wire colour	DPM	DPM+
Brown wire (bn)	+24V DC	+24V DC
Green wire (gn)	-24V DC	-24V DC
White wire (ws)	No function	*) switching signal, remote on/off +24V DC

9. Commissioning

⚠ CAUTION! 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. (Chapter 8.1)
- The dryer is connected electrically and voltage supply is ensured.
- 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.

Please check the following directly before commissioning:

- The operating limits must not be exceeded.(Chapter 5.1)
- The dryer is disconnected from the voltage supply.
- The shut-off valves provided by the customer and located upstream and downstream of the dryer are closed.
- The connections may have become loose due to dryer transportation. Make sure the piping connections, screwed joints and pneumatic lines are tightly secured. Tighten loose connections using the appropriate tools.
- Make sure the cable clamps in the control box are tightly secured. Tighten all the screw connections using the appropriate tools.
- Check all the components for visible damages. If there are defective components, commissioning of the dryer is not permitted!

 DANGER! Moisture and contamination in electrical components 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

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

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

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

Commissioning

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) 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. (Chapter 10.4)
- 4) 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) If flow noise is no longer present when further opening the valve, it can be opened completely.
- 3) 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.

9.2.3 Starting the dryer program

- 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.
- switch on the power. (→Chapter 9.1)
- The start of the program is accompanied by a notable clicking of the valves (V1-4)

Monitor dryer operation. The dryer now performs the phases described in section "Function description". (→ Chapter 6.4)

10. Operation

The components of the dryer, via which the dryer can be monitored and operated, are described below.

10.1 Power supply

For the operation of the dryer, an external power supply with an output voltage of 24V = DC voltage is to be provided by the customer. (DPM <4Watt, DPM + <20Watt)



The 5/2-way valve opens when the voltage supply is interrupted

Please note that when the power supply is interrupted, both main valves are opened. That means that theregenerating vessel is then suddenly pressurized via the opening main valve. We therefore recommend that the power supply is not interrupted until both vessels have the same pressure.



Switch off the dryer from external

A disconnection of the dryer without interruption of the voltage supply can be realized by means of a "compressor contact" in the voltage supply line (DPM + only). The dryer has only a low current consumption. Therefore, the dryer can also be switched off by interrupting the voltage supply.


10.2 Valve control


The valve control is factory-programmed to customer requirements. If the operating conditions change, always contact the FST service or a sales partner.


10.3 Error handling

The following table provides a list of possible errors and alarm messages, their reasons and handling instructions.

Please observe the described safety instructions when working on the dryer:

 DANGER! The dryer is pressurized. Suddenly exiting compressed air can lead to serious injuries. Never carry out any mechanical or electrical work on the dryer while the dryer is pressurized.

 DANGER! The dryer is operated with electrical voltages of 24V =. Work on electrical components may only be carried out by suitably qualified and authorized personnel. Ensure that the dryer has been disconnected from the power supply and that no parts of the dryer are live before starting maintenance.

 WARNING! . Pressure is exhausted by a silencer approx every 4 minutes. A loud and strong air breeze can entangle small parts and lead to injuries. Do not place any parts near the silencer. The silencer must not be manipulated or removed. Wear ear protection when working near the dryer.

The proper functioning of the dryer can be recognized by the constantly similar rhythm of the valve circuits and the associated noise generation. The valves switch with an audible click. This is followed by the sound of exhaust air at the mufflers. Furthermore, an LED on the valve connector V1 indicates whether the valve is switched directly to the left or right container. The process runs for several minutes and alternates between the two containers in the same time intervals.

For an error analysis, the dryer should be observed for several minutes to keep track of at least one complete process run.

