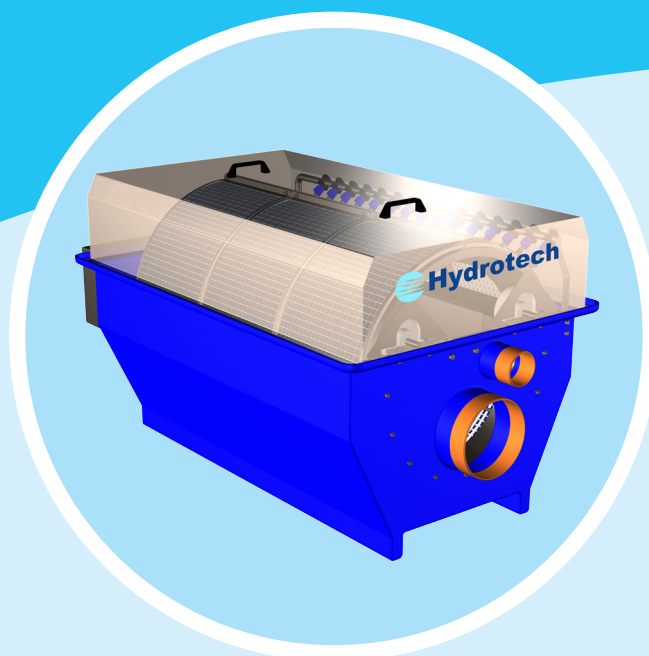




# HYDROTECH

## Operation and Maintenance Manual Drumfilter HDF800-series



TYPE: 1H, 1F, 1P, 1FP, 1A, 1B, 2H, 2F, 3H, 3F

SERIAL NO: .....

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## PREFACE

This manual comprises instructions for operation and maintenance of Hydrotech Drumfilter HDF800-series.

The manual should always be available to the personnel who work with the equipment.

It is important that:

- The manual and other applicable documents are preserved during the whole life span of the equipment. The manual and other applicable documents constitute a part of the equipment.
- This manual is carefully studied by all users of the equipment, and always kept at hand for future reference

## 1. SAFETY PRECAUTIONS

Hydrotech Drumfilter HDF800-series are designed for safe operation when properly in-stalled and used according to the enclosed instructions. The equipment must be properly installed and adapted according to local regulations. The machine equipment is designed to be handled by several operators. Before use of or maintenance on this equipment, please read the applicable parts in the manual.

- Pay attention to all warning symbols in this manual. Serious personal injury or damage to the machine can be inflicted if this information is disregarded.
- Consider all electric equipment as alive.
- Consider all tubes and pipes as pressurised.
- Before maintenance, set the safety switch (see Figure 1.7) to OFF and lock it in the OFF position by means of a padlock.
- Only authorised personnel may perform service and maintenance.

### 1.1 Safety alert symbols

In this manual a warning symbol is used to call attention to potentially hazardous situations:



#### **WARNING!**

**Information about potential personal injury and/or damage to the equipment.**

Safety warning labels (see Figure 1.1) are affixed to the Drumfilter lids to warn personnel to keep hands and fingers away from moving parts of the filter.



Figure 1.1  
Moving parts can cause injury.

### 1.2 CE Marking

This equipment is CE marked ensuring that the equipment is designed, manufactured and described in conformity with the Machine Directive of EU 98/37/EU (AFS 1994:48).



Figure 1.2  
The CE marking

### 1.3 Redesigned equipment

The CE marking does not cover components not approved by Hydrotech AB, used in redesigning or rebuilding of the equipment.

Warning signs and the CE marking shall be placed fully visible. If any part of the equipment with a sign is being replaced, a new sign must be attached at the same place. Damaged signs and CE markings must be replaced promptly.

### 1.4 Personnel requirements

In order to avoid personal injury and machine damages only personnel who are trained in accordance with your local supplier's instructions may perform service and maintenance. Service and maintenance personnel may only handle parts of the equipment for which they are trained.

During maintenance and adjustment before operation, the operator can work within the safety fence and in the restricted area.

## 1.5 Emergency shutdown

The filter is equipped with a safety switch (see *Figure 1.7*). In an emergency shutdown situation, set the safety switch to OFF (0).

In the event of a power failure, set the safety switch to OFF to prevent the filter to accidentally start rotating when power returns.

## 1.6 Electrical safety

Electrical connection must be performed by an authorized electrician and in accordance with local regulations. See also Appendix D.

The filter tank or frame must be connected to earth. See also section 4.4

A lockable safety switch must be installed if the control box is mounted far away from the filter (further away than 7 m within EU countries).

## 1.7 Safety instructions

The filter is activated by setting the safety switch to ON (1) and then selecting HAND or AUTO on the selector switch on the panel front. Setting the selector switch to 0 stops the filter.

**Note!** See also section 5.1 (Start up procedure).



**WARNING!**  
*Set the safety switch to OFF (0) and lock it in the OFF position by means of a padlock before starting any work on the filter.*



**WARNING!**  
*Access to the filter by unauthorised persons must be strictly prohibited. An outdoor installation should be fenced off.*



**WARNING!**  
*The filter can suddenly start rotating if automatic control is activated. Do not touch any moving parts. Do not climb up on the filter construction when the filter is activated.*

Protection guards are fitted around the power transmission and in front of the support wheels. Make sure these are correctly and firmly fitted at all time.



**WARNING!**  
*The vapours from the backwash water may contain harmful substances. If the filter is equipped with a chemical dosage system, the vapours from the chemical dosage system contain substances that are harmful. Use suitable personal protection according to local regulations.*

Measured noise level from the filter is less than 74 dB (A). If necessary, use suitable personal protection according to local regulations.

