

## CONDITIONS FOR EFFECTIVE FILTRATION

with CANDEFILT filter cartridges HMV, HMVS, HMVP, HMS, HMP

### STEP 0 – STORAGE

#### Proper Storage of Filter Cartridges

The recommended storage life of the cartridge is 20 months after the units have been dispatched from the HOBRA – Školník s.r.o. plant. Filter cartridges are to be stored in a clean, dry environment in the original package and should not be exposed to direct light. It is recommended to store the cartridges at a common temperatures (20°C–30°C). Filter cartridges stored at the conditions given above are expected to deliver nearly zero reduction of quality even after periods in excess of 20 months. Any cartridges that have been stored longer than the recommended storage period should be thoroughly tested for integrity before use. One of the possible indications of cartridge damage is discoloration of the cartridge. The cartridge gaskets are especially prone to damage. If these components show clear indication of ageing or frailty, they should be replaced with new ones before use.

### STEP 1 – INSTALLATION

#### Correct Installation of the Membrane Filter Cartridge

1. Wipe any dirt from the plastic bag, cut the bag open at the end near the O-rings. Check if the rings are not damaged.
2. Lubricate/moisten the O-rings and the filter seating face with the service medium (water) or any other suitable liquid.
3. Use a light rotating motion to insert the connection with the O-rings (for higher protection of the cartridge, leave the plastic bag on the unit and hold as near to the O-rings as possible).  
WARNING: Excessive rotation or pressure to the joined cartridge components may cause damage to the unit.
4. Once the cartridge is seated in the housing mount, turn the cartridge slowly by several degrees in both directions so that the O-rings sit in place and the safety tongues fit into the grooves.
5. Remove the bag from the cartridge and assemble the stainless-steel housing.

**NOTE:** You may see a different kind of mounting (adapter) in practice; however, the procedure will be very similar. The baseline is to provide that the liquid to be filtered does not leak around the sealing elements of the cartridge being used.

### STEP 2 – WETTING (FLOODING)

#### Proper Wetting of the Filter Cartridge

Perfect cartridge wetting is the prerequisite for wine filtration as well as for the integrity test. CANDEFILT filter cartridges contain a hydrophilic polyethersulphone membrane filtration medium that wets easily in water or in any other water-based liquid. As the ends are manufactured from polypropylene, they might act as a slightly hydrophobic barrier between the wetting liquid and the hydrophilic membrane material. For this reason, it is also necessary to flush the filter cartridge with the wetting liquid so that the entire membrane becomes wet. A typical microporous membrane contains 10,000,000 pores per 1 cm<sup>2</sup> of the filtration medium; a single non-flooded pore may cause failure of the integrity test. The wetting procedure described in the manual provides a reliable utilisation of the product and assessment of integrity. Exceptional circumstances may require special wetting procedures.

**NOTE:** The cartridge should not be exposed to gas during the filtration operation as this might lead to partial drying of the cartridge. In order to prevent this risk, air should be properly bled from the filter housing and the housing should be full of liquid during the filtration process.

Please contact us for individual assistance.

#### The Wetting Process

The wetting process is described by the HOBRA – Školník s.r.o. company and represents the most suitable and effective procedure for the CANDEFILT filter cartridges. We suggest that all wetting and rinsing operations be performed with water that has been pre-filtered in a



cartridge with pore size smaller or identical to the cartridge being wetted. If this procedure is followed closely, most water-based liquids flood the cartridge with equal reliability.

1. Fill the cartridge with pre-filtered water (with a temperature  $\geq 20^{\circ}\text{C}$ ); the drain valve must be closed.
2. Bleed the air from the housing by running a flow of the liquid through the air bleed valve. Once the air has bled entirely, close the valve.
3. Flush the cartridge for a period of 5 minutes at a flow corresponding to 10 litres per minute at 10" (25 cm). At the same time, set the draining valve to provide 1.4 bar of constant reverse pressure and maintain the flow rate equivalent to 10 litres per minute at 10" (25 cm).
4. Drain the remaining liquid from the housing and conduct an integrity test or initiate product filtration.

### STEP 3 – SANITATION and STERILISATION Proper Sanitation or Sterilisation of the Filter Cartridge

#### General guidelines for sanitation and sterilisation of filter cartridges in the food and beverage industries and cosmetics applications.

Sanitation of the manufacturing plant and equipment in food, beverage, and cosmetics applications is necessary for intermittent maintenance of the equipment between individual process stages and for keeping the presence of microbial organisms at a minimum. A quality sanitation procedure results in reduction of risks related to microbial contamination of products and extends the service life of the cartridges.