Operation

Error observation	Error	Possible causes	Recommended action
The status LED does not light	No 24VDC voltage is present at the dryer	1. The power supply is interrupted or the wrong voltage has been connected.	1. Check power supply. (Brown wire = [+] 24VDC / green wire = [-])
The status LED lights red	The dryer control has been stopped	1. 24VDC was switched to the remote ON / OFF signal line (white wire) and the program was thus stopped.	1. Check if the dryer has been stopped via the remote-off signal. (See chapter 8.3)
No click of the valves audible or no relief noises more audible	The valve V1 no longer switches. (Or the valve V2 no longer open)	<p>1. 24VDC was switched to the remote ON / OFF signal line (white wire) and the program was thus stopped.</p> <p>2. The valve is not controlled so that no voltage supply is present at the dryer control</p> <p>3. The valve has not been actuated since the electrical connection between the dryer control and the valve is interrupted.</p> <p>4. The valve does not switch, because the solenoid valve is defective.</p> <p>5. The silencer is clogged and can no longer discharge compressed air.</p>	<p>1. Check whether the status LED lights up red and the dryer is stopped via the remote-off signal. (See chapter 8.3)</p> <p>2. Check if the status LED lights green</p> <p>3. For valve V1, check that the LED in the valve plug lights up at regular intervals. Check whether the valve plug is firmly seated on the magnet coil. If necessary, check whether the electrical connections of the wires in the valve plug are firmly tightened.</p> <p>4. Check that the solenoid coils are warm. A defective magnet coil remains cold! Electrically savvy users can check the electrical resistance of the magnetic coil winding with a multimeter. Disconnect the dryer from the power supply. Then unplug the valve plug. On the magnet coil are the electrical connection tabs. An intact magnetic coil has an electrical resistance of <math><500 \Omega</math> between the two opposing connection pads. If necessary, replace the valve</p> <p>5. Disconnect the dryer and unscrew the silencer. Check the inside of the muffler for impurities and free flow. If necessary, replace the silencer.</p>

Operation

Error observation	Error	Possible causes	Recommended action
LED on valve plug V1 no longer lights up		<ol style="list-style-type: none"> 1. 24VDC was switched to the remote ON / OFF signal line (white wire) and the program was thus stopped. 2. The valve is not controlled so that no voltage supply is present at the dryer control 3. The valve has not been actuated since the electrical connection between the dryer control and the valve is interrupted. 	<ol style="list-style-type: none"> 1. Check whether the status LED lights up red and the dryer is stopped via the remote-off signal. (See chapter 8.3) 2. Check if the status LED lights green 3. For valve V1, check that the LED in the valve plug lights up at regular intervals. Check whether the valve plug is firmly seated on the magnet coil. If necessary, check whether the electrical connections of the wires in the valve plug are firmly tightened
Water in the pipe behind the dryer	The dryer doesn't work properly	<ol style="list-style-type: none"> 1. see the above points 2. The desiccant in the dryer containers is dirty. 3. The dryer is not operated within the specified operating limits. 4. The throttle valves at the upper end of the dryer container are turned or clogged. 	<ol style="list-style-type: none"> 1. check the function acc. of the above points 2. Check the silencers for any contamination by oil. Check the pre-filtration before the dryer for function. Refer to the operating instructions of the filter. If necessary, replace the dryer containers. Check the maintenance intervals (chapter 12.1) 3. Check the operating parameters (air-to-air flow, operating pressure, air inlet temperature). See chapter 6.4 4. After the expansion bang, a small amount of compressed air flows continuously through the muffler into the open air. The quantity of this "regeneration air" is fed into the upper end of the dryer containers via the throttle check valves. The throttling position is secured at the factory with sealing lacquer in the correct position. The throttle control valve must not be closed. Check the free flow of regeneration air in the time after the expansion bang. If necessary, contact the FST GmbH

11. Shutting down and restarting the dryer

11.1 Shutting down the dryer in case of emergency

- Disconnect the power supply to the dryer
- Opening the compressor contact (DPM + only)

NOTE! 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

11.2 Shutting down the dryer

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

Shutting down and restarting the dryer

11.3 Depressurising the dryer

⚠ WARNING – 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

Close the valves upstream and downstream of the dryer.

11.4 Restarting the dryer

Please proceed as described in chapter "Commissioning". (Chapter 9.2)

If the relevant requirements have already been fulfilled, the corresponding steps of the chapter can be skipped.

12. Maintenance and repair

⚠ DANGER! 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! 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! – 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". (Chapter 4.1)
- Observe the "Safety notes" and the "General safety notes" in particular)
- Provide the required spare parts. Only use genuine spare FST parts.
- The FST GmbH provides prepared spare part packets
- 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 (→ Chapter 9.2).



