AQUACURA Station

- assembly instruction -

The AQUACURA Station is based on PAUL,
developed by the University of Kassel, Germany.

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1 Principle of PAUL Station

The waterbackpack PAUL is the basis of the PAUL Station arrangement. The basic idea behind it is that it is essential to be able to tap large amounts of water in a short time. As the filtration process in PAUL is steady but slow, two additional tank are necessary:

- a **R**aw **W**ater **T**ank (**RWT**) that stores the raw water so PAUL can filter continuously
- a **F**iltered **W**ater **T**ank (**FWT**) to store the filtered water during times where no water is tapped

Figure 1 shows a scheme of the PAUL Station arrangement.

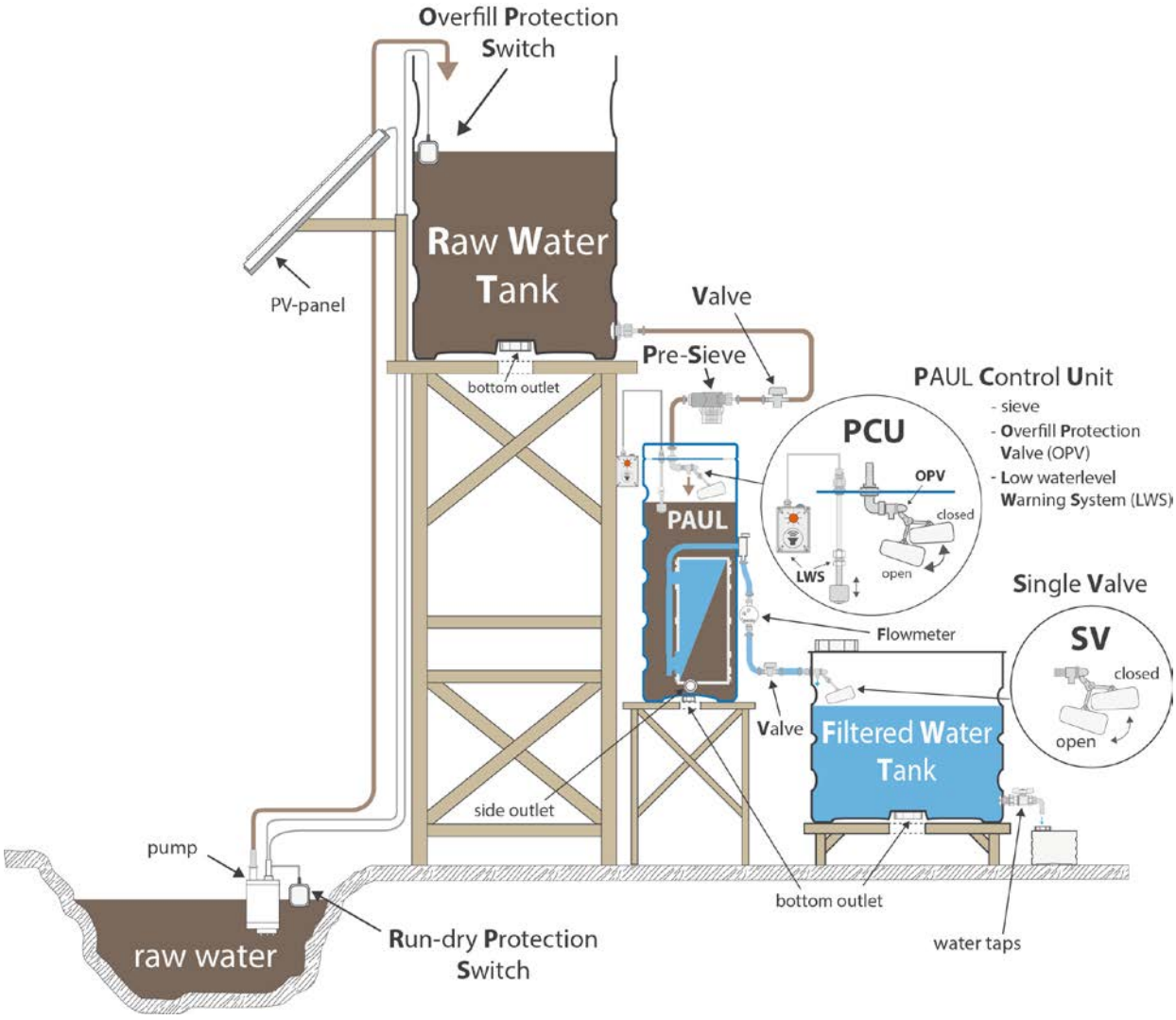


Figure 1: Scheme of the PAUL Station arrangement

Water is pumped into the RWT (in the scheme above realized with a solar powered solution) and flows into the PAUL unit. The filtered water from the PAUL unit then

flows into the FWT. As a consequence, all three units have to be equipped with installations that prevent overfilling in order to allow fully unattended use.

