Residential Irrigation System Rainfall Shutoff Devices, or Rain Sensors[1]

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Rain sensors—also called rain shutoff devices—are designed to interrupt the cycle of an automatic irrigation system controller when a specific amount of rainfall has occurred. They are small devices connected to the irrigation system controller and mounted in an open area where they are exposed to rainfall.

Some of the new irrigation controllers have a special connection which allows a rain sensor to be attached directly. If such a feature is not available, or the sensor doesn't work with a given controller, the sensor can always be "hard-wired" into the controller. This is done by wiring the rain sensor in series with the common wire. When a specific amount of rainfall has occurred, the rain sensor will interrupt the system's common wire, which disables the solenoid valves until the sensor dries out.

Florida is one of just a few states with a rain sensor statute. The most recent version of this statute (2010) says the folllowing: "Any person who operates an automatic landscape irrigation system shall properly install, maintain, and operate technology that inhibits or interrupts operation of the system during periods of sufficient moisture" (Florida Statute 373.62). Thus, *all* automatic landscape irrigation systems require a rain sensor or other shutoff device, such as a soil moisture sensor irrigation controller (see https://edis.ifas.ufl.edu/ae437). Rain sensors are available wherever irrigation supplies are sold, and a homeowner or irrigation professional can install them.

A rain sensor:

- Conserves water—prevents irrigation after recent rain events.
- Saves money—reduces utility bills and lawn maintenance costs by interrupting the irrigation system after adequate rainfall.
- Reduces wear on the irrigation system because the system runs only when necessary.
- Reduces disease and weed pressure by eliminating unnecessary irrigation events.
- Helps protect surface and groundwater by reducing the runoff and deep percolation that carries pollutants, such as fertilizers and pesticides, into storm drains and groundwater.

Types of Devices

Rain sensors operate by one of two methods: 1) Devices that collect rainwater, measuring the water weight or the electrical conductivity of water; 2) Devices that measure the proportional expansion of hygroscopic disks.

Water weight—When a preset weight of water is collected in a small dish, the connection to the automatic irrigation

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valve is interrupted until the dish is emptied or a portion of water evaporates, reducing the weight below the critical level. A disadvantage of this device is that any other weight (debris, frogs, etc.) can turn off the irrigation system. It also requires more maintenance (Figure 1).

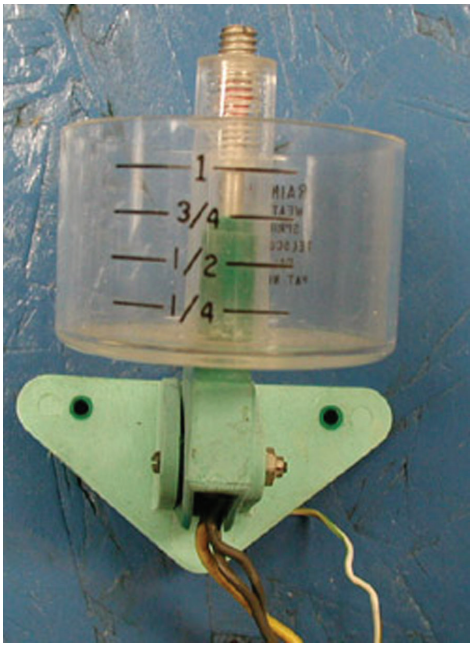

Figure 1. Weight-based rain shutoff device.

Electrical conductivity of water—A set of electrodes is used to detect the water level in a small collection dish. The distance between the bottom of the collection dish and the electrodes can be adjusted so the irrigation system is not switched off by small rain events. Typically, the sensor is set to detect rain events larger than 1/2 inch. Similar to the previous type, water may have to be removed from the dish, and debris may create some problems (Figure 2).

