Terracotta Valve User Manual

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Terracotta Valve

Terracotta Valve in operation

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1. Introduction

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

The Terracotta Valve is an unpowered irrigation valve suitable for automatic sprinkler irrigation or drip irrigation. The valve operates in the pressure range 10 kPa to 800 kPa. The Terracotta Valve does not require an irrigation controller. Each valve is self-controlled whereby variations in the irrigation frequency are automatically controlled by the on-site prevailing weather conditions (namely, evaporation and rainfall).

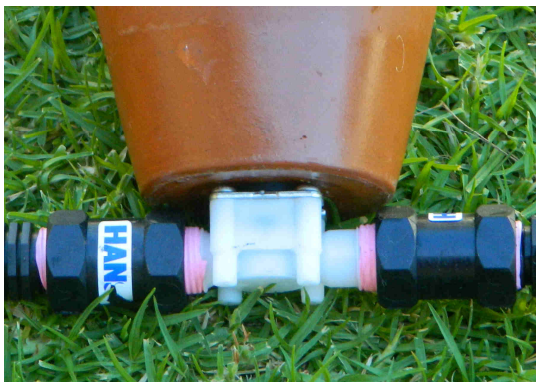
Terracotta is porous and so the water level in the pot falls as water evaporates from the outside surface of the pot. A float inside the pot floats on the water. When the water level reaches the low level, a magnet inside the float activates the valve so that the valve opens and the irrigation starts. 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.

Terracotta Valve showing float and water level

Float showing the ring magnet at the bottom of the float

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

The Terracotta Valve has a 15mm inlet and outlet, and so it is not suitable for large irrigation applications that require a bigger valve.



Terracotta Valve showing 15mm inlet and 15mm outlet

2. How to use the Terracotta Valve

Connect the water supply to the valve inlet and connect the irrigation application to the valve outlet (note that the control dripper is on the outlet side of the valve).

Connect the water supply to the valve inlet

Connect the irrigation application to the valve outlet

Turn on the water supply and the irrigation will start immediately. The control dripper drips water into the terracotta pot during the irrigation. The irrigation stops automatically after 250 mls of water have dripped into the pot.

The control dripper drips water into the terracotta pot and the irrigation stops after 250 ml have dripped into the pot.

The irrigation starts again automatically after 250 ml of water have evaporated from the outside surface of the porous terracotta pot. The cycle continues indefinitely and so you can leave your garden unattended for months on end. A terracotta saucer sits on top of the pot so that the water in the pot is protected from algae, mosquitoes and thirsty animals. There are 8 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 self-controlled terracotta valve you don't need a timer. The duration of the irrigation event is simply the time it takes for 250 ml of water to drip into the pot.

The irrigation starts again automatically after 250 ml of water have evaporated from the outside surface of the porous terracotta pot.

It is important to note here that the control dripper is adjustable. If you reduce the flow rate of the control dripper, then it will take a lot longer for the 250 ml to drip into the pot and so the duration of the irrigation event increases and your plants will get more water. On the other hand, if you increase the flow rate of the control dripper, the 250 ml will drip into the pot more quickly and so the duration of the irrigation event decreases and your plants will 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 interval between irrigation events if the time it takes for 250 ml to evaporate from the outside surface of the porous terracotta pot. The important thing to realise here is that the time it takes for 250 ml to evaporate is determined by the prevailing weather conditions. When it is hot and dry, the water will evaporate more quickly and so the interval between irrigation events will be shorter. When it is cool and overcast, the water will evaporate more slowly and so the interval between irrigation events will be longer.

If it rains, rainwater will collect in the saucer and drain into the pot. This means that the start of the next irrigation event will be delayed. In addition to the 250 ml that needs to evaporate, the rainwater that has entered the pot will also need to evaporate.

If it rains, rainwater will collect in the saucer and drain into the pot.

The 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 Terracotta Valve can be used for both gravity feed and pressurised irrigation. It can be used with pressure compensating drippers and non pressure compensating drippers. It can also be used with weeper hose or 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 Terracotta Valve.

