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Motorcycles and Loop Detectors - Is This a Problem?

Variables

Inductive loop sensors can reliably detect motorcycles if they are properly configured and adjusted. A number of variables affect the degree to which the introduction of a conductive object will change the effective inductance of the sensor loop. These variables include:

- The size, shape, and conductivity of the object
- The 3-D orientation of the object with respect to the wires in the loop
- The 3-D position of the object over the loop
- The size and shape of the sensor loop
- The nominal operating frequency of the circuit

Since motorcycles are small vehicles and have less conductive materials in them than automobiles do, they are harder to detect with inductive loops. Often the sensor loop is very large or the detector circuitry is not sensitive enough to detect the slight inductance decrease caused by the motorcycle. It is purely the size and net conductivity of an automobile that makes it easier to detect than a motorcycle. Often times making the loop smaller puts the loop on a scale that allows easy detection of motorcycles. However, this may result in problems in picking up high bed vehicles such as SUVs or tractor trailer beds. The maximum height of detection is roughly 2/3 the length of the short side of the loop up to a maximum of four feet. Therefore, the smaller the loop the lower the height of detection.

Dipole Loops

Most installed loops are classified as dipole (single loop design). Oftentimes a simple dipole loop sensor, especially a large one, will not detect a small car or a motorcycle. The sensitivity of the dipole loop is actually weakest at its center and strongest over its perimeter wires, the longest stretches of which are often routed near the lane edges. This makes the dipole loop configuration vulnerable to false positives when adjusted to detect small vehicles.

Quadrupole Loops

In order to address this reliability problem, many installers have switched to a quadrupole loop as shown below. A quadrupole loop is actually two loops wired in a figure-8 pattern side-by-side, in series with a single wire. Because each loop has two magnetic poles, the sensor has a total of four poles, hence the name quadrupole. The two poles are wound in opposite directions, such that whenever the magnetic North is pointing up out of one loop, it is pointing down into the adjacent loop. This creates a tight channelization of magnetic flux from one loop over into the other, resulting in maximum sensitivity over the center of the sensor footprint with much less spillover around the sides. Also, note that the center sawcut in the loop, which runs parallel to the direction of vehicle travel, has twice as many conductors in it as the edge sawcuts, and the current runs in the same direction for all of the center-sawcut conductors. This makes the center sawcut the most sensitive place over which to position motorcycle wheels. The quadrupole loop offers at least four significant advantages over the dipole loop:

- Improved sensitivity
- Lower false positive detections
- A larger "sweet spot" over the center wires
- More logical placement of the "sweet spot" (in the center of the lane)

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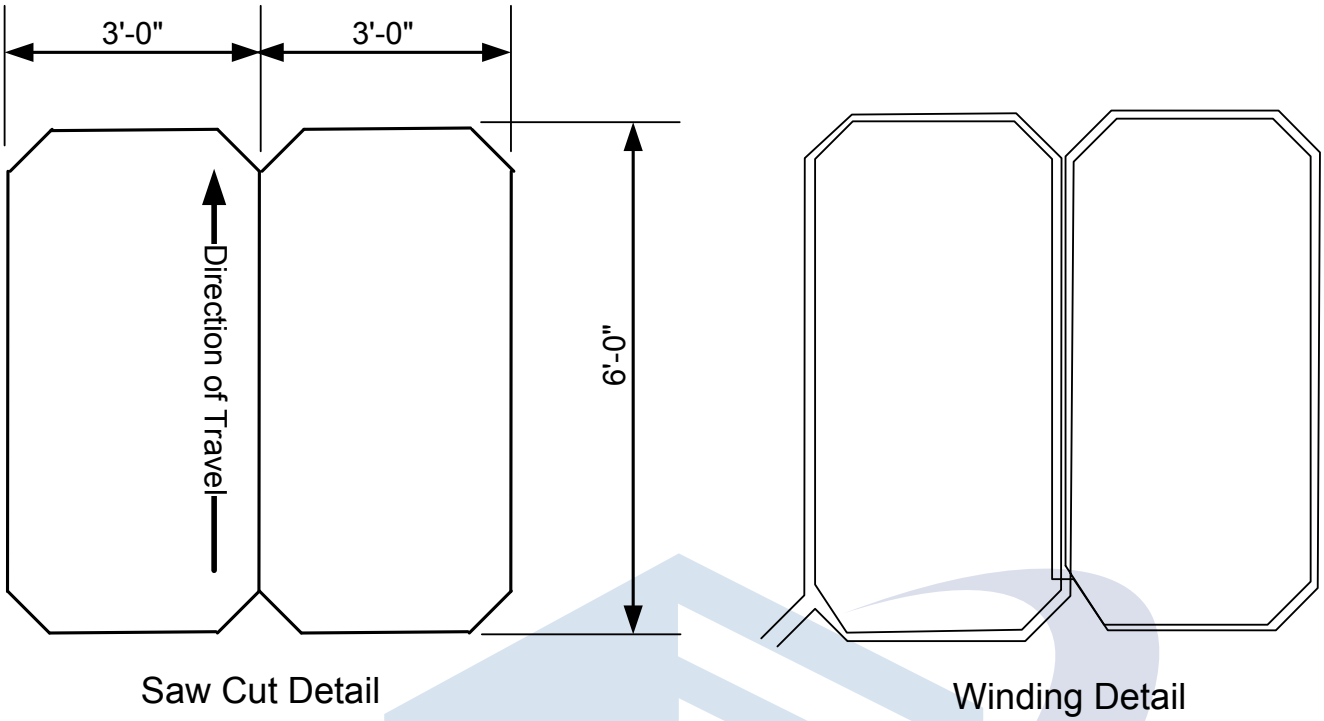

Saw Cut Detail

Winding Detail

Motorcycle rims lend well to detection by inductive loop detectors because they provide an excellent conductive loop and are located close to the ground where the loop wires are. By positioning the rims over a straight leg of the loop, wire pointed in the same direction allows the magnetic field lines around the loop wire to pass through the profile of the wheels. The larger the area of the wheels in comparison to the area of the sensor loop, and the better the positioning of the wheels over the loop wires, the greater the chance of detection. Positioning the wheels at a different angle or moving them to either side from the wire reduces their effectiveness. Therefore, the quadrupole loop configuration provides loop wires in the center of the lane of travel parallel to the direction of travel.

If the loop footprint is very long then the relatively small motorcycle wheels will intercept a very small percentage of the magnetic flux generated by the loop. If the loop footprint is a more modest length (as shown in the above sketch), the larger relative size of the motorcycle wheels in the path of the magnetic field will make them easier to be detected. In fact, a small quadrupole loop at high sensitivity can usually detect a motorcycle anywhere over the loop, not just over the center wires. However, detection of a motorcycle over a well-designed quadrupole loop requires that the detector circuit be adjusted more sensitive than what is typically required for automobile detection. It is also recommended that markings be placed in the roadway to identify the center of the loop to motorcyclists.

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