This automatic overfilling prevention for the whole PAUL Station is realized by the following tools:

- in the **RWT**: the **OPS**, i.e. **O**verfill **P**rotection **S**witch, an electrical switch in a float is used that switches off the electrical raw water pump if the waterlevel exceeds an adjustable level
- in the **PAUL** unit: the **OPV**, i.e. **O**verfill **P**rotection **V**alve (also called "auto-stop valve") is used that closes the inlet if the waterlevel in PAUL exceeds a certain height
- in the **FWT**: the **SV**, i.e. **S**ingle **V**alve (also called "auto-stop valve") is used that closes the inlet to the FWT if the water level in the FWT exceeds an adjustable level

Another thing that is necessary in most situations is the **R**un-dry **P**rotection **S**witch (**RPS**) for the electric pump. The device itself is identical with the OPS.

A standard PAUL Station Kit consists of

- PAUL unit equipped with
- **OPV** (**O**verfill **P**rotection **V**alve) which replaces the standard sieve of PAUL, including the nozzle to connect the RWT with PAUL and a self-closing cover which can be opened in order to fill PAUL with a bucket alternatively. Here a sieve is provided identical to the standard sieve.
- **LWS** (**L**ow waterlevel **W**arning **S**ystem): Actually, the **LWS** consists of **two separate parts:**
  - the **L**ow waterlevel **W**arning **S**ystem (**LWS)** sensor detecting the water level. This sensor is integrated in the **OPV** unit. This means, that the OPV can be upgraded. However, it of course is best to decide before ordering whether an OPV with LWS or without LWS is needed (and ordered)
  - the **LWS** box, which is separate and is connected to the **LWS** sensor via a 2-wire electric connection. The LWS box can be mounted close to PAUL or even far remote by simply adding more wiring (regardless of polarity), e.g. in the house of the caretaker.
- set connecting RWT to PAUL (via the PCU or OPV)
- set connecting PAUL to the FWT
- set side bottom outlet with hose
- set outlet of the FWT
- OPS and

- RPS

Optional, we can also provide

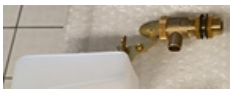
- **OPV** (**O**verfill **P**rotection **V**alve) instead of the standard sieve of PAUL, including the nozzle to connect the RWT with PAUL, but without the LWS,
- 12 V DC pump and
- the matching solar panel

PCU and OPV replace the standard sieve, so upgrading of a standard PAUL with a PCU or an OPV is very simple.

2 List of parts

Table 1: Parts of the PAUL Station

Part no	count	Specification	Picture
1	2	Tank connector, PP, white, ¾“, incl. seal and connecting nut, AF 32	
2	1	Hose nozzle incl. seal and ¾“ connecting nut, Ø 13 mm	
3	6	Hose clamp 19,2 - 21,8 mm, stainless steel	
4	2,5 m	drinking water hose 12.8 mm, solid blue	
5	1	Hose valve, HDPE, Ø 12-15 mm, length 97mm	
6	1	Hose nozzle incl. seal and ½“ connecting nut, Ø 13 mm	
7	1	Shurflo filter, ½“ outside thread, ½“ inside thread	
8	1	Threaded nozzle ½“, Ø 13 mm, 10 bar, PP, AF22	
9	1	**P**AUL **C**ontrol **U**nit **(PCU):** sieve with **O**verfill **P**rotection **V**alve (**OPV**) and water level sensor as part of the **L**ow waterlevel **W**arning **S**ystem (**LWS)**	
10	1	Threaded nozzle PP Ø 13 mm, AF 17	
11	1 + 2 + 2	Hose clamp 13.9 – 16.1 mm, stainless steel	

Part no	count	Specification	Picture
12	2 m	Drinking water hose, 10 x 15 mm, white-blue	
13	1	Hose clamp 15.6 - 17.8 mm, stainless steel	
14	1	**S**ingle **V**alve (float valve) (**SV**) ½“ outside thread incl. 2 seals und 2 nuts	
15	1	Water tap with green grip, ¾“ inside thread / ¾“ connecting nut, incl. 1 seals, AF30	
16	1	Water meter ¾“ outside thread (incl. 2 seals, not needed, can be used as spare parts for seal of no. 15)	
17	1	Hose nozzle 90° incl. seal and ¾“ connecting nut, Ø 20 mm	
18	1	**O**verfill **P**rotection **S**witch (**OPS**)	
19	1	**R**un-Dry **P**rotection **S**witch (**RPS**)	
20	1	**LWS box**, the alarm device belonging to the **L**ow water-level **W**arning **S**ystem (**LWS**), see part no 9 (**PCU**)	
21	1	Hose valve, HDPE, Ø 9-11 mm, length 85mm	
22	2	Hose nozzle incl. seal and ¾“ connecting nut, Ø 10 mm	
23		Hose nozzle incl. seal and ½“ connecting nut, Ø 10 mm	

Please note: If you ordered PAUL together with the parts needed for the PAUL Station configuration, some items are already mounted on your PAUL unit.

If you upgrade an existing standard PAUL unit, some items (sieve on top of PAUL, outlet hose) will have to be exchanged. Exchange process is described in this assembly manual.