Sanitation may be performed before and after each production cycle or periodically, with hot water, steam, or water solutions with cleaning chemical products. Selection of the optimum procedure depends on the type of the filter cartridge used in consideration of the application, possibilities, and experience of the user.

Any wetting, rinsing, sanitation, and regeneration of **membrane (PES) cartridges must be performed in observation of the direction of the filtration flow**. Reverse direction flow may be used for flushing, sanitation, and regeneration of pre-filtration cartridges only.

System sanitation always commences in the finest cartridges and gradually advances to the coarsest.

Food and beverage industry applications occasionally require sanitation of the entire production plant with cleaning chemicals that are incompatible with the cartridges. In these cases, the filtration system or only the filter cartridges must be excluded from the sanitation and rinsing circuit of the plant.

#### 3.1 Sanitation of the Filtration System with Hot Water

The hot water used for the sanitation process must be filtered to a degree that is equal or finer than that of the end filter. Hot water sanitation may be performed in the beginning and/or in the end of the filtration process. Allow for the filtration system to cool down after hot water sanitation.

##### Hot Water Sanitation Process

Prior to the sanitation process, it is necessary to drain the remaining process liquid from the filtration system and flush with cold water for approximately **5 minutes**.

It is recommended that the user wear protective gloves when handling the valves during the sanitation process.

The hot water (**50°C**) sanitation process is depicted in the diagram in **Figure 1**; the process consists of the stages defined below:

1. Close all valves and open valve **C** (hot water supply)
2. Open valve **D** (air bleed valve) and start filling the filtration with hot water slowly.
3. After the filling has completed, close valve **D** and partially open valve **G** (outlet) and allow hot water to run through the filtration system at a pressure of 0.5 bar for 15–30 minutes.
4. You may continue by increasing water temperature to **85°C** and perform sterilisation as well. The high temperature must be kept for 20 minutes.
5. Now close valves **C** and **G**.

If you wish to initiate the filtration process immediately or to fill the system with cartridge preservation liquid, the equipment must be cooled by slow filling with cold, filtered water. Cartridges that have been treated this way may remain under water until the next day and may be used again after a short flush. Unless the equipment has been filled with a



sanitation medium, the line and filtration system must be sanitised again after a 48-hour stoppage.

### 3.2 Steam Sterilisation of the Filtration System

Sterilisation steam must be free of corrosion particles and products. Therefore, the general practice suggests that the steam be filtered with sintered stainless-steel cartridges. Furthermore, the steam must be saturated, free of condensate traces, and not super-heated. The most common temperature of cleaning steam is 121°C at 1.1 bar. It is recommended to perform a cold water flush and hot water (50°C) sanitation prior to the sterilisation process so that the organic impurities are dissolved and prevented from “burning down” or coagulating to the membrane at high temperatures.

**Table of Sterilisation Steam Temperatures and the Minimum Required Times.**

Temperature (°C)	Time (min)
115	30
118	24
121	12
124	6
127	3

The sterilisation process consists of three stages:

Stage 1: Continuous heating to the sterilisation temperature (10–15 minutes)

Stage 2: Preservation of the sterilisation temperature – see Table above

Stage 3: Slow cooling with filtered water or air

While the steam is running through the filtration system, we recommend that there be no pressure drop higher than 200–300 mbar and that the temperature within the system be kept constant. It is necessary to observe the temperature and pressure levels provided in the instructions during steam sterilisation of the filtration system. The temperature should never exceed 130°C.

### Procedure of Steam Sanitation of the Filtration System

For the steam cleaning procedure diagram refer to **Figure 1**. Prior to cleaning make sure that the process liquid has been drained entirely, the system has been thoroughly flushed and that all valves are closed. It is recommended that the user wear protective gloves when handling the valves during the cleaning process.

Gauges **M1** and **M2** serve for reading steam pressure (**M1**) and pressure drop levels in the filtration system during steam flow. Steam cleaning consists of the stages given below:

1. Open valves **D, F, G, V3** to full and open valve **B** in part.
3. Slowly open valve **V1**, drain all the condensate from the steam line via valve **V3** and close the valve.
4. Slowly open valve **V2** to admit steam into the system.
5. Set the valves **D, F, G**. After the pressure required for cleaning has been achieved, allow it to stabilise for 5 minutes or as your operational experience suggests.
6. At the end of the cycle close valves **V1** and **V2**, open valve **E** and admit filtered air or nitrogen into the system at the minimum volume required for system cooling without causing a temperature shock.
7. Now close valves **G, D**, and **B**.
8. Admit air or nitrogen via valve **F** to drain the condensate and cool the filtration system.
9. Once the unit has attained ambient temperature, close valves **E** and **F**.
10. Fill the system with filtered water or with cartridge preservation liquid.

