Use Valve or Pump for Low Pressure Irrigation?

Q. Can you suggest an affordable electric valve which can be actuated by a standard irrigation controller to control drip systems which are gravity fed from tanks above ground filled with captured rainwater? The water pressure is less than 1 PSI, though flow rate through valve can be as high as 5 GPM.

A.

Automatic Valves for Rain Barrels:

I can't think of any standard solenoid irrigation valves that would work with a typical rain barrel. The standard solenoid valves used for irrigation systems simply need more pressure than you have available from a typical gravity fed rain barrel. The higher pressure requirement for the valve is a function of the hydraulics that makes the valve operate. You either need more pressure or you need a different type of automatic valve. If you want to create more pressure you need to raise the height of the rain barrel. For every foot you raise the rain barrel you will create 0.433 PSI. The minimum operating pressure of most irrigation valves is at least 15 PSI, that means the barrel needs to be 34 feet above the height of the valve. That is simply not practical in most cases! Now you understand why those water towers you see in some communities are so high!

Yes, they do make motor-operated valves that will work with almost zero water pressure. I'll address that later.

Use a Pump for your Rain Barrel!

The best way to accomplish what you want may be by not using a valve at all! Consider using a small pump placed on your rain barrel outlet hose. Most irrigation systems do not work very efficiently at the low water pressures typical of rain barrel systems. Thus a pump is often the best solution as it may provide the added benefit of more water pressure.

Drip Emitter Selection

Most people use drip irrigation with their rain barrels, so that is what I will assume here. (If you want to use sprinklers you will probably need a lot more water pressure, and therefore a larger pump.) I've found the best emitters for the very low pressures in a rain barrel fed system are the most simple emitters, such as those commonly called a "flag emitter" or "take-apart emitter". Another popular choice for emitters when using a rain barrel is the adjustable flow emitter/bubbler. These use more water, but are particularly good for watering pots of various sizes as you can adjust the flow needed for each pot. Stay away from higher cost emitters and those labeled as "pressure compensating" as they tend require higher pressures to operate efficiently. Keep the tube lengths short, longer tubes need more water pressure to push the water to the end of the tube. Note: Very low pressure drip systems are going to be less uniform. That's just the way it is, you will have to either live with that, or use a pump that creates a pressure of 15 PSI (35 feet of lift) or more. Most people just elect to be content with the low uniformity. If you want to test the uniformity of your drip system it is very easy to do, simply build your drip system and attach it to your rain barrel. Then place a disposable plastic cup under each emitter and run the system for a few minutes. All the cups should have about the same amount of water in them. If the water in the cups varies greatly then the uniformity is pretty bad. If the uniformity is bad enough that you think it will create uneven watering you can do a simple test to see if more pressure will help by hooking your drip system up to a garden hose. Be careful, the garden hose will provide more pressure than you need, so turn the valve on slowly and don't turn it on all the way. Usually the higher pressure from the garden hose will result in more

uniformity between the water in the cups.

Selecting and Installing Your Pump

Make sure the pump is rated for enough flow to supply your emitters, and enough lift to get the water needed for your irrigation over the top of the barrel. Add the flow rate of all the emitters together to determine the flow rate needed for the pump. for example if you have 15 emitters that are rated at 1gph (gallon per hour) then the pump will need to supply at least 15 gph. If the barrel is 5 feet tall then the pump will need to lift the water 5 feet. Some pumps list a PSI output value rather than a foot of lift value. To convert PSI to feet of lift multiply PSI times 2.31. So a pump with a 5 PSI output will lift water 11 feet. (5 x 2.31= 11.55)

If you can find one the right size, a submersible pump is the easiest and best method. Unfortunately most are made to be fountain pumps or sump pumps and they don't create enough water pressure. If you find one that will work for you, attach your irrigation hose to the pump, put the pump in the bottom of the barrel, and run the tube up over the top of the barrel. You will need a air vent at the high point on the tube near the top of the barrel (above the maximum water level) to prevent water from siphoning out of the barrel through the tube when the pump is not running. You can buy an air vent from any drip irrigation store. Or… a very simple and cheap way to create an air vent is to add a drip emitter on the hose at the top of the barrel, so that the water from the emitter drips back into the barrel and is not wasted. When the pump turns off, this emitter will allow air to flow back into the tube and the air will stop the water from siphoning out.

