Irrigation Troubleshooting Guide

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INTRODUCTION

The following pages are a compilation of class information from the Rain Bird ASC seminar “Troubleshooting an Irrigation System.” Its purpose is to serve as a reference manual for troubleshooting problems. We hope that you keep this manual and refer to it when needed. Remember, you don’t have to know the answer, you just need to know where to look for the answer.

We also encourage you to share this information with your coworkers. We at Rain Bird have always believed that education is the way to improve not only ourselves, but also our industry.

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SPRAY HEADS

Spray heads are relatively simple to troubleshoot. Below are the most common problems found with spray heads.

Misting - This is a result of excessive water pressure. Reducing the pressure may be done in one of two ways.

1. Using the flow control on the remote control valve, or
2. Installing a pressure regulator before or on the valve

Inaccurate pattern - This is usually caused by some type of blockage, either in the nozzle itself or in the screen. Only water, air, or a soft bristled object should be used to clean the nozzle and water to clean the screen.

Leaking around the stem (also known as “blow by”) - This is usually caused by debris between the wiper seal and stem. A quick way to solve this problem is to step down lightly on the stem while the sprinkler is in operation. This causes water to flush quickly between the stem and cap, taking the debris with it. If this doesn’t work, the cap is probably damaged and needs to be replaced.

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IMPACT SPRINKLERS

All impact sprinklers work in the same basic fashion. This includes impact style rotors as well as most of the different styles or brands available today. The following is a quick overview of how an impact sprinkler works.

Operation

Water enters the bottom of the sprinkler through the bearing nipple, proceeds up through the body and exits out the nozzle. When the water hits the arm, it is propelled out away from the sprinkler. This action causes the arm to pivot away from the water stream, creating tension on the arm spring. When the spring tension is stronger than the force against it, the arm moves quickly toward the water stream and “impacts” against the body. This “impact” causes the sprinkler to turn in a very consistent manner. This is where the term “impact” was derived from.

All Rain Bird Sprinklers share a common trait. This common trait is *very important* when troubleshooting impact sprinklers!

All Rain Bird Sprinklers Are Water Lubricated

The worst thing that can be done to an impact style sprinkler is to apply a foreign lubricant. This includes oil, WD-40, silicone, Teflon, pipe dope, etc. These foreign lubricants might make the sprinkler work right away, but it will actually cause the sprinkler to wear out faster. Foreign lubricants attract dust and debris. When lubricants are applied to the bearing washers initially, an oil base forms on the washers. This allows the sprinkler to spin freely for a short time only! Over time, dust is attracted to the washers on the bearing stack. This causes additional friction on the washers and causes them to wear out much faster. If foreign lubricants have been applied, all of the washers and seals will need to be replaced. It is also a good idea to clean the brass at this time by a process called bead blasting.

This ability to rebuild an impact is one of its biggest advantages. Impact sprinklers are totally serviceable in the field. If a foreign lubricant has been used, or if the sprinkler is just worn out from years of use, *most parts are available and it is totally serviceable!* By simply replacing worn parts (usually washers, seals, and springs) the sprinkler will be in operation for several more years of reliable service.

Troubleshooting

First check for the obvious. Problems such as:

- turf obstruction
- dirt or debris in case or nozzle
- excessive water pressure
- broken arms, trips, etc.
- foreign lubricants
- inadequate water pressure

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Common Problems

The sprinkler is stuck or won't return - The most common reason for this is water pressure that is too high or to low. Impact sprinklers can fail under either scenario. To determine what the operating pressure is, a pitot tube and a pressure gauge may be used to get a pressure reading at the head. This is done by placing the end of the pitot tube in the water stream, as close to the nozzle as possible. *It is important to not place the end of the pitot tube inside of the nozzle opening.* This can scratch the inner wall of the nozzle, as well as giving an inaccurate pressure reading. If the inner wall of the nozzle is scratched, the distribution pattern may be effected. Any of the previously mentioned problems can result in a non-rotating sprinkler.

The sprinkler is leaking - This is normally caused by worn washers and seals. They should be replaced at this time.

The sprinkler is not throwing as far as it should - This is usually caused by some type of blockage, either in the nozzle or the inlet screen. Cleaning the nozzle should be done with air, water or a soft bristled object (such as a pipe cleaner). *Do not use wire or a screwdriver!* This can scratch the nozzle.

MAXI-PAW™

The Maxi-Paw™ is a plastic impact rotor that operates in the same manner as other impacts. The Maxi-Paw™ does have one unique feature, and that is an arm spring that can be changed based on pressure requirements and nozzle size. It comes with the spring in the "A" position. The "A" position is the farthest notch from the counterweight end of the arm (refer to the figure below). This spring should stay in this position if using the 8, 10 or 12 regular nozzles, or the 10 low angle nozzle. The spring should be moved to the "B" position (refer to the figure below) when using the smaller nozzles. This is especially important when used in low pressure situations. Although this is an added feature, if the spring is in the wrong position the Maxi-Paw™ will not trip properly.