Unless the equipment has been filled with sanitation liquid, it is necessary to sanitise the line and the filtration system again after a 48-hour stoppage and before production commences.

### 3.3 Sanitation with Chemical Product Dissolved in Water

It is best to perform sanitation after each filtration cycle has finished, after a thorough flush of the system with water (cold/hot).

**Procedure of Sanitation with Chemical Product Dissolved in Water** Each sanitation commences with rinsing the system with filtered **water (20–50°C) for a period of 5–10 minutes**. The next step is preparation of the sanitation product by dilution



in filtered water and filling the entire filtration system. (see the procedure of sanitation with hot water). Before allowing the product to circulate, it is recommended to drain the heavily soiled first several litres of the solution. During the approximate **10 minutes of circulation**, observe the recommended flow rate of 30 litres per minute for each 30-inch filter cartridge. After the pump is powered off and the system full of the sanitation medium is closed, the membranes are prepared for a short downtime (**not longer than a week**). The next filtration cycle starts with a thorough flush with filtered water. A pH neutrality check of the discharge water can be used to verify whether the cleaning solution has been flushed well.

#### STEP 4 – INTEGRITY TEST

##### Correct Procedure of Membrane Cartridge Integrity Test

##### Integrity Test

Integrity of the membrane may be verified in several ways: the so-called bubble point test, diffusion flow, and the pressure hold test. All of these tests are based on the ability of the wet membrane to withhold a given pressure of gas; they only differ in the manner of measurement and assessment.

##### Common Start of Procedure for All Measurements:

1. Install a CANDEFILT HMV cartridge into the housing as per the procedure provided in this Manual.
2. Open the air bleed valve and fill the housing with the wetting liquid (filtered water) until the liquid runs from the air bleed valve.
3. Use the wetting procedure to flood the filter cartridge. (see Step 2).
4. Open the input/intake and output/discharge valves of the housing and allow the wetting liquid to drain
5. Close the valve at the input/intake side of the housing,
6. Connect a controlled source (0–7 bar) with clean, pressurised gas (air/nitrogen) to the air bleed valve. Warning: Do not use CO<sub>2</sub>.
7. Build and hold a pressure of 0.2 bar for 30 seconds to drive off all the remaining wetting liquid.

##### 4.1. Bubble Point Test – Final Assessment

8. Increase gas pressure slowly and monitor generation of bubbles in the bubble vessel.
9. The Bubble Point denotes the pressure value whereupon a burst of bubbles is released from the collector pipe.

The acceptable minimum values for the Bubble Point (in clean, filtered water at 20°C) are given below:

Microns	Bubble Point minimum	
	psi	bar
0.2	≥46	≥2,8
0.45	≥20	≥1.4
0.65	≥16	≥1.1
0.8	≥ 10	≥0.7

##### 4.2. Diffusion Flow – Final Assessment

8. Connect the housing delivery port to a mass flow meter or a similar suitable device to measure gas flow (e.g. a calibrated cylinder, turned upside down and filled with liquid or a burette with stemming cock.)
9. Build test pressure in the cartridge as per the table below.
10. After flow rate has stabilised, measure flow rate (millilitres per minute) of leaking gas for a period of 3 minutes



The maximum permitted diffusion flow levels for 10" CANDELFILT cartridges filled with water (20°C) are:

Microns	Test pressure		Max. diffusion flow
	µm	psi	
0.2	≥35	≥2.4	≤16,5
0.45	≥16	≥1.1	≤20
0.65	≥13	≥0.9	≤20
0.8	≥ 8	≥0.6	≤20

**NOTE:** Most failures of the integrity test are caused by incomplete wetting of the filter cartridge rather than by a defect in the cartridge membrane. Therefore, if the test has failed, wet the cartridge again and repeat the test.

#### 4.3. Pressure Hold Test – Final Assessment

8. Build test pressure in the cartridge as per Table 3 and after the system has stabilised, disconnect the system by closing the pressure supply line.
9. Monitor pressure drop at the cartridge input side for a period of 5 minutes.
10. The maximum acceptable pressure drop depends on the inlet volume of the housing tested, the length of the cartridge tested, the type of testing gas and wetting liquid.

Maximum values of the pressure hold test:

Microns	Test pressure	Acceptable limits of pressure hold in a 30" filter cartridge
µm	bar	bar
0.2	2.4	0.1
0.45	1.1	0.15
0.65	0.9	0.15
0.8	0.6	0.15

Please contact a HOBRA authorised distributor or technician for further details. We can perform the above test for you upon request. Please contact us for more information.

