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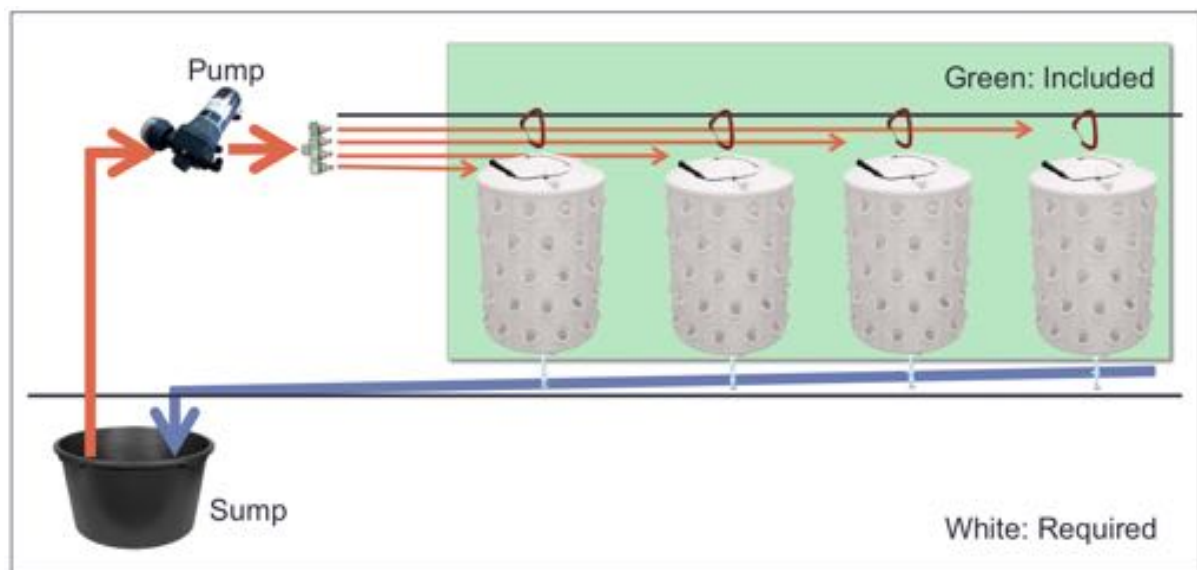
Prerequisites to running one or many vertical barrels

The vertical barrel in this manual is meant to be integrated into an existing circulation system or facility. Which means, it can not be run independently. In the following we describe the required prerequisites in to integrate one or more vertical barrels into an existing circulation system.

Required...

- ... is an existing nutrient cycle either using hydroponics (with mineral fertilizer) or aquaponics (using organic fertilizer from fish).
- ... is a suitable pressure pump (see chapter ,Dimensioning of the right pressure pump') to power the included spray nozzle [5.2] in your vertical barrels delivering the nutrient solution with a pressure of 3 bar.
- ... is a suitable lighting situation for your plants to thrive either using natural sunlight or artificial plant lighting.
- ... are all other surrounding conditions for optimal plant growth, depending on your crop like air and root temperature, availability of CO2, sufficient aeration, shading if necessary etc.
- ... is a solution to return the liquid to your cycle exiting at the bottom of the barrels to your sump or reservoir preferably just by using gravity.

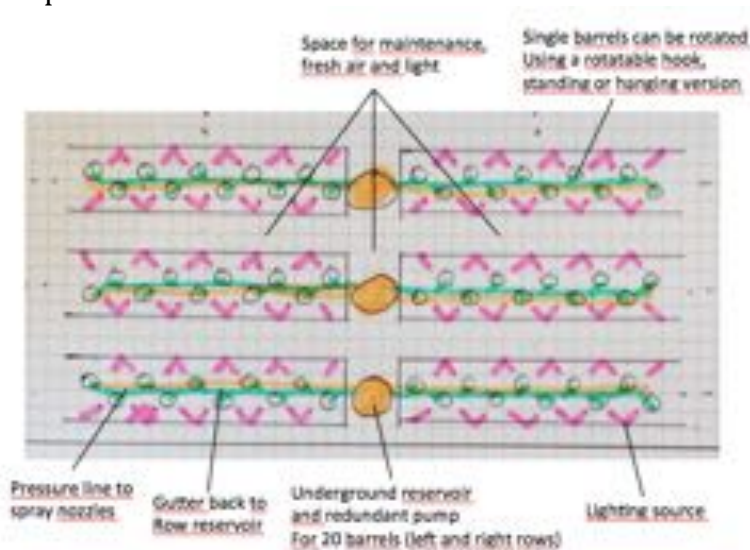
The mentioned vertical barrel can be utilized as planting equipment to set up many grow spaces quickly in your existing circulation system.