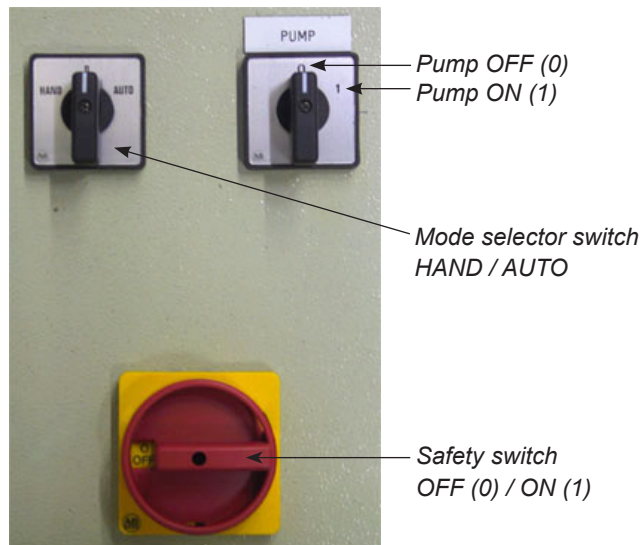


Figure 1.7 Switches of the control cabinet (optional)

## 2. HYDROTECH DRUMFILTER HDF800-SERIES

### 2.1 Overview

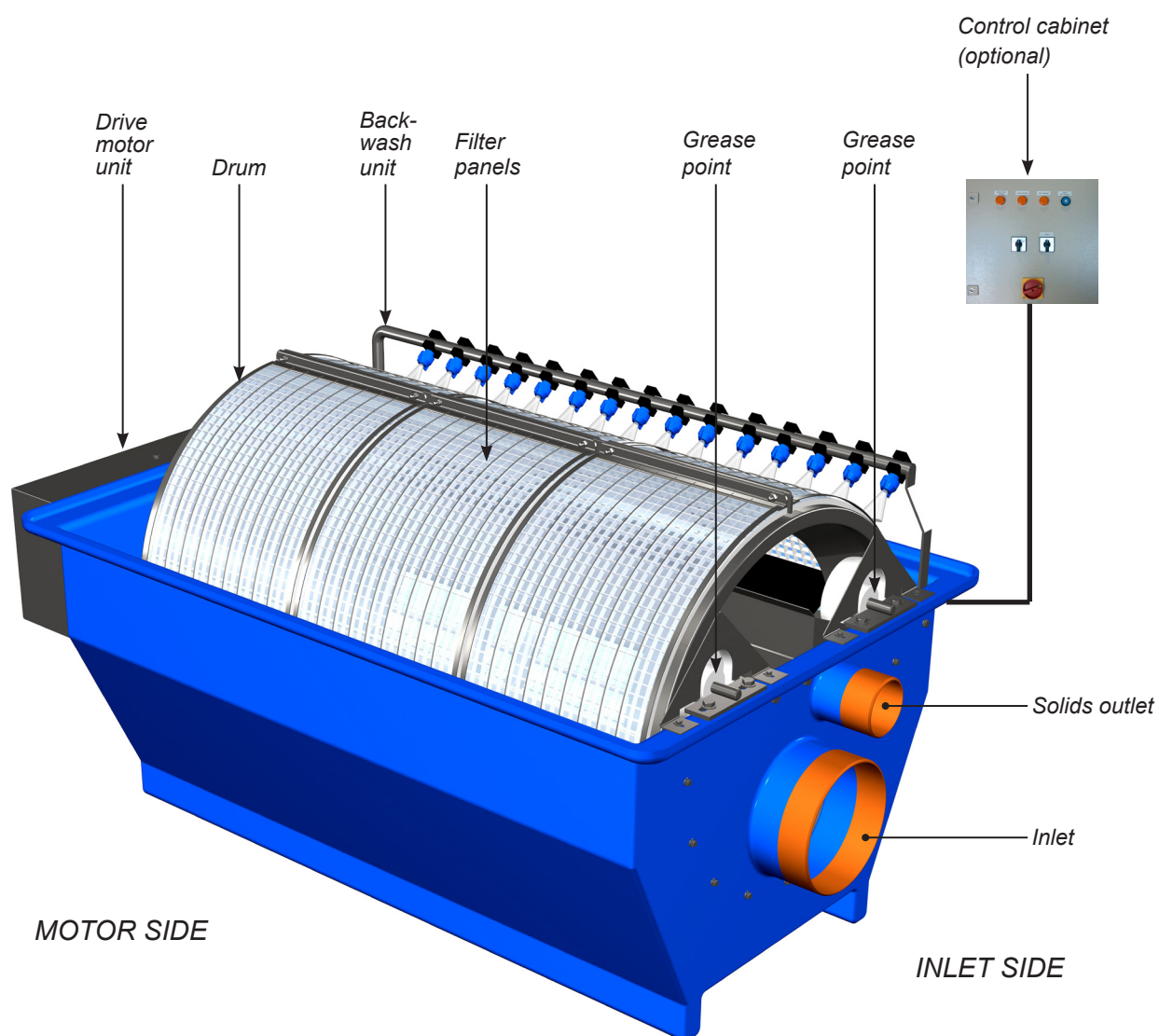


Figure 2.1 Parts of HDF800-series



## 2.2 Identification of the filter

Filter type, serial number and year of manufacture can be found on the affixed data plate. Filter type and serial number is also specified on the front page of this manual.