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 communication purposes, please specify the type and the manufacturing number. This information can be found on the type plate on the control box of the dryer. Contact details of the FST GmbH can be found at the end of this operating manual.

12.1 Regular maintenance intervals

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

Maintenance activity	weekly	monthly	yearly	Every 2 years or 8000 operating hours
Check vessels with LED and expansion noise	■			
Replace the vessels with a desiccant				■
Replace valves				■
Check expansion silencer and replace if necessary			■	

12.2 Visual check and function monitoring

- Check the dryer for external damages.
- Check the operating parameters of the incoming compressed air (pressure and temperature in particular)
- Check the individual components for unusual noise development and leaks.
- Check the expansion silencer on the compressor and prefilter for function.
- Check the dew point.

12.3 Cleaning the dryer

Make sure the surroundings are clean and tidy.

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

12.4 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.

- Decommission the dryer. (Chapter 11)
- Depressurise the dryer. (Chapter 11.3)
- Disconnect the electrical power supply from the dryer and protect it against unintentional reconnection.
- Make sure the cables and terminals are securely fixed by tightening them, if required.
- Only use tools approved for electrical work.
- Replace any damaged or corroded components.

12.5 Replacing the dryer vessel

In contrast to other dryers, the DPM dryers are the containers which are self-contained units. These are renewed every two years.

Tools required:

17mm wrench

16mm wrench

4mm hex wrench

- 1) Pull out the two hoses for gas inlet and gas outlet from the plug connections (Fig11- 2, 9)
- 2) Loosen the wall bracket and place the unit on a flat surface
- 3) Pull the two connecting hoses out of the plug connections (11) at the bottom of the vessel
- 4) Unscrew the lower plug connections (11) from the containers (5) (16mm open-end wrench)
And place them aside
- 5) With the DPM +, you must dismount the 2-way valve. To do this, turn the unit and place it on the front. The 2-2-way valve is screwed to the lower mounting bracket with 2 Allen-head screws (4mm allen key)
- 6) Now place the unit on the back and screw the upper throttle valves (1) (17mm open-end wrench).
Caution: always one turn alternately so that they do not jam up.
- 7) Then remove the gas outlet connector and place it aside.
- 8) Now both the upper and lower Allen screws (3, 12) (4mm Allen key) should be freely accessible.
Loosen the upper and lower mounting brackets (4, 6), together with the valves (8) and the electronics on the back, and place it aside.
- 9) The old containers are now ready for professional disposal. Take the new containers by hand and assemble in reverse order.
- 10) After assembly, pressurize the dryer again.
- 11) Restart the dryer. (→ Chapter 11.4)