To troubleshoot a Maxi-Paw™ sprinkler, follow the same procedures that would be used with any other impact.

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T- Bird

The T- Bird is Rain Bird’s first gear driven sprinkler. It is designed to operate in the 25-60 PSI range and cover a radius of 16-30’. It has a pressure compensating flow bushing, resulting in matched precipitation and pressure activated wiper seal.

Arc Adjustment

To increase the arc - Keep in mind that the part circle T- Bird comes preset at 180°. Pull up on the stem, and while holding the textured area, rotate the nozzle until it is turning to the right (clockwise). Slide the vandal collar out of its groove. Push down on the nozzle, and rotate it to the right until the desired arc is obtained. Pull up slightly on the nozzle, *making sure to replace the vandal collar when finished.*

To decrease the arc - Pull up on the stem, and while holding the textured area, rotate the nozzle until it just trips at the left stop. Slide the vandal collar out of its groove. Push down on the nozzle, and rotate it to the left (counter-clockwise) until the desired arc is obtained. Pull up slightly on the nozzle, and again be sure to replace the vandal collar. Failure to replace the collar will cause the riser to stay up just a bit. (If it doesn’t seal completely, the famed sprinkler harvester comes along and eats the sprinkler!)

Troubleshooting

Over tightening the nozzle - This usually occurs during the initial installation. The proper way to nozzle the T- Bird is to place the nozzle into the cap assembly and begin to turn it to the right (clockwise). After feeling the threads engage, pull the stem up and grasp the area of the riser assembly (this area is textured to ensure a positive grip when wet). *This is the most critical time of the installation process, continue to tighten the nozzle only until it is **snug**!* If the nozzle is over tightened either the clutch will break, or the omega springs or the gears inside the gear assembly will pop off. In this case, the old saying “the tighter, the better” doesn’t apply!

Common Problems

Cap to body leaks - Grit getting caught between the wiper seal and riser. This can cause water to leak from between the riser and cap (this is also known as blow by). Steps have been taken to prevent this by making the wiper seal deeper and adding a tall spring support. These additions make the wiper seal stronger, thereby preventing grit from entering this area.

R-50 TROUBLESHOOTING

Operation

The R-50 is an internal impact sprinkler. This means that there are two small stainless steel balls that act as the drive mechanism.

Arc Adjustment

To increase the arc - Keep in mind that the sprinkler is preset to approximately 180°. Pull up on the stem, slide the vandal collar out of its groove. Push down on the nozzle slightly, and rotate the nozzle to the right (clockwise). The arc will be increased by the amount the nozzle is turned. For example, if the arc was previously set for 180°, and it was turned 90° while the nozzle was pushed down, the sprinkler will now have an arc of 270°. *Be sure to replace the vandal collar when finished.*

To decrease the arc - Pull up on the stem, slide the vandal collar out of its groove. Push down on the nozzle slightly, and rotate the nozzle to the left (counter-clockwise). The arc will now be decreased by the amount it is turned. *Be sure to replace the vandal collar when finished.*

To change the arc to a full circle - Remove the internal assembly from its case. Slide the vandal collar out of its groove, and rotate the nozzle to the right (clockwise) until a strong resistance is felt. It will feel as though it is locked in place. Return the vandal collar to its groove. Rotate the nozzle to the right (clockwise), there should be no resistance felt in the 360° turn.

Troubleshooting

Stalling/fast rotation - Be sure that the adjustable bypass at the bottom of the internal assembly is set to match the nozzle that is installed. If the bypass is set too high, the drive assembly will flood and stall. If set too low, there will not be sufficient water and this can also cause the sprinkler to stall.

Cap to body leaks - You might encounter cap to body leaks on some older units. To resolve this, we have tightened the specs on the wiper seal and also added additional spring support around the wiper seal.

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R-70

The R-70 is a piston driven, water lubricated sprinkler. The R-70 was designed to emulate, or mimic, our impact sprinklers. Impact sprinklers are considered to have the most efficient water distribution. The R-70 uses only 2% of the water passing through the unit to drive the head. This gives the R-70 a distinct troubleshooting advantage in that it is an excellent closed case dirty water rotor.