### STEP 5 – MICROFILTRATION

#### Filtration Conditions to be set and observed, Interruption or Finish of Filtration

##### Optimum Conditions for Microfiltration

- ✓ Smooth start and finish of the filtration process
- ✓ Stable, regular flow
- ✓ Observation of the recommended output (litres per hour) and the maximum permitted pressure difference
- ✓ Minimise pressure ram and abrupt changes of filtration speed (attributable e.g. to filler stoppage) – apply reverse flow of filtrate before the pump or use a frequency converter
- ✓ Avoid filtration stops if possible
- ✓ Avoid suction of air

##### End of Filtration

At the end of the filtration cycle, the product remaining in the filter is driven off by filtered air or nitrogen and the filter is ready for rinsing and sanitation or regeneration.

### STEP 6 – REGENERATION

#### Increase Overall Capacity of Membrane Cartridges and Reduce Filtration Costs

If the desired result of cleaning cannot be achieved by sanitation of the filter cartridge as described above or if pressure has been seen to rise by **0.5 bar** or more during the filtration cycle, regeneration with a solution of chemical products might be a viable answer. If the pressure is allowed to rise up to the **maximum** recommended operational level of **2 bar**, the regeneration procedure might be ineffective. This would require the total regeneration or replacement of the filter cartridge to be performed. The principle of the regeneration process is that the organic impurities trapped by the membrane are dissolved with chemical products and driven off through the membrane pores. If the filter cake is too thick or if it contains inorganic material (bentonite, kieselguhr, etc.), the chemical products are not capable of



dissolving the impurities and allow them to penetrate the membrane. Therefore, it is generally preferable to perform regeneration sooner (the circulation time may be reduced) rather than later. Recommended regeneration chemicals are provided in the **table below**.

#### Regeneration process in two consecutive cycles:

**A)** Each regeneration commences with rinsing the system with filtered **water (20–50°C) for a period of 5–10 minutes**. The next step is preparation of the regeneration product by dilution **in filtered water** and filling the entire filtration system. Before allowing the product to circulate, it is recommended to drain the heavily soiled first several litres of the solution. During the approximate **30–60 minutes of circulation**, observe the recommended flow rate of 30 litres per minute for each 30-inch filter cartridge. After Cycle A has finished, flush the system with filtered water and only then Cycle B can be initiated. Insufficient flush between the two cycles may result in an unwanted reaction of the A and B solutions.

**B)** After rinsing with water, prepare the solution of the chemical product for Cycle B by dilution in **filtered water** and fill the entire filtration system. Before allowing the product to circulate, it is recommended to drain the heavily soiled first several litres of the solution. During the **30–60 minutes of circulation**, observe the recommended flow rate of 30 litres per minute for each 30-inch filter cartridge. Once the regeneration is complete, flush the system with water and sanitise, see STEP 3. After this treatment, the system may be closed and shut down.

NOTE: Any filling, flushing, sanitation, and regeneration of a filtration system with **membrane (PES) cartridges must be performed in observation of the direction of the filtration flow**. Reverse direction flow may be used for flushing, sanitation, and regeneration of pre-filtration cartridges only. The circulation time during the regeneration process may be modified to correspond to the degree cartridge clogging.

#### 6.1 Total Regeneration

This is the last resort of preservation in situations when the other recommended means are incapable of releasing the cake on the filter cartridge. This procedure may be applied **no more than 3 or 4 times** throughout the service life of the membrane filter cartridge. An integrity test must be performed after each total regeneration to reveal potential damage of the membrane.

##### Total Regeneration Procedure:

Flush the membrane filter cartridges with filtered water. Prepare a **2–3% solution of sodium hydroxide** by dilution in filtered water and fill the entire filtration system at a temperature below 20°C. Before allowing the product to circulate, it is recommended to drain the heavily soiled first several litres of the solution. During the **10 minutes of circulation**, observe the recommended flow rate of 30 litres per minute for each 30-inch filter cartridge. After 10 minutes shut down the pump, close all input and output ports, and allow the product to **act for 8 hours** without motion. A thorough flush with filtered water follows. Up to 3% by volume of citric acid may be added to promote flush efficiency.

#### STEP 7 – STORAGE OF THE USED CARTRIDGES

Safe long-term storage of used filter cartridges is a key factor towards achieving their maximum service life. The term “long-term storage” refers to a pause in the filtration operation longer than **7 days**. In these instances, select cartridge storage in substances different from short-term pause in the filtration operation. Recommended storage substances are provided in the conclusive table below. Membrane filter cartridges should **never dry**.