One example for a possible facility design

The net density of plants in your cultivation area that can be achieved using our vertical barrel is depending on the design of your facility. It depends on the planned height of the barrels your production setup and the actual production process. One example:



Grow spaces

One grow space is an insert for a 2" net pot (diameter 5cm or 2 Inches). As a growing medium to keep the inserted seedlings in its grow space as it grows, we recommend simple rock woll as shreds or cubes. You can insert seedlings which already have a small root and first leaves (same like in other systems like NFT). Netpots are not included and can be purchased in bulk.



The vertical barrel is suitable to grow small vegetable crops, herbs, lettuce and even strawberries. Each growspace provides a vertical space of 30cm and 15cm horizontally for fruits and leaves.

Hint: The more light can shine through the grow spaces into the inside of the barrel, the more algae can grow on the inside of your barrel. We recommend to seal the netpots with your seedlings with a simple piece of filter foam like in the following picture. The filter foam can also serve as medium at the same time:



Vertical spraying and pump

Depending on the selected pump spraying can be permanent or on interval. According to the atmospheric conditions, the chosen intervals should ensure, that the plants never dry. Example: 15min spraying, 15min pause in a closed underground situation without direct sunlight would be sufficient to avoid a permanently running pump.

2 barrel variants – please distinguish hanging and standing versions

Hanging barrel:



Uses 2 identical lids.
Is hung up. In order to hang the barrels you need a mounting kit including the steel ring hooks and nylon robbons.

Standing barrel:



Uses only one top lid and a stand, which practically is utilized as bottom lid at the same time.



Positioning of barrels in your production facility and height of the barrels

Each barrel has a diameter of 57cm and should have at least 40cm (rather 80cm) of space to the next barrel, so your plants can get enough light and ventilation. Each hanging barrel is hung on to a stable hook. The number of grow spaces increases with the height.

The weight of a barrel with out plants or fruit with 10 ring segments for the hanging version is 12kg and for the standing version 15kg.

Each ring segment [2] of a barrel has a height of 15cm and provides 12 grow spaces. Calculate with additional 15cm for each bottom and top lid and the some space for the hook. A barrel with 9 ring segments provides 108 grow spaces and needs around 1,75m of space over ground. An ideal height is using 12 ring segments with a height of 2,10m for the standing version and 10 ring segments for the hanging version. Both can be maintained by hand by a person without any climbing aid.

The condensed water exits the barrel in the center of the bottom lid or stand. Generally the water is returned just by gravity to your sump tank or reservoir. Ideal would be an underground reservoir in order to maximize the height and the number of grow spaces of the used barrels.

Please consider, that it could be necessary to rotate the barrels due to you individual lighting situation. This can be achieved with a swivel hook. Please arrange your barrels in a way, that you can reach your grow spaces conveniently for inserting new seedlings and for harvesting.

Connecting a barrel to your system

Each barrel provides one connection to its own spray nozzle [5.2] on the top lid. Please consider investing in individual switches for each barrel to connect and disconnect it to and from the nutrient pressure line. This will be handy if a certain barrel in a row of barrels has no plants or needs maintenance.

Scope of delivery

[1] 1/6th part, regardless of the adapter used (here two 2" net pot inserts)

[2] One ring segment is assembled using 6 of the 1/6th parts [1]



[3] Bottom lid with liquid exit on the bottom through a centered hole. Only the hanging version requires the bottom lid.