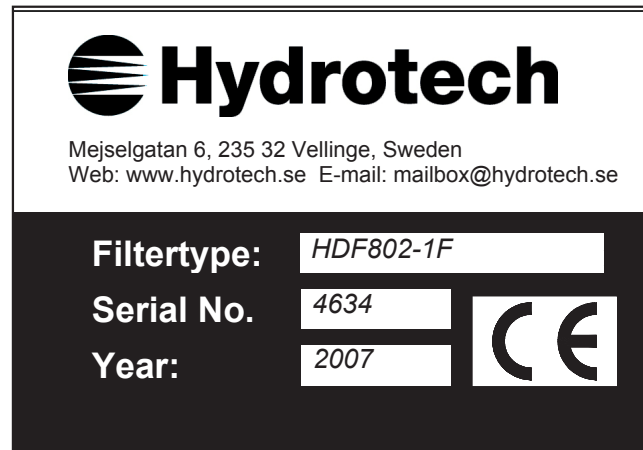
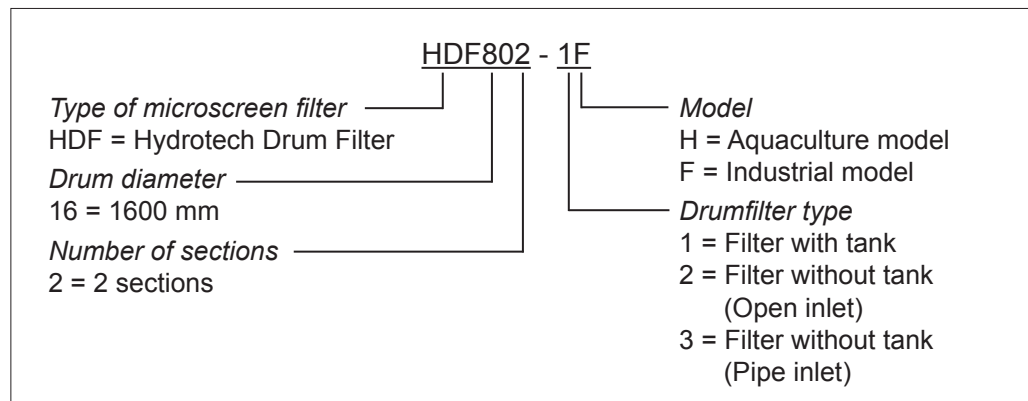


Figure 2.2  
Filter data plate

The filter designator definitions are:





### 3. RECEIVING AND HANDLING

#### 3.1 Receiving

When received, the equipment should be thoroughly inspected for any damage that may have occurred during transport.

The delivery note, manual and the spare part set are attached to the equipment.

Check all parts against the packing list. For safe transport it is necessary that some parts are not assembled when delivered. Handle fragile parts with care.

#### 3.2 Storage

Should it be necessary to store the equipment for a longer period (several days or more) certain precautions should be taken in order to prevent unnecessary damage to the equipment:

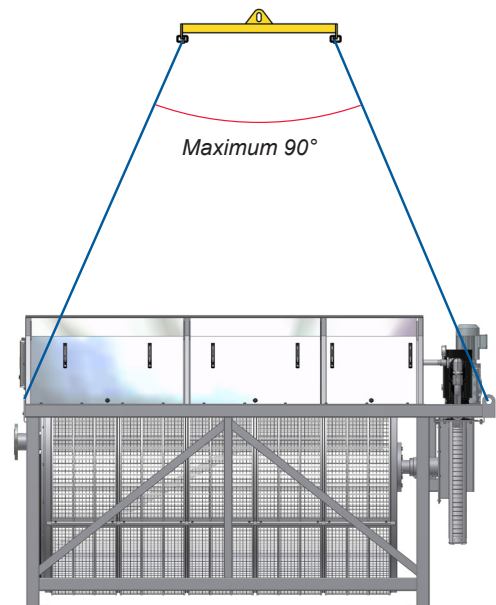
- Preferably, the equipment should be stored inside, in a room with temperature above freezing.
- For outdoor storage it is necessary to protect the filter from direct sunlight as the heat and UV radiation may damage the filter panels.
- Filters are delivered covered by plastic, within the wooden crate. If placed outdoors, a special type of corrosion may develop, especially in coastal areas. Humidity on the inside of the plastic forms the anode, and dry exposed parts the cathode. Filters must therefore be unpacked after delivery in these areas.

#### 3.3 Lifting

- When lifting the unopened crate a fork lift with fork extensions should be used.
- Unpacked filters with tank (type 1) may be lifted by a fork lift or using a crane or overhead gantry, and straps.
- Unpacked filters without tank (type 2 & 3) can be lifted using a crane or overhead gantry, and straps. The straps should be positioned as shown in *Figure 3.3*.



**WARNING!**  
*Before unloading, the working area should be fenced off according to local regulations to prohibit access by unauthorised persons.*



*Figure 3.3 Lifting points for filters without tank (type 2/3)*

## 4. GENERAL INSTALLATION INSTRUCTIONS

The following requirements must be met before installation can begin

- The electrical specifications of the equipment corresponds to the available line current specifications
- The equipment is undamaged (no damages from transport or storage)

### 4.1 Installation site

#### 4.1.1 Outdoor installation

For outdoor installations it is necessary to protect the filter panels from direct sunlight as the heat and UV radiation may otherwise destroy the filter panels.

Protect the filter from freezing. At water temperatures above +5 °C and air temperatures warmer than -10 °C, the lids of the filter is enough for protection. At lower water and air temperatures, the filter should be installed indoors.

#### 4.1.2 Foundation

- The filter should be fitted on an even surface with appropriate torsional and structural strength.
- Foundation bolting is required
- The filter must be properly levelled in both directions (see figure 4.1).
- 600 mm wide walkways should be fitted around the filter in order to provide easy access to the filter for service work.
- For type 2 and type 3 filters (without tank), the gap between the filter frame and the concrete construction must be covered to avoid access to moving parts and to stop objects from falling into the filter.

