



Irrigation Design Information



Wire Sizing

To operate a valve or controller energy is needed. In today's irrigation market the majority of controllers and valves are run on electrical energy. Copper wire is used to connect the controller to the valves. Solenoids on the valves require a minimum amount of energy for the valve to operate correctly, therefore the right size (gauge) wire must be used.

When electricity is flowing through the wire some voltage is lost due to resistance in the wire. This loss is dependant upon (1) the total length of the wire run, (2) the resistance of the particular gauge wire being used, and (3) the current flowing in the wire. Electrical resistance is comparable to friction loss in a piping network. Resistance opposes the current and energy is lost overcoming it. This energy loss due to resistance is called voltage drop.

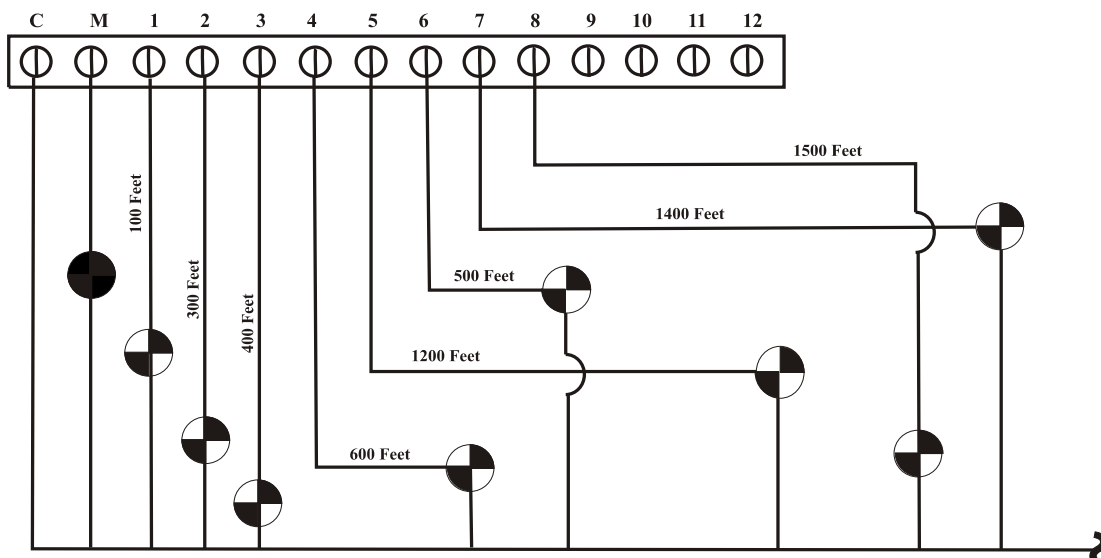
Valve solenoids are normally rated at 24 volts AC operating at less than 85 psi. Most solenoids will operate well at 20 volts AC. This means that you might get by with a 4 volt drop and still have your valve operate.

Voltage drop is calculated by the formula: $V = \frac{2L \times I \times R}{1000}$

Where: V = voltage drop
L = Length of wire run one way
I = Amperage use of solenoid coil
R = Resistance of wire

In the following diagram we will calculate the voltage drop to some of the valves. To do this we need the following information:

1. The output voltage of the controller = 24 VAC
2. The current draw of the solenoid = .66 amperes
3. The resistance of the wire connecting the controller and valves 16 AWG @ 4.09/mft



Typical Controller to Valve Wiring Diagram

4. The static water pressure of the system = 65 psi

Our furthest zone is # 8 at 1500 feet: $\frac{(2 \times 1500) \times .66 \times 4.09}{1000}$ or $\frac{8098.2}{1000} = 8.098$ volts

Controller output = 24 VAC - 8.098 = 15.9 volts at the solenoid, which means the solenoid will not work at that voltage, we need a larger wire gauge. 14 AWG gives us a 5.11 drop which can be iffy and 12 AWG gives us a 3.21 volt drop which will give us adequate voltage to operate the solenoid.

Use the following chart to figure your voltage drops. Use the 77°F resistance

Wire Gauge (AWG)	Wire Type (UF)	Insulation Thickness (inch)	Resistance (Ohms / 1000 feet)	
			77°F	149°F
00	Stranded	5/64	.079	0.092
0	Stranded	5/64	.100	0.116
2	Stranded	5/64	.159	0.184
4	Stranded	5/64	.253	0.292
6	Stranded	5/64	.403	0.465
8	Solid	5/64	.641	0.739
10	Solid	4/64	1.020	1.180
12	Solid	4/64	1.620	1.870
14	Solid	4/64	2.580	2.970
16	Solid	4/64	4.090	4.730
18	Solid	4/64	6.510	7.510

Other Considerations

Another consideration to keep in mind is the incoming voltage to the controller, the transformer is usually a 1 to 5 step down ratio, so at 120 VAC the output will be 24 VAC. If your incoming voltage is 110 VAC the output will be 22 VAC, which will affect the performance of the valve.

The more splices you have in the wiring the greater the chance to have voltage leaking to ground, giving you less than optimal voltage to open the solenoid. If you have to make a splice in the wire do not bury it directly in the ground, instead place a small valve box around the splice keeping the chance of a ground fault to a minimum.

Do not stretch the wire tight, leave some slack to account for the expansion and contraction of the wire due to temperature change.



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