3. Drip irrigation with water usage independent of pressure

Ideally, the amount of water used to irrigate your garden should be independent of the water supply pressure. Provided that all of the drippers are identical, the Terracotta Valve can be used to ensure that the dripper discharge is independent of the water supply pressure. Conventional drip irrigation systems control the volume of water discharged by a dripper by using PC (pressure compensating) drippers to control the flow rate of the dripper and an irrigation controller to control the time. In a domestic garden with mains water supply and, many zones are usually required to ensure that the pressure in each zone does not fall below the lower limit for pressure compensation. The irrigation controller is programmed so that each zone is irrigated at a different time.

Provided that variations in pressure within the zone due to head loss are negligible, the volume of water discharged by each dripper during the irrigation event will be approximately the same. For domestic gardens, the irrigation system can usually be designed so that variations in pressure within the zone are negligible.

To ensure that approximately the same volume of water delivered by each dripper during the irrigation event regardless of the water supply pressure, the adjustable control dripper must be replaced by an irrigation dripper. For example, if the irrigation drippers are Antelco 2 L/H NPC drippers, then the control dripper must also be an Antelco 2 L/H NPC dripper. Then the volume of water discharged by each dripper will be the same as the volume of water discharged by the control dripper during the irrigation event, namely 250 ml, regardless of the water supply pressure. By using the Terracotta Valve in this way, many zones with PC drippers can be combined into a single zone with a single Terracotta Valve, and so the cost of the irrigation system can be reduced dramatically.

The adjustable control dripper must be replaced by an irrigation dripper.

We now need to address the problem that 250 ml will often be too much or too little water for your plants at their current stage of growth. If 250 ml is too much, then you can use more than one dripper as the control dripper. For example, if the control dripper consists of 2 drippers, then the volume of water discharged by each of the irrigation drippers will be 125 ml.

If 250 ml is too little, then you will need to use a control dripper that delivers a fraction of the volume of water discharged by an irrigation dripper during the irrigation event. For example, if the control dripper delivers one quarter of the water discharged by an irrigation dripper, then the volume of water discharged by each of the irrigation drippers will be 500 ml regardless of the water supply pressure.

In the next section we will discuss a method for making a **fractional dripper** for use as a control dripper.

