



Operating Manual Filter for Compressed Air Series FWS

Version: 08/2011/EN

Water Separator.....	FWS 140 - 2000
Coalescing Filter.....	FWS 140 - 2000
Activated Carbon Filter.....	FWS 140 - 2000
Dust Filter.....	FWS 140 - 2000



Table of contents

1.	General information	4
1.1	Manufacturer.....	4
1.2	Definitions	5
1.3	Warranty notes.....	5
1.4	About this operating manual.....	5
2.	Description of application	7
2.1	Intended use	7
2.2	Technical data.....	8
3.	Safety notes	10
3.1	Signs and instructions.....	10
3.2	Danger zones at the filter	11
3.3	General safety notes.....	13
4.	Technical product description	14
4.1	Function description.....	15
4.2	Options	16
5.	Transportation and storage	17
5.1	Transportation.....	17
5.2	Storage.....	17
6.	Installation.....	18
6.1	Installing the connecting pipelines.....	18
7.	Commissioning	20
7.1	Pressurisation of the filter	20
8.	Decommissioning	21
9.	Maintenance and repair	22
9.1	Regular maintenance intervals.....	23
9.1.1	Condensate drain (if available): visual check and function monitoring	24
9.1.2	Differential pressure gauge (if available): visual check and function monitoring.....	24
9.1.3	Replacing the filter element or the filter cartridge	24
10.	Errors and measures.....	27
11.	Appendix and technical documents	28
11.1	General arrangement drawing and filter configuration.....	28



1. General information

1.1 Manufacturer



FST GmbH

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! For any questions about the product, please contact the sales office !

In case of questions about the product, please specify the following:

- Filter type: e.g. FWS 190 XNF
- Filter element type: e.g. EFST 190 XN
- Manufacturing number: e.g. 10/12/24

This information can be found on the type plate of the filter housing. (→ Page 10)

1.2 Definitions

In the following the term „filter“ will be used as a common substitute for the terms „water separator“, „coalescing filter“, „activated charcoal filter“ and „dust filter“ as far as common properties are concerned.

1.3 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 filter is operated or maintained by personnel who do not have the required qualifications. (→ see "Target group": Page 5)
- If the filter is used for anything other than its intended use. (→ Page 7)
- If aggressive substances in the compressed air or ambient air cause damage to the filter.
- If parts other than genuine parts of the manufacturer have been used for maintenance and repair.
- If the filter is operated although defects are evident.

1.4 About this operating manual

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

Target group

This operating manual is directed to all persons working on and with the filter. We point out that these persons have to be qualified personnel who, because of their qualification and experience, are familiar with handling pressure equipment and compressed air systems. If you are not experienced in using these systems, please ask the relevant experts for help. We recommend that installation, commissioning and maintenance be carried out by a compressed air specialist company.

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 filter 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 filter and must be easily accessible.

When selling or hiring out the filter, 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 filter 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 the 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 to persons 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 filter is used to remove solid, liquid and – for activated carbon inserts – also gaseous contaminants from the compressed air, nitrogen and other uncritical fluid group 2 gases (group 2 fluids: → see Pressure Equipment Directive 97/23/EC).

Typically, the filter is used for treating compressed air from a compressor station. The filter almost completely removes dust, oil droplets and condensate from the compressed air. The filter version with an activated carbon filter element also removes oil vapour from the compressed air until the residual oil content is negligible.

The specifications on filter performance in this operating manual and in the product data sheets exclusively refer to compressed air and nitrogen. For specifications with regard to other gases please contact the manufacturer or one of the authorised service partners.

2.1 Intended use

The filter is exclusively designed for cleaning compressed air and nitrogen!

Using the filter for cleaning other gases (e.g. carbon dioxide) must be agreed on with the manufacturer. It may be necessary to observe special safety directives.



DANGER ! Caused by fire and explosion when used for oxygen

When oxygen comes into contact with grease in the filter and accessories there is a danger of violent fire and filter bursting.

Never use this filter for oxygen or gases rich in oxygen.

For filtration of oxygen please ask the manufacturer for advice.

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

- Frost-free
- Dry
- No vibration via brackets or connected piping
- Free from dangers due to explosive atmospheres inside and outside the filter. (The standard filter version does not comply with ATEX.)

The filter must only be operated with compressed air or nitrogen within the maximum allowable operating conditions.

The maximum allowable operating conditions are defined on the type plate (→ Page 10).

Modifications to the filter or use of non-genuine parts may cause unpredictable danger and damage. These measures must only be carried out after previous inspection 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.

For the nominal operating conditions please refer to the following table. (→ Page 8)

For a filter designed to your individual operating conditions and for other gases, please refer to your contract documents or contact the manufacturer.

Description of application

Filtration performance may be reduced considerably if the filter is not operated within these operating conditions.

The supplied compressed air must comply with the following requirements:

All filter versions

- Free from aggressive and corrosive substances

Coalescing filters and dust filters

- Coarsely filtered *

Activated carbon filters

- Finely filtered, free of liquid contaminants **

*= The filter only removes finely distributed contaminants (aerosols) carried in the compressed air. Flowing liquids may lead to overloading of the filter. The filter must be protected against water shocks and splashing water. We highly recommend coarse filtration using a water separator upstream of the filter.

