Unpowered Wicking Valve

User Manual

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1. Introduction

Any irrigation system with a conventional irrigation controller can be upgraded to an unpowered system where each solenoid valve is replaced by an Unpowered Wicking Valve. The conventional irrigation controller and the associated wiring become redundant.

The Unpowered Wicking Valve has a standard one inch (25 mm) inlet and outlet. The Unpowered Wicking Valve is also available with a 40 mm inlet and outlet (contact Measured Irrigation for a quote).

This amazing invention lets you set the volume of water discharged by each dripper during the irrigation event. The dripper discharge is independent of the flow rate of the dripper (pressure compensating or non pressure compensating). The dripper discharge is also independent of the water supply pressure.

The Unpowered Wicking Valve uses onsite weather conditions to control irrigation scheduling rather than the static timer intervals in conventional devices.

After irrigation and as water evaporates from the soil, water also evaporates from the container. The water in the container eventually reaches a low level corresponding to the soil drying out. The valve opens and irrigation begins. A dripper attached to the irrigation system refills the container during the irrigation. When the water in the container reaches a high level corresponding to the required watering of the plants, the valve shuts off and the cycle restarts.

Once correctly calibrated, the Unpowered Wicking Valve only sends water when plants need it and does not overwater. It responds to the same local weather conditions as the soil. Deep or shallow watering, frequent or delayed watering – all can be accommodated. You don't have to 'turn it off' over winter as rain and cooler temperatures keep the container from drying out. You can leave your irrigation system unattended for weeks on end.

A polyester cloth wicks water from inside the container to outside the container to evaporate and so the cloth is always wet.

The Unpowered Wicking Valve has an operating pressure range of 70 - 1034 kPa.

2. Installing the Unpowered Wicking Valve

Steo 1. Connect the water supply to the valve inlet and connect the irrigation application to the valve outlet.

Connect the water supply to the valve inlet

Connect the irrigation application to the valve outlet

Step 2. Position one or more drippers so that they drip water onto the lid of the container. These drippers are referred to collectively as the control dripper. The adjustable control dripper may also be used. There are a number of drain holes in the lid. A cable tie is provided to secure the control dripper.

A cable tie is provided to secure the control dripper

Step 3. Make sure that the polyester cloth is wet.

Step 4. Use the two rubber band provided to secure the lid so that it doesn't when the float jumps up at the end of the irrigation event.

3. Dripper discharge using irrigation drippers as the control dripper

The volume of water delivered to the container during the irrigation event is called the **control volume**. The control volume is also the volume of water that evaporates between irrigation events.

The float inside the container is adjustable. **The gap between the upper and lower float determines the control volume.**

gap between the upper and lower float	control volume
zero gap	870 mL
3 mm	988 mL
6 mm	1106 mL
9 mm	1224 mL
12 mm	1342 mL
15 mm	1460 mL
18 mm	1578 mL
21 mm	1696 mL
24 mm	1814 mL
27 mm	1932 mL
30 mm	2050 mL

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

Instead of connecting a single irrigation dripper to the Unpowered Wicking Valve, multiple irrigation drippers may deliverer water to the container. The following table shows the dripper discharge for various gaps between the upper and lower float, and 1, 2, 3 or 4 irrigation drippers as the control dripper delivering water to the container. It is assumed that all drippers are identical and at approximately the same level. It is also assumed that frictional head loss is negligible.

gap between the upper and lower float	dripper discharge with 1 dripper as the control dripper	dripper discharge with 2 drippers as the control dripper	dripper discharge with 3 drippers as the control dripper	dripper discharge with 4 drippers as the control dripper
zero gap	870 mL	435 mL	290 mL	217 mL
3 mm	988 mL	494 mL	329 mL	247 mL
6 mm	1106 mL	553 mL	369 mL	276 mL
9 mm	1224 mL	612 mL	408 mL	306 mL
12 mm	1342 mL	671 mL	447 mL	335 mL
15 mm	1460 mL	730 mL	487 mL	365 mL
18 mm	1578 mL	789 mL	526 mL	394 mL
21 mm	1696 mL	848 mL	565 mL	424 mL
24 mm	1814 mL	907 mL	605 mL	453 mL
27 mm	1932 mL	966 mL	644 mL	483 mL
30 mm	2050 mL	1025 mL	683 mL	512 mL

Table 2. Dripper discharge for various gaps between the upper and lower float, and multiple drippers as the control dripper

The adjustable gap between the upper and lower float determines the dripper discharge

Example using two drippers as the control dripper

4. Sprinkler discharge using drippers as the control dripper

The **flow ratio *r*** is defined as the ratio of the flow rate of the sprinklers to the flow rate of the drippers used for the control dripper. It is assumed that all sprinklers are identical and at approximately the same level. It is also assumed that frictional head loss is negligible.