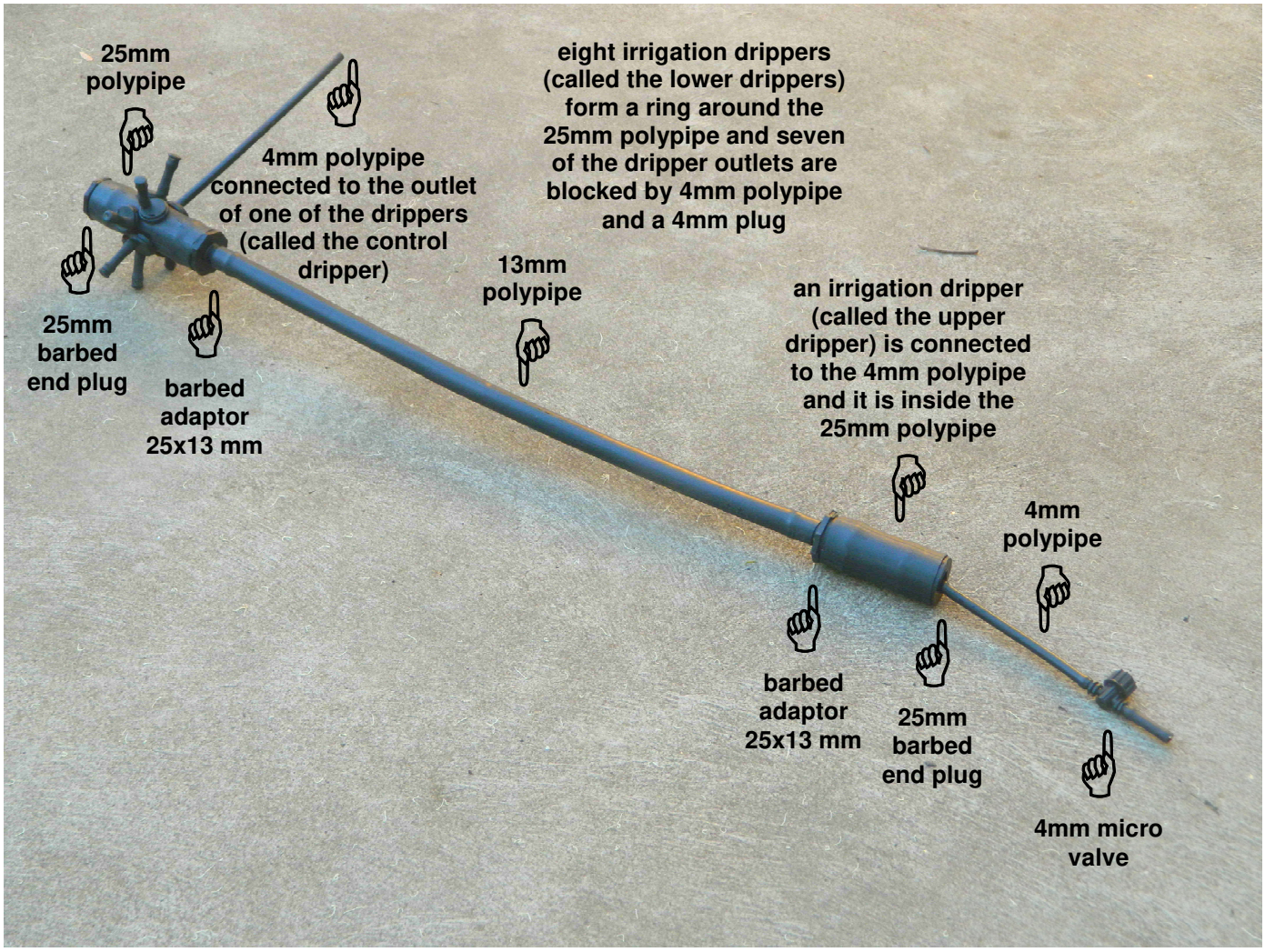
Suppose that you are using automated drip irrigation on flat land from a rainwater tank by gravity feed without using a pump. If you are not using a Terracotta Valve, you will be faced with the problem that dripper discharge will decrease as the water level in the tank falls. By using the Terracotta Valve with the appropriate control dripper, you can irrigate directly from the rainwater tank by gravity feed without using a pump. Furthermore, the volume of water discharged by each dripper will be independent of the water level in the tank. The Terracotta Valve is a game-changer for automated gravity feed irrigation from a rainwater tank without using a pump.

The Terracotta Valve is a game-changer for automated gravity feed irrigation from a rainwater tank without using a pump.

4. How to make a fractional dripper

To ensure that each irrigation dripper discharges the appropriate volume of water during the irrigation event (regardless of the water supply pressure) you will need to make a control dripper that delivers a fraction of the volume of water discharged by an irrigation dripper. This can be done for either PC (pressure compensating) drippers or NPC (non pressure compensating) drippers. If you are using PC drippers, then the pressure at PC drippers does not need to be within the pressure range specified by the manufacturer for pressure compensation.

The component parts of the fractional dripper are labelled in the picture below.



The component parts of the fractional dripper are labelled in the above picture

The following pictures provide step by step instructions for making the fractional dripper.

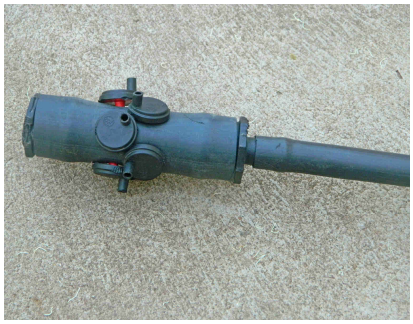
Step 1. Connect 4mm polypipe to the 4mm micro valve. Drill a 13mm hole in the 25mm end plug.

Step 2. Insert the 4mm polypipe through the hole in the end plug.

Step 3. Connect the irrigation dripper to the 4mm polypipe.

Step 4. Insert the 25mm end plug into one end of a 70mm length of 25mm polypipe. Insert a barbed adaptor into the other end of the 25mm polypipe. Insert the other end of the barbed adapter into a 400mm length of 13mm polypipe.

Step 5. Insert eight irrigation drippers in a circle around a 100mm length of 25mm polypipe so that the outlets of the drippers are in line.