Arc Adjustment

To increase the arc - Keep in mind that the part circle R-70 is preset to approximately 180°. The left edge of the arc is fixed, marked by double ribs on the lower edge of the cover (refer to the drawing below). As the sprinkler is rotating to the right (clockwise), turn the adjustment screw to the adjust (ADJ) position using the thumbwheel. Allow the R-70 to rotate to the approximate desired setting, return the arc adjustment screw to the locked (LKD) position. The rotor will continue to rotate past this point 10-15°. The instant the rotor has started on its counter-clockwise rotation, turn the adjustment screw to the adjust (ADJ) position. When the R-70 has reached the desired arc, turn the adjustment screw to the locked (LKD) position. *Always return the adjustment wheel to the locked (LKD) position.*

To decrease the arc - As soon as the R-70 trips at the right edge (now turning counter-clockwise) turn the adjustment screw to the adjust (ADJ) position. When the rotor reaches its desired arc setting, turn the adjustment screw to the locked (LKD) position. *Always return the adjustment wheel to the locked (LKD) position.*

It is important that you return the arc adjustment screw to the locked position when you are finished. If not, the setting may change!

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Common Problems

Variable arc - As stated above, the adjustment screw must be returned to the locked (LKD) position when the arc adjustment procedure has been completed. Failure to do so may allow the arc to change. The stem should also be inspected to determine if it is of current design. A prior version had a slip clutch built into the stem. Refer to the water distribution section for further information.

Water distribution - The current design for R-70 nozzles are referred to as Phase I. This nozzle is easily identified from previous series, because:

a. "Rain Bird" is now stamped on the top of the nozzle.
b. The nozzle color coding, signifying the nozzle size, visible from the top.

Be aware that several years ago, there was a different version of the stem in the R-70. The current stem has two tabs that protrude up from the top of the stem 180° apart from each other (refer to the drawing below). When installing the Phase I nozzles on the old style stem, it is possible that as the nozzle engages, the fixed left arc will change. In order to correct this problem, it is necessary to replace the stem with the new style. *The stem must be replaced **before** the Phase I nozzle is installed on the old stem, as damage may occur to the nozzle.* Contact your inside sales person for more information.

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REMOTE CONTROL VALVES

The valves covered in this section will be electrically operated remote control valves (RCV's). All remote control valves can be separated into two different types. The difference between the two is how the water enters the upper chamber. The upper chamber is the area between the cover and the top side of the diaphragm. Once the water has entered the upper chamber there are only two paths for it to escape: the manual bleed or the solenoid exhaust port.

Forward Flow - The water inters the upper chamber through a port in the center of the diaphragm. This port will normally by filtered, be sure that the filter is kept clean.

Reverse Flow - The water can enter the upper chamber in several ways. Through an external tube that runs from the pressure side to the upper chamber, through holes in the outer edge of the diaphragm, or through ports machined in the valve body.

Operation

A common misconception is that a valve stays closed because of a higher pressure above the diaphragm (the upper chamber). If there is, for example, 100 psi of static water pressure in the mainline, how can there be more than 100 psi above the diaphragm? Without a pump installed at each valve, this situation would be impossible. The valve will stay closed because the surface area above the diaphragm is roughly 2 ½ times larger than the pressurized surface area below the diaphragm. This difference causes a greater *force* above the diaphragm than there is below the diaphragm. *Force equals Pressure times Area* (Force = P x A). Water enters the valve on the pressure side (usually the side opposite the solenoid). The water will then enter and fill the upper chamber through the path detailed in the preceding section. When operating properly, this water is trapped in the upper chamber. The valve will only open once the force above the diaphragm has been relieved. This can happen in either of two ways, the solenoid has been energized by the controller, or the manual bleed has been activated.

Common Problems

Before assuming that there is a valve problem, check the obvious. Is the water turned on, is the controller plugged in and programmed correctly, are there isolation valves that might be turned off? Verify valve operation by using the manual bleed. This might indicate a controller or wiring problem if the valve works properly when using the manual bleed.

Valve will not close - There are two things that will cause this. The first cause is a physical obstruction (rocks or other debris) preventing the diaphragm from seating. When removing a physical obstruction, be sure to thoroughly inspect the diaphragm assembly and valve seat area for damage. The second reason is insufficient force being developed above the diaphragm. Insufficient force above the diaphragm can be caused by several things.

1. The plunger is missing or stuck in the up position. Remove and inspect the solenoid.
2. Diaphragm filter plugged. This will prevent water from entering the upper chamber.
3. Flow control turned up too high. The diaphragm can stick in the up position under low flow/low pressure conditions.
4. Constant voltage from the controller. The solenoid will usually be warm to the touch and a slight vibration can be felt if this is happening.
5. Leak between the bonnet and body. Water will be visibly leaking where the body and bonnet are connected
6. An open manual bleed. An open external manual bleed will be very obvious. An internal manual bleed system can be unknowingly activated if the valve is unfamiliar to the customer.
7. A large hole in the diaphragm. (Forward flow valve only). Sufficient force will not build up in the upper chamber. Remove the diaphragm assembly and inspect it very carefully, replace it if there are any bubbles or other signs of wear.
8. The valve is installed backwards. The valve is now an expensive coupling. The arrows on the valve body indicate the direction of water flow through the valve.

