

DIY Unpowered Terracotta Valve

User Manual

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Unpowered Terracotta Valve

Contents

1.	Introduction	page 2
2.	Components of the DIY Unpowered Terracotta Valve	page 3
3.	Assembling the DIY Unpowered Terracotta Valve	page 4
4.	Above ground installation	page 5
5.	In ground installation	page 5
6.	How to use the Unpowered Terracotta Valve	page 6
7.	Key features of the Unpowered Terracotta Valve	page 8
8.	Conclusion	page 9

1. Introduction

It is recommended that you watch the YouTube video Unpowered Terracotta Valve:
<https://www.youtube.com/watch?v=A90f5aAxvHA>

The Unpowered Terracotta Valve has a half inch inlet and outlet. The valve is suitable for automatic sprinkler irrigation or drip irrigation, and can be installed either above ground or in ground. The valve operates with water supply pressure in the range 10 kPa to 800 kPa. The interval between irrigation events responds automatically to the on-site prevailing weather conditions (namely, evaporation and rainfall). For in ground installation, the interval between irrigation events also responds automatically to the transpiration requirements of your plant at their current stage of growth.

Terracotta is porous and so the water level in the pot falls as water seeps through the pot. A float inside the pot floats on the water. When the water level reaches the low level, a magnet inside the float activates the valve so that the valve opens and the irrigation starts. During the irrigation event a control dripper drips water into the pot and the water level rises. When the water level reaches the high level, the magnet inside the float disengages from the valve so that the valve closes and the irrigation stops.



Unpowered Terracotta Valve showing the float and the water level



Float showing the ring magnet at the bottom of the float

This remarkable low-cost invention may enable poor smallholders in remote locations to grow higher-valued crops cost-effectively.

The valve has a half inch inlet and outlet, and so it is not suitable for large irrigation applications that require a bigger valve. If the flow rate through the valve is inadequate, you may wish to subdivide the irrigation application into zones with an Unpowered Terracotta Valve for each zone.

A clear acrylic tube is connected to the valve is quite fragile, so be very careful not to break it.

3. Assembling the DIY Unpowered Terracotta Valve

1. Remove the 4 screws from the solenoid valve and carefully remove the solenoid from the valve.
2. Remove the metal base plate from the solenoid and reattach the metal base plate to the valve (stainless steel screws are preferable).
3. Connect the bush to the valve inlet.
4. Connect the elbow to the valve outlet.
5. Connect a piece of 19mm polypipe to the barb on the elbow.
6. Use a 21/64 inch drill bit to increase the inner diameter of one end to the acrylic tube. The drill bit should rotate anticlockwise to avoid damaging the fragile acrylic tube.
7. From the inside, insert the grommet into the drain hole.
8. Insert the acrylic tube into the grommet so that it is flush with the bottom of the pot.
9. Using a sharp knife, cut off the grommet so that it is flush with the bottom of the pot.
10. Slide the acrylic tube over the white plastic shaft.
11. Using the pool noodle and a sharp knife, cut a 40mm lower float and a 15mm upper float.
12. Cut the threaded joiner into a 30mm piece and a 10mm piece.
13. Insert the magnets into one end of the lower float so that the magnets are flush with the bottom of the float.
14. Screw the all thread poly riser into the 30mm piece.
15. Screw the other end of the all thread poly riser into the 10mm piece.
16. Stretch cloth adhesive tape over the outside of the 30mm piece and the 10mm piece (most adhesives will stick to the cloth side of the adhesive tape but not to the poly).
17. Apply a thin layer of a suitable adhesive to the outside of the 30mm piece and the outside of the 10mm piece.
18. Insert the 30mm piece into the open end of the lower float.
19. Insert the 10mm piece into the 15mm upper float.
20. After the glue has set, rotate the upper float to adjust the gap between the upper and lower floats.
21. Slide the float over the acrylic tube.
22. Use a masonry drill to drill six equi-spaced small drain holes in the terracotta saucer. Drill an extra hole near one of the drain holes so that the cable tie can be attached to the saucer.
23. Attach one end to the 4mm polypipe to the adjustable dripper and attach the other end to the takeoff adaptor.
24. Punch a hole in the 19mm polypipe and insert the takeoff adaptor.
25. Use the cable tie to secure the adjustable dripper.
26. Position the valve in a suitable location in your garden so that the evaporation matches the evaporation at your plants.
27. Connect the water supply to the valve inlet and connect the irrigation application to the valve outlet.