[4] Top lid with smaller hole for the spray nozzle and small holes for tightening the nozzle plus 1/2 inch hose connector.



[5] Stand for standing version with liquid exit in the lowest spot.





[6] Assembly kit containing:

[6.1] 3 nylon ribbons and either carabiner or simple hook or swivel hook to mount the hanging barrel.



[6.2] Spray nozzle and ½" hose connection to connect pressure nutrient line plus zip ties to attach the nozzle to the top lid of a barrel.



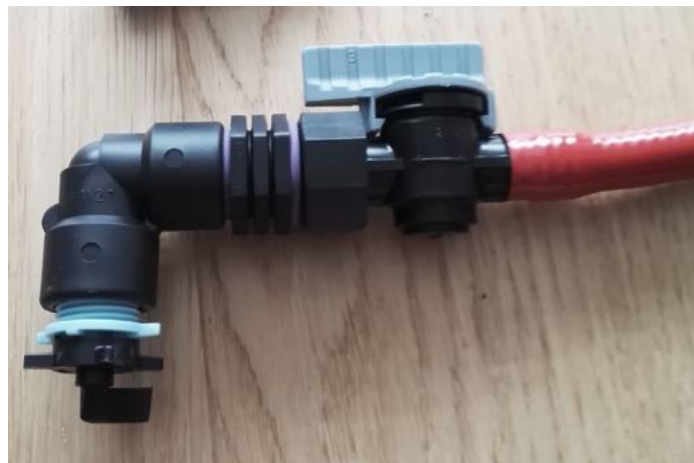


The new top lid using the sprinkler

As of December 2016 there is another more robust option for irrigation: a sprinkler. In order to operate with the sprinkler you will need the new lid shape which has a circular barrier for the water.



The new lid with the circular barrier



The sprinkler can be screwed to the hole in the lid. The hose has a diameter of ½ an inch.



Important note: Depending on the incoming pressure for the sprinkler (can be operated from 1.5bar) you will need to adjust the flow through using the tap. The flow rate needs to be adjusted that no water runs down the outside of the barrel during operation to harm your plants. But that you have enough pressure that the water reaches the inside surface of the barrel where it is supposed to irrigate your plants.

Assembly of a barrel

Step 1 – Assemble ring segments [2] from 1/6th parts [1]

Preparation:

Please use rubber gloves to push the 1/6th parts together.

Pick six of the 1/6th parts.



MANUAL – Aponix Vertical Barrel



Two parts can be pushed together starting from the bottom to the top. The most efficient way is to push alternating the top and the bottom of the tongue and groove system in front of you until there is no more gap between the parts.

The parts are very robust and can be pushed by hand using some force.

The two small noses inside of the tongue and groove to ensure the parts being assembled correctly and well aligned.





Important: All assembled ring segments need the same diameter in order to be stacked later on easily. In order to achieve that, please make sure all 1/6th parts are pushed tightly leaving on visible gaps between any adjacent parts.



Now you really get yourself a pair of gloves.

Push one after another of the 1/6th parts together until you have an open ring segment with six parts.

The open ring is very robust and it is no problem if it dangles a bit. The material will not bend or break.





Close your ring segment after the sixth part.

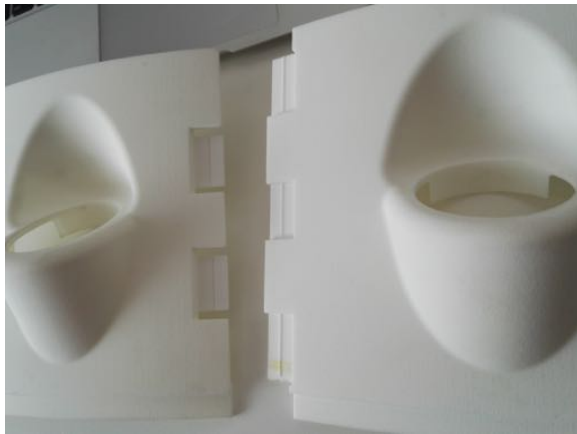
Repeat this step until you have assembled as many ring segments [2] you need to assemble your next barrel.