Valve seeping - This is usually indicated by a puddle at the lowest sprinkler head. Using an automotive stethoscope may aid in determining which valve is leaking in a manifold. There are two main causes for this to happen.

1. Solenoid or solenoid seat is damaged. Water will constantly leak past the plunger. Replace the solenoid plunger of the seat if possible.
2. Valve seat is damaged. Check the valve seat and the diaphragm seating area for pitting and small debris. Replace the diaphragm if damaged. It may be necessary to replace the valve body if the seat area is damaged.

Valve will not open - There are again two main causes of this problem.

1. The first cause is an adjustment problem. The flow control stem is tightened all the way down.
2. The second is that the force is not being released from the upper chamber. There are several reasons for this to happen.
   a) Solenoid burned out. A resistance test will verify if the coil is bad or not. Refer to the volt ohm-meter section to learn how to perform this test. Replace if necessary. 2. A torn diaphragm. (Reverse flow valve only). The hole in the diaphragm will allow more water into the upper chamber than can be bled off through the solenoid port. Inspect the diaphragm, and replace it if necessary.
   b) Plugged ports. The port below the solenoid and/or the port leading to the solenoid chamber is plugged. This would again prevent the water in the upper chamber from being relieved. Clean the ports with a paper clip, *never drill out the ports.*
   c) Solenoid not receiving voltage. The controller is not sending the necessary voltage, there are wiring problems, or the wire connections are faulty. Refer to the volt ohm-meter section to learn how to inspect the field wiring.

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CONTROLLERS

This section will describe some troubleshooting procedures that will determine if the controller is indeed the bad component in the irrigation system. The controller is usually the first component blamed from an irrigation system failure. Typically, once the controller has been removed and taken to a repair facility, a conservative estimate is that 25% are returned without a defect being found in the controller. Before removing the controller it is recommended that the following are checked:

Programming - A program consists of three steps:
1. Start time - The time of day that the irrigation should begin.
2. Run time - The irrigation duration for each station.
3. Days on - The day that the irrigation will operate.

If any of these steps are missing, the controller will not activate the valves.

Auto/Off switch - This switch must be in the AUTOMATIC or ON position in order for the controller to operate.

Sensors - If the controller is equipped with a rain sensor or moisture sensor, the program will not run if they have been activated.

Troubleshooting

This section will be divided into two sections in order to give more accurate troubleshooting tips.

Electromechanical	Hybrid/Solid State
RC series	ISC series
RC 8 series	RCM series
RC 11 series	CRC series
RC-12, 18, 23 series	CIC series
	HP
	ESP series
	EZ1 series

Electromechanical Controllers

Time and/or day incorrect - As long as an electromechanical controller is connected to its primary power source the correct time and day can be determined upon visual inspection. If this is not the case, check the following:

Primary power - Verify that the 117 volt VAC power is on and correctly connected to the controller. The acceptable range is between 105 and 129 VAC. If the voltage is above or below this range, contact a certified electrician.

Transformer - The transformer output should be between 24 and 28 VAC. If the primary power is correct, then the transformer should be replaced. This is not a Rain Bird warranty item, as this is usually caused by incorrect fuse sizing.

Circuit breaker/fuse - Check the condition of the circuit breaker or fuse, if it has been blown the most likely reason is a field wiring short. An Electromechanical controller will stop on the station that caused the problem. Reset the controller to its rest position and replace the fuse or reset the circuit breaker. Manually advance the controller to station #1 and allow it to run for one minute. If station #1 operates correctly then advance to station #2 and repeat this procedure until the fuse blows. This will determine the problem station. Once the defective station has been located, disconnect the wire that operates that valve. Continue the above procedure to test the rest of the stations as there could be more than one problem. Once this has been completed the controller will operate all of the stations that are still connected. The faulty field wiring will have to be repaired before they can be reconnected to the controller. Refer to the VOM section for field wire testing.

Clock motor - In order for the controller to maintain the proper time and day, the clock motor (sometimes referred to as the timing motor) must constantly operate. Because of this the clock motor will tend to fail before any of the others. Verify the motor is receiving the proper voltage, set the hour dial to the correct time, and wait for approximately one hour. If the hour dial has not moved then replace the motor.

