HSM Wire International Inc.

Phone: 330-244-8501 Fax: 330-244-8561 www.hsmwire.com

Voltage Loss Formula's

Voltage loss in a wire is synonymous to pressure loss in a pipe. Electric current flows in a wire, just like water in a pipe, and create a loss. The loss is a function of:

- The diameter of the wire - The smaller the diameter, the larger the loss.
- The length of the wire - The longer the wire, the larger the loss.
- The type of metal used in the wire - The higher the resistance, the larger the loss. Copper and Aluminum wires are the most common types, with copper having the lower resistance.

Voltage Loss is calculated using "**OHM'S LAW**", as follows:

$$E = IR$$

Where: **E** is the Voltage Loss, in volts

I is the current flowing through the wire, in amperes

R is the resistance of the wire, in ohms

For single-phase circuits, the formula for Voltage Loss is:

Voltage Loss **=** Amps **X** Wire Resistance per 1,000 feet **X** Distance in thousands of feet **X** 2 Wires

For three-phase circuits, the formula for Voltage Loss is:

Voltage Loss **=** .866 X Amps **X** Wire Resistance per 1,000 feet **X** Distance in thousands of feet **X** 2 Wires

Example:

A controller in a city park will be installed 4,200 feet away (this is the total trench length) from the 115 VAC power source. What is the voltage loss using 14 AWG wire? Is this size wire large enough?

1. From the catalog of the controller manufacturer we find that the controller will consume 0.25 amperes when two valves are activated.
2. From the chart below, the resistance for 14 AWG wire is 2.525 ohms/thousand feet.

COPPER WIRE RESISTANCE (OHMS PER 1000' OF WIRE)												
WIRE GAUGE (AWG)												
18	16	14	14/12	14/10	12	10	8	6	4	2	1/0	2/0
6.385	4.016	2.525	2.057	1.762	1.588	.999	.628	.395	.249	.156	.098	.078

3. From the formula for single-phase circuits:

   Voltage Loss = Amps X Wire Resistance per 1,000 feet X Distance in thousands of feet X 2 Wires

   Voltage Loss = 0.25 amps X 2.525 ohms/MFT X 4.2 MFT X 2 Wires

   Voltage Loss = 5.3025 or approximately 5.3 volts
4. To determine if this is acceptable, we subtract the 5.3 volt loss form the 115 VAC at the source. The voltage at the controller is 115 - 5.3 = 109.7 volts. This is within the controller manufacturer's requirements of 105 - 120 volts, and is therefore acceptable.