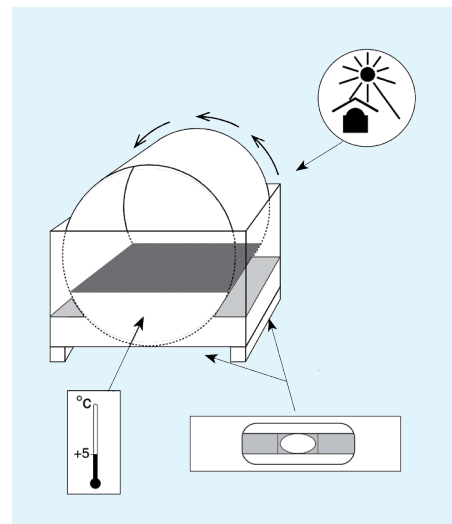


Figure 4.1 Filter installation

### 4.2 Emergency by-pass

Type 1 filters (with *stainless steel* tank) and type 3 filters (without tank, pipe inlet) have a built-in emergency by-pass weir as standard. For a type 2 filter (without tank, open inlet), an inlet channel can be used for the emergency by-pass. For type 1P filters (with GRP tank) an external by-pass must be arranged

In some applications an external by-pass must be arranged in case of e.g. a power failure to avoid a too high differential pressure across the filter cloth.

### 4.3 Electrical connection

Electrical connection must be performed according to local regulations. Check the settings of the motor protectors against amperage readings on the motors (see Appendix A & D).

#### 4.4 Equipotential earth bonding

The Hydrotech Drumfilter and its associated equipment should be protected using a suitable Equipotential Earth Bonding system. This is very important to avoid galvanic corrosion. Typically use a cable with an area of 10-16 mm<sup>2</sup>. The cable should be attached to the same electrical potential as the drive system.



**WARNING!**

*All electrical works should be installed by a qualified and competent electrically trained person.*

#### 4.5 Pipe connections

Nominal pipe sizes are indicated in the Technical specifications, Appendix A. The inlet water velocity should not exceed 1 m/s.

Piping from the sludge channel must have an inclination of at least 1%.

#### 4.6 Backwash system

A new rinse water pipe system should be flushed for at least 10 min. before connecting it to the filter. Thoroughly check that no rinse nozzles are clogged.

Any particles in the rinse water supply must be removed. A simple in-line strainer can normally be used to remove particles (see also section 7.7).



Figure 4.6  
In line strainer (optional)

## 5. START-UP AND OPERATION

### 5.1 Start-up procedure

1. Make sure that the drive unit cover is firm and correctly fitted.
2. Set the pump switch to OFF (0) (see ⑥ in Figure 5.2).
3. Set the safety switch to ON (1) (see ⑦ in Figure 5.2).
4. Set the selector switch to HAND (see ⑤ in Figure 5.2).
5. Open the main valve partly to make the water slowly enter into the filter drum. Make sure that the water level difference between the inside and outside of the filter does not exceed 450 mm (see section 5.2.1).

If the filter clogs it may be necessary to fill up the tank or concrete chamber with water from an external source or to remove a filter panel and let unfiltered water flow into the chamber.

6. When the water level inside the tank or concrete chamber goes above the suction pipe or the pump (if a submerged pump is installed), the pump switch should be set to ON (1).

**Note!** Read also section 1.7 (safety instructions).



#### **WARNING!**

***The backwash pump must not be started before the water level has risen above the suction pipe (or the pump), otherwise the pump will run dry and break down.***

7. When the water level inside the tank (or concrete chamber) reaches the level weir, set the selector switch from HAND to AUTO.
8. Open the main valve completely.

The filter is now running in automatic level control mode. It may be needed to adjust the level sensor to make the filter run optimally (see section 5.2.3).