If you don't use a submersible pump then the pump will be attached to an outlet at the bottom of the rain barrel. Make sure the pump is bolted or screwed down to a firm surface or it will jump all over the place when it runs. The tube from the pump outlet will need to be looped up above the top of the barrel and an air vent (or emitter as described above) installed at the high point to prevent the water from draining out through the pump when the pump is off.

Controlling the Rain Barrel Pump:

The pump can be turned on and off by using a timer. A simple lamp or other household electricity timer will often work for an extreme low cost option, however lamp timers are pretty limited. Most timers of this type will only turn on and off the pump once a day, and do it every day. Most people don't need to water daily, so this could waste water. If you do use a simple timer make sure it is rated for a voltage and amperage that is equal to or higher than the input of your pump.

If you want to use a standard irrigation timer to control the pump you will need to buy a pump relay unit. Irrigation timers output 24 VAC, most pumps use 120 VAC. So the pump can't be connected directly to the irrigation timer. A relay is used to allow the pump to be turned on by the timer. You can purchase a pump relay made for irrigation timers at almost any irrigation supply store. Make sure the relay is rated for the correct voltage and amperage for your pump. Instructions for installing and wiring the pump relay should be provided with the pump relay.

Multiple Watering Circuits:

Most rain barrels don't hold enough water to supply more than a single irrigation watering circuit, but in some cases they might. If you need more than one "valve circuit" you can simply duplicate the pump solution above and use two pumps. Multiple pumps may be the least expensive solution for as many as 3 or more irrigation circuits. As an alternative, you can use multiple motorized valves (see below) with or without a pump. Another alternative is to use a single pump that is sized to provide enough water and pressure for a standard irrigation setup using solenoid valves. I would suggest that the pump for this would need to create a minimum of 25 PSI in

addition to sufficient flow to supply the largest irrigation circuit. Use a standard irrigation controller that has a "pump start" feature to turn on and off both the valves and the pump. The pump will require a pump relay to control it as described above for the single pump system.

Motorized rain barrel valves:
They do make mechanical motor-operated ball or butterfly type valves that will open at any pressure. They are used primarily for non-irrigation purposes. Before you purchase a motorized valve I suggest you install your irrigation system and test it using a manual valve as described above. If it works fine without a pump then you can use a motorized valve to control it.

When using a motorized valve make sure the motor operates on 24VAC. When I first wrote this article, the only motorized valves I was familiar with were very expensive, industrial quality models, costing several hundred dollars. However, an email from "Randy G." says he has successfully used the much less expensive motorized ball valves that are made for hydronic heating systems. I haven't tested these valves, but I looked over the literature on the Taco valve Randy mentions, and it seems to indicate the valve would work. Per Randy, "the Taco Sentry series are motorized ball valves…, and can be had for $70 or so at most online stores… Honeywell, White-Rodgers, and several other companies also sell ones with similar prices. You can get the Honeywell ones dirt cheap…, but I've heard their reliability is lower, so I haven't tried them – something about oxygen breaking down the rubber over time. And, of course, make sure you get a motorized ball valve, not a heat motor valve, unless you really want to use lots of power and take several minutes to open or close…"

Randy also suggests "Virtually all modern (heating) zone valves are 24VAC, and thus directly compatible with standard irrigation timers, especially the Taco electronic ones that draw relatively little power, good for cheap electronic timers." To find these motorized valves do a search for "hydronic zone valve". Be sure to note the connection types for the valves, most are made to connect to PEX pipe or be soldered onto copper. You may have to install adapters to fit them to your irrigation system pipes or tubes.

Special thanks to Randy for supplying this helpful tip! If you try these valves for your system I would love to hear your thoughts on them as well.

People keep writing to say they are having trouble finding equipment that will work with a rain barrel, particularly pumps, so I'll add some links below as I discover suitable products. Disclosure: I get a small commission on sales of these items if you buy them through these links.

The Little Giant 35-OM pump is made for high pressure applications like commercial carpet cleaners, but it produces good pressure at a low flow, a combination that is great for small drip systems. Amazon doesn't list the performance chart for this pump so here it is:

40 gph at 70 ft hd
60 gph at 65 ft hd
80 gph at 58 ft hd
100 gph at 54 ft hd
120 gph at 45 ft hd
140 gph at 30 ft hd

gph = gallons per hour. gph/60=gpm

ft hd = feet of lift. ft hd x 0.433 = psi (pounds per square inch)