The following table shows the sprinkler discharge for various gaps between the upper and lower float, and 1, 2, 3 or 4 drippers as the control dripper delivering water to the container.

gap between the upper and lower float	sprinkler discharge with 1 dripper as the control dripper	sprinkler discharge with 2 drippers as the control dripper	sprinkler discharge with 3 drippers as the control dripper	sprinkler discharge with 4 drippers as the control dripper
zero gap	*r* x 870 mL	*r* x 435 mL	*r* x 290 mL	*r* x 217 mL
3 mm	*r* x 988 mL	*r* x 494 mL	*r* x 329 mL	*r* x 247 mL
6 mm	*r* x 1106 mL	*r* x 553 mL	*r* x 369 mL	*r* x 276 mL
9 mm	*r* x 1224 mL	*r* x 612 mL	*r* x 408 mL	*r* x 306 mL
12 mm	*r* x 1342 mL	*r* x 671 mL	*r* x 447 mL	*r* x 335 mL
15 mm	*r* x 1460 mL	*r* x 730 mL	*r* x 487 mL	*r* x 365 mL
18 mm	*r* x 1578 mL	*r* x 789 mL	*r* x 526 mL	*r* x 394 mL
21 mm	*r* x 1696 mL	*r* x 848 mL	*r* x 565 mL	*r* x 424 mL
24 mm	*r* x 1814 mL	*r* x 907 mL	*r* x 605 mL	*r* x 453 mL
27 mm	*r* x 1932 mL	*r* x 966 mL	*r* x 644 mL	*r* x 483 mL
30 mm	*r* x 2050 mL	*r* x 1025 mL	*r* x 683 mL	*r* x 512 mL

Table 2. Sprinkler discharge for various gaps between the upper and lower float, and multiple drippers as the control dripper

PC (pressure compensating) sprinklers

If pressure compensating sprinklers are being used, the control dripper should be one or more 2 L/H PC drippers. The flow ratio *r* is half the flow rate of the sprinkler (as specified by the manufacturer).

NPC (non pressure compensating) sprinklers

If non pressure compensating sprinklers are being used, the control dripper should be one or more of the red NPC drippers provided.

You will need to calculate the flow ratio by following the two simple steps below:

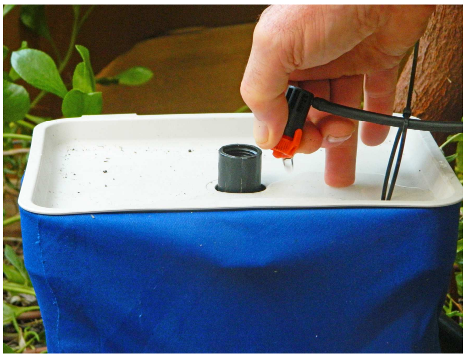
Step1. Connect a sprinkler and a red dripper to the water supply and use empty containers to collect the discharge from the sprinkler and the discharge from the dripper for a certain time interval (one minute for example).

Step 2. The flow ratio *r* is the ratio of the sprinkler volume to the dripper volume.

Example using one red dripper as the control dripper

5. Dripper or sprinkler discharge using the adjustable control dripper

Increasing the flow rate of the adjustable control dripper decreases the emitter discharge. Decreasing the flow rate of the adjustable dripper increases the emitter discharge.



Adjustable control dripper

6. Adjusting the irrigation frequency

The frequency of watering is determined by how quickly water evaporates from the container via the polyester cloth. The irrigation frequency is adjusted by exposing more or less of the polyester cloth outside the container. The time interval between irrigation events can be from half a day to a week or more.

Large area of polyester cloth exposed

Small area of polyester cloth exposed

An irrigation event can be started manually at any time by pushing the float down. An irrigation event can be stopped manually at any time by lifting the float up.

7. Weather-based irrigation control

The time it takes for the control volume of water to evaporate depends on the prevailing onsite weather conditions. When it is hot and dry, the water evaporates more quickly and so the interval between irrigation events is shorter. When it is cool and overcast, the water evaporates more slowly and so the interval between irrigation events is longer.