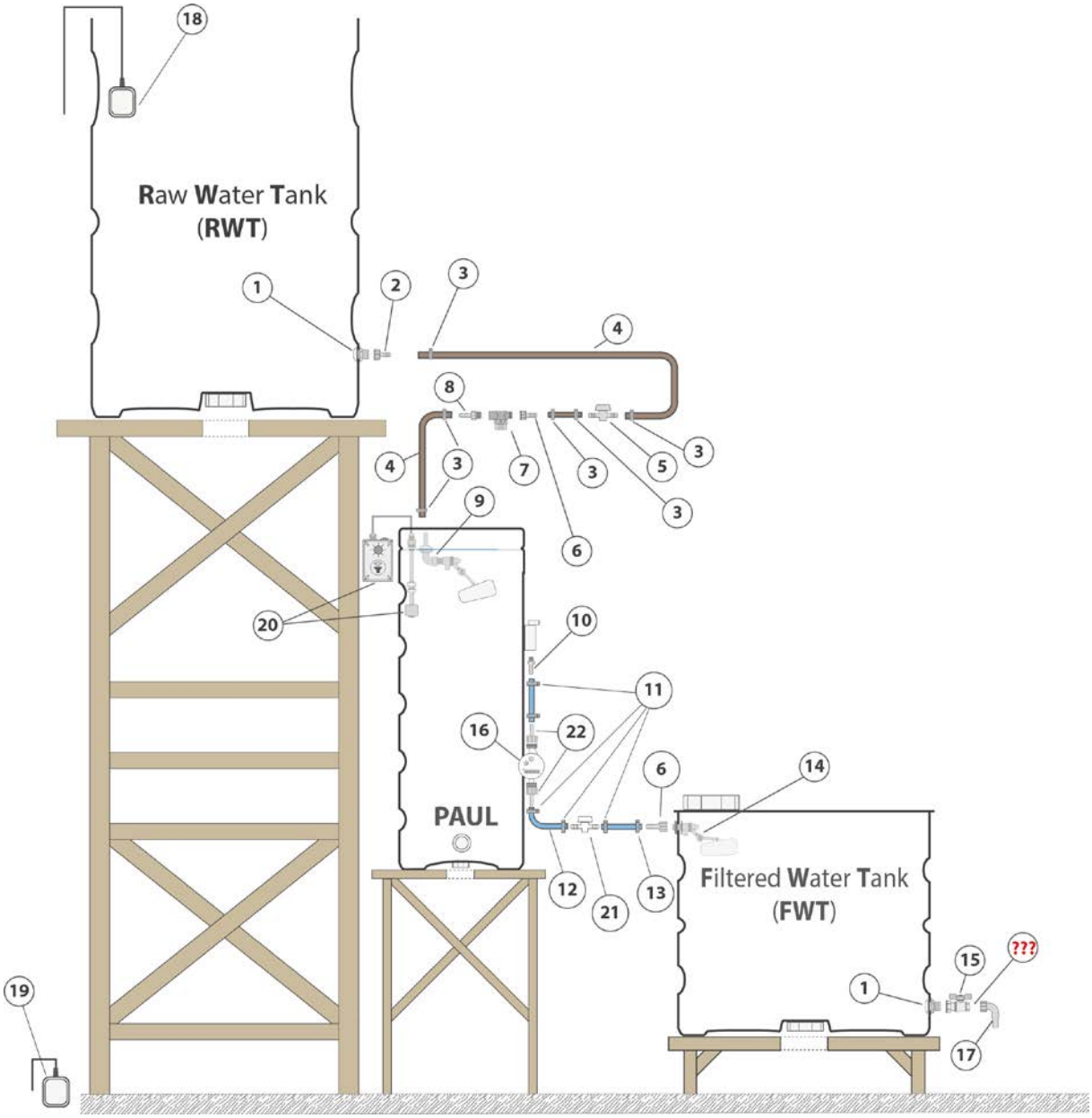


Figure 2: Connections PAUL Station – complete overview

3 Scope of delivery depending upon order

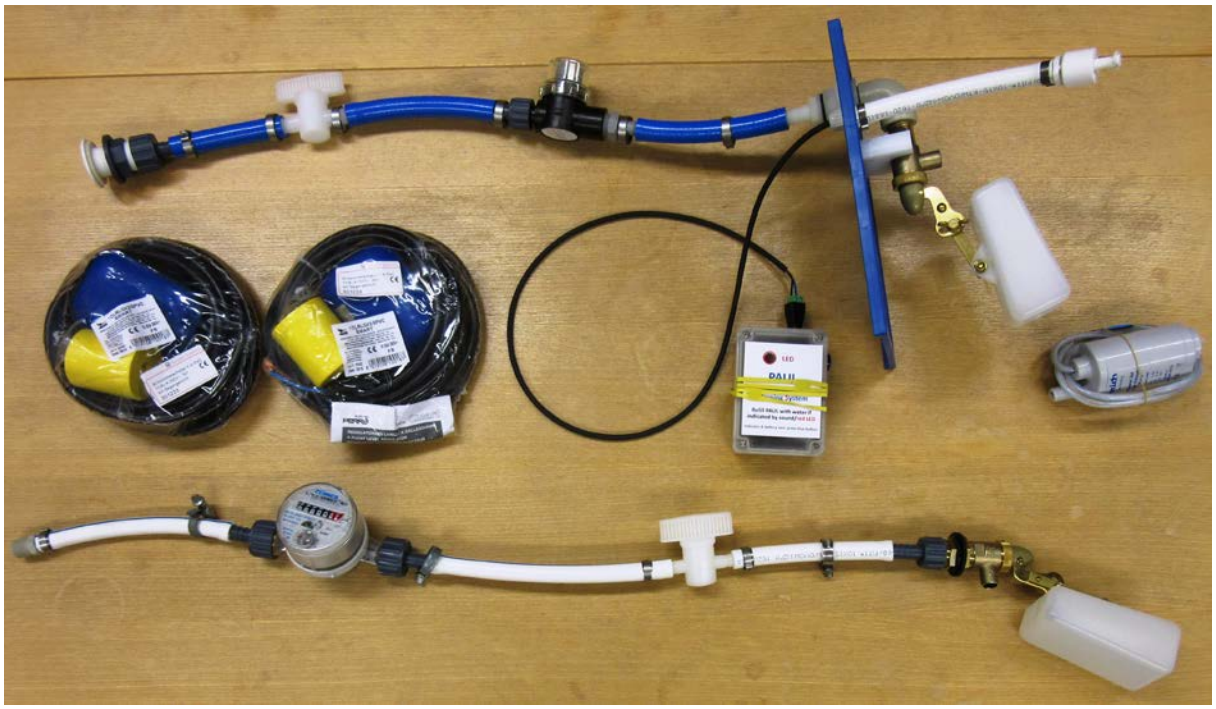


Figure 3: Scope of delivery (depending upon order)

Scope of delivery may vary according to the customer's order.

4 Assembly

4.1 Necessary tools

- Screw-wrench AF 17, 22, 25, 30 and 32
- Hose cutter, alternatively stable scissor or cutter or knife
- Crimping tool, alternatively gripper
- Centre bit ¾“
- Drilling machine is recommended

4.2 Height of the tanks relative to the PAUL unit

Before assembling the PAUL Station kit, it is essential to determine the exact three-dimensional position of all three tanks, i.e. the RWT, PAUL and the FWT, to assure that all connections between the tanks fit and fulfil specific restrictions.

The only requirement concerning positioning is that we recommend minimum distances in height, as can be seen from Figure 4.