Gears and clutches - (Note: Some controllers are direct drive and have no gears. The gear referred in this section relate to the RC-4, 7, 1230, and 1260 series only.) The gears transfer the rotation of the clock motor to the hour dial and station timing. Try to turn the station dial and hour dial in the opposite direction of the arrows shown on the face plate.

Do not exert excessive force when performing this test. If the dials will turn backwards then the clutch is stripped and the gears will need to be replaced. Inspect the gears for missing or worn teeth; also, inspect the hub where the metal shaft inserts through the gear for cracking. It is recommended that if either the station dial shaft assembly or the pilot shaft assembly needs replacement, both assemblies should be replaced as a set.

Advance motor - This motor only received voltage and operates when the controller is changing stations and when returning the station dial to the rest position. When checking to determine if the motor is receiving the proper voltage, be sure that the motor is supposed to be engaged at that time. It may be necessary to apply the correct voltage directly to the motor from another source to verify operation. Before doing this, be sure to disconnect the motor from its existing power source! If the motor does not turn it will need to be replaced. If it does turn, then it is not receiving its proper voltage. Check the primary power and transformer.

Micro switches - A micro switch is a small switch that when activated, instructs the controller to perform a certain function. When there switches fail or are out of adjustment the controller will not perform as programmed. To determine if the switch has failed, turn off the primary power to the controller and conduct the following resistance test. Using your volt ohm-meter, check the switches, the resistance should be below 2 ohms when closed and infinite open. When micro switches fail they tend to not make contact when they should be closed. The resistance test will read several hundred ohms or higher when closed. The switch must be replaced and readjusted.

The button of the micro switch should not be depressed until a program pin is locked into position to activate the switch.

Wafer switches - The wafer switch is the distribution point for the valve voltage. As the center hub turns with the station dial, the valves receive their voltage one at a time. normal wafer problems occur when dirt accumulates on the tab or the contacts. This prevents the voltage being sent to the valves, or the valves turning on and off sporadically during their operating cycle. The wafer switches may be cleaned using the eraser end of a pencil, being careful not to bend any of the contacts. Be sure to check and clean the back side of the wafer switch. To do this it will be necessary to remove the two mounting screws and lift the wafer switch off of its shaft. When excessive wear occurs on a wafer switch, it is possible for the tab to break off. When this occurs, the switch will need to be replaced.

Hybrid/Solid State Controllers

Hybrid and solid state controllers are designed to provide the programming versatility that is needed to better protect our water resources. the technology that is necessary to accomplish this makes repairs by untrained persons. The following items should be checked before assuming that the controller is the problem.

Visible damage - Inspect the controller for any visible signs of damage. Check the keyboard for collapsed buttons: run your finger lightly over each of the buttons (a slight “hill” should be felt at each location). If a “valley” is felt then the keyboard must be replaced. This is not a warranty item. Inspect the printed circuit board for burned components; this is normally caused by lightning or other power surges. Power surges are also not covered by Rain Bird warranty.

Primary power - Verify that the primary power is within acceptable limits. Contact an electrician if incorrect.

Transformer - Verify that the transformer output voltage is between 24 and 28 VAC. If the output voltage is zero and the primary power is correct, then replace the transformer.

Circuit breaker/Fuse - Check the condition of the circuit breaker or fuse. If it has blown, the most likely reason is a field wiring short. When this happens, it only interrupts the 24 volt section of the transformer. The 12 volt section will remain active; therefore, the display will show that the station is on. Press the appropriate button(s) on the keypad to turn the active station(s) off. Reset the circuit breaker or replace the fuse with the valve specified by the manufacturer. Manually6 advance the controller to station #1 and allow it to run for one minute. If station #1 operates correctly then advance to station #2 and repeat this procedure until the fuse blows. This will determine the problem station. Once the defective station has been located, disconnect the wire that operates that valve. Continue the above procedure to test the rest of the stations as there could be more than one problem. Once this has been completed the controller will operate all of the stations that are still connected. The faulty field wiring will have to be repaired before they can be reconnected to the controller.

Microprocessor Lockup Problems

The microprocessor is the "brains" of the controller. Occasionally, due to electrical problems, the microprocessor will freeze all of its functions. The symptoms of this are:

Display blank, (the display does not show any information)
or
Frozen display, (the display shows erratic information that cannot be cleared or changed from the keypad)
and
The controller will not perform any of its programmed functions.

If the following steps are taken, the microprocessor will usually resume its normal functions. It will be necessary to completely power down the controller.

***Note: This process will delete your existing program!*

1. **Primary power** - It is necessary to disconnect the controller from its primary electrical source either by unplugging it from the outlet or by turning off the appropriate circuit breaker in the electrical panel

2. **Battery backup** - Remove the battery from the controller. The purpose of the battery is to maintain the information inside of the microprocessor in the event of a primary power failure. By removing the battery the microprocessor is allowed to reset itself to its normal condition.

