Unpowered Measured Irrigation Valve

User Manual

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1. Introduction

The Unpowered Measured Irrigation Valve (UMIV) uses on-site 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 valve's bucket. The water in the bucket 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 bucket while the irrigation system 'refills' the soil. When the water in the bucket reaches a high level corresponding to the required watering of the soil, the valve shuts off and the cycle restarts.

Once correctly calibrated, the UMIV 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 bucket from drying out. You can leave your irrigation system unattended for weeks on end.

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

A polyester cloth wicks water from inside the bucket to outside the bucket to evaporate

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

The UMIV has a standard 25 mm inlet and outlet. The operating pressure range is 70 -1034 kPa. The maximum flow rate is 6800 L/H.

A 40 mm and 50 mm version of the UMIV is also available. This means that any drip or sprinkler irrigation application can be installed without using solenoid valves and without using a conventional irrigation controller. By using UMIV's, the irrigation control is completely unpowered.

2. Installing the Unpowered Measured Irrigation Valve

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

Connect the water supply to the valve inlet and connect the irrigation system to the valve outlet

tep 2. Screw the bucket onto the valve.

Screw the bucket onto the valve

Step 3. Connect the adjustable control dripper to the irrigation system and use the cable tie to position the control dripper so that it drips water into the bucket.

Use the cable tie to position the control dripper so that it drips water into the bucket

Step 4. Make sure that the polyester cloth is wet.

Step 5. You may wish to protect the UMIV with a cage or a tree guard, but make sure that the evaporation is not impeded.

3. Calibrating the Unpowered Measured Irrigation Valve

The UMIV controls the irrigation in 2 ways:

- The volume of water applied during each watering, and
- The length of time between watering.

Both these factors are determined by the water level in the UMIV bucket. Water evaporates from the bucket and when the water level reaches the low level, irrigation starts and the control dripper then delivers water into the bucket. Eventually the rising water level lifts the float and magnet inside the bucket and when the water level reaches the high level the irrigation stops. The amount of water that the control dripper delivers to the bucket is called the **control volume**. The control volume is also the amount of water that evaporates between irrigation events. The control volume is approximately 220 ml.

The following two steps work together to calibrate the controller:

First, you set how much water is discharged from each emitter during the irrigation event by adjusting how long it takes for the control dripper to deliver the control volume to the bucket. So while the bucket is filling, the plants are being watered. The time it takes to deliver the control volume to the bucket is adjusted by changing the flow rate of the control dripper (by turning the orange part). If you set the control dripper to a fast flow rate, the bucket fills more quickly; thus there will be less time for watering and the plants receive less water. If you set the control dripper to a slow flow rate, the bucket fills more slowly and the plants receive more water.

Adjusting the control dripper

Next, you set the frequency of watering by adjusting how quickly water evaporates from the bucket. This is done by exposing more or less of the polyester cloth outside the bucket. The time interval between irrigation events can be from one day to a week or longer.

Large area of polyester cloth exposed

Small area of polyester cloth exposed

It is important to realize that the control dripper is simply replacing water that has evaporated from the bucket. This means that an irrigation event may be started or stopped manually at any time without affecting the water usage rate (litres per week for example). An irrigation event can be started manually by pushing the float and magnet down. An irrigation event can be stopped manually by lifting the float and magnet up.

The volume of water applied during an irrigation event can be increased by temporarily removing the control dripper.

4. Weather-based irrigation control

The time it takes for the control volume of water to evaporate depends on the prevailing on-site 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 bucket via six small drain holes in the lid, and so the start of the next irrigation event is delayed. Any rainwater that has entered the bucket between irrigation events needs to evaporate before the next irrigation event can start.

Rainwater enters the bucket via the six small drain holes in the lid

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 on-site weather data. Instead they use weather data from the nearest weather station of the Bureau of Meteorology.

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

5. Pressure independent dripper discharge

Conventional drip irrigation systems control the dripper discharge by using PC (pressure compensating) drippers to control the flow rate and an irrigation controller to control the time. In a domestic garden with mains water supply, 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.

If you use the Unpowered Measured Irrigation Valve and the following three conditions are satisfied, the dripper discharge is approximately the same for all drippers in the zone and independent of pressure:

- Identical NPC drippers are used throughout the zone including the control dripper
- All drippers are at approximately the same level
- Frictional head loss within the zone is negligible.

When these three conditions are satisfied, the pressure independent dripper discharge is the same as the control volume, approximately 220 ml. Note that the pressure independent dripper discharge is also independent of the flow rate of the irrigation drippers. For example, 4 L/H (at 100 kPa) NPC drippers will deliver the same pressure independent dripper discharge as 2 L/H (at 100 kPa) NPC drippers. For this example the duration of the irrigation event for the 2 L/H drippers will be twice as long as the duration of the irrigation event for the 4 L/H drippers.