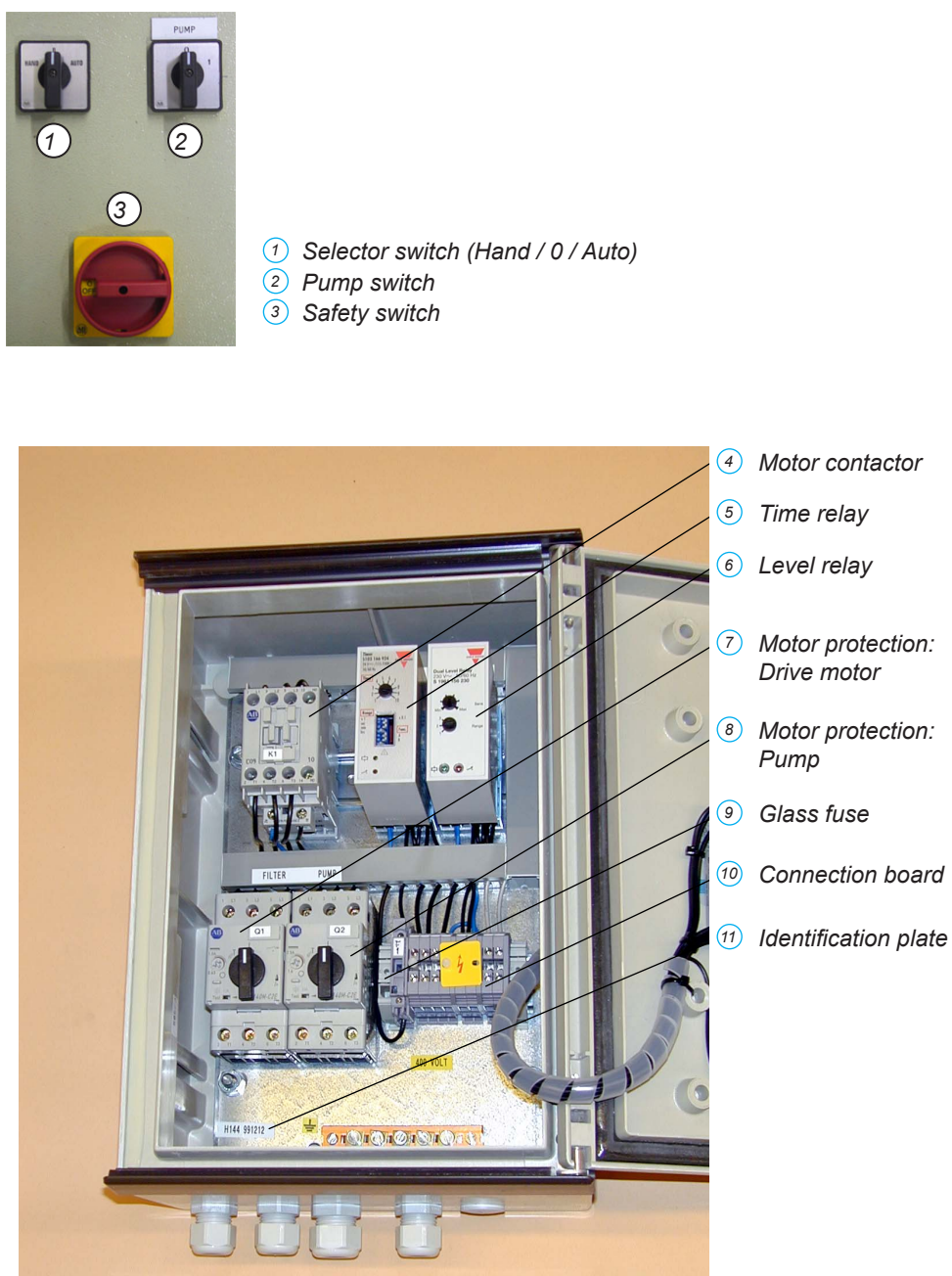
## 5.2 Control settings

The control system for the HDF800-series operates with 50 Hz as standard.

If the filter is equipped with a Hydrotech standard control, the filter has two operation modes:

1. Continuous rotation (HAND mode)
2. Automatic level control (AUTO mode).

Use the selector switch to select operation mode (see ⑤ in *Figure 5.2*).



*Figure 5.2 Hydrotech standard control cabinet (optional)*  
*(The design of the control cabinet is often adapted to each application)*

### 5.2.1 HAND mode – continuous rotation

During continuous drum rotation and backwash, the water level inside the drum is kept nearly constant.

The maximum allowed difference of the water level inside and outside the drum is 250 mm during continuous operation (see Figure 5.2.1). The recommended operational difference is 100-200 mm. Long-term operations with a pressure differential exceeding the indicated maximum will reduce life span for and bearings and filtration media.

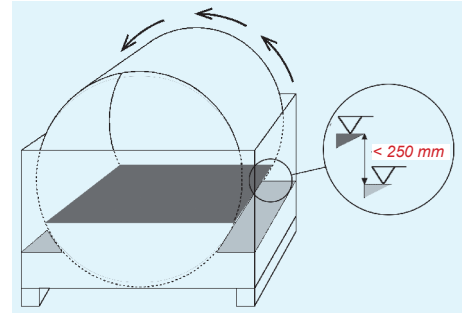


Figure 5.2.1 Maximum allowed differential pressure at continuous operation



#### **WARNING!**

**The filter should be installed so that the differential pressure will under no circumstances exceed a maximum of 450 mm. The filter can withstand maximum pressure for a limited period of time and only if the filter is stationary.**

The level sensor and the automatic control system are disabled when HAND mode is selected.

### 5.2.2 AUTO mode – automatic level control

With level control, the drum rotation and the backwash pump is activated when the water level inside the drum reaches the level sensor. If an independent rinse water supply is used, the level sensor controls a solenoid valve instead of the pump.

The water level inside the centre drum will vary when AUTO mode is selected. The lowest level is just after a backwash cycle, and rises until the level sensor is reached.

If a constant water level inside the drum is required, the filter should run continuously (HAND mode).

The maximum allowed difference of the water level inside and outside the drum is 300 mm during level controlled operation (see Figure 5.2.2). The recommended operational difference is 100-200 mm. Long term operations with a pressure differential exceeding the indicated maximum will reduce life span for and bearings and filtration media.

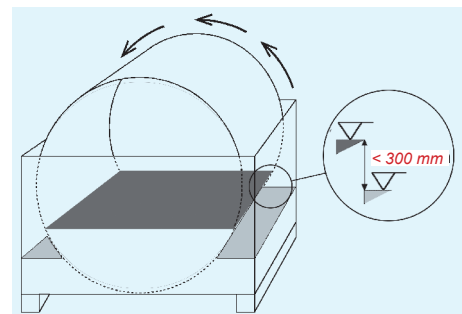


Figure 5.2.2 Maximum allowed differential pressure at continuous operation



#### **WARNING!**

**The filter should be installed so that the differential pressure will under no circumstances exceed a maximum of 450 mm. The filter can withstand maximum pressure for a limited period of time and only if the filter is stationary.**



### 5.2.3 Adjusting the level sensor

Place the level sensor 50–100 mm below the emergency overflow weir. The optimal position depends on how turbulent the water surface is (see *Figure 5.5.2*).

### 5.2.4 Setting the time relay

A time relay (see ⑤ *Figure 5.2*) is used to delay the backwash stop when the water level is below the level sensor. The time relay is preset so that the drum is backwashed during one rotation.

In some applications it might be necessary to increase the backwash time delay to avoid long term clogging.

### 5.2.5 Setting the level relay

The sensitivity of the level sensor can be set from MIN. to MAX. on the level relay and three different sensitivity ranges can be selected on the lower level relay switch (see ⑥ in *Figure 5.2*).

If the appropriate sensitivity is not within the selected range change it to another sensitivity range.

- For water with a high conductivity (= low resistance) chose setting 1.
- For water with a low conductivity (= high resistance) chose setting 3.