3. **Wait** - Maintain this power down condition for 5 minutes to be certain the microprocessor will reset itself.

4. **Primary power** - Reconnect the primary power to the controller.

5. **Function check** - The display should now show 12:00 A.M. Set the time and day to the current setting. Using the manual controller function, turn on several stations and observe that they operate properly.

   If the controller now operates properly re-enter your original program and continue on to step 6. If controller still will not perform correctly it will need to be repaired by a qualified facility.

6. **Battery replacement** - If the controller uses an alkaline battery, it is recommended that it be replaced with a new one at this time. (See section to determine if your model controller uses alkaline or NICAD batteries.) Reinstall the correct battery in the controller and perform a final resistance test to ensure proper operation. This procedure will normally resolve approximately 30% of the solid state "failures".

VOLT OHM-METER
(VOM)

A volt ohm-meter is an inexpensive piece of test equipment that is capable of measuring AC volts, DC volts, and resistance. By learning how to use this equipment, it is possible to troubleshoot controllers, solenoids, field wiring, and to verify AC and DC voltage levels.

There are two styles of VOM's, analog and digital. An analog VOM is the style that has a needle that moves across a face (similar to a speedometer). The DMM (digital multi-meter) has a digital display. DMM's normally have additional features than are available with an analog VOM, and therefore are more expensive. For this reason the following instructions are designed to work with an analog style VOM.

Electrical terms

AC volts (VAC) - Alternating Current, this is household voltage. Most irrigation solenoids operate on AC voltage.

DC volts (VDC) - Direct Current, this would normally be from a battery. DC voltage is polarized, meaning that there is a positive (+) and a negative (-), sometimes referred to as ground. The VOM must be connected properly to prevent VOM damage, the RED lead is (+), and the BLACK lead is (-).

Resistance - a measurement of how difficult it is for the current to flow through the electrical system. This would be similar to being able to actively measure the friction loss when water flows through a piece of pipe.

Comparisons between water and electricity

Water term	Electrical term
Pressure (psi)	Voltage (volts-V)
Friction Loss (psi)	Resistance (ohms-Ω)
Flow (GPM)	Current (amps-A)

For irrigation applications, a solenoid is considered to be good if its resistance is between 20 - 60 ohms

Short - when the measured resistance is below 20 ohms for a single solenoid.

Open - if the resistance is above 60 ohms when measuring the field wiring.

Note…when two valves are operated together on a single station, the resistance will be approximately ½ of a single solenoid.

Hook-up

Your VOM will have one jack labeled (-) COM, into which the Black lead will be inserted. Insert the Red lead into the jack marked (+) V - Ω - A. this same setup is used to measure AC volts, DC volts, and resistance.

Taking measurements

AC volts - Set the dial to the appropriate VAC scale. For example, if 117 volts is expected to be measured, the dial must be set to a scale above that. WARNING - if the dial is set to the 50 ACV range and 117 volts is measured, damage to the VOM is likely. If the voltage is unknown, start with the dial on the highest available setting.

DC volts - As above, the dial must be set to the appropriate scale. in addition be sure that the polarity is correct. DC voltage has a positive (+) and a negative (-) terminal. The red lead is (+), and the black is (-), connecting the leads in reverse can cause damage to the VOM. If, from the rest position, the needle moves to the left, the polarity is incorrect; reverse the leads on the circuit that is being tested and take the measurement again.

Resistance - *Important, to prevent VOM damage the circuit power must be turned off.* There are several scales on the VOM, usually Rx1, Rx10, Rx100, etc. When changing the dial settings, it is necessary to multiply the uppermost scale by the dial setting. For example, if the needle is pointing to 15 on the ohms (Ω) scale, and the dial is set at Rx1, then there are 15 Ω of resistance (15 x 1 = 15). If the dial is set on Rx10 then there are 150 Ω of resistance (15 x 10 = 150). If the dial is set on Rx100, then there are 1500 Ω of resistance (15 z 100 = 1500).

Whenever resistance is measured, the VOM must be calibrated. This is a very simple procedure. Set the VOM to the correct scale (usual Rx1). Touch the two probes together and use the ohms adjust wheel to set the needle to zero. Keep in mind that zero ohms is on the right hand side of the scale (this would indicate a short) and the left side is infinite resistance (indicating an open). Start with the dial on the lowest setting (Rx1). If the reading shows infinite, change the dial to the next higher setting. Keep increasing the setting until an accurate reading is obtained. If the needle stays to the left side of the scale then the circuit is open.