**= The filter only removes gaseous contaminants (vapour) carried in the compressed air. Liquids contaminants may lead to overloading of the filter. The filter must be protected against liquid contaminants. We highly recommend fine filtration using a coalescing filter upstream of the filter.

2.2 Technical data

Filter	Nominal volume flow rate	Compressed air connection	Weight	Height	Width	Depth	Matching filter element
	V [m³/h]*	Inch	[kg]	[mm]	[mm]	[mm]	
FWS140	1.000	50	32	857	380	250	1 x EFST140**
FWS170	1.500	80	38	1280	380	250	1 x EFST170**
FWS190	2.500	80	44	1320	440	285	1 x EFST190**
FWS200	3.000	100	101	1440	500	405	2 x EFST170**
FWS300	4.500	100	102	1440	500	405	3 x EFST170**
FWS400	6.000	150	136	1590	640	460	4 x EFST170**
FWS600	9.000	150	220	1650	790	580	6 x EFST170**
FWS800	12.000	200	230	1730	790	580	8 x EFST170**
FWS1000	15.000	200	353	1780	840	750	10 x EFST170**
FWS1200	18.000	250	450	1940	940	840	12 x EFST170**
FWS1600	24.000	250	460	1940	940	840	16 x EFST170**
FWS2000	30.000	300	520	1970	940	840	20 x EFST170**

Classification acc. to PED 97/23/EC	<div>■ FWS140 to FWS300: Category II</div> <div>■ FWS400 to FWS800: Category III</div> <div>■ FWS1000 to FWS2000 Category VI</div>
Fluid group	2
Max. allowable pressure (PS)	16 bar
Max. allowable temperature (TS)	<div>■ Filter housing without filter element: 120°C</div> <div>■ Filter water separator W: 80°C</div> <div>■ Filter with filter element V, ZN, XN, XXN: 65°C</div> <div>■ Filter with filter element A, filter cartridge CA: 45°C</div>
Min. allowable temperature (TS)	+1°C

* = Standardised to 1 bar(a) and 20°C as well as to operating conditions of 7 bar operating overpressure.

** = The filter can be used with filter elements providing different filtration performances. The letter at the end of the filter element name specifies the filtration performance. For detailed information on the filtration performance of the different elements and for other details, please refer to the relevant product data sheet. The product data sheets can be found on the Internet at:

→ www.fstweb.de → Download

3. Safety notes

The filter 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 filter must be aware of. In particular, improper handling of compressed air may result in serious injury or death. If you are not experienced in using pressure equipment, please ask the relevant experts for help.





Note!

- In order to prevent personal injury or damage to the equipment, the safety notes must be observed when using this filter.
- 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

Office-/Service¶ Im-Teelbruch-106¶ 45219-Essen¶ GERMANY¶	Registered-Office¶ Weiherdamm-17¶ 57250-Netphen¶ GERMANY¶	EST GmbH Filtrations-Separations-Technik
Modell¶ Model¶	FWS190XNF¶ F80-000-01¶	
Filterelement¶ Filter-Element¶	EFST190XN¶	
Max.zulässiger-Druck{PS}¶ Max.allowable-Pressure{PS}¶	16-bar¶	
Min./Max.zulässige-Temperatur{TS}¶ Min./Max.allowable-Temperature{TS}¶	+2°C--+65°C¶	
Volumen{V}¶ Volume{V}¶	23,02-Liter¶	
Medium¶ Fluid¶	Druckluft¶ Compressed-Air¶	
Herstellnummer¶ Manufacturing-Number¶	10/12/24¶	