Sea water, for example, has a high conductivity. See also appendix E, level sensors.

**Note!** Read also section 1.7 (safety instructions).

## 5.3 Backwash system

The standard backwash nozzles (TeeJet 6505) have an equivalent opening size of 1.4 mm. For some applications it may be necessary to use a lower rinse water flow. This can be achieved by installing nozzles with a smaller opening size. Contact the supplier or Hydrotech for more information.

**Note!** Read also section 1.7 (safety instructions).

The backwash system pressure is set to 7-8 bars.

## 5.4 Drum rotation

The filter is powered by a gear motor that rotates the drum by direct drive. Direction of rotation is marked on the motor cover.

## 5.5 Re-tightening of bolts

After two working weeks or 80 production hours, all bolted joints must be re-tightened.

**Note!** Read also section 1.7 (safety instructions).



*Figure 5.5.2 Adjusting the level sensor*



## 6. FUNCTION

### 6.1 Intended use

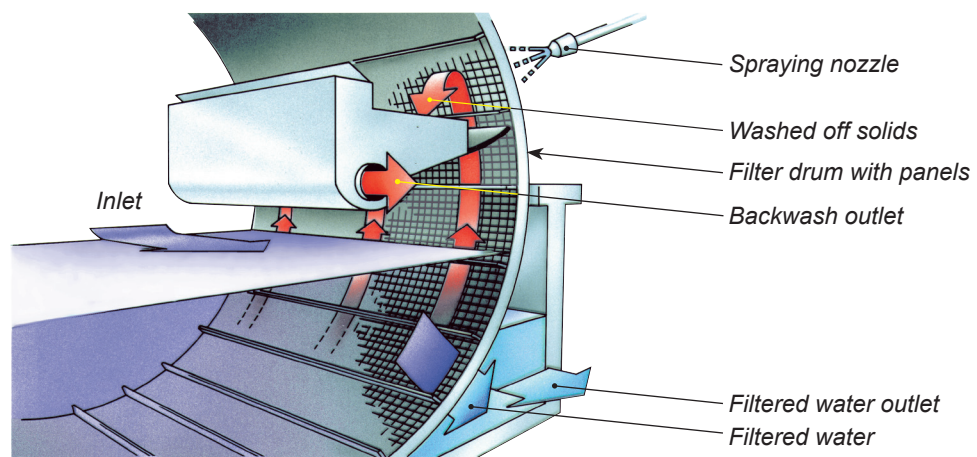
The filter is designed and manufactured to remove suspended solids from non-pressurised water. The filter is not a pressure vessel.

### 6.2 Non-foreseen use

If not approved by Hydrotech, the filter may not be used for other liquids than water. The filter must not be installed in an area where there is an explosive atmosphere or any other risk of explosion, e.g. high dust load.

### 6.3 Filtration and backwash process

1. Water to be filtered flows by gravity into the filter panels from the centre drum.



2. Solids are separated from the water by a microscreen cloth fitted on the two sides of the filter panels while the clean water passes through the cloth to the outside of the drum.
3. AUTO mode - The solids collected on the inside of the filter cloth is gradually impeding the flow of water through the drum. The water level inside the drum begins to rise. When the water level reaches the level sensor the drum rotation and the backwash starts.  
HAND mode - Drum rotation and backwash is continuous.
4. Backwash nozzles spray clean rinse water from the outside of the filter panels. The collected solids are washed off the filter panels into the solids collection trough as the drum rotates.
5. The removed solids flow together with the backwash water out of the filter by gravity.

## 7. MAINTENANCE

### 7.1 Backwash system

The most frequent reason for a malfunctioning rinse system is clogging of the spray nozzles. Clogging is due to particles in the rinse water supply or e.g. to biological growth in the rinse piping system.

The nozzles should be checked for clogging every week or as often as the application requires.

#### 7.1.1 Removing and cleaning the spray nozzles

1. Set the safety switch to OFF (0) and the selector switch to 0 (OFF). If a backwash pump not supplied by Hydrotech is used, make sure that the rinse water supply is shut off.
2. Remove the filter cover.
3. Check for clogged nozzles by observing if water cannot pass through.
4. Remove the bayonet nut by turning it  $\frac{1}{4}$  of a revolution counter clockwise. Be careful not to loose the rubber seal.
5. Clean the nozzle with compressed air or a plastic brush. **Never** use a steel brush or steel pin, as this will damage the nozzle.
6. Assemble the nozzle in the reverse order. Make sure that the nut has come to a full stop after tightened it  $\frac{1}{4}$  of a revolution clockwise.
7. Set the selector switch to 0 (OFF) and the safety switch to OFF (0)
8. Open the main valve.
9. Put back the removed filter cover.
10. Set the safety switch to ON (1) and the selector switch to AUTO

**Note!** Read also section 1.7 (safety instructions).

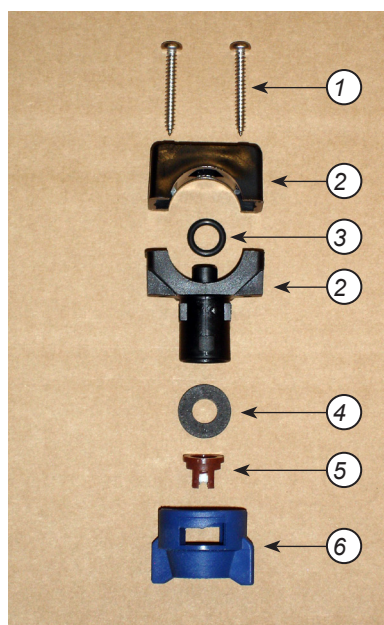


Figure 7.1.1  
Spray nozzle parts:  
① Screws  
② Nozzle body  
③ O-seal  
④ Rubber seal  
⑤ Nozzle tip  
⑥ Bayonet nut



