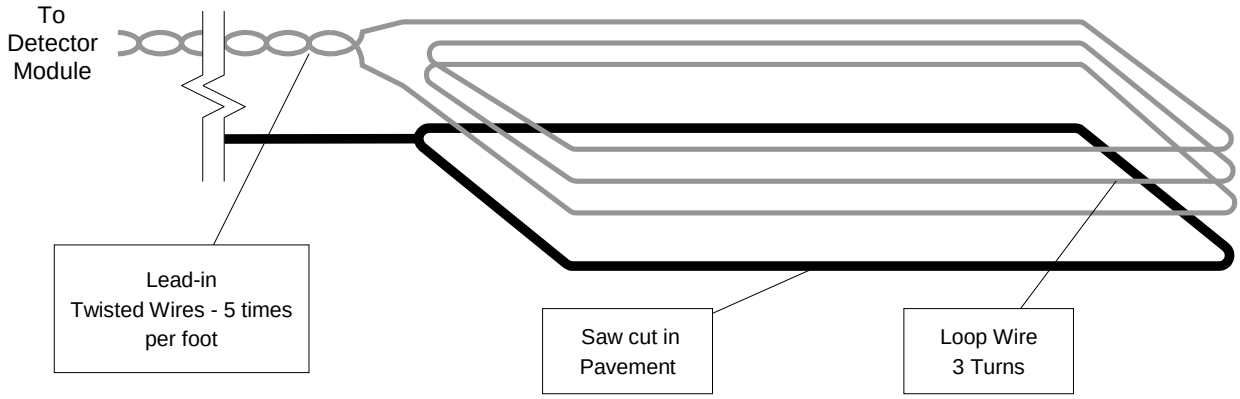
Reno A & E
4655 Aircenter Circle
Reno, Nevada 89502
USA

Telephone: (775) 826-2020
Facsimile: (775) 826-9191
Internet: www.renoae.com
e-mail: sales@renoae.com

What is an inductive loop?

An inductive loop is a wire wound in a rectangular or square shape that is typically sawcut into the pavement. The ends of the wire are brought back to an enclosure, which houses the inductive loop detector module. The detector module oscillator powers the loop that causes a field to form around the loop. The loop automatically tunes to a resonant frequency. The detector module monitors this resonate frequency to determine if a vehicle is in the loop area.



What is inductance?

Inductance is the resistance to the change of current flow. When a current is applied to a conductor a magnetic field is formed around the wire. If the current source is removed, the magnetic field collapses into the wire trying to maintain the current flow. By winding several turns of the wire into a coil, the magnetic field is intensified which increases the inductance.

How is the vehicle detected?

When a vehicle enters the loop the body and frame provide a conductive path for the magnetic field; causing a loading effect, which in turn causes the loop inductance to decrease. The decreased inductance causes the resonant frequency to increase from the nominal value. If the frequency change exceeds the threshold set by the sensitivity setting, the detector module will output a detect signal.

There has been a misconception that an inductive loop requires a mass of metal for detection. Placing a single wire around the perimeter of the loop and shorting the ends together will quickly disprove the misconception. The single wire forming a shorted turn provides a current path for the magnetic field; thus causing a loading effect similar to that of a vehicle. The shorted turn effect of the single wire coil in the proximity of the loop acts much like a shorted turn secondary of a transformer.

How many turns of wire should be installed in the loop?

The Inductive loop detectors will tune from 20 to 1000 microhenries of inductance. It is preferable that the loop and lead-in have a minimum of approximately 50 microhenries for stability. The loop inductance should be equal to or greater than the lead-in inductance.

How many turns of wire should be installed in the loop?

The number of turns required in the loop is dependent on the loop size. The loop inductance can be calculated as follows:

$L = P/4\ (t^2 + t)$; Where: L = Inductance (microhenries)
P = Perimeter (feet)
t = Number of turns

The formula can be simplified to: L = PK
Substituting a constant K for $(t^2 + t)/4$
Filling in the Number of Turns and calculating K:

Number Of Turns (t)	K (constant) $K=(t^2 + t)/4$
1	0.5
2	1.5
3	3.0
4	5.0
5	7.5
6	11.5
7	14.0

Example: 4' x 8' with 4 turns
L = P K
P = 4'+4'+8'+8' = 24 feet
K = 5.0
L = 24 x 5.0
L = 120 microhenries

How many turns of wire should be installed in the loop?

PERIMETER feet	NUMBER OF TURNS						
	1	**2**	**3**	**4**	**5**	**6**	**7**
10	5	15	30	50	75	115	140
20	10	30	60	100	150	230	280
30	15	45	90	150	225	345	420
40	20	60	120	200	300	460	560
50	25	75	150	250	375	575	700
60	30	90	180	300	450	690	840
70	35	105	210	350	525	805	980
80	40	120	240	400	600	920	1120
90	45	135	270	450	675	1035	1260
100	50	150	300	500	750	1150	1400

Use the highlighted values to determine the number of turns required. Always use at least 2 turns.

Does increasing the number of turns in the loop increase the sensitivity or detection height of the loop?