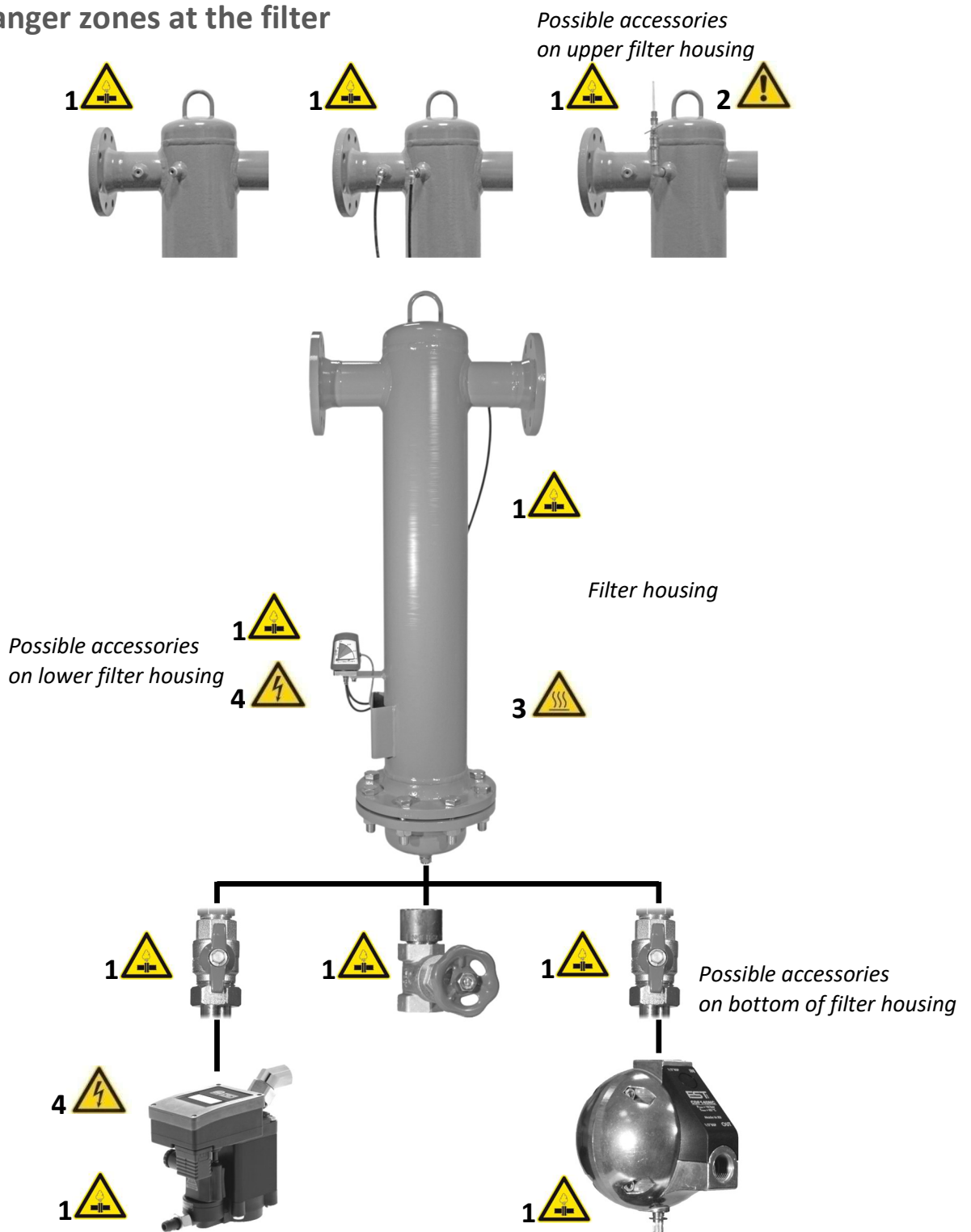
*Type plate of the filter
on the filter housing
(example: FWS190XNF)*

W+Z Rohrsystem-Technik GmbH Weiherdamm 17 D-57250 Netphen-Deuz		Rohrsystem-Technik GmbH	
Type type	FWS 190	Herstell-Nr. serial number	17000/1
max. zul. Druck max. pressure	PS 16 bar	Baujahr year of construction	2010
min. zul. Druck min. pressure	PS 10 bar	Volumen volume	V 18 L
min. zul. Temperatur min. temperature	TS -10 °C	Element	EFST190XN
max. zul. Temperatur max. temperature	TS 120 °C	Prüfdruck test pressure	PT 22,88 bar
CE - 0525		Prüfdatum date of inspection	11/10

*vessel plate of the filter
on the filter housing
(example: FWS190XNF)*

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

3.2 Danger zones at the filter



- 1 Gefahr durch drucktragende Teile
- 2 Gefahr durch loses Indikatorröhrchen
- 3 Gefahr durch heiße Oberflächen
- 4 Gefahr durch elektrische Spannung

Safety notes



DANGER ! – Overpressure (1)

The filter is pressurised.

Suddenly escaping compressed air may result in serious injury.

Do not carry out mechanical work on the filter as long as the filter is pressurised.



WARNING ! – Loose indicator tube (2) (option)

The indicator tube may break or loosen. When opening the valve at the indicator, the pressure may cause the indicator tube to be expelled.

This may lead to serious eye injury.

Check if the indicator tube is securely fixed by slightly pulling it by hand prior to opening the needle valve.

Open the valve carefully and turn away from the indicator.

Wear eye protection when working on the indicator.



WARNING ! – Hot surfaces (3)

Depending on the temperature of the compressed air the filter surfaces may be very hot.

Unprotected touching of these surfaces may cause burns.

Avoid direct contact to these surfaces. Restrict access to the surfaces, if necessary, or install thermal insulation on the hot components.

Never exceed the maximum allowable temperature of the filter. (→ Page 8).



DANGER ! – Electric voltage (4)

The accessories on the filter may be operated with electric voltage.

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 accessories have been disconnected from the power supply and that there are no live parts in and on the filter before starting maintenance work.

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

Observe the specific operating manuals for electrical accessories and the safety notes included.



3.3 General safety notes



DANGER ! – Overload

The filter must only be operated with compressed air within the maximum allowable operating conditions. The operating conditions are defined on the type plate (→ Page 10). 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 safeguarded such that the maximum allowable operating pressure (PS) and the minimum and maximum allowable temperatures (TS) are not exceeded. Please also refer to section "Intended use". (→ Page 7)



DANGER ! – Unauthorised modifications

Modifications to the filter may result in dangerous operating states. Violations may cause serious injury or death. Never modify the filter function by means of conversions. Never carry out welding work on pressure-bearing parts. Any modifications of the filter must be agreed on with the manufacturer and confirmed in writing.