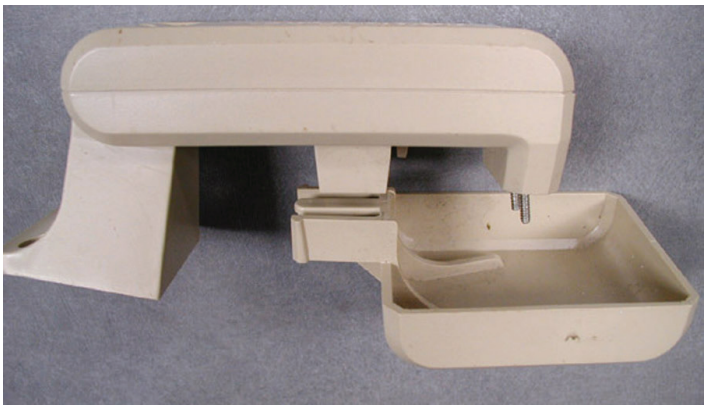

Figure 2. Hygroscopic shutoff device based on electrical conductivity.

Expanding disks—These devices are the most popular rain sensors due to their good reliability, low cost, simple installation, and low maintenance. There are both wired and wireless versions (Figure 3 and Figure 4). Some advantages of the wireless models include a quicker and easier installation and additional mounting locations to choose from (up to 300 ft away from the receiver), especially for sites that present difficulty in routing wire as well as for retrofit applications.

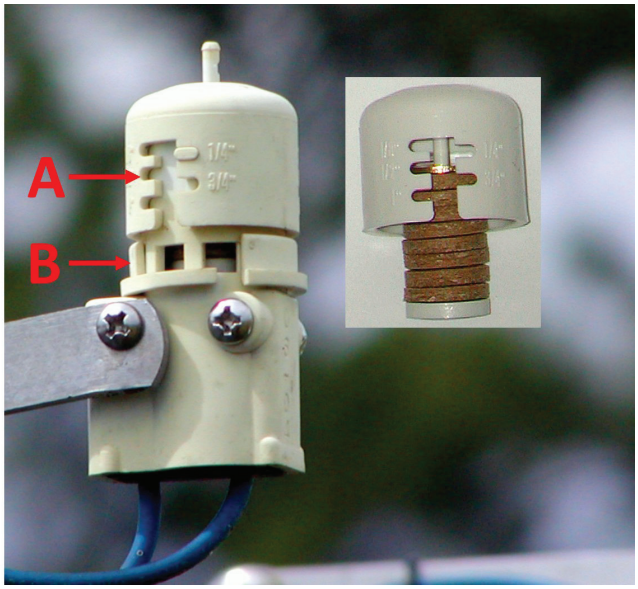

Figure 3. Wired rain shutoff device with expanding disks: (a) Rain threshold set-point slots; (b) Vent ring. The insert shows the expanding hygroscopic disks.

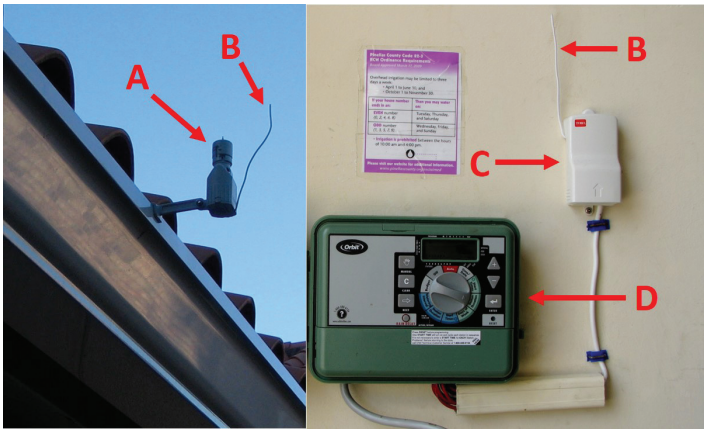

Figure 4. Wireless rain shutoff device with expanding disks: (a) Transmitter, (b) Antenna, (c) Receiver, (d) Irrigation Controller or Timer.