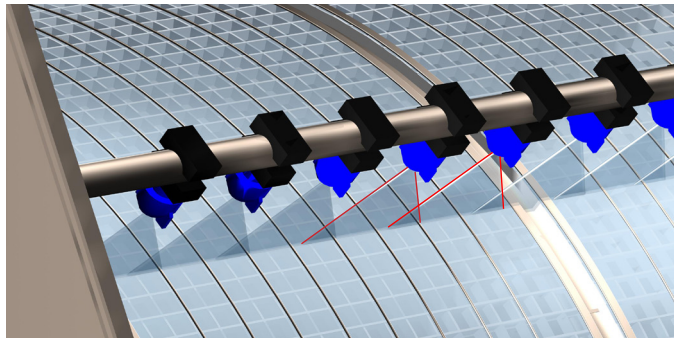
#### **WARNING!**

**It is important that the bayonet nozzle nuts (see figure 7.1.1) are reassembled correctly after cleaning of the nozzles. If a nut loosens, the nozzle will fall out and the resulting water jet can destroy the filter cloth.**

### 7.1.2 Checking the spray nozzles for wear

The nozzles will eventually be worn out and a replacement will be necessary. The life length depends on the quality of the rinse water. If the rinse water contains coarse sand or similar particles, the nozzles will be worn out faster than a nozzle that operates in “clean” rinse water. When a nozzle becomes worn out, the nozzle tip opening becomes enlarged (see *Figure 7.1.2c*).

This leads to a less efficient back wash (changed dispersion) and higher rinse water consumption. Therefore it is important to regularly check the functionality of the nozzles (at least once every year) and change the nozzles if needed (see also section 7.1.1).

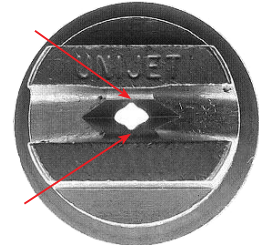


*Figure 7.1.2a*  
Correct rinse water  
dispersion picture

A comparison between a worn out nozzle and a brand new nozzle is shown in *Figure 7.1.2.b* & *c*. In the worn out nozzle, a change in the nozzle opening can be seen.



*Figure 7.1.2 b*  
New nozzle



*Figure 7.1.2 c*  
Worn out nozzle

## 7.2 Bearings

### 7.2.1 Lubrication

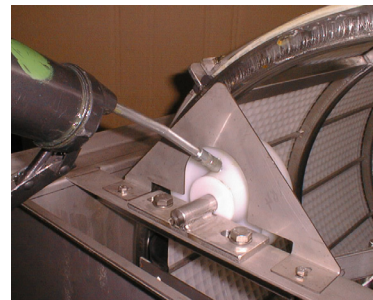
The support wheels have ball bearings that should be greased every second week.

The grease nipples of the bearings are fitted on the support wheels. Lubrication labels identifying the lubrication points are attached to the filter housing (see *Figure 7.2.1a* and *Figure 2.1*).

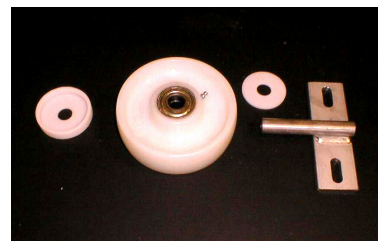
The bearings should be lubricated with the grease recommended in the maintenance schedule (see section 7.9).

**Note!** Read also section 1.7 (safety instructions).

Visually check the support wheel bearings for exceptional wear every year.



*Figure 7.2.1b  
Greasing the support wheel bearing.*



*Figure 7.2.1c  
Support wheel assembly*

### 7.3 Filter panels

It may be necessary to perform supplementary manual cleaning of the filter panels. The need for this becomes apparent when automatic backwashing becomes more and more frequent. Manual cleaning can be made with a high pressure cleaner.

**Note!** Read also section 1.7 (safety instructions).



**WARNING!**

***With the high pressure cleaner, use a cleaning nozzle with a wide opening size and a cleaning pressure of max. 80 bar. Never hold the cleaning nozzle directly to the filter media.***

Long term clogging of the filter cloth may be caused by iron, calcium or organic material in the water. If the problem seems to be precipitation of carbonates or iron, then apply diluted hydrochloric acid, (HCl) or available special products (based on hydrochloric acid) designed for cleaning of filter cloths.

If the clogging is caused by fat or oil, diluted sodium hydroxide (NaOH) can be used.



**WARNING!**

***HCl and NaOH is highly cauterant. See local regulations for protection.***



### 7.3.1 Change the filter panels

1. Set the safety switch to OFF (0) and lockit in the OFF position with a padlock.
2. Unscrew the bolt nuts on the lower angle bar of the filter element strap (See figure 7.3.1 a).
3. Loosen the the old filter panel and the lower angle bar by using something flat and blunt to lift the angle bar over the bolts (See figure 7.3.1 b).
4. Lift up the strap section with one hand and take out the old filter element with your other hand (See figure 7.3.1 c).
5. Check that the pin bolts are undamaged. Then adjust each pin bolt so that about half of it is screwed into the flat bar on the drum.
6. Put the new filter element in place under the strap section's upper angle bar.
7. Bring down the lower angle iron of the strap section to the end of the filter element. Press down the strap and filter element together over the holes of the angle iron that fit over the pin bolts (See figure 7.3.1 d). Be careful not to damage the cloth when the filter element is fitted under the pin bolts.
8. Use poly clutching-tongs to hold the angle iron of the strap close to the flat bar of the drum when putting on the two nuts.
9. Tighten the nuts, but only so hard that you can still adjust the flat bars of the straps.
10. Align the flat bars with the filter element's grid structure (parallel to the long side of the filter panel).
11. Tighten all nuts so that the strings and edge straps are tense on the filter cloth. Use a box spanner and hand power only. It is not necessary to tighten the angle iron until it makes contact with the flat bar.
12. Set the safety switch to ON and the selector switch to AUTO (see also section 5.1).