DANGER ! – Suspected misuse

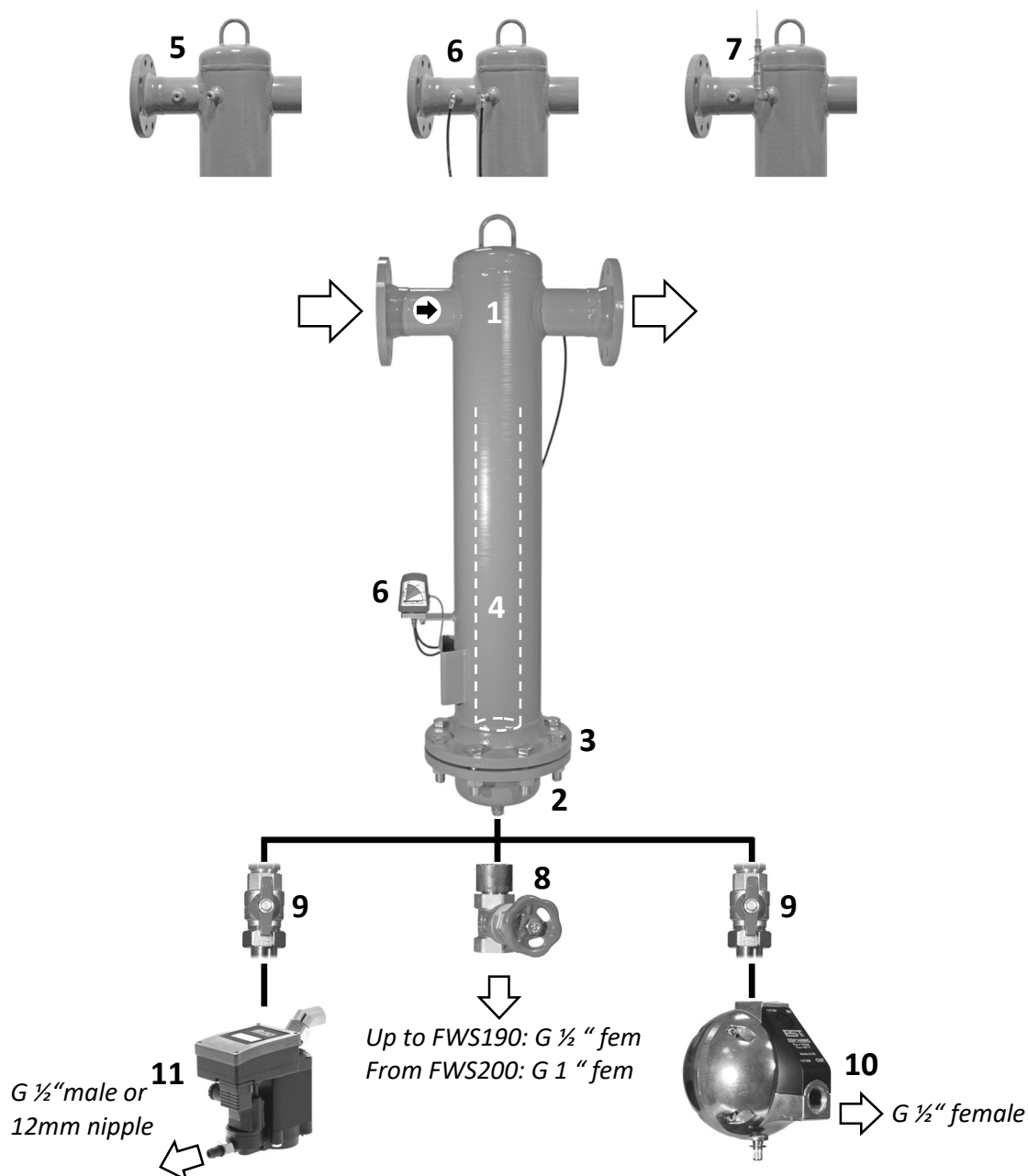
Using the filter for unintended purposes may result in dangerous situations. Violations may cause serious injury or death. Never use the filter as a climbing aid. Never use the filter as a support for external weight loads. Never use filter components for unintended application purposes. Please also refer to section "Intended use". (→ Page 7)



Additional safety notes

Additional safety notes can be found in the relevant chapters and operating manuals for the different accessories.

4. Technical product description



- | | |
|--|--|
| 1 Filter housing with compressed air inlet and outlet (one flat gasket for sealing the filter housing to close the filter with the filter bottom) | 6 Differential pressure gauge (option) |
| 2 Filter bottom | 7 Condensate drain: manual drain |
| 3 Flange of filter housing | 8 Condensate drain: manually operated drain valve |
| 4 Filter element(s) (inside) | 9 Shut-off valve |
| 5 Plug screw | 10 Condensate drain: float trap (external) with manually operated drain valve |
| | 11 Condensate drain: electronic (external) |

For further filter views and filter combinations, please refer to the appendix.