Recommended chemicals for **CANDEFILT** membrane filter cartridges:

Application	Product	Concentration (%)	Temperature (°C)	Circulation (min.)
<b>Sanitation</b>	Oxidán Extra	0,1	20	10
	Divosan Forte	0,1	20	10
<b>Regeneration A</b>	Cip Alka 60	1.5	30	30-60
	Divos 124, (110)	1.5	30	30-60
<b>Regeneration B</b>	Cip Acid FB	1	50	30-60
	Divos 2	1	50	30-60
<b>Total regeneration</b>	Sodium hydroxide	2.5	20	10
<b>Short-term storage</b>	Oxidán Extra	0,1	20	
	Divosan Forte	0,1	20	
<b>Long-term storage</b>	Ethanol solution	40-50	20	

The user must strictly observe the operation procedures and the specifications provided by the suppliers of the cleaning products!

Should the above cleaning products be unavailable, the table below provides information on common chemicals and their concentrations that can be used for sanitation of **CANDEFILT** filter cartridges:

Name	Concentration
Quaternary ammonium salts	100-1000 ppm
Hypochlorite	10-200 ppm
Hydrogen peroxide	0.2-1%
Peracetic acid	0.1-0.5%

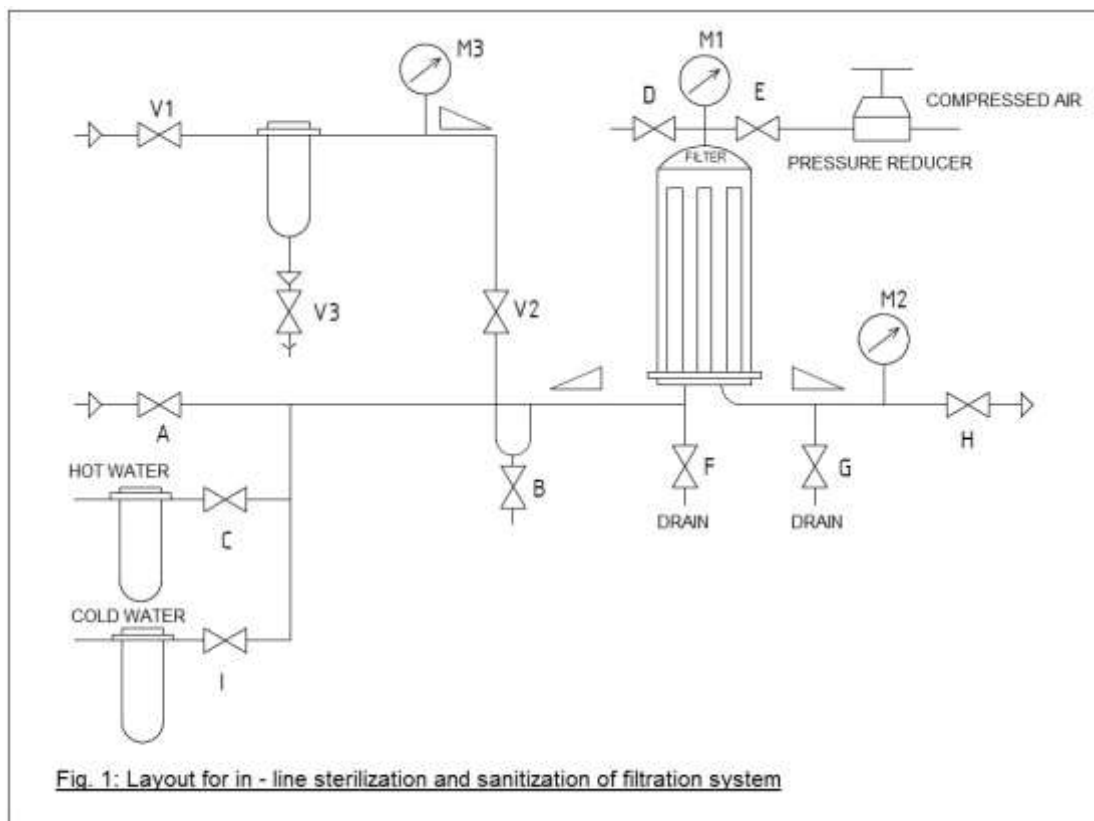
Table data is only informative.

## STEP 8 – DISPOSAL

### Trouble-free Disposal of Used Filter Cartridges

Filter cartridges are manufactured, for the most part, from polypropylene and other plastics; therefore, it is recommended that they be disposed of in plastic recycling containers or in mixed communal waste. Should dangerous substances be filtered, the used filter cartridge should be treated according to the regulations relevant to the particular substance.





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