4. Above ground installation of the Unpowered Terracotta Valve

For above ground installation, position the valve in a suitable location in your garden so that the evaporation matches the evaporation at your plants.

Connect the water supply to the valve inlet and connect the irrigation application to the valve outlet (note that an arrow under the valve indicates the direction of flow).

Connect the control dripper to the irrigation application.



Connect the water supply to the valve inlet



Connect the irrigation application to the valve outlet



Connect the control dripper to the irrigation application

5 In ground installation of the Unpowered Terracotta Valve

In ground installation is ideal for drip irrigation of row crops. Follow the installation steps below.



Step 1. Dig a hole midway between two adjacent plants. There should be no irrigation drippers near these two plants.



Step 2. Connect vertical pipes to the valve inlet and outlet and position the valve in the hole so that rim of the pot is above ground level. Back fill the soil around the pot. Connect the control dripper to the outlet pipe.



Step 3. Connect the water supply to the inlet pipe and connect the irrigation application to the outlet pipe.

Because the terracotta pot is in the ground near the roots of plants, the valve responds to changes in plant transpiration. As the crop grows and requires more water, the irrigation frequency increases automatically.

6. How to use the Unpowered Terracotta Valve

Turn on the water supply and the irrigation starts immediately. The control dripper drips water into the terracotta pot during the irrigation. The **control volume** is the volume of water that drips into the pot during the irrigation event. It is also the volume of water that seeps through the terracotta pot between irrigation events.

The irrigation stops automatically when the control volume of water has dripped into the pot. The irrigation starts again automatically after the control volume of water has seeped through the pot. The cycle continues indefinitely and so you can leave your garden unattended for months on end. A saucer sits on top of the pot so that the water in the pot is protected from algae, mosquitoes and thirsty animals. There are small drain holes in the saucer.

When using a conventional irrigation controller, you need to set the start time and the end time for each irrigation event. However, with the Unpowered Terracotta Valve you don't need a timer. The duration of the irrigation event is the time it takes for the control volume of water to drip into the pot, and the interval between irrigation events is the time it takes for the control volume of water to seep through the pot.

It is important to note that the control dripper is adjustable. If you reduce the flow rate of the control dripper, it takes a lot longer for the control volume of water to drip into the pot and so the duration of the irrigation event increases and your plants get more water. On the other hand, if you increase the flow rate of the control dripper, the control volume of water drips into the pot more quickly and so the duration of the irrigation event decreases and your plants get less water. Adjust the control dripper so that the irrigation delivers the appropriate amount of water to your plants at their current stage of growth.



The control dripper is adjustable.

The time it takes for the control volume of water to seep through the pot depends on the prevailing on-site weather conditions. When it is hot and dry, the water seeps more quickly and so the interval between irrigation events is shorter. When it is cool and overcast, the water seeps more slowly and so the interval between irrigation events is longer.

If it rains, rainwater collects in the saucer and drains into the pot. This means that the start of the next irrigation event is delayed. In addition to the control volume of water that needs to seep through the pot between irrigation events, any rainwater that has entered the pot between irrigation events also needs to seep through the pot.

To avoid irrigating during the heat of the day, you can turn off the water supply. Alternatively, a tap timer can be used so that water is only available between sunset and sunrise.

The Unpowered Terracotta Valve uses on-site weather data (namely, evaporation and rainfall). Most smart irrigation controllers do not use on-site weather data. Instead they use weather data from the Bureau of Meteorology.