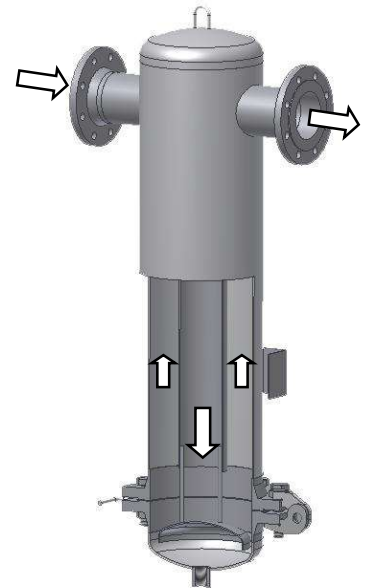
4.1 Function description

Water Separator (type W)

The filter (1) is installed in the compressed air piping. The compressed air is flowing through the filter. Inside the filter the compressed air is guided with high velocity through a down-come-tube onto an impact plate. Droplets are separated and guided into a turbulence free area in the bottom of the filter housing (stage 1: mass inertia effect). The compressed air slows down and flows up through the filter housing to the compressed air outlet. The remaining droplets in the slow air flow drop back into the filter bottom (stage 2: gravity effect).

The droplets are collected in the external condensate drain until a small amount of liquid has been produced (condensate). This liquid is discharged from the filter using a condensate drain (10 or 11).

When using an impact water separator the air flow direction through the filter always is from the inside to the outside.



Coalescing Filter and Dust Filter (Type V, ZN, XN, XXN)

The filter (1) is installed in the compressed air piping. The compressed air is flowing through the filter. In the filter the compressed air is led through a filter element (3). The filter element comprises a filter fleece in the form of a dense fabric consisting of finest fibres.

The compressed air freely flows through the filter fleece. Dust particles and finest droplets, however, are trapped in the fibre fabric and separated from the compressed air flow in this way.

The dust particles remain in the filter fleece.

The droplets pass the filter fleece and merge with one another to form larger droplets (coalescence effect). These larger droplets leave the filter fleece on the outside of the filter element and are drawn down by gravity to finally drop off the filter element.

The droplets are collected in the external condensate drain until a small amount of liquid has been produced (condensate). This liquid is discharged from the filter using a condensate drain (10 or 11).

When using a coalescing filter the air flow direction through the filter element always is from the inside to the outside.

When using dust filter the air flow direction through the filter element normally is from the inside to the outside. If the air flow through the filter element is to be in the opposite direction, the correct polarity of the differential pressure gauge must be observed. Changing the direction of flow also requires the polarity of the differential pressure gauge to be changed. The \oplus -connection of the differential pressure gauge shall be connected to the inlet side of the filter.



Special disposal of the condensate

Usually, the condensate from compressed air filters is contaminated and consists of an oil/water mixture. This kind of condensate must not be discharged into the municipal wastewater system.

The filter manufacturer also offers condensate treatment systems which clean the condensate and treat it such that it can be disposed off into the municipal wastewater system.

Activated Carbon Filter (Typ A,CA)

The filter (1) is installed in the compressed air piping. The compressed air is flowing through the filter. In the filter the compressed air is led through an activated carbon element (4). The activated carbon in the activated carbon element removes the oil vapour from the compressed air and stores it in its internal structure.

The activated carbon element (4) is fitted with a filter fleece in the form of a dense fabric consisting of finest fibres.

The compressed air freely flows through the filter fleece. Dust and carbon particles, however, are trapped in the fibre fabric and separated from the compressed air flow in this way.

The dust and carbon particles remain in the filter fleece.

When using an activated carbon filter with integrated filter fleece the air flow direction through the element always is from the inside to the outside.

Continuous loading of the activated carbon with contaminants results in reduced cleaning performance until the activated carbon finally is saturated. The saturated activated carbon element needs to be replaced by a new activated carbon element. The service life of the activated carbon element depends on the quality of the inflowing compressed air. (→ Page23)

4.2 Options

The filter can be configured individually.

- Different differential pressure gauges and condensate drains are available.
- Several filters can be installed to form filter combinations.
- The filter can be provided with an oil indicator.

For possible configurations, please refer to the appendix or the manufacturer's price list.

For a detailed description of the options, please refer to operating manuals and product data sheets provided separately.

The product data sheets can be found on the Internet at: → www.fstweb.de → Download

5. Transportation and storage

5.1 Transportation

**DANGER ! – Damage**

Damages of the filter may lead to unpredictable hazardous situations.
Operating a damaged filter may result in serious injury or death.
Never start or operate a damaged filter.

Although great care is taken damages caused by transportation cannot be ruled out. Therefore, always check the filter 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.

- Consider the size and weight of the filter. (→ Page 8)
The use of auxiliary equipment might be necessary for carrying/transporting the filter. Make sure to provide adequate lifting equipment when transporting and loading or unloading the filter.
- Persons responsible for transportation must be appropriately qualified.
- Do not remove the packaging material until the filter is moved to its final place of installation.
- The national regulations for accident prevention must be adhered to.

5.2 Storage

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

Store the filter in the supplied transport packaging. If necessary, the filter should be protected against dust using an additional cover.

The place of storage has to fulfil the following requirements:

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

6. Installation

6.1 Installing the connecting pipelines

**DANGER ! – Overpressure**

The filter is under pressure.

Suddenly escaping compressed air may result in serious injury.

Do not carry out mechanical work on the filter as long as the filter is under pressure.

**DANGER ! – Overload**

The filter must only be operated with compressed air within the maximum allowable operating conditions. The operating conditions are defined on the type plate (→ Page 10).

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 safeguarded such that the maximum allowable operating pressure (PS) and the minimum and maximum allowable temperatures (TS) are not exceeded.

