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Controlling Your Controller

Irrigation controllers and timers maintain the functional success of plants and landscapes without the hassle of hand watering or manually turning on the system. They are undoubtedly convenient, but, unfortunately, most automatic controllers tend to overwater. They do not irrigate to current conditions and water needs because they have not been programmed correctly and attentively.

Programming a controller/timer requires time and some math. There's no way around it. If programmed properly, irrigation will go on when a soil dries to a predetermined depth and then replenish the moisture lost. For example, if a bed of shrubs and perennials dries to 6", then the irrigation will water to 6" deep. The interval between watering should be the length of time it takes the soil to dry to 6" again.

Quick Tips for Controlling the Controller

Programming a controller is not a process you want to rush. Taking the time to do it right will save time in the long run. Following are some tips to help you off to a good start:

- Raise the controller off the ground and either install it at seating level (about 3.5') or standing level (about 5').
- Put the controller where there are views of the landscape.
- Put the controller in the shade.
- Put valve names and run times in both English and Spanish.
- For rapid control, put an on/off switch between the controller and each valve.
- And finally—expect and budget the time necessary to update the controller once a month.

The position of this controller indicates a weak commitment to water conservation. It is tucked into the far corner of the property, irrigators need to be on their knees with their backs turned to the landscape to use it, and there is no shade.

This chapter covers the steps necessary to ensure that the controller accurately reflects current conditions and needs. There are two basic questions to answer when programming a controller. The first is how much to water. The second is how often to water. This chapter is devoted to answering those two questions.

1. How Much to Water?

To determine how much irrigation is needed you need to figure out the length of time a valve should be turned on. Valve run time is a product of watering goal, type of soil, and type of delivery device. The watering goal is the depth of soil that you want the irrigation to penetrate. The type of soil influences the amount of water required. Finally, the type of watering device used determines the rate at which water is delivered. This can be reduced to a simple formula:

Run Time = Water Goal / Rate of Delivery

Watering Goal

The watering goal is the depth to which you want water to penetrate. This goal will change with time. It will vary depending on the season of the year and the maturity of the landscape.

If an irrigation valve is irrigating a single type of plant, then determining the water goal is easy: look up its "dry-to depth" in a Plant chapter. Dry-To depths are the watering goal.

If many plants are on one irrigation valve, then one of those plants must be selected as the base plant to obtain a dry-to depth. As illustrated in the scenarios below, there is no one right way to select the base plant. Here are a few methods:

- Pick the plant used in the greatest number within the area covered by the valve.
- Pick the plant with the lowest water requirements.
- Pick the plant that provides the greatest benefit/function, such as shade or screening.
- Get a base average from all the plants' dry-to depths.

This area is irrigated with one valve and includes *Senecio*, agave, fountain grass and 3 trees, a locust, eucalyptus and live oak. What plant would you irrigate to? The grass is the most water needy, the oak and Eucalyptus the least. Watering to the grass overwaters all else; irrigating to the trees will cause all others to suffer. The Grand Park, Los Angeles.

Type of Soil

The type of soil greatly affects the amount of water required and the rate at which the soil can receive it. Clay soils may need as much as twice the water and time as sandy soils. The watering times below are based on dry soils. Moist or wet soils should be dried before using these recommendations. Another thing to keep in mind is that soils that are reluctant to receive water, such as clay, are also reluctant to lose it. Even in the middle of summer it can take clay soils weeks to dry.

Quick Note: *1 inch of water over 1 sq. ft. equals 0.623 gallons of water* ■

Chart 1: Amount of Water Required and Rates of Maximum Delivery per any sq. ft.*

Watering Depth / Dry-To Depth	Course (sandy loam) Amount of Water Amount of Time	Medium (silt) Amount of Water Amount of Time	Fine (clay loam) Amount of Water Amount of Time
3"	Needs: .25" Takes: 1–2 minutes	Needs: .375" Takes: 4–5 minutes	Needs: .5" Takes: 8 minutes
4"	Needs: .33" Takes: 2–3 minutes	Needs: .48" Takes: 7–8 minutes	Needs: .66" Takes: 20 minutes
5"	Needs: .42" Takes: 3–4 minutes	Needs: .59" Takes: 10 minutes	Needs: .83" Takes: 36 minutes
6"	Needs: .5" Takes: 4–5 minutes	Needs: .75" Takes: 13 minutes	Needs: 1" Takes: 60 minutes
9"	Needs: .75" Takes: 12 minutes	Needs: 1.25" Takes: 25 minutes	Needs: 1.5" Takes: 1 hour and 30 minutes
1'	Needs: 1" Takes: 18 minutes	Needs: 1.5" Takes: 36 minutes	Needs: 2.1" Takes: 2 hours and 15 minutes
1.5'	Needs: 1.5" Takes: 26 minutes	Needs: 2.25" Takes: 48 minutes	Needs: 3" Takes: 3 hours
2.25'	Needs: 2.25" Takes: 42 minutes	Needs: 3.37" Takes: 1 hour and 15 minutes	Needs: 4.5" Takes: 4 hours and 50 minutes
3'	Needs: 3" Takes: 1 hour and 6 minutes	Needs: 4.5" Takes: 1 hour and 45 minutes	Needs: 6.5" Takes: 7 hours and 10 minutes