Knowing how to operate a VOM will save considerable time when testing the wiring on a job site. It is possible to inspect the solenoid and field wiring condition from the controller. The procedure is as follows:

Resistance measurements

1. Disconnect the common wire from the controller.

2. Set the VOM to the Rx1 scale and zero the meter.

3. Connect one of the VOM leads to the common wire (not the controller common terminal).

4. Touch the second VOM lead to each of the station terminals and record the resistance readings. Compare your readings to the acceptable range of 20-60 ohms.

5. If the measurements are within the acceptable range then the electrical circuit for that station is good. This test only inspects the field wiring, it is possible for that station to not work properly because of controller and/or valve problems.

6. If the resistance range is below 20 ohms (a short), proceed to the valve and disconnect the solenoid from the field wires. Test the resistance of the solenoid only. If the measurement is still low, than the solenoid must be replaced. Is the solenoid resistance is acceptable then the short is in the field wiring itself (2 solenoids connected to the station can also produce a low reading). Wire tracing equipment should be used to locate the problem.

7. If the resistance is above 60 ohms (an open), as above test the solenoid without the field wires connected. Replace the solenoid if the resistance is still above 60 ohms. More than likely the solenoid will test within proper limits. If this is the case, then cut out the wire connectors, twist the station and common wires together and re-test the resistance from the controller. The resistance should now read very low, possibly only 2-3 ohms. If the resistance is this low, then the problem was a faulty wire connector. Install new waterproof wire connectors on the existing solenoid and test the resistance again at the controller. If the resistance is still high when the common and station wires are twisted together, then there is an open somewhere between the valve and the controller. Wire tracing equipment should be used to locate the problem.

8. The final test will determine shorts directly into the earth. For this test, the scale on the VOM should be changed to Rx1K (1K = 1,000). Disconnect each of the stations wires from the controller, in addition to the common still being removed. Connect one of the VOM leads to a piece of wire wrapped around a screwdriver. Insert the screwdriver into the ground. Touch the second lead to each of the station wires and the common. Each of these measurements should be above 700K (700,000) ohms. If the resistance is below 700K, it would indicate that a section of the wire has the insulation removed, and is making contact with the earth. Wire tracing equipment should be used to locate the problem.

RAIN BIRD

621970 Relay

Description

This relay has three sets of contact “families” called poles.

Terminals	1, 4, & 7 make up pole #1	(Refer to figure 1)
	2, 5, & 8 make up pole #2	(Refer to figure 1)
	3, 6, & 9 make up pole #3	(Refer to figure 1)

Each pole is electrically independent of the others. This means that there are no wires that internally connect the three poles.

Each pole consists of three contacts, a normally closed (NC) contact, a normally open (NO) contact, and a movable contact called the wiper.

Terminals 1, 2, & 3 are the normally closed contacts.	(Refer to figure 1)
Terminals 4, 5, & 6 are the normally open contacts.	(Refer to figure 1)
Terminals 7, 8, & 9 are the wipers	(Refer to figure 1)

In addition to the three poles there are two terminals marked A & B. These terminals are connected to the coil. In this relay, the coil is operated by 24 VAC (VAC = household voltage). This allows the relay to be connected to any manufacturer’s controller that has a 24 VAC output.

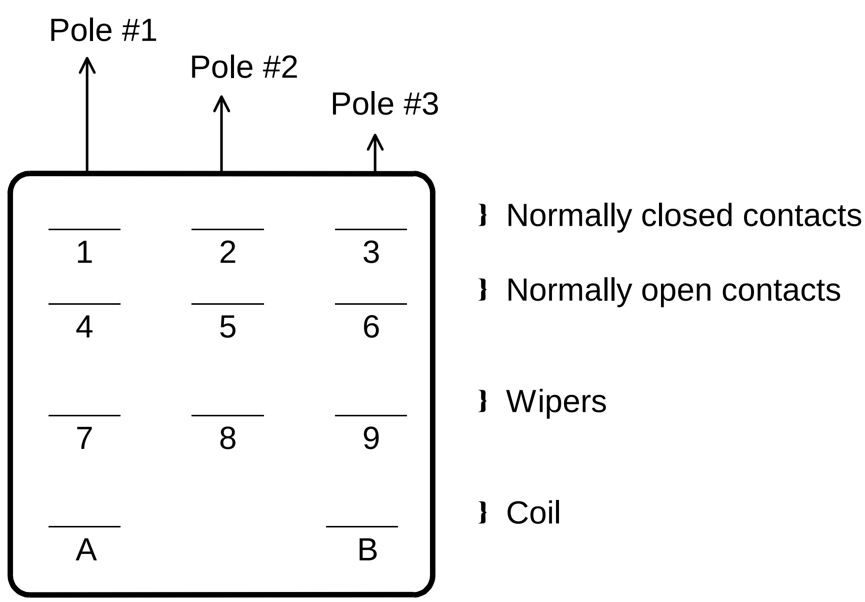

Figure 1
Bottom view of the 621970 relay

OPERATION

In its "rest" position within each pole, the wiper is making contact with its NC contact. Example: Pole #1, terminal 7 is touching terminal 1; pole #2, terminal 8 is touching terminal 2; pole #3, terminal 9 is touching terminal 3. Remember: the three poles are not connected to each other. Refer to figure 2.