The new connection of the 1/6th parts

As of December 2016 there is a new connection mechanism replacing the nut and groove system described above. It is more precise, easier to connect and results in more accurate ring segments making it easier to stack a barrel.



Push the parts together until you hear the click.



The new parts also have a few improvements of which one are the internal wings that help divert the liquid running down the inside to the root areas of your plants enabling you to stack even higher barrels.



Step 2 – Mount the ring hooks to the bottom lid [3] (hanging version), top lid [4] and stand [5] (standing version)

If the ring hooks are already attached to your lids/stands please skip this step.

Tighten each ring hook like shown in the picture:

- First thread the nut to the end of the ring hook.
- Add a hard disk to the ring hook.
- Put the ring hook through one of the designated three holes from the outside of the barrel to the inside.
- Add the soft rubber sealing ring from the inside to the ring hook.
- Add another hard disk from the inside.
- Tighten the 2nd nut from the inside to the thread.
- Align the eye of the ring hook upward.





Tighten the threaded tank connector to the bottom. Use the rubber sealing from the inside. The connector will serve as exit for the condensed liquid from the barrel during operation. From this liquid exit on it is up to you how you manage to drain the liquid back to your sump tank or reservoir by gutter or hose (not included).





Step 3 – Stack ring segments [2] onto the bottom lid [3] (hanging version) or stand [5] (standing version)

Put the bottom lid [3] (lid with the bigger center hole for hanging version) or respectively the stand [5] (standing version) on front of you.



The bottom lid [3] and the stand [5] provide small dimples in the outer ring. The ring segments [2] have the analog noses to fit tightly into.

Put the first bottom ring segment [2] on the bottom lid [3] or respectively the stand [5] and rotate it until the noses find the dimples.





This is important for the overall stability of the barrel. Please repeat the same procedure with every subsequent ring segment.



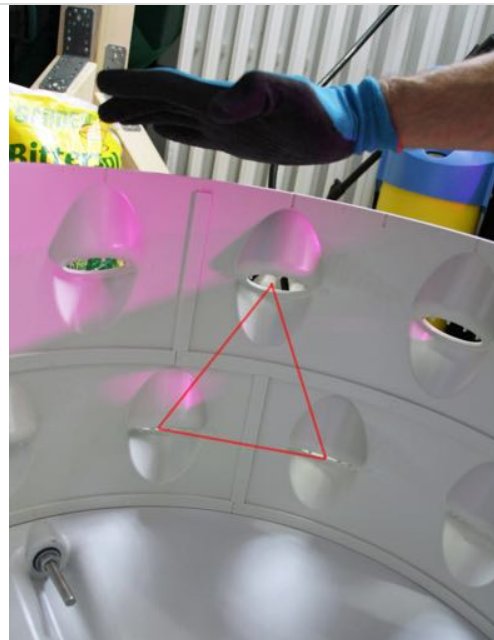
Stack the other ring segments [2]. Please note that the noses and dimples fit together that way the grow spaces are distributed evenly, meaning no grow space is exactly underneath or above another grow space. This way your plants will have the maximum available space to thrive into each direction.



MANUAL – Aponix Vertical Barrel



Stacking rings works easiest, when you align a dimple and a nose exactly on one side of the ring segment and tap the ring on the other side to push the whole ring into place.



Stack ring segments [2] until you have reached the desired height for your system design.

The higher a barrel is stacked, the more it tends to fall over during assembly. You can lean a barrel under construction towards a wall, get helped by a second person or put it on a round bucket.





Step 4 – Add the top lid [4] and align the ring hooks between top and bottom

As soon as you have correctly stacked all the required ring segments you can add the top lid.

Align the ring hooks from the bottom lid [3] or stand [5] for the nylon ribbons vertically with the ring hooks of the top lid that way, the nylon ribbons do not cross any grow space and point up in a straight line.