If the water supply pressure decreases, the flow rate of the NPC drippers also decreases. However, the duration of the irrigation event increases automatically to ensure that the control volume of water is discharged by each dripper. For domestic gardens on level ground, the irrigation system can usually be designed so that variations in pressure within the zone due to frictional head loss are negligible.

The adjustable control dripper is replaced by one of the dripline irrigation drippers

By using the UMIV with pressure independent dripper discharge, many zones with PC drippers can be combined into a single zone with NPC drippers and a single UMIV, and so the cost of the irrigation system can be reduced significantly.

The UMIV has flow control so that the flow can be adjusted to suit the pressure limitations of the irrigation system. For example, if you prefer not to use hose clamps on barbed fittings, then you can use the flow control to reduce the pressure accordingly.

If the pressure independent dripper discharge is more than your plants require at their current stage of growth, the pressure independent dripper discharge can halved by using 2 irrigation drippers for the control dripper. On the other hand, if the pressure independent dripper discharge is less than your plants require at their current stage of growth, increase the number of irrigation drippers so that your plants get more water.

If PC drippers are being used and all drippers are identical (including the control dripper), the dripper discharge is approximately the same for all drippers in the zone and independent of pressure.

6. Key features of the UMIV

1. Unpowered (no batteries, no wires, no solar panels, no electronics, no computers, and no WiFi)
2. If you upgrade to the UMIV, the conventional irrigation controller and associated wiring become redundant
3. Use for sprinkler irrigation or drip irrigation
4. Use with PC (pressure compensating) drippers or NPC (non pressure compensating) drippers
5. 25 mm inlet and outlet
6. Operating pressure range 70 – 1034 kPa
7. Flow control
8. Adjust the dripper discharge by adjusting the control dripper
9. Adjust the interval between irrigation events by adjusting the exposed surface area of the polyester cloth
10. Adjusting the dripper discharge does not affect the interval between irrigation events, and adjusting the interval between irrigation events by adjusting the polyester cloth does not affect the dripper discharge
11. Responds automatically to on-site evaporation and rainfall
12. The irrigation frequency increases significantly during a heat wave
13. When it rains, water enters the bucket and delays the start of the next irrigation event
14. Provided the same drippers are used throughout the irrigation application (including the control dripper), the dripper discharge is independent of the water supply pressure
15. Water in the bucket is protected from debris, algae, mosquitoes and thirsty animals
16. UV resistant including the bucket and polyester cloth
17. Simple, unpowered, and low tech, and therefore fewer things can go wrong
18. Leave your irrigation application unattended for weeks on end

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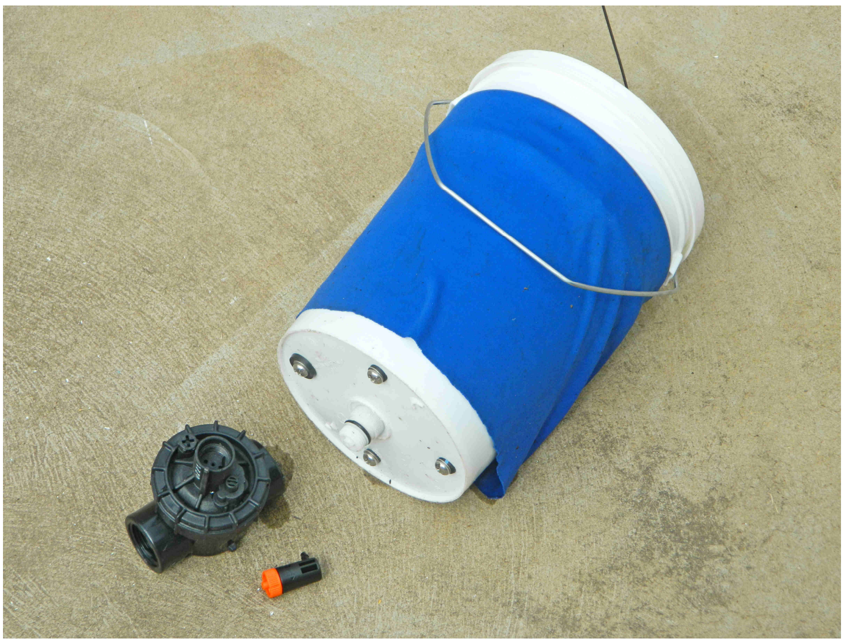

Unpowered Measured Irrigation Valve prior to installation

7. Conclusion

Any drip or sprinkler irrigation application can be installed without using solenoid valves and without using a conventional irrigation controller. By using UMIV's, the irrigation control is completely unpowered. The Unpowered Measured Irrigation Valve uses measured irrigation, 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.

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

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 a UMIV. The performance of the UMIV 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 on-site weather sensors or data from nearest weather station.

The cost of the on-site 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 on-site evapotranspiration. Weather-based irrigation controllers calculate evapotranspiration by multiplying the crop coefficient by the reference evapotranspiration. Reference evapotranspiration uses a formula based only 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 UMIV responds to changes in the actual on-site 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/