NO. Increasing the turns does **not** increase the sensitivity of the loop. It can improve the efficiency of the loop system (loop inductance + lead-in inductance), if the lead-in length is over 400 feet. The amount of inductance change a vehicle can cause in a loop is determined by the following factors:

$$\textbf{Amount of Change Caused by Vehicle} \approx \frac{\textbf{Vehicle Size}}{\textbf{(Loop Size) (Vehicle Height)}}$$

The above formula indicates the following:

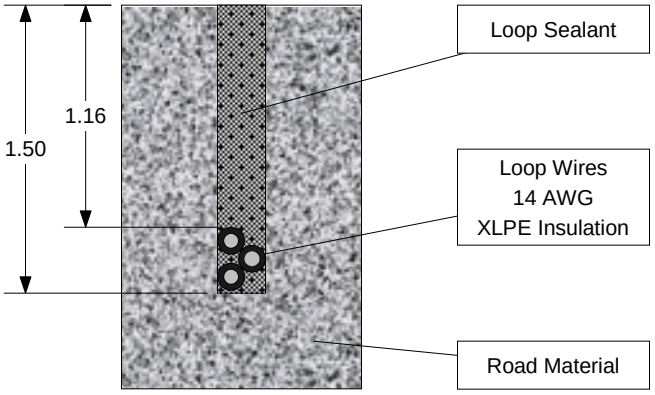
1. Increasing the loop size will decrease the amount of change caused by the vehicle. Example: If a vehicle causes a 1.0% change on a 6'x6' loop, then the same vehicle will cause a 0.5% change when over one of two 6'x6' loops connected in series.
2. A smaller vehicle will cause less change. A small motorcycle causes approximately 1% to 2% of the change caused by a standard automobile.
3. The higher the vehicle is from the road (loop) surface the smaller the inductance change.

NO. Increasing the turns does **not** increase the detection height. **Rule of Thumb:** The reliable detection height of a loop is 2/3 of the short side of the loop.

Examples: 6'x6' loop. The sort side is 6 foot. 2/3 of 6 = 4 feet.
6'x20' loop. The sort side is 6 foot. 2/3 of 6 = 4 feet.
4'x20' loop. The sort side is 4 foot. 2/3 of 4 = 2' 8".

How deep should the loop wire be installed?

The deeper the wires are below the road surface the more they are protected from road surface wear and the elements. The top wire should be a minimum of 1 inch below the road surface.



Nonconductive materials such as concrete and asphalt will not influence the loop fields. Installing the loop one inch deeper (e.g. 3" depth not 2" depth) would have the same result as raising the vehicle one inch above the pavement surface.

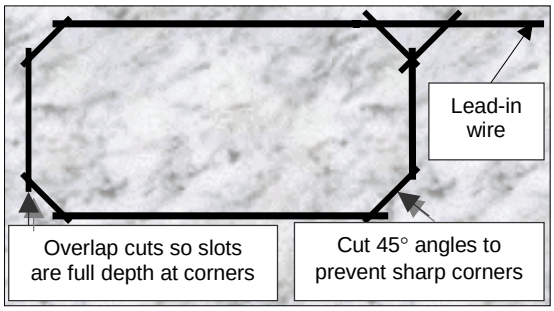
What type of wire should be used for the loop?

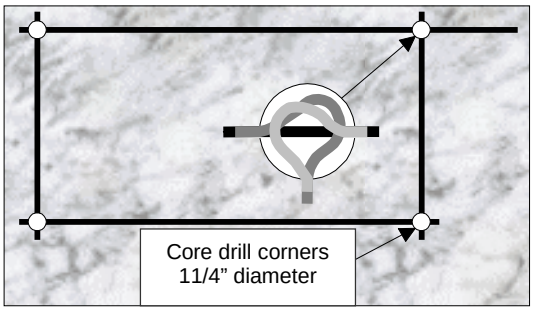
The main consideration in selecting a wire for loop installations is the type of **insulation**. XLPE (crosslinked polyethylene) rated at 600volts is highly recommended over PVC insulation. Under similar conditions XLPE insulation will absorb approximately one percent of the moisture absorbed by PVC. When insulation absorbs moisture loop drift occurs, which if great enough, can cause false detections. XLPE also has higher resistance to abrasion, heat, oils and gasoline.

What wire gauge should be used?

Number 14,16 or 18 AWG **stranded** wire can be used. The wire gauge is not important to the operation of the loop detector. The wire should maintain its integrity under the pavement stress. Because asphalt is more flexible than concrete it is recommended that a heavier gauge wire be used for loop installations in asphalt.

To reduce stress and abrasion of the loop wire the 90° corners should be cut at a 45° angle, core drilled (1.5” diameter) or at a minimum the sharp inner corners should be rounded with a chisel.





How far from a gate should the loop be installed?

As the length of the loop, which parallels the gate, increases the inductance change caused by the gate also increases. The graph shows the inductance change for different spacings between the gate and the loop for different size loops.

The closer the loop is to a gate the more influence the gate has on the loop! Hence, the lower the detector sensitivity must be set to insure the gate will not cause the detector to generate an output when the gate closes.

The following rule should be observed: **The longer the loop the greater the spacing must be between the gate and the loop!**

The inductance change at 2 feet is a third of the change at 1foot. At four feet the effects from the gate are minimal.