Hygroscopic disks absorb water and expand proportionally to rainfall amount, triggering a pressure switch. The expansion space can be easily adjusted by rotation of the disk cover to a predetermined amount of rain required to trigger the switch. The amount of rain that will interrupt the irrigation system is marked on the adjustment cap (Figure 3 and Figure 4). The switch remains open as long as the disks are swollen. When the rain has stopped, the disks begin to dry out and contract, and the switch closes again.

Installing the Device

The sensing portion of a shutoff device should be mounted where it will be exposed to unobstructed rainfall, but not

in the path of sprinkler spray. It is typically installed near the roofline on the side of a building (Figure 4). However, it should not be mounted such that it comes into contact with water running directly off the roof. If vandalism is not a threat, it can be mounted lower on a fence post or deck railing. It is important that trees, overhangs, and awnings are not blocking direct rainfall onto the device.

The closer the wired sensor is to the controller, the shorter the wire and less chance for wire breaks. Mounting the sensor in a very sunny, southern end of a building may cause the water to dry out sooner than desired. Conversely, mounting on the northern end of a building with constant shade may keep it from drying soon enough, especially in Florida's humid climate. Some experimentation with adjustment of sensor level is strongly recommended for best results.

The controllers that are provided with a plug for a rain sensor require that the sensor be compatible with a given type of controller. The sensor can operate as "normally closed" or "normally open."

If a given sensor does not work with a controller that is already installed, it can always be "hard-wired" into the controller. If the sensor is purchased at the time of controller installation, it is a good idea to check for compatibility of both devices.

Testing

The device can be tested during normal rainfall events by setting out several containers with dimensions similar to those recommended for testing irrigation system uniformity (see How to Calibrate Your Sprinkler System). At least three containers should be located in the yard such that rainfall can accumulate freely in these containers. Measure the depth of water in each container with a ruler, and calculate the average of the measurements. When the containers average 1/2 inch of rainfall, set the rainfall sensor to 1/2 inch and manually initiate the irrigation system at the controller. The system should not operate. If this is the case, the rainfall sensor is adjusted properly. If the system runs, the rainfall sensor may have to be: 1) cleaned, 2) located so that rainfall will contact it, or 3) repaired or replaced. Sensors with electrodes (see Figure 2) may require cleaning of the electrodes and/or cleaning of the catch container. Sensors with a weighing dish or cup (see Figure 1) may require periodic cleaning of the container.

Potential Water and Cost Savings

The amount of water that can be saved using rain shutoff devices varies, but in a year with average rainfall, savings are usually substantial. There are several factors involved in determining how much a sensor can reduce water usage: how often it rains, whether or not the controller is left on for automatic operation, and the amount of water applied by the system per cycle. If the water costs and the amount of water applied per watering cycle by the whole system are known, it is easy to calculate how much money is being saved each time the sensor interrupts the watering cycle because of rainfall.

As an example, if a system irrigates 1/2 acre of turf and is set to run each zone so that 1/2 inch of water is applied per cycle, one can calculate that 13,576 gallons are being applied over the 1/2 acre of turf per cycle. Assuming water costs $2.00/thousand gallons, the savings will be $27.15 every time the sensor eliminates an irrigation event. Even more importantly, 13,576 gallons that would be lost to deep percolation or runoff will be saved. If this amount is multiplied by the number of substantial rainfalls that occur in the area over one growing season, a significant amount of money and water can be saved.

Research Results and Recommendations

Cardenas-Lailhacar and Dukes (2008) showed that smaller set points led to the highest water savings. Thus, homeowners should use the smallest set point possible with 1/8 inch being the lowest on most devices. In any case, we recommend not exceeding a set point of 1/4 inch. This same study estimated a payback period of less than a year. However, in practice, water savings have not been found significant (see publications at https://abe.ufl.edu/faculty/mdukes/publications/).

References

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