When it rains, water enters the container via the drain holes in the lid, and so the start of the next irrigation event is delayed. Any rainwater that has entered the container between irrigation events needs to evaporate before the next irrigation event can start.

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.

Most smart irrigation controllers do not use onsite weather data. Instead they use weather data from the Bureau of Meteorology.

The Unpowered Wicking Valve uses the prevailing onsite weather information (namely, evaporation and rainfall) rather than information from the Bureau of Meteorology, and so it is ideal for greenhouse applications. Because the Unpowered Wicking Valve uses onsite weather information, it is more water-efficient than conventional smart irrigation controllers.

8. Key features of the Unpowered Wicking Valve

1. Unpowered (no batteries, no wires, no solar panels, no electronics, no computers, and no WiFi)
2. If you upgrade to the Unpowered Wicking Valve, the conventional irrigation controller, the associated wiring and the solenoid valve become redundant
3. Use with drippers or sprinklers, pressure compensating or non pressure compensating
4. 25 mm inlet and outlet (40 mm also available)
5. Operating pressure range 70 – 1034 kPa
6. Using one or more irrigation drippers as the control dripper, set the dripper discharge to any value between 200 mL and 2 L by adjusting the float
7. Using one or more irrigation drippers as the control dripper, the dripper discharge is independent of the flow rate of the drippers and the water supply pressure
8. Using one or more the drippers as the control dripper, the sprinkler discharge is independent of the water supply pressure
9. Using the adjustable control dripper, the dripper or sprinkler discharge may be adjusted by adjusting the control dripper
10. Adjust the interval between irrigation events by adjusting the exposed surface area of the polyester cloth
11. Responds automatically to onsite evaporation and rainfall
12. The irrigation frequency increases significantly during a heat wave
13. When it rains, water enters the container and delays the start of the next irrigation event
14. Water in the container 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 weeks on end

	Unpowered Wicking Valve	Smart Wi-Fi Irrigation Controller
No solenoid valve required	Yes	No
No wiring required	Yes	No
No power required	Yes	No
* Dripper discharge independent of dripper flow rate	Yes	No
Dripper or sprinkler discharge independent of the water supply pressure	Yes	No
Responds to onsite evaporation and rainfall	Yes	No
Irrigation frequency control	Yes	Yes

* The asterisk indicates the assumption that all the drippers are identical and at approximately the same level, and that frictional head loss is negligible.

9. Conclusion

The Unpowered Wicking Valve uses a radically different approach to irrigation scheduling (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.

Suppose your irrigation system has a conventional irrigation controller. When one of the solenoid valves for a particular zone fails to operate, you can take the opportunity to upgrade the zone to measured irrigation by installing an Unpowered Wicking Valve. The performance of the Unpowered Wicking Valve can then be compared with the performance of the conventional irrigation controller for the other zones.

Weather-based smart irrigation controllers

According to the Irrigation Association (USA), weather-based controllers use weather data to calculate evapotranspiration, the amount of water that evaporates from the soil surface or is used by the plant. Based on local weather conditions, smart controllers automatically adjust the irrigation schedule. Different controllers use different sources of weather data. These include onsite weather sensors or data from the nearest weather station.

The cost of the onsite weather sensors required to calculate evapotranspiration is prohibitively expensive. Hence almost all weather-based irrigation controllers use data from the nearest weather station to approximate the onsite evapotranspiration. Weather-based irrigation controllers calculate evapotranspiration by multiplying the crop coefficient by the reference evapotranspiration. Reference evapotranspiration uses a formula based on weather data that does not include the evaporation rate. Furthermore, the crop coefficient is a theoretical value that depends upon the stage of growth of the crop.

The Unpowered Wicking Valve responds to changes in the actual onsite evaporation. This approach to irrigation control is more appropriate than using a theoretical formula based on off-site weather data. Research done by the Bureau of Meteorology has demonstrated a strong correlation (about 90%) between pan evaporation and reference evapotranspiration:
http://www.bom.gov.au/watl/eto/reference-evapotranspiration-report.pdf
My own research has demonstrated a correlation greater than 90%. See *Evapotranspiration and Measured Irrigation: Report for Smart Approved Watermark* which can be downloaded from the Measured Irrigation website: https://www.measuredirrigation.com/