Step 6. Insert a 25mm end plug into one end of the 100mm length of 25mm polypipe. Insert a barbed adaptor into the other end of the 25mm polypipe. Insert the other end of the barbed adaptor into the 13mm polypipe.

5. How to use the fractional dripper

Fractional dripper suspended above the Terracotta Valve

To install the fractional dripper, replace the adjustable control dripper by a length of 4mm polypipe connected to the fractional dripper so that the fractional dripper is suspended above the Terracotta Valve. The length of polypipe connected to one of the lower drippers (called the control dripper) is positioned so that it drips water into the terracotta saucer during the irrigation event. The remaining seven lower drippers should be blocked using a short length of 4mm polypipe and a 4mm plug.

The remaining seven lower drippers should be blocked.

Water overflowing from the 13mm hole at the upper dripper

The control dripper drip water into the terracotta saucer.

When the irrigation starts, the upper dripper fills the 13mm polypipe until water start to overflow from the 13mm hole in the 25mm barbed end plug, and the control dripper drips water into the saucer.

Progressively unblock the lower drippers until water stops overflowing at the upper dripper. The unblocked drippers (excluding the control dripper) drip water outside the terracotta saucer. As the number of unblocked drippers increases, the flow rate of the control dripper decreases. Adjust the fractional dripper by unblocking lower drippers until the irrigation delivers the appropriate amount of water during the irrigation event to your plants at their current stage of growth.

Progressively unblock the lower drippers until water stops overflowing.

Adjust the fractional dripper by unblocking lower drippers until the irrigation delivers the appropriate amount of water to your plants.

When you use the fractional dripper you must ensure that water does not overflow at the upper dripper.

The following table shows the volume of water discharged by each irrigation dripper during the irrigation event as the number of unblocked drippers increases. The volume of water discharged by each irrigation dripper during the irrigation event is independent of the water supply pressure.

Number of unblocked drippers	Fraction for fractional dripper	Volume of water discharged by each irrigation dripper during the irrigation event
1	1	250 ml
2	1/2	500 ml
3	1/3	750 ml
4	1/4	1000 ml
5	1/5	1250 ml
6	1/6	1500 ml
7	1/7	1750 ml
8	1/8	2000 ml

The table cannot be used when water is overflowing from at the upper dripper. However, you may be able to stop the water overflowing by increasing the length of the 13mm polypipe,

7. Key features of the Terracotta Valve

1. Completely automatic
2. No electricity required (no batteries, no solar panels, no electronics, no computers, and no WiFi)
3. No timer required
4. Smart irrigation – the irrigation is controlled by the prevailing weather conditions
5. Valve operates in the pressure range 10 kPa to 800 kPa
6. Use for both gravity feed and pressurised irrigation
7. Use with PC (pressure compensating) drippers and NPC (non pressure compensating) drippers
8. Use for sprinkler irrigation, drip irrigation, or porous hose irrigation
9. Adjust the water usage by adjusting the control dripper
10. Variations in the irrigation frequency throughout the year are controlled by the prevailing net evaporation rate (evaporation minus rainfall)
11. Responds appropriately when there is an unexpected heat wave
12. When it rains, water enters the terracotta pot and delays the start of the next irrigation
13. Uses less water without affecting the yield
14. Water in the terracotta pot is protected from algae, mosquitoes and thirsty animals
15. Simple, unpowered, and low tech, and therefore fewer things can go wrong
16. Provided you have a continuous water supply, you can leave your irrigation application unattended for months on end

8. Conclusion

The 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 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. Because it is no longer necessary to control the flow rate, one can use NPC drippers as well as PC drippers. Because the pressure range is not restricted by pressure compensation, the Terracotta Valve can be used with any pressure in the range 10 kPa to 800 kPa.

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

The Terracotta Valve is a game-changer for automated irrigation from a rainwater tank. If you are using pressure compensation from a rainwater tank, the following items are required. These items are not required if you are using a Terracotta Valve, and so the cost of installing and running the irrigation system is reduced dramatically.

- Pump for the rainwater tank
- Solenoid valves (one needed for each zone for PC irrigation)
- Irrigation controller
- Hose clamps