Please also refer to section "Intended use" (→ Page 7).

**DANGER ! – Bursting components due to external forces**

The filter 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 points of the filter is not permissible.

**DANGER ! – Electric voltage**

The accessories on the filter may be operated with electric voltage.

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 accessories have been disconnected from the power supply and that there are no live parts in and on the filter before starting maintenance work.



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

Observe the specific operating manuals for electrical accessories and the safety notes included.

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

To avoid damages during transportation the accessories may be provided separately and need to be mounted to the filter after the filter has been installed at the place of installation.

Please observe the following steps when installing the compressed air pipeline:

- Make sure that the filter 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 safeguarded 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 filter from the piping system. We recommend using shut-off valves with continuous opening behaviour. This behaviour avoids sudden pressure equalisation between the piping sections.
- In the event that operation cannot be interrupted for maintenance purposes, we recommend installing a bypass line around the filter.
- The pipelines must be suitable for use with the maximum possible operating pressure.
- The connection points have to be compatible with the filter 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 filter via the pipelines. This may damage the filter and the accessories. If required, install compensators or pulsation absorbers in the pipelines to be connected.
- Wet pipelines upstream of the filter should be installed at a slope in order for the liquid condensate (water and oil) in the line to be discharged in flow direction. If installation of an upright pipeline with upward flow 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 must be avoided.
- Install a valve in the piping system which can be used for depressurising the filter. Also install a pressure gauge which indicates the pressure in the filter.
- Install the filter in upright position.
- Consider the direction of flow! The direction of flow is indicated by means of an arrow on the housing. (→ Page 14)
- Keep an adequate distance to walls and other system parts around the filter.
- Make sure to provide adequate space below the filter in order to replace the filter element easily. (→ For details on the height that should be available for replacement, please refer to the appendix.)
- Prior to closing the connected pipelines, please check that there are no objects or contaminations left in the pipelines.
- The filter is supported by the connecting pipelines. Provide adequate support for the incoming and outgoing pipelines to carry the weight of the filter even when it is completely filled with liquid.
- When an automatic condensate drain was selected (**10, 11**), a condensate line between the condensate outlet at the condensate drain and a collecting tank must be installed. The collecting tank must be exhausted against the atmosphere to avoid pressurisation in the collecting tank. The condensate line can be connected to the threaded nozzle of the condensate drain outlet.
Make sure the condensate line is appropriately pressure-proof.
- When checking the installation for leaks the maximum allowable operating pressure of the filter must not be exceeded. (→ See specification on the type plate: Page 10)
- Check all the components for visible damages. If there are defective components, commissioning of the filter is not permitted.



Suitable place of installation

In most applications the compressed air cools down while passing the piping system. As a result, moisture condenses from the compressed air. To obtain optimum filtration performance the filter should therefore be installed at a place in the piping system that is as cold as possible.

Often, the best location for installing the filter is directly upstream of the system part that is to be protected by the filter (e.g. compressed air dryer or compressed air distributor).

7. Commissioning



DANGER ! – Overpressure

The filter is under pressure.

Suddenly escaping compressed air may result in serious injury.

Do not carry out mechanical work on the filter as long as the filter is under pressure.



WARNING ! – Loose indicator tube (option)

The indicator tube may break or loosen. When opening the valve at the indicator, the pressure may cause the indicator tube to be expelled.

This may lead to serious eye injury.

Check if the indicator tube is securely fixed by slightly pulling it by hand prior to opening the needle valve.

Open the valve carefully and turn away from the indicator.

Wear eye protection when working on the indicator.

Once installed the filter is immediately ready to operate and may be pressurised.

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

7.1 Pressurisation of the filter



CAUTION ! – Pressure blows and overload

Rapid opening of the valves may cause pressure blows and increased flow rates in the filter. Pressure blows and increased flow rates may lead to damages of the filter.

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 filter as follows:

- 1) Make sure that the filter is completely closed. The flat gasket has to be placed between the flanges of filter housing and bottom. All bolts of the housing flange (3) shall be present and closed tightly.
- 2) Make sure that the accessories are securely installed.
- 3) Make sure that the compressed air system upstream or downstream of the filter inlet is under pressure. If necessary, the compressor must be started.
- 4) Open the valves upstream and downstream of the filter **very slowly** until hearing the first clear flow noise. Stop the procedure when the flow noise becomes louder.
- 5) 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 filter has to be depressurised again. (→ Page 21)
- 6) If flow noise and a pressure increase are no longer present when further opening the valves, they can be opened completely.
- 7) Air can now freely flow through the filter.

8. Decommissioning



WARNING ! – Exhausting compressed air

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, if necessary. Open the valves for releasing the pressure only **very slowly**.

Always wear eye and hearing protectors when working in the vicinity of the filter.

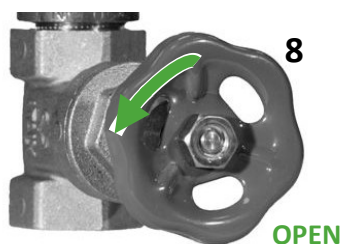


- 1) Close the valves upstream and downstream of the filter.
- 2) The filter has now been shut down.
- 3) Prior to working on the filter it has to be depressurised. For this purpose, open a valve (customer scope) installed in the piping system and observe a pressure gauge (customer scope). Wait until the pressure on the pressure gauge has dropped to 0 bar.