Maintenance and repair

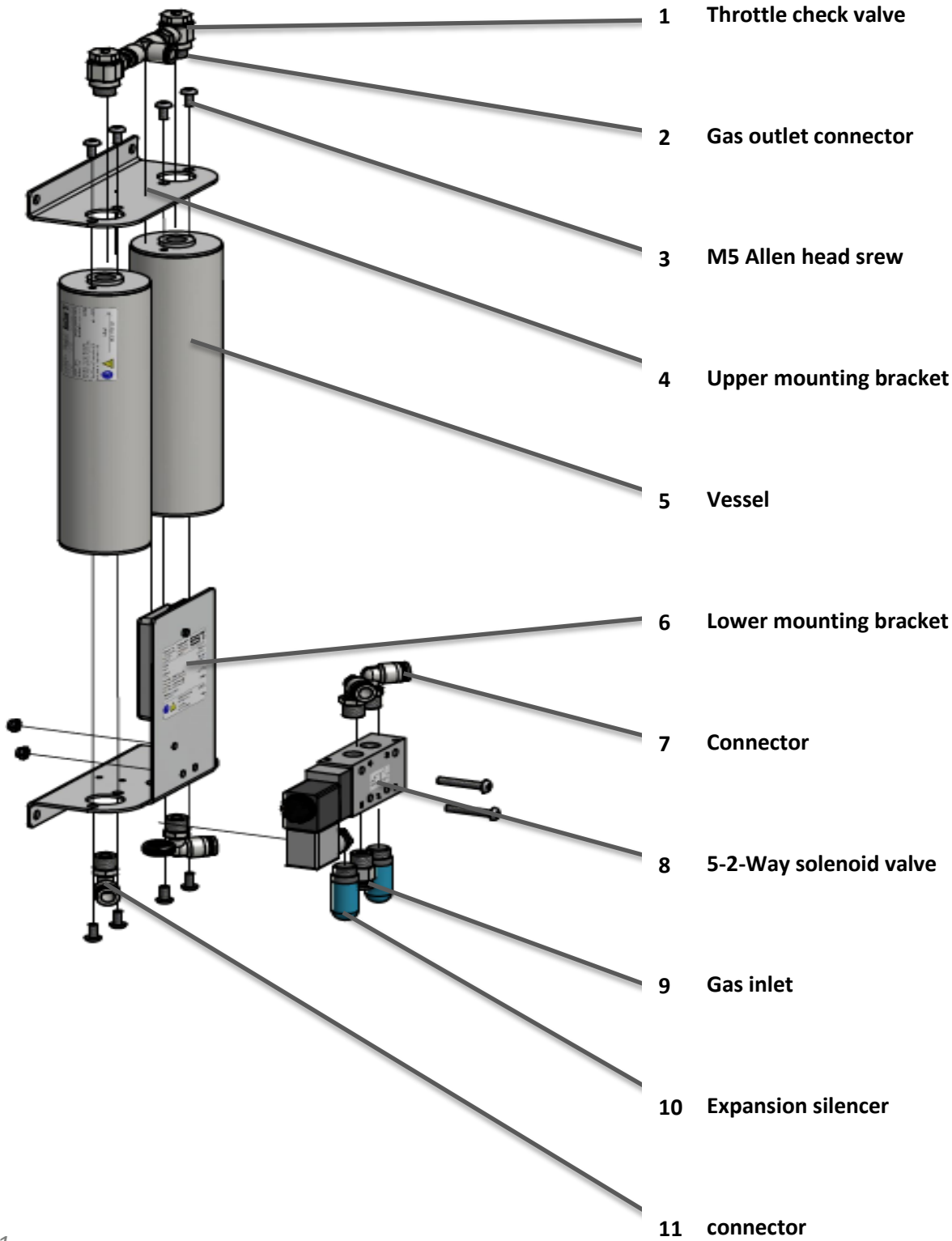


Fig. 11



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.

12.6 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.

Decommission the dryer. (Chapter 10)

- 1) Depressurise the dryer. (Chapter 10.3)
- 2) Unscrew the old expansion silencer (X1) from the connecting part using your hands or an appropriate tool.
- 3) Screw the new expansion silencer (X1) in the connecting part and tighten it using your hands or an appropriate tool.
- 4) Pressurise the dryer and commission the dryer again. (Chapter 11.4)

Dispose of the desiccant according to the local regulations.

- 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.

Manufacturer's Declaration

Herewith we declare under the sole responsibility 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.

Manufacturer/authorised representative:	FST GmbH Weiherdamm 17 D-57250 Netphen
Description of the assembly:	Compressed Air and Nitrogen Adsorption Dryer DPM02 to DPM04 DPM02+ to DPM04+
Description of the pressure equipment constituting the assembly:	The dryer essentially consists of a pressure vessel combination. These products fall under article 4, paragraph 3 of the directive 2014/68/EU and will not be marked with the CE mark. The dryer is described in the product data sheet and in the operating manual in more detail.
Harmonised standards applied:	DIN EN ISO 12100
European Commission directives applied:	2014/68/EU 2011/65/EG * (* = applied depending on chosen electrical parts)

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

Signature:



04.01.2017, ppa. Christian Ruff, Technical Manager

13.1 Manufacturer



Head office: Weiherdamm 17 – 57250 Netphen, Germany

Sales office: Im Teelbruch 106 – 45219 Essen, Germany

☎ +49 (0) 2054 8735-0

📠 +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.

13.2 Warranty notes

For warranty information, please refer to our "General Terms of Sale and Delivery".
(→ 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.
- If the dryer is used for anything other than its intended use. (Chapter 3.2)
- 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.