*Bear in mind that your municipality may have watering restrictions during drought or critical shortages and that you will need to water in intervals within local watering restrictions.

Chart 2: Gallons of Water Needed in Dry Soil per 200 sq. ft.

Watering Depth	Course: Sandy Loam	Medium: Silt	Fine: Clay
3"	31	47	63
4"	41	60	83
5"	53	74	104
6"	63	94	125
9"	94	157	188
1'	125	188	263
1.5'	188	282	376
2.25'	282	423	564
3'	376	564	815

Watering Device

The next step in determining valve run times is finding out how much water your existing system delivers. High-pressure sprinklers deliver water between 0.5 to 20 gallons per minute (gpm). Low-pressure devices, like inline emitters and micro-spray heads, deliver water between 0.5 to 4 gallons per hour (gph).

To figure how many gallons a device delivers per sq. ft. divide its gpm or gph by the area it covers in sq. ft. If gph, then divide the total by 60 to get gallons per minute.

High Pressure: ___ gpm / ___ sq. ft. covered = _____ gallons per sq. ft. per minute

Low Pressure: ___ gph / ___ sq. ft. covered / 60 = ___ gallons per sq. ft. per minute

Example 1: A sprinkler head that delivers water at 2 gpm and covers 70 sq. ft. delivers 0.03 gallons per sq. ft. per minute.

Example 2: The emitters in the tubing deliver water at 0.5 gph and cover 0.75 sq. ft., delivers 0.01 gallons per sq. ft. per minute.

Inline emitter tubing being installed a couple inches below ground. Courtesy of Camrosa Water District.

There are three ways to determine the amount of water a device delivers. The list is ranked from most to least accurate.

1. Take measurements. If the system uses overhead sprinklers, place cups within its radius, run irrigation for 10 minutes and measure collected amounts; if it uses low-pressure, place cups under the devices, run for 20 minutes and measure collected amounts.

2. Read the stamp on the device. Many devices have imprints or prints signifying the rates of delivery, but be aware that age and use change those rates dramatically.
3. Identify the product and search the Internet for specifications. Be aware, though, that these specifications are usually expressed as a range, and it is difficult to pinpoint a specific performance.

Emitter Wetting Patterns

The emitter wetting patterns vary and are a product of the type of soil and the watering depth. The greater the depth, the greater the horizontal spread of water. The absolute best way to find out the wetting pattern is to physically examine the soil: turn on the irrigation for 20 minutes, turn off and wait for two hours, and then dig to the edges and bottom of the wetting pattern to determine its size.

Another method of determining the wetting pattern of emitters is a rough calculation. In sandy soil emitters spread 1 times the depth; irrigating 6" down wets 6 sq. inches. In silt soils the wetting patterns is 2 times depth; 6" down wets 1 sq. ft. In clay soil water spreads 4 times the depth; 6" down wets 2 sq. ft.

Type of soil greatly impacts the amount of water needed and its horizontal spread. Irrigating 1 square foot to 4" deep requires 0.205 gallons of water in sandy soils, 0.300 in silty soils, and 0.415 in clay soils.

As an Example

Let's say you have two valves to irrigate an area with a mass of ground covers. One valve is low-pressure inline emitter tubing and the other is rotor sprinkler heads. The soil was determined to be silt and the ideal watering depth for the ground cover is 5".

As a reminder: *1" of water per sq. ft. equals 0.623 gallons of water.* ■

Valve 1: This valve is comprised of inline emitter tubing that delivers water at 1 gph. According to the information above this emitter wets 1 sq. ft. Using Chart 1 we see that watering to 5" in silt requires 0.59 inches of water per sq. ft.

The Numbers

Need 0.59 inches = 0.59" * .623 = .37 gallons per sq. ft.