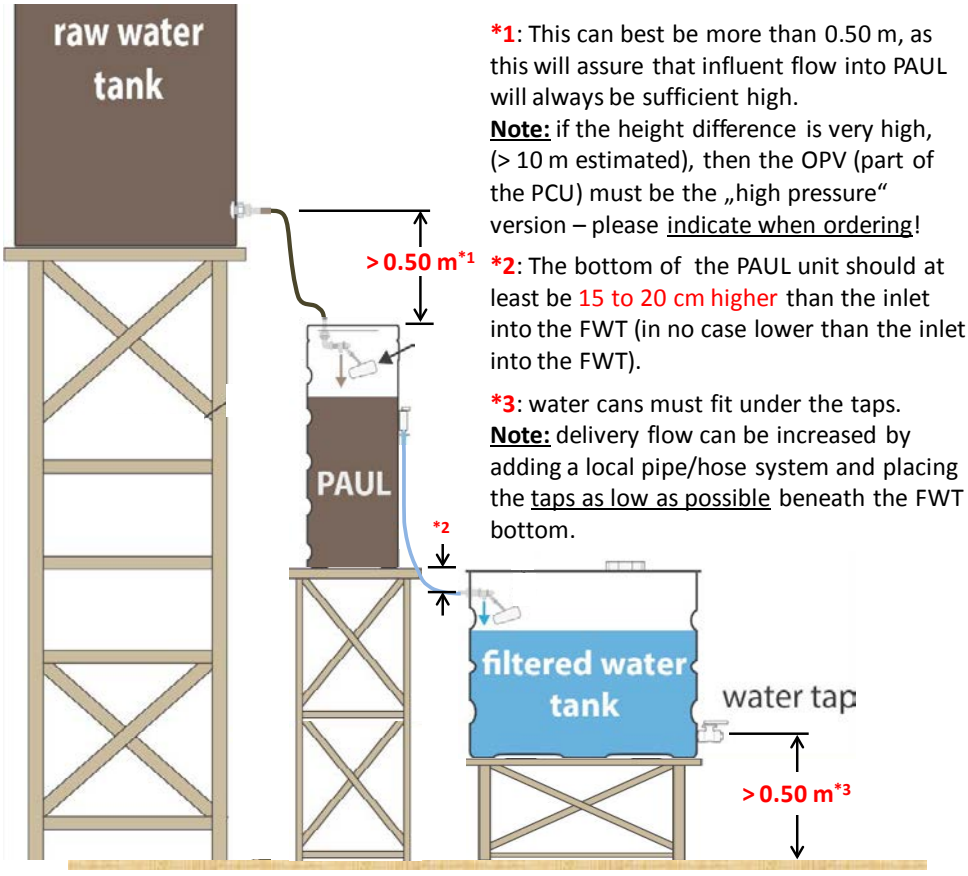


Figure 4: requirements concerning height of tanks and PAUL unit

4.3 How to connect the Raw Water Tank with PAUL

4.3.1 Overview

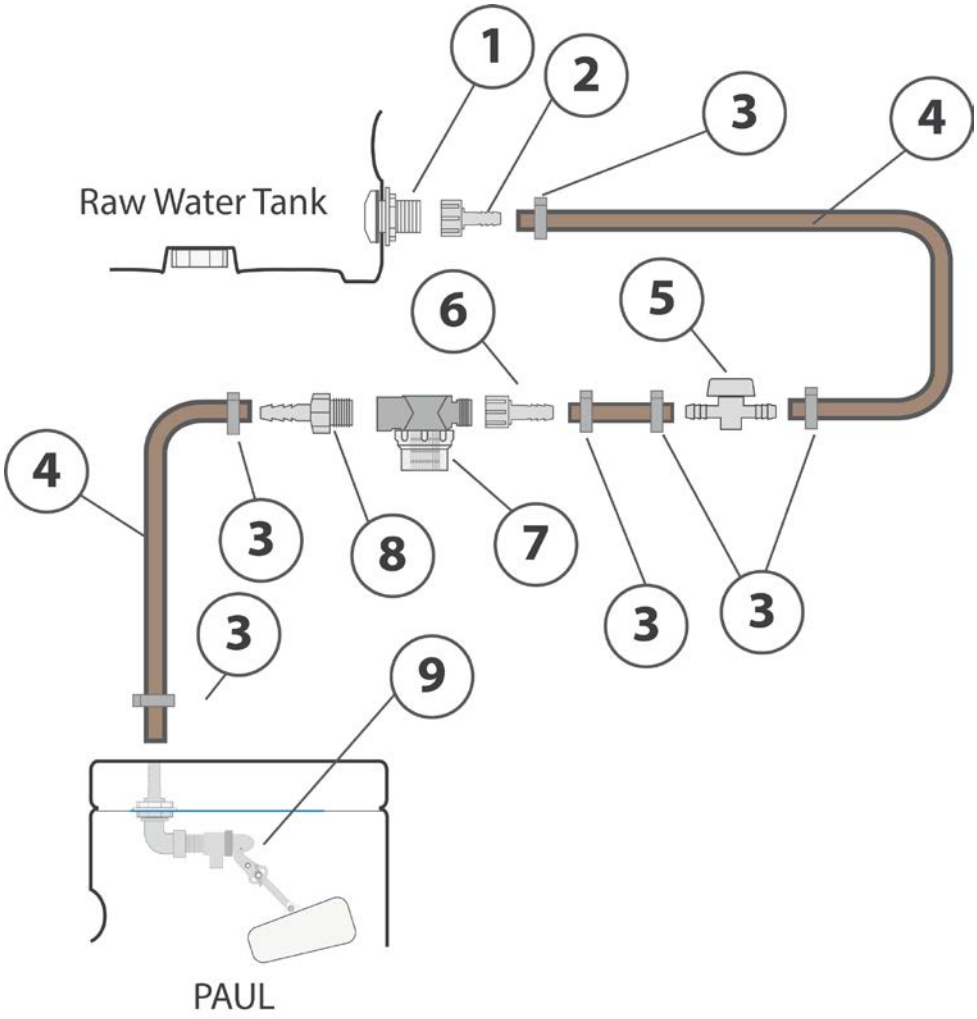


Figure 5: Connection between Raw Water Tank and PCU or OPV

Figure 5 shows the connection between Raw Water Tank and the **P**AUL **C**ontrol **U**nit or the **O**verfill **P**rotection **V**alve. The hose used here is **solid blue**.

If you upgrade a standard PAUL unit, you have to exchange the sieve that is mounted in the cap of PAUL by removing the two screws that hold the sieve, and then mount the PCU or OPV in this place by using the same screws.

If you ordered the PAUL unit ready for the PAUL Station configuration, then the PCU or OPV (depending upon your order) should be in place already.

4.3.2 Before putting the Raw Water Tank in place

First, drill a hole in the RWT using the centre bit ¾“. Then, push the tank connector (1a) together with the seal from inside the tank to the outer. Fasten the tank connector with the connecting nut **using the screw wrench AF 32** – please do not use any type of gripper, as the nut is from plastic.

Then, mount the hose nozzle (2). Be sure to use the seal that comes with the hose nozzle.

4.3.3 After the RWT is in place

Now you have to connect the RWT with the PAUL unit, and thus carefully decide where to cut the hose, **regarding the following issues**:

- the water filter (7) has to be placed horizontal with the sieve facing downward, see Figure 5
- please regard the direction of flow through the water filter
- the valve (5) has to be **first in direction of flow**, then the water filter **follows**
- we recommend to place the valve (5) close to the water filter
- we recommend to place both valve and water filter close to the PAUL unit as this will ease servicing (i.e. cleaning the filter from time to time)

The hose clamps (3) have to be fixed with the crimping tool. They cannot be used multiple.

4.4 Mounting the PCU or OPV

If you upgrade an existing PAUL, then you will have to remove the standard sieve on top of PAUL.

Instead, mount the PCU or OPV in the place the standard sieve has been; it might be a good idea to store the sieve in a safe place.

Fixing the PCU or OPV with the two little screws is very important as otherwise the PCU or OPV will float when the water level is rising, and thus will keep PAUL from overfilling.