Depending on the filter configuration you have the option to open the manual drain valve (8) or the manual valve of the float trap (10).

When using an electronic condensate drain the pressure can usually only be reduced until reaching a system-dependent residual pressure. For further information, please refer to the operating manual of the condensate drain.

Attention: The valves on the filter and on the condensate drains are not suitable for depressurising large volumes. For this purpose, we recommend a valve to be installed in the piping system (customer scope).



Condensate drain type CDM15N



Condensate drain type CDF140NC

9. Maintenance and repair



DANGER ! – Overpressure

The filter is under pressure.

Suddenly escaping compressed air may result in serious injury.

Do not carry out mechanical work on the filter as long as the filter is under pressure.



WARNING ! – Exhausting compressed air

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, if necessary. Open the valves for releasing the pressure only **very slowly**.

Always wear eye and hearing protectors when working in the vicinity of the filter.



CAUTION ! – Qualification and experience required

Persons working on and with the filter have to be qualified personnel who, because of their qualification and experience, are familiar with handling compressed air systems. If you are not experienced in using these systems, please ask the relevant experts for help. We recommend that commissioning and maintenance be carried out by a compressed air specialist company.

Please observe the following requirements for maintenance:

- Observe the notes in section "Intended use". (→ Page 7)
- Observe the "Safety notes" and the "General safety notes" in particular. (→ Pages 10, 13)
- Provide the required spare parts. Only use genuine spare parts of the manufacturer.
The manufacture provides prepared spare part packets. (→ Page 4)
- Maintenance must only be carried out if the filter is depressurised. (→ Page 21)

Please observe the following when completing maintenance work:

- Make sure that all the connections are tight and sealed.
- 8) Make sure that the filter is completely closed. The flat gasket has to be paced between the flanges of filter housing and bottom. All bolts of the housing flange (3) shall be present and closed tightly.
- Make sure that the accessories are securely installed. (→ Page 26)
- Carry out a leak test.
- Commission the filter as described on → Page 20.

9.1 Regular maintenance intervals

The following table provides an overview of the maintenance activities to be carried out routinely. The maintenance activities are described in detail on the following pages.

Component	Maintenance activity	Every day to every week	Every month	Every three months / or when the residual oil content becomes worse	Every 12 months / or at a differential pressure of 50 mbar at the latest	Every 12 months / or at a differential pressure of 350 mbar at the latest	Repeated vessel testing	See page
Condensate drain	Visual check and function monitoring	■						24 *
Differential pressure gauge (option)	Visual check and function monitoring	■						24 *
Oil indicator (option)	Check residual oil content of compressed air		■					*
Filter element for activated carbon filter	Replace filter element			■ **				24
Filter elements at operating pressure of 0 bar to 4 bar	Replace filter element				■			24
Filter elements at operating pressure of 5 bar to 16 bar	Replace filter element					■		24
Filter housing FWS400 to FWS2000	Repeated vessel testing (with notified body)						■	
Oil indicator (option)	Replace indicator tube	When indicator tube is used up *						
Water separator	Clean insert and filter bowl	When required						
* = Maintenance information can be found in the separate operating manuals of these components. ** = Significantly reduce the maintenance intervals at compressed air temperatures above 35°C								

9.1.1 Condensate drain (if available): visual check and function monitoring

During operation a coalescing filter permanently separates condensate. When not discharging the condensate the filter is flooded with condensate and the condensate reaches the compressed air outlet. If the condensate drain is operating properly, only a small amount of liquid should remain in the condensate drain.

- 1) Check the condensate drain for external damages.
- 2) Check the condensate drain for leaks.
- 3) Activate the manual valve or the test button and check the discharged amount of condensate. After a very short time compressed air should be flowing out of the condensate drain.
 - The condensate drain is blocked or defective and needs to be replaced if there is only a little amount of condensate and compressed air flowing out.
 - The condensate drain is not operating properly if there is a large amount of condensate flowing out before the compressed air is flowing out. (→ Observe the notes in the operating manual of the condensate drain.)

9.1.2 Differential pressure gauge (if available): visual check and function monitoring

The differential pressure gauge is an indicator for the state of the filter element. The filter elements in the filters will be clogged over time and thus the compressed air flow is throttled. The differential pressure continually increases. If the differential pressure exceeds 350 mbar, the filter element should be replaced. The filter element must be replaced after one year at the latest.

- 1) Check the differential pressure gauge for external damages.
- 2) Check the differential pressure gauge for leaks.
- 3) Write down the differential pressure in order to record the contamination level of the filter element over the time.
 - In the event of constant compressed air flows and a constant operating pressure, the differential pressure should only change little or increase slowly for a long time. Replace the filter element if the differential pressure increases more rapidly.
 - If the differential pressure suddenly drops although the compressed air flow remains constant, the filter element may have been damaged by a pressure shock.

9.1.3 Replacing the filter element or the filter cartridge

The filter element in the filter prevents particles and aerosols in the compressed air flow from entering the system.