The valve can be used for both gravity feed and pressurised irrigation. It can be used with sprinklers, drippers, weeper hose and soaker hose.

You can irrigate directly from a rainwater tank by gravity feed without using a pump provided that the water level in the tank is at least 1 metre higher than the valve.

It is recommended that you adjust the interval between irrigation events before adjusting the water usage rate. You may need to readjust the interval between irrigation events and the water usage rate as the plants grow and their water requirements change.

Note that the term **water usage rate** refers to the number of litres per week used by the irrigation system.

How to adjust the interval between irrigation events

You can adjust the interval between irrigation events by adjusting the gap between the upper and lower floats. The interval between irrigation events is the time it takes for the control volume of water to seep through the porous terracotta pot. To adjust the gap by 4 mm, rotate the upper float by two and a quarter turns.

Adjusting the interval between irrigation events does not change the water usage rate. For example, if you increase the interval between irrigation events by increasing the gap between the upper and lower floats, the amount of water used during the irrigation event increases automatically to ensure that the water usage rate remains the same.



To adjust the interval between irrigation events, adjust the gap between the upper and lower floats

gap between the upper and lower floats	control volume using the Control Volume Boost Container
zero gap	1000 ml
4 mm	1103 ml
8 mm	1206 ml
12 mm	1309 ml
16 mm	1412 ml
20 mm	1515 ml
24 mm	1618 ml
28 mm	1721 ml
32 mm	1825 ml

Table 1. Control volume for various gaps between the upper and lower floats

The gap between the upper and lower floats should be chosen so that the next irrigation event starts when there is no further soil moisture available to the plants. Soil moisture sensors or probes may be used to determine the soil moisture profile.

You can start the irrigation at any time by pushing the float down. You can stop the irrigation at any time by lifting the float up.

How to adjust the water usage rate

If your plants are not getting enough water, reduce the flow rate of the control dripper. Reducing the flow rate of the control dripper increases the duration of the irrigation event and so your plants get more water. If your plants are getting too much water, increase the flow rate of the control dripper.

Adjusting the water usage rate does not affect the interval between irrigation events.

You may wish to position an empty measuring container under one of the drippers so that water drips into the container during the irrigation event.

7. Key features of the Unpowered Terracotta Valve

1. Unpowered (no batteries, no solar panels, no electronics, no computers, and no WiFi)
2. Water supply pressure 10 kPa to 800 kPa
3. Half inch inlet and outlet
4. Use for sprinkler irrigation or drip irrigation
5. Use for gravity feed or pressurised irrigation
6. Adjust the water usage rate by adjusting the control dripper
7. Adjust the interval between irrigation events by adjusting the float
8. Adjusting the water usage rate does not affect the interval between irrigation events, and adjusting the interval between irrigation events does not affect the water usage rate
9. Responds automatically to on-site evaporation and rainfall
10. The irrigation frequency increases significantly during a heat wave
11. Install above ground or in ground
12. For in ground installation the valve responds automatically to plant transpiration
13. Irrigate directly from a rainwater tank without using a pump
14. Water in the terracotta pot is protected from debris, algae, mosquitoes and thirsty animals
15. Simple, unpowered, and low tech, and therefore fewer things can go wrong
16. Leave your irrigation application unattended for months on end

8. Conclusion

The Unpowered Terracotta Valve uses a radically different approach to irrigation scheduling called Measured Irrigation. See the Measured Irrigation website for more information:

www.measuredirrigation.com.au

Conventional irrigation systems **indirectly** control the volume of water discharged by a dripper by using PC (pressure compensating) drippers to control the flow rate and an irrigation controller to control the time. However, measured irrigation **directly** controls the volume of water discharged by a dripper, rather than controlling the flow rate and the time. It is recommended that NPC (non pressure compensating) drippers be used for measured irrigation.

The Unpowered Terracotta Valve uses on-site weather information rather than information from the Bureau of Meteorology, and so it is ideal for greenhouse applications.