Figure 7.3.1 a-d

### 7.5 Gear motor

Information on the gear motor is found in Appendix F.

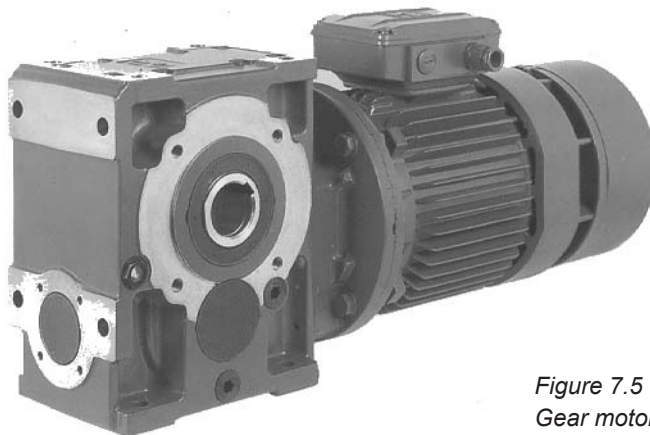


Figure 7.5  
Gear motor

### 7.6 Rubber sealing

The inlet rubber sealing between the filter frame and the drum, must be checked every year for wear and leakage.

**Note!** Read also section 1.7 (safety instructions).

### 7.7 Backwash strainer

A backwash strainer can be used to remove particles in the rinse water. Cleaning instructions of the backwash strainer is found in Appendix G.

**Note!** Read also section 1.7 (safety instructions).

**Note!** A blocked backwash strainer might drastically reduce the capacity of the Drumfilter.



Figure 7.6  
Inlet rubber sealing



## 7.8 Maintenance schedule

Inspection / Action	Maintenance interval
<p>Check the nozzles. (If clogged, see section 7.1.1)</p> <p><b>Note!</b> Before service read section 1.7 (safety instructions).</p>	Every week or other interval based on experience for the actual application.
<p>Visually check the filter panels for damages. (See also section 7.3)</p>	Every week or other interval based on experience for the actual application.
<p>Inspect the inside of the filter for larger pieces of debris which cannot be removed by the rinse water system and check the sludge trough for any accumulated sludge. Remove this debris manually and hose down the sludge trough if sludge accumulates.</p> <p><b>Note!</b> Before service read section 1.7 (safety instructions).</p> <p><b>⚠ WARNING!</b> Set the safety switch to OFF (0) and lock it in the OFF position by means of a padlock before starting any work on the filter.</p>	Every week or other interval based on experience for the actual application.
<p>Wash the surface of the stainless steel constructions with clean water. Especially in salt water systems, keeping surfaces free of contamination minimizes corrosion.</p>	Every 2nd week or other interval based on experience for the actual application.
<p>Grease the ball bearings in the support wheels with grease type NLGI:2 Grease: Molykote Multilub, Rembrandt EP or equivalent grease.</p> <p><b>Note!</b> Before service read section 1.7 (safety instructions).</p>	Every 2nd week or other interval based on experience for the actual application.
<p>Check the inlet rubber sealing between the filter frame and the drum, for wear / damage. (See also section 7.6)</p> <p><b>Note!</b> Before service read section 1.7 (safety instructions).</p>	Every year.
<p>Visually check the support wheel bearings for exceptional wear</p>	Every year.
<p>Check if the nozzles are worn. Change if necessary (see 7.1.2).</p> <p><b>Note!</b> Before service read section 1.7 (safety instructions).</p>	Every year or other interval based on experience for the actual application.
<p>Change the gearbox oil. Oil type: ISO viscosity VG 680 (e.g. Omala oil 680 (Shell) or equivalent).</p> <p><b>Note!</b> Before service read section 1.7 (safety instructions).</p>	See appendix F.

## 8. TROUBLESHOOTING

Problem	Possible cause	Solution
1. The filter does not start although the water level inside the drum has reached the level sensor.	A. The water has a low conductivity.	A. Increase the sensitivity by setting the level relay switch towards MAX. If this does not help, change the sensitivity range to a more sensitive setting (see 5.2.2).
	B. The sensor is not correctly grounded. For detection, the sensor bottom end must be in contact with the filter frame. A wire from the level relay is connected to the filter frame.	B. Check that all wires are undamaged and that the screw fitted to the filter frame is secured.
	C. The level relay is defective. The red diode lamp on the level relay (see ⑨ in <i>Figure 5-1</i> ) should be lit as long as the water is in contact with the sensor. The green diode lamp should always be lit (when there is power to the relay).	C. Replace the defective level relay.
	D. The UP/DOWN switch is in the UP position.	D. Set the UP/DOWN switch to the DOWN position.
2. The filter does not stop after the time set on the time relay.	A. There is permanent contact between the level sensor and the filter tank	A. Remove any object that could connect the sensor to the filter tank, e.g. biological growth.
	B. The level relay is too sensitive.	B. Decrease the sensitivity by setting the level relay switch towards MIN. If this does not help, change the sensitivity range to a less sensitive setting (see 5.2.2).
	C. The time relay is defective. When the red diode lamp on the level relay is lit, the red diode lamp on the time relay (see ⑧ in <i>Figure 5-1</i> ) should be lit as long as the water is in contact with the level sensor, plus the time set on the time relay. The green diode lamp on the time relay should always be lit (when there is power to the relay).	C. Replace the defective time relay.
	D. The level relay is defective. The red diode lamp does not go out when the water level drops below the sensor.	D. Replace the defective level relay.





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