The PCU is equipped with a water level sensor that indicates if the water level falls below a certain limit. This water level assures that a long term standstill is possible. The sensor in the PCU must be connected via a very simple two line wire. At delivery, the connector is attached to the sensor cable, and this connector has to be plugged into the LWS box that can be seen in Figure 6.

Figure 6: LWS box

If desired (which might be the case in many situations), the wire can easily be extended to the desired length,. e.g. by placing the LWS box in a nearby flat etc.

The LWS operates with 4 AA batteries. If no warning is issued, there is no current, which means that the batteries last as long as their official lifetime is. In order to save battery power due to unwanted conditions during transportation, the batteries are blocked. Open the LWS (4 screws) and remove this plastic, then close the box again and tighten the 4 screws properly.

Then check functionality of the LWS box itself by pressing the blue knob – a LED light should appear and a sound should be heard. Check this from time to time.

To check the functionality of the whole LWS system, connect the LWS box to the PCU at a low water level inside PAUL – LED and beep should indicate low water condition. After reaching a certain height in PAUL, the alarm will go off. Of course it can also be switched off by unplugging the sensor cable from the LWS box, but do not forget to **reconnect** it after PAUL is filled up again.

4.5 Connection between PAUL and the Filtered Water Tank

PAUL comes with a hose 0.5 m long that ends with a valve which is already fixed to the hose and secured by a hose clamp. This is the standard PAUL configuration. Figure 7 shows the situation.

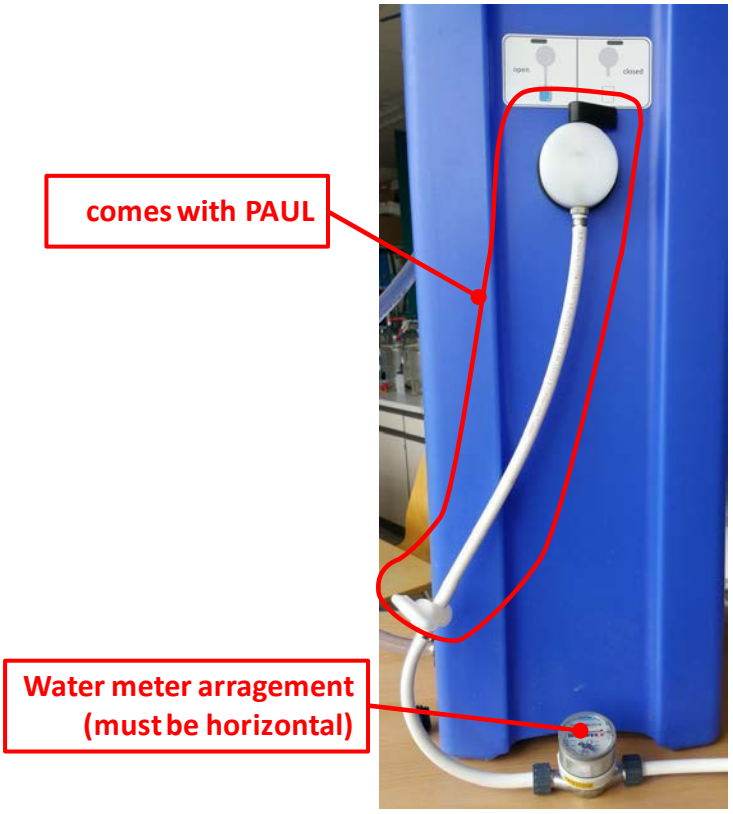


Figure 7: Connection between PAUL and the Filtered Water Tank – what comes with PAUL and how to mount the water meter

From the valve, a hose connection must be made using the **white-blue** hose to the water meter, and then further to the Single Valve (14) that has to be mounted in the Filtered Water Tank as follows:

Drill a hole in the FWT close to the top of the FWT using the centre bit ¾“. Remove the outer nut and seal from the Single Valve (14) and push it together with the other seal and nut from inside the tank to the outer. Fasten the valve with the seal and the nut you just had removed **using the screw wrench AF 32** – please do not use any type of gripper, as the nut is made of plastic..

Note: The water meter must be fixed in a horizontal position., see Figure 7.

Note: The hose that connects PAUL with the FWT is white-blue and has an inner diameter of 10 mm. This is essential. Do not use a hose with a bigger inner diameter, because this could affect the flow of water trough PAUL!

4.6 Side outlet at the bottom of PAUL

The side outlet of PAUL is needed to flush the slurry that PAUL retains and stores inside PAUL. This has to be done from time to time, depending upon the solids content of the raw water.

We recommend to flush out PAUL every week so it will probably not been forgotten.

In order to facilitate this, and also in order to be able to see the waterlevel inside PAUL, we recommend the **"Side outlet with hose" set**. Figure 8 shows how it works.

Remove the black cap and install the brass screw with hose connector. Then mount the hose on the hose connector and fix it with a hose clamp.

In standard operation, fix the end of the hose higher than PAUL is, so no water will flow out of the hose. As the hose is transparent, you can exactly see and observe the water level inside PAUL.

If flushing time has come, lower the outlet of the hose so water can flush out of PAUL.

Figure 8: Side outlet with hose

Of course any other solution offering the same functionality is also possible.