Please consider: Tightening and even using the nylon ribbons at all is optional for the standing version of the vertical barrel (using stand [5]). If you do not use the nylon ribbons here you will be able to rotate the whole barrel from the lowest ring segment. To rotate the standing barrel you can hold two opposite grow spaces tightly and push gently so the dimple and nose get loose and let the barrel rotate freely inside the stand. The stand [5] will remain in a fixed position while you rotate. Rotating the barrel might be a useful feature to ensure even lighting of your plants. Please ensure that the top lid [4] with the attached spray nozzle has enough space to move with the rotation.

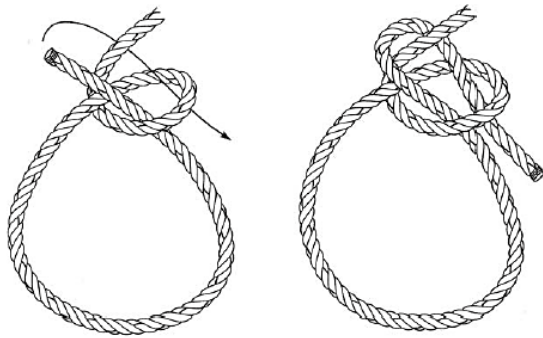




Step 5 – Attach the nylon ribbons [6.1] from the assembly kit [6]

Each nylon ribbon is attached by a knot to the bottom ring hook first. You can use a bowline knot – a sling that does not close even under pressure.

How to do a bowline knot:





Step 6 – Attach the nylon ribbons to the top lid [4]

Loop the end of a nylon ribbon two times around the ring hook coming from the bottom of the barrel.

Attention: Do not make a fixed knot to the top ring hook! As the weight of the barrel pulls down and plants and water are added, the nylon ribbons will expand a little and need to be tightened a little more from the top ring hooks.





Tighten the three loose ends of the nylon ribbons just in the center of the top lid [4] and make a tight simple knot to combine all three ribbons.

Half hitch knot:



To attach the top/swivel hook you can use two half hitch knots:



It is important, that whatever knots you chose, please make sure that the barrel will not fall or tilt over time or with pressure on those nylon ribbons. You can also secure the loose end of the ribbons with a figure-eight knot.

Important: As soon as you lift the barrel on the finished ribbons, and put in your designated hook, the nylon ribbons will expand. Don't worry even if the lid goes off the top. Tighten each ribbon pulling it over the top hook, where you did the two loops until every ring segment and the top lid fits as it should again. The top lid [4] must sit tightly on the top ring segment. It stabilizes the whole barrel.

Another option would be to use the





optional swivel hook to hang your vertical barrel. This would allow the barrel to be rotated during production to achieve more even lighting for your plants.



Step 7 – Attach the spray nozzle [5.2] from the assembly kit [5]

Connect your ½" connecting hose (not included) to your nutrient pressure line. Before you do that you need to lace the zip tie through the small hole. Then pull the spray nozzle tight to the top lid with the zip tie.

Recommendation: Secure your hose with a hose clamp.

Find the spray nozzle [5.2] which is probably already threaded into to the ½"-hose socket. Place the end of the spray nozzle, where the water will exit into the centered hole in the top lid [4].

When you need to disconnect the pressure line for maintenance, you need to cut the zip tie. You need a new zip tie when you reconnect.





Please consider: The setup of the pressure line providing your nutrient solution from your sump tank or reservoir and the distribution via hoses to the top of your vertical barrels are not part of the vertical barrel.



Step 8 – Connect the liquid exit on the bottom lid [3] or stand [5]

Hanging barrel: During operation the condensed liquid will exit at the centered outlet of the bottom lid [3]. Depending on the planned arrangement of your barrels you need to find a solution to return the exiting liquid to your nutrient circulation system. You could use a simple gutter with a slope of 1% or a connected hose.

We use a flexible hose (not included) to direct the liquid to a PVC pipe. When you remove a hanging barrel from its hook, you can place it on a round bucket for stability.