Device delivers 1 gph over 1 sq. ft. (1/60) = .0167 gallons per minute

= .37 gallons (needed) /0 .0167 (delivered) = 22 minutes

Valve 2: This valve has rotor heads that delivers water at 2 gpm. One head covers 60 sq. ft. According to Chart 1 watering to 5" in silt requires 0.59 inches of water per sq. ft.

The Numbers

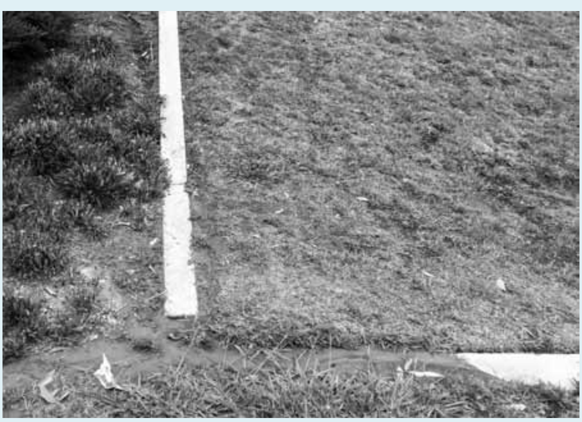
Need .59 inches = .59" * .623 = .37 gallons per sq ft.

Device Delivers 2 gpm over 60 sq. ft. (2/60) = .033 gallons per minute

= .37 gallons (needed) / 0.033 (delivered) = 11 minutes

Pulse Irrigation

Delivery devices may supply water faster than a soil can absorb it. If that is the case pulse irrigation is the remedy. Pulse irrigation works by irrigating the top 2" of soil, where infiltration occurs quickly, stopping irrigation for several hours, and then watering the top 2" again. Getting water to 6" deep with this practice might require 3 pulses, that is, 3 cycles of brief irrigation. Pulse irrigation is often used on slopes and areas with dense soils.



This slope needs pulse irrigation. Rills at the top of the photo and a buried mow strip at the bottom mean that the slope is getting water faster than it can accept it.

2. How Often to Water?

To figure out how often to water you need to know how long it takes a particular soil to dry out. There are many books, formulas, and online calculators that help determine the interval between irrigation, but none are as accurate as physical measurements.

The best way to determine drying times is to wet the landscape, turn off the irrigation, and take soil samples every two to four days. Continue taking soil samples until the soil dries to the base plant's dry-to depth, at which point you have the number days between watering. Although these tests should be performed every several months, they are especially important in spring and late summer, when irrigation plays a pivotal role in both plant health and regional conservation.

Despite the soil looking dry both the moisture meter and wooden dowel indicate that there is plenty of moisture 4" down.

Best Time of Day to Irrigate

Landscapes along the coast should be irrigated early morning to reduce chances of mildew and rot. Landscapes in the drier foothills, mountains and deserts should be irrigated mid-evening to minimize water loss to evaporation. Also, try to have the irrigation go on when someone is around to observe. Broken irrigation or overspray will persist for weeks if no one notices.

Weather-Based Timers

A weather-based timer calculates your landscape's water needs according to the weather and then turns on the valves individually to meet the demands of each hydrozone. The timer does this by taking the information you give it about your landscape and combining that with information it gets from the nearest weather station.

Weather-based timers are the most efficient irrigation controller for established landscapes, large lots, and gardens close to a weather station. The timer is a little unyielding for gardens that change a lot, and for those where the weather station is in a different microclimate. In order for the timer to work properly—that is, maintain plant health without wasting water—it needs accurate and timely information. This means someone must change the timer's information every time a change occurs in the landscape.

Budget Adjustment

A feature rarely used on irrigation controllers (despite the fact that most have them) is the budget adjuster. This feature allows you to turn the entire irrigation system up or down by percentages, instead of reprogramming each station. These adjustments are handy when unusual weather happens, such as summer fog or rain.

The budget adjustment feature on your automatic irrigation controller is a quick way to respond to changing conditions. Mid-summer monsoon? Reduce all irrigation by 60%. June gloom in July? Reduce all irrigation by 40%. Budget adjustment allows for quick control of all irrigation valves.

Troubleshooting Irrigation Controllers

Controller Will Not Keep a Program

Why: A controller reverts back to pre-programmed settings.

Remedy: Replace the controller's battery and either replace the timer's plug or the structure's outlet.

The Irrigation System is Always Over or Underwatering

Why: The gardener is not giving the controller accurate information.

Remedy: Install a weather-based controller, or install a rain gauge and/or moisture sensors. Always, remember to water with any local watering restrictions.

The Irrigation System Comes on in the Rain

Remedy: Install an inexpensive rain sensor.

