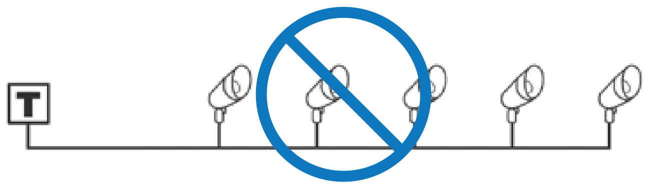
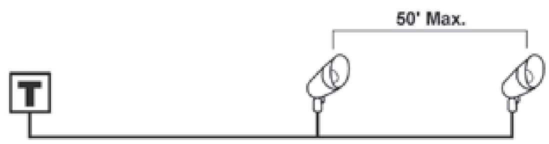
Designing Cable Runs

AVOID STRAIGHT RUNS, end fed with the wire going to the closest fixture first.



This type of run feeds most of the voltage to the first lamp. The remaining lamps receive progressively less and less voltage, so the line is not in balance.



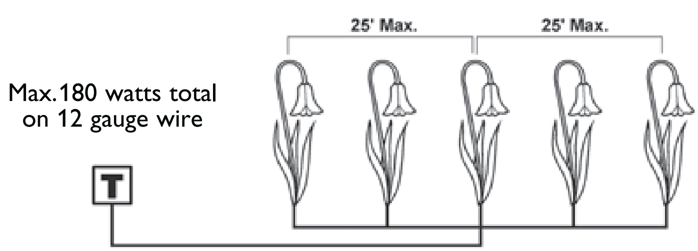
Only do this up to two fixtures. Three or more, go to center feed.

Center Fed "T" Runs

These work the best.

- 3–5 fixture per run.
- *Maximum 180 watts per run on 12 gauge wire.*
- Center feed to the load of the run.
- Max. 25' from "T" connection to any fixture.

This delivers almost equal voltage to all fixtures resulting in equal brightness and prolonging lamp life.



From the above calculations and examples it becomes obvious that properly designed systems require the use of more wire. Just like a properly designed sprinkler system, it is necessary to equalize the delivery of water (electricity) to each sprinkler head (lamp). Keep in mind that wire is the least expensive component of a system.

Calculating Voltage Drop

Voltage drop on the lighting system will effect the lamp life and the amount of light the lamps will deliver. Too much voltage drop lowers the light output and changes the color of the light from white to yellow or orange. Too little voltage drop burns the lamps, too hot and shortens lamp life.

The following table shows the effect of voltage drop for standard non-halogen lamps.

Voltage	Light Output	Lamp Life
12.5	170%	80%
12.0	100%	100%
11.5	80%	200%
11.0	75%	300%
10.5	65%	500%
10.0	50%	900%

A lamp with a design voltage of 12V will deliver 80% of its light output and its life will double by reducing the voltage .5V. The light loss is hardly noticeable to the naked eye while the lamp life is greatly extended. Therefore, in the outdoor environment, we want to design for a slight voltage drop to all lamps.

The recommended voltage to each lamp is 10.8V–11.5V

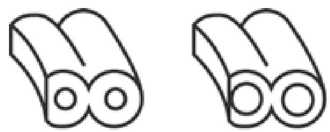
Remember, with halogen lamps such as the MR-16 a voltage feed of less than 10.8V may adversely affect the lamp. (Halogen cycle).

$$\frac{\text{Total Watts} \times \text{Cable Length}}{\text{Cable Constant}} (\times 2) = \textbf{Voltage Drop}$$

Total Watts – Sum of wattage for every lamp on one piece of cable.

Cable Length – Length of cable used (feet) from transformer to fixture for which you are calculating voltage drop.

Cable Constant – Indicates thickness of copper wire. The thicker the wire, the lower the conduction resistance and the lower the voltage drop.



Wire Size	Cable Constant
#18	1380
#16	2200
#14	3500
#12	7500
#10	11920
#8	18960

Voltage at lamp is determined by subtracting voltage drop from voltage at the transformer.

The voltage at the transformer will change depending upon:
1. Which voltage tap is used (12, 13, 14, 15, 17, 20, or 22V).
2. The total load on the transformer.
3. The voltage feed to the transformer.

Voltage drop to the lamps can be controlled by:
1. Using the proper voltage tap on the transformer.
2. Center feeding to the load of each run.
3. Using proper cable size.
4. Using fewer fixtures on a cable run.
5. Using lower wattage lamps.

Any of these methods can be used in conjunction with each other.

The simplest and easiest way to lay out your wire runs is to connect all cables and fixtures, leaving the cable above ground. Mark each run at each end with colored or numbered tapes. Connect all runs to the 12 volt tap. (You may have to do these a few at a time.)
Take a voltage meter reading at the fixtures at the point of center feed. Whatever the reading is, note the difference, go back to the transformer and connect that run to the tap that will deliver 11.5 volts. If you have followed all the recommendations above and following, all other lamps should be receiving a minimum of 10.8 volts, but check them all just to be sure.

NOTE: For exceptionally long runs, you can use larger gauge wire for the main leg.