4.7 Water tap at the Filtered Water Tank

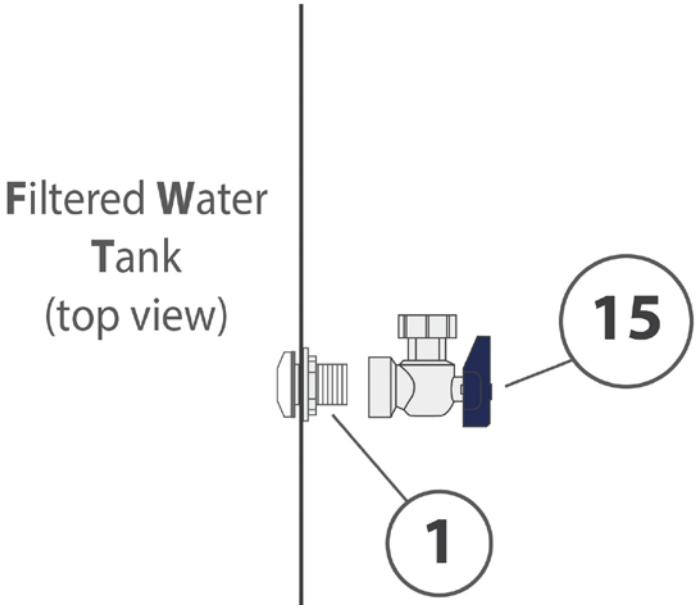


Figure 9: Water tap at the Filtered Water Tank

The water tap at the Filtered Water Tank is shown in Figure 9 (example 90°-tap, also straight taps may be delivered).

Drill a hole in the FWT close to the bottom using the centre bit ¾“. Then, push the tank connector (1) together with the seal from inside the tank to the outer. Fasten the tank connector with the connecting nut **using the screw wrench AF 32** – please do not use any type of gripper, as the nut is made of plastic.

Be sure to mount the tap (15) on the tank connector (1) with the **inside thread**!

All parts are already slightly connected in order to prevent loss of the specific seals. They will have to be disconnected at least partly in order to mount the water tap.

If you have received a 90°-tap with a blue handle, seals are located between (1) and the tap (15). If you have received a straight tap with a green handle, no seal is necessary at this connection.

Note: As there is no pressure in the FWT, it is highly recommended to use multiple outlet taps and/or large diameter outlet taps.

4.8 Overfill Protection Switch (OPS) for the Raw Water Tank

The **O**verfill **P**rotection **S**witch (**OPS**) (18) has to be installed in the RWT. This switch determines the maximum water level at which the feed pump must be switched off. By this, overfilling of the RWT will be prevented.

Concerning the necessary connections, please refer to the instructions provided with the OPS. The black wire is the zero connector. We recommend to test whether the blue or the brown wire is to be used besides the black wire.

4.9 Run-Dry Protection Switch (RPS)

It is highly recommended to prevent the feed pump that is used for raw water pumping from running dry. This can be done by using a **R**un-dry **P**rotection **S**witch (**RPS**) (19) and realize the wiring according to this task, which means that the black wire is used and the second wire to be used is the opposite one compared with the wiring needed for overfill prevention at the OPS. We recommend to test whether the blue or the brown wire is to be used besides the black wire.

4.10 Set of solar panel and pump – instructions

In general, the design of the pump and the solar panel has to be made according to the local circumstances. Especially, the total water head has to be considered.

We offer a standard set of solar panel and pump that is capable of pumping 1,200 Liter within a few (<4) hours at a height difference of <10 m using a hose with a diameter > 14 mm under normal circumstances. If necessary, a booster pump which is used together with the pump mentioned is available to increase the maximum water pressure head.

However, it is up to the user to assure that a solar panel/pump configuration is designed correctly. Also, it is important to keep in mind that usually 12 V DC pumps do not have a 10 year lifetime.

Depending upon the raw water quality, special pumps have to be considered like dirty-water pumps or pumps for sandy water pumping (although also these pumps have a limited lifetime).

The pump offered is designed for 12 V DC. The solar panel has an open circuit voltage of 22 V DC. As the pump has a high current of 6 to 8 amps, usually the solar panel will not reach the open circuit voltage, but will be below 12 V. If, whatsoever, the panel-pump combination reaches voltages of 15 V or more, this might damage or quickly outwear the pump.

In addition, it has to be noticed that solar panels lose efficiency if they reach high temperatures. This has to be taken into account. Tests are recommended. Additional panels or panel of different specifications can also be delivered.

5 Operation

5.1 OPV adjustment

The OPV is fixed to the standard sieve or (in the next version) will be fixed to a board with 50% as a solid part (where OPV and the LWS sensor are mounted) and 50% of the board surface being a sieve, as it should always be possible to fill PAUL manually with a bucket.

Two issues might arise and are important to assure safe unattended use. The float has to be in the right position, and the screw, see Figure 10, must not be tightened too hard.