The filter element in the filter will be clogged over time and thus the compressed air flow is throttled. The activated carbon element in the filter is continuously laden with oil vapour and other contaminants. This results in gradually reduced cleaning performance until the activated carbon finally is saturated. The saturated activated carbon element needs to be replaced by a new activated carbon element or cartridge, respectively.

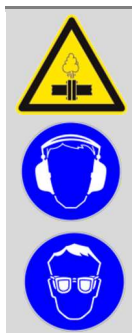
To prevent operating errors from occurring, the filter element or filter cartridge has to be replaced regularly according to the maintenance intervals. (→ Page 23).

In the following the term “filter element” will also be used as a substitute for the term “filter cartridge”.

- 1) Provide a suitable filter element. The filter element type is specified on the type plate of the filter.
(→ Page 4)
- 2) Only take the filter element out of its packaging when it is to be inserted. Make sure the working area is clean. Do not touch the filter element when your hands or tools are dirty.

Opening the filter housing:

- 3) Depressurise the filter, (→ Page 21)
- 4) Remove the condensate line from the filter, if installed.
- 5) Disassemble a large condensate drain, in case it obstructs the access to the filter bowl.
Externally installed condensate drains are supplied with a shut-off valve and a screwed joint with a cap nut. Open the connection between the shut-off valve and the condensate drain by loosening the cap nut.



WARNING ! – suddenly escaping compressed air

When activated the shut-off valve opens suddenly. If the filter is under pressure and the condensate drain has been removed, opening the shut-off valve leads to sudden depressurisation. This results in a very loud and hazardous compressed air stream which carries small particles and may cause serious injury. Do not use the shut-off valve between the filter and the condensate drain for depressurisation.

- 6) Open the depressurised filter housing by unscrewing and removing the bolts on the filter housing flange (3). If compressed air flows out, the opening procedure must be immediately interrupted and the filter needs to be depressurised. (→ Page 21)
 - FWS140 to FWS190
Leave one bolt loose in the flange and turn the filter bottom to the side. Or completely remove the filter bottom.
 - FWS200 to FWS2000
The filter bottom is fitted with a handle and it is connected to the filter housing via a hinge. Remove all bolts from the housing flange and swing open the filter bottom. The hinge is designed to hold the full weight of the filter bottom.



Filter housing flange
with handle and hinge

Replacing the filter element:

- 1) Slightly turn and pull the old filter element (4) to remove it from the filter housing (1).
- 2) Clean the filter holder and the flanges of the housing parts.
- 3) Replace the flat gasket of the filter housing, if necessary. Undamaged flat gasket can be used again.
- 4) Lubricate the filter holder.
- 5) Take the new filter element out of its packaging. Insert the filter element by slightly turning and pushing it into the filter holder.

Closing the filter housing:

- 6) Close the filter housing by placing the flat gasket between the two housing parts and fit the filter bottom (2) back onto the filter housing (1). Tighten the bolts using suitable tools.
- 7) Mount all the parts that have been removed before.
- 8) Check if all the connections are securely fixed.
- 9) Recommission the filter as described on → Page 20.



Disposal

A clean filter element can be disposed of with the domestic waste.

However, if the filter element is contaminated with hazardous substances, the type of disposal has to be determined by the owner of the equipment with regard to the type of contamination.

10. Errors and measures



CAUTION ! – Qualification and experience required

Persons working on and with the filter have to be qualified personnel who, because of their qualification and experience, are familiar with handling compressed air systems. If you are not experienced in using these systems, please ask the relevant experts for help. We recommend that commissioning and maintenance be carried out by a compressed air specialist company.

The following table explains the possible reasons for the errors and provides the recommended measures for remedy.

Error	Reason	Recommended measure
Condensate and oil in the pipeline downstream of the filter	<ul style="list-style-type: none"> ■ Volume flow rate in the filter too high ■ Operating pressure too low ■ Temperature downstream of the filter lower than upstream of the filter ■ Strong fluctuations of inlet temperature ■ Defective condensate drain on filter ■ Closed shut-off valve between filter and condensate drain ■ Open bypass line ■ Connected pipelines downstream of the filter were already contaminated with oil during installation or have been contaminated by the previously opened bypass line ■ Oil breakthrough on the compressor 	<ul style="list-style-type: none"> ■ Compare the operating conditions with the specified values and correct the operating conditions, if necessary. (→ Page 8) ■ Check filter element and replace, if necessary. ■ Check condensate drain for proper function and correct any malfunctions. ■ Make sure bypass line is closed. Protect it against unintentional opening. ■ Clean or replace pipelines. ■ Monitor the oil consumption on the compressor and correct any malfunctions, if necessary.
High pressure fall in the filter	<ul style="list-style-type: none"> ■ Closed shut-off valves ■ High differential pressure in the filter element ■ Large amounts of dust and encrustations block the pipelines 	<ul style="list-style-type: none"> ■ Check valves and open, if necessary. ■ Check filter element and replace, if necessary.



Monitoring the compressor

With oil-lubricated compressors the main source of the oil is in the compressor.

Compressors that are insufficiently cooled and maintained lead to particular high oil load on the filter.

Regularly check the oil consumption and monitor the oil consumption over a longer period. The compressor must be maintained at regular intervals.

11. Appendix and technical documents

11.1 General arrangement drawing and filter configuration

The product data sheets can be found on the Internet at: → www.fstweb.de → Download