The Irrigation System Runs Despite Breaks in the Line

Remedy: Install a flow sensor before the manifolds. These sensors detect irregularities and will shut off the problem valve.

Too Many Stations to Re-Program Individually During Shift in Weather

Remedy: Use the Water Budget feature. This feature will cut watering to all stations by a certain percentage. Overcast? Reduce irrigation by 20%. A light summer rain? Reduce irrigation by 80%.

or

Alternative Remedy: Install on/off switches between the controller and each valve.

Pulling It All Together: 3 Examples

California Lilac (*Ceanothus gloriosus*) in sand

	Spring	Summer	Fall	Winter
Watering Depth	6"	6"	1'	0
Soil	Sand			
Water Needed: gallons per sq. ft.	0.5" = 0.31 gallons (.5*.623)	0.5" = 0.31 gallons (.5*.623)	1" = 0.623 gallons (1*.623)	0
Time to Infiltrate	5 minutes	5 minutes	18 minutes	0
Rate of Delivery	Emitter: 2 gph	Emitter: 2 gph	Emitter: 2 gph	Emitter: 2 gph
Wetting Pattern	6 sq. inches	6 sq. inches	1 sq. ft.	0
Delivery per sq. ft. per minute	0.067 gallons (2/60/.5)	0.067 gallons (2/60/.5)	0.033 gallons (2/60/1)	0
Time Needed	4.6 minutes (.31 / .067)	4.6 minutes (.31 / .063)	9 minutes (.623 / .033)	
Pulses	0	0	0	0
Valve Run Time	**5 minutes**	**5 minutes**	**19 minutes**	**0**
Dry Time*	**6 days**	**4 days**	**6 days**	**0**

* Dry Time is a product of observation and soil tests.

Coral Bells (*Heuchera spp.*) in clay

	Spring	Summer	Fall	Winter
Watering Depth	4"	6"	6'	0
Soil	Clay			
Water Needed: gallons per sq. ft.	0.66" = 0.41 gallons (.66*.623)	1" = 0.623 gallons (1*.623)	1" = 0.623 gallons (1*.623)	0
Time to Infiltrate	20 minutes	60 minutes	60 minutes	0
Rate of Delivery	Rotor Head: 2 gpm	Rotor Head: 2 gpm	Rotor Head: 2 gpm	Rotor Head: 2 gpm
Wetting Pattern	60 sq. ft.	60 sq. ft.	60 sq. ft.	0
Delivery per sq. ft. per minute	0.033 gallons (2/60)	0.033 gallons (2/60)	0.033 gallons (2/60)	0
Time Needed	12 minutes (.41 / .033)	19 minutes (.623 / .033)	19 minutes (.623 / .033)	
Pulses**	2	4	4	0
Valve Run Time	**6 minutes / 2 times**	**5 minutes / 4 times**	**5 minutes / 4 times**	**0**
Watering Interval/ Dry Time*	**6 days**	**8 days**	**11 days**	**0**

* Dry Time is a product of observation and soil tests.

** Pulses are needed because Time to Infiltrate exceeds Time Needed, meaning these heads deliver water faster than the soil can absorb it.

California Fescue (*Festuca californica*) in clay

	Spring	Summer	Fall	Winter
Watering Depth	4"	6"	6"	4"
Soil	Clay			
Water Needed: gallons per sq. ft.	0.66" = 0.41 gallons per sq. ft. (.66*.623)	1" = 0.623 gallons per sq. ft. (1*.623)	1" = 0.623 gallons per sq. ft. (1*.623)	0.66" = 0.41 gallons per sq. ft. (.66*.623)
Time to Infiltrate	20 minutes	60 minutes	60 minutes	20 minutes
Rate of Delivery	Emitter: .5 gph	Emitter: .5 gph	Emitter: .5 gph	Emitter: .5 gph
Wetting Pattern	1.5 sq. ft.	2 sq. ft.	2 sq. ft.	1.5 sq. ft.
Delivery per sq. ft. per minute	0.005 gallons (.5/60/1.5)	0.004 gallons (.5/60/2)	0.004 gallons (.5/60/2)	0.005 gallons (.5/60/1.5)
Time Needed	82 minutes (.41 / .005)	157 minutes (.623 / .004)	157 minutes (.623 / .004)	82 minutes (.41 / .005)
Pulses	0	0	0	0
Valve Run Time	**82 minutes**	**157 minutes**	**157 minutes**	**82**
Dry Time*	**6 days**	**9 days**	**11 days**	**20 days**

* Dry Time is a product of observation and soil tests.