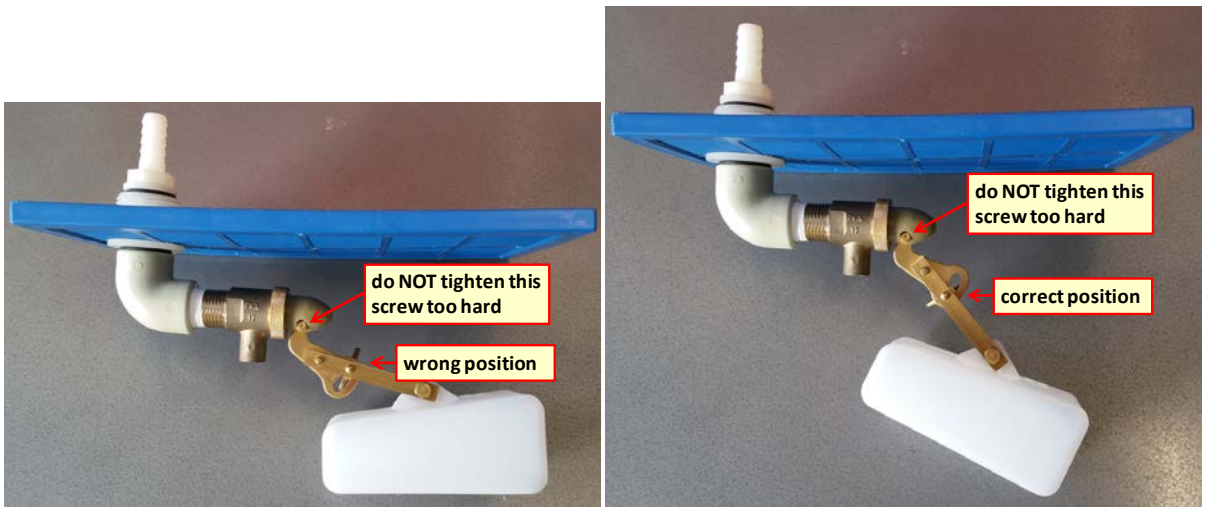


Figure 10: OPV adjustment: wrong position (left) and correct position (right)

If the screw is too tight, the arm with the float cannot move freely, which resilts in that is stay in the "open" position although water level is rising even above the float, resulting in an unwanted overflow of PAUL.

5.2 Startup of the PAUL Station

After having assembled everything, please clean all installations, especially the FWT. Please close all valves and then follow these steps:

- fill RWT and check OPS
  - in order to speed up, you can test the OPS in a low level position, so not too much water is needed before the autostop waterlevel is reached
- open the tap valve at PAUL
- open the valve in the connection between RWT and PAUL unit
  - PAUL slowly is filled. Make sure to enable the LWS, so you can also check its function right now

- After some time close tap valve at PAUL
  - This is to check whether the OPV in PAUL is working properly. After successful test (please listen to the water flowing into PAUL. This gentles sound must disappear without water overfilling PAUL), open it again
- fill FWT (without tapping water) and check whether the SV in the FWT inlet closes properly when the FWT is full (this will take some time depending upon the volume of the FWT, but the PAUL Station can be left unattended during this test)

5.3 Temporary stop of operation

If the operation of PAUL Station must be stopped for a short time (e.g. some hours, some days, but not several weeks), then please stop the process by **first** closing the tap valve at PAUL (or the valve in the hose between PAUL and the FWT, if installed). This assures that PAUL is filled with water during pause, which is necessary.

Then, all other necessary steps (switching off machines, closing taps etc.) can be done.

5.4 Measurement of waterflow

It is recommended to check the water flow daily or at least **weekly**. To do so, make sure the FWT is not full (water level well below SV, or open all taps at the FWT).

Make sure that water from the RWT can run into the PAUL unit, and the water meter is working (rotating). Then note the exact reading of the water meter (all digits incl. 3 red digits) and after 10 minutes note the reading again. Figure 11 shows an example:

Figure 11: meter reading at start (left), after 10 minutes (right)

in this case, an amount of 24 – 12 = 12 Liter was recorded. This means than an amount of 72 Liter per hour and an amount of 1,728 Liter per day was measured.

This is a good efficiency, well above 1,200 Liter per day as a minimum delivery, which is equal to 50 Liter per hour.

Please transfer this data to us from time to time.

6 Troubleshooting

6.1 LWS alarm

If the LWS sounds alarm, the water level in PAUL is too low. This might have two reasons:

- there is no more water in the RWT. Solution:
  - fill RWT. In order to increase the water level quickly, close the tap valve at PAUL (or the hose valve before the FWT, if installed) temporarily.
- water flow from RWT is slower than filtration (more water per time is filtered than can flow into PAUL from RWT). reasons and solutions:
  - filter unit is dirty ➔ close hose valve before filter unit and clean filter unit
  - OPV in PAUL is blocked or dirty ➔ check OPV and remove dirt. See also chapter 5.1 and Figure 10.
  - if this does not help, a larger filter unit or a larger hose diameter in the connection between RWT and PAUL might be necessary. Also you might contact us after you tested the first two measures without success.
  - increase height difference between RWT and the PAUL unit. Usually, this is not necessary, but in some cases the filtration capacity of PAUL is so high that this measure might be necessary.
  - decrease height difference between the PAUL unit and the FWT. Usually, this is not necessary, but in some cases the filtration capacity of PAUL is so high that this measure might be necessary.