Standing barrel: The stand is always in a fixed position, even if you decide to omit the nylon ribbons in order to be able to rotate the barrel inside the stand. The condensed liquid exits the standing version at the lowest point in the stand. From this point on you need to find your own solution to return the exiting liquid to your nutrient circulation system. You could use a simple gutter with a slope of 1% or a connected hose.

We use a flexible hose (not included) to direct the liquid to a PVC pipe. When you remove a hanging barrel from its hook, you can place it on a round bucket for stability.



Maintenance and cleaning

In order to clean your vertical barrel please remove all plants and detach it completely from your circulation system. It is possible to a) clean the barrel still standing/hanging with high pressure through the grow spaces. In this case make sure, the waste water from the cleaning procedure does not contaminate your circulation.





Normally you would rather go for a more thorough procedure detach your barrel completely and clean it in an maintenance area separate from your production using high pressure water. Depending on how much algae and roots you have in your barrel you could leave some ring segments stacked together while cleaning. We recommend you leave the net pots in the grow spaces, they probably need to be cleaned too. Turn the ring segments, during cleaning.

Notice: You do not need to disassemble your ring segments for the cleaning procedure. You should also clean the rest of your equipment regularly, like your hoses and the spray nozzles and other tubing.



Storing unused barrel parts

If barrels are not in use for a longer time, you can always deconstruct them completely. Please clean the barrel parts after using them. Just disassemble in opposite order as described in this manual. You can also disassemble all your ring segments [2] into single 1/6th parts [1] to save a lot of storing space. Lids [4] + [3] and stands [5] can also be stacked in a very compact way. Small parts from the assembly kit [6] can also be disassembled, cleaned and stored best in a small box. Please also clean the nozzle and hoses.

Dimensioning of the right pressure pump

You need to ensure, that every spray nozzle/barrel gets its nutrient solution delivered with 2-3 bar pressure in order to have even irrigation inside each connected barrel. Die Your choice for the right pump for your operation depends on the number of maximum connected barrels/spray nozzles during operation, distance, diameter of your line and how many bends you have. Please consider all factors in order to ensure at least 2bar at each spray nozzle. Each barrel uses one spray nozzle (Lechler), which reduced the pressure in your line while spraying. Please calculate with a flowrate of 1-1,2 liters per minute at 2-3bar for each spray nozzle. The capacity of the chosen pump must exceed



the simply added flowrate in liters per minute of all your barrels. Smallest pumps could be self regulating membrane pumps like they are used in mobile homes.

Example – Using 4 to max 6 barrels the required pressure capacity should be:
6 barrels times 1,2 liters/minute equals = 7,2 liter/minute flow rate in total at least at 2 bar. Sufficient in this case would be a ,SHURflo WhisperKing LS061' pump mit with a maximum flow rate of 10 liters/minute.



Example: Shurflo WhisperKing und Reservoir

On bigger setups more professional pumps are recommended like the ones that provide pressure lines in buildings and are capable of a permanent operation.

Please consider, that most small 12V membrane pumps are not built for permanent operation. In this case you will need to irrigate in intervals like 15min on, 15min off.

Recommendation: Please always have at least one spare pump of the same type at hand. If irrigation stops for a longer period, it will cause a lot of stress on your plants. When using rockwool as a medium you could lose your crop after ½ or 1 day of no irrigation at all.

Materials of the parts

All thermoplastics used can optionally be manufactured with materials specifically certified 'food-safe' if required.

1/6 part

As of December 2016 all 1/6th parts are made from ASA (Acrylester-Styrol-Acrylnitril).

Properties: UV-resistant, Antistatic, dirt-repellent, long-living, inherently stable, shatter-proof, heat-resisting, having a stable color.



Lids and stands

PVC sheets vacuum molded.

Development status as of December 2016

The vertical barrel is in its first large series produces, manufactured in Germany. We did our best to select the most durable and suitable materials available. The aponix.eu vertical barrel is patented in Germany so far.