When 24 volts is applied to the coil (terminals A & B), the relay will be turned on, or energized. Once the relay has been energized, the coil will develop a magnetic field. This will pull the wipers in each pole away from their NC contacts and cause them instead to touch the NO contacts. Refer to figure 3. Example: pole #1, terminal 7 is touching terminal 4; pole #2, terminal 8 is touching terminal 5; pole #3, terminal 9 is touching terminal 6.

RELAY USES

One of the most common uses of the relay is as a pump start relay. The pumps used for irrigation systems operate on 117 VAC or higher. The contacts of the 621970 relay are rated at 10 amps (per pole) at 240 VAC. If your pump or other devices has a higher current or voltage requirement, then contact an electrical supply for the availability of a different relay. Relays are available in a very wide range of shapes, sizes and electrical characteristics.

The example below will explain the use of the relay to activate a 117 VAC booster pump. The booster pump should operate only when the controller is activating one of its stations. With most controllers, when one of the stations is activated, 24 volts is supplied between the common and pump start terminals. There are some controllers that supply 117 VAC to the master valve terminals. DO NOT use the 621970 relay in this situation.

The controller common should be connected to terminal A. The pump start wire from the controller will now be connected to terminal B. (When using the 621970 relay, be sure that only 24 VAC is being supplied between the common and pump start terminals.)

The black "hot" wire will run from the electrical service to terminal 7, the wiper for pole 1. Figure 4 uses pole 1, but any one of the three poles may be used.

The black wire going to the pump will be connected to terminal #4, the normally open contact of pole 1. The white "common" wire and the green ground wire will run directly from the electrical service to the booster pump. No other connections to the relay are necessary. Refer to figure 4.

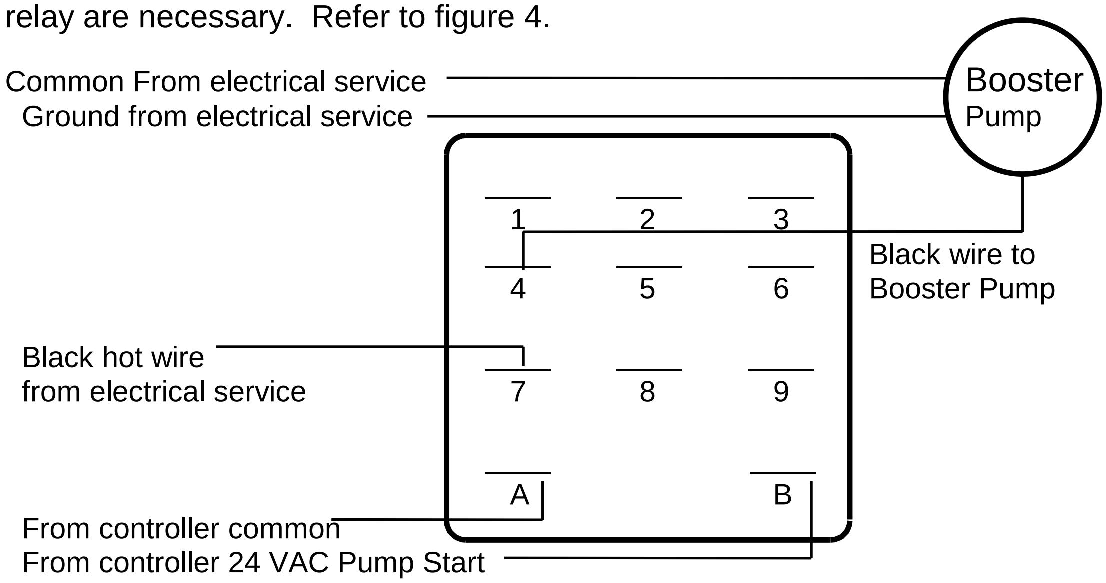

Figure 4

When the controller is not operating, the relay will not be energized. The 117 VAC needed to operate the booster pump is being interrupted at the relay. Refer to figure 5.

As soon as the relay is energized by the controller, the 117 VAC is allowed to pass through the relay to the booster pump. Refer to figure 6.