Manual

Traffic and Road Use Management
Volume 4 – Intelligent Transport Systems and Electrical Technology

Part 5: Configuration and placement of vehicle detection

November 2017
## Contents

1  **Introduction** ....................................................................................................................................1
2  **Scope** ..............................................................................................................................................1
3  **Definition of terms** .........................................................................................................................1
4  **Reference documents** ...................................................................................................................2
5  **Technology options** .......................................................................................................................2
6  **Sensor placement for vehicle detection** ........................................................................................2

6.1  **Sensors at a signalised intersection** ............................................................................................2
6.1.1  **Sensor selection** .............................................................................................................3
6.1.2  **Stop-line sensors** ...........................................................................................................3
6.1.3  **Right-turn sensors** ..........................................................................................................3
6.1.4  **Mid-block crossing sensors** ............................................................................................3
6.1.5  **Advance detection sensors** ............................................................................................3
6.1.6  **Mid-block measurement sensors** ....................................................................................4
6.1.7  **Depart-side sensors** .......................................................................................................4
6.1.8  **Red light camera sensors** ...............................................................................................4
6.1.9  **Bicycle sensors** ...............................................................................................................4

6.2  **Motorway detection sensors** ........................................................................................................4
6.2.1  **On motorways** ................................................................................................................5
6.2.2  **Ramp signalling** ..............................................................................................................5

6.3  **Loop placement for vehicle identification** ..................................................................................9

7  **Sensor installation** .........................................................................................................................9

7.1  **Numbering of sensors** ................................................................................................................9
7.1.1  **Intersection sensors** .......................................................................................................9
7.1.2  **Isolated detector loops** .....................................................................................................9

7.2  **Inductive loop installation** ..........................................................................................................9
7.2.1  **Loop installed in asphalt pavement** ..................................................................................10
7.2.2  **Loop installed in concrete pavement** ...............................................................................11
7.2.3  **Loop cabling standards** ...................................................................................................11
7.2.4  **Loop feeder cable** ............................................................................................................11
7.2.5  **Loop configuration** ..........................................................................................................12
1 Introduction

This document sets out the practices used by the Department of Transport and Main Roads (the department) on the selection, configuration, placement and installation of a vehicle detector and associated sensors for the purposes of traffic management, traffic surveys and vehicle identification.

2 Scope

Vehicle detectors are used to measure vehicle flow, occupancy, headways, speed and length. A vehicle detection site is to consist of a STREAMS-supported vehicle detector and associated sensors that are capable of accurately measuring these parameters. One-minute data is used by the following STREAMS applications:

- Ramp Signalling
- Incident Detection
- Traffic Signal Control
- Co-ordination plan selection
- Travel Time data
- Variable Speed Limit (VSL)
- Vehicle Activated Signs (VAS)

This document only deals with vehicle detectors and associated sensors for the purposes of traffic management, traffic surveys and vehicle identification. It does not cover the additional components such as cabinets required at a vehicle detection/identification site. Nor does it include systems associated with vehicle classification in accordance with the Austroads vehicle classification scheme.

Details on vehicle detector and sensor selection, configuration, placement and installation given in this document are the normal practice used by Transport and Main Roads. However, the exact configuration and placement may be changed to suit a particular installation, in which case the reader should consult with the department's Road Operations section.

3 Definition of terms

Table 3 – Definition of terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detector</td>
<td>A device that processes the raw signal received from the Sensors. The processed data is in a readable form.</td>
</tr>
<tr>
<td>Detector site</td>
<td>A location on the road network where vehicle data collection is taking place.</td>
</tr>
<tr>
<td>STREAMS</td>
<td>Traffic Management System used by Transport and Main Roads</td>
</tr>
<tr>
<td>Sensor</td>
<td>Device that perceives the vehicle and produces raw signals. In some cases this sensor may be an integrated part of the detector and not a separate item.</td>
</tr>
</tbody>
</table>
4 Reference documents

Table 4 – References

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 2276.2</td>
<td>Part 2 Vehicle Detector Loop Feeder Cable</td>
</tr>
<tr>
<td>AS2276.3</td>
<td>Part 3 Vehicle Detector Loop Cable</td>
</tr>
<tr>
<td>MRTS93</td>
<td>Traffic Signals</td>
</tr>
<tr>
<td>Standard Drawing 1424</td>
<td>Traffic Signals - Detector loops installation details asphalt pavement</td>
</tr>
<tr>
<td>Standard Drawing 1425</td>
<td>Traffic Signals - Detector loops placement details</td>
</tr>
<tr>
<td>Standard Drawing 1426</td>
<td>Traffic Signals - Detector loops standard configurations</td>
</tr>
<tr>
<td>Standard Drawing 1701</td>
<td>Traffic Signals - Detector loops counting/right turn loops and diode connection details</td>
</tr>
<tr>
<td>Standard Drawing 1702</td>
<td>Traffic Signals - Detector loops motorways management placement details</td>
</tr>
</tbody>
</table>

Standard Drawing 1703 is withdrawn and some of the details are superseded by Standard Drawing 1425

5 Technology options

Vehicle detectors and sensors may rely on various technologies, such as pneumatic tubes, inductive loops, infrared, laser, radar and video imaging technologies. The majority of sensors used by the department are of the inductive loop type, whereby the presence of a vehicle is detected from the distortion of the magnetic field around the loop caused by a vehicle passing over the loop and the raw signal processed by the vehicle detector. Irrespective of the sensor technology, detection accuracy depends on its configuration, placement and sensitivity.

6 Sensor placement for vehicle detection

The placement of a sensor depends upon its intended use and pavement type/characteristics.

Unless otherwise specified, sensors for the purposes of vehicle detection and/or identification, must be able to measure traffic volume (counting), occupancy, speed, headway and length.

6.1 Sensors at a signalised intersection

Sensors at a signalised intersection can be used for traffic signal control, traffic management, for traffic survey data or for traffic violation detection. Except for red light camera application, a separate sensor is to be allocated for each traffic lane at signalised intersections. Traffic lanes which do not have individual sensors are to be connected in series at the pit. Sensors used in traffic signal control and management can be:

a) stop-line or right-turn sensors at intersections
b) slip lane sensors
c) advance or queue sensors, and
d) sensors at mid-block or school pedestrian crossings.
6.1.1 Sensor selection

Unless otherwise specified, sensors that are directly required to operate the traffic signal controller, as a minimum, are to measure traffic volume, headway and occupancy. This only applies to the following:

- stop-line sensors
- right turn sensors
- slip lane sensors
- advance detection sensors.

6.1.2 Stop-line sensors

Stop-line sensors are to be located upstream of the stop-line at a signalised intersection as shown on Standard Drawing 1425 Traffic Signals - Detector loops placement details.

6.1.3 Right-turn sensors

For the detection of right-turn vehicles, one or more sensors connected in series are to be used. Details on the placement of sensors are shown on Standard Drawing 1425. Additional sensors, if required, are to be placed 1 m downstream from the last sensor downstream from the stop line.

6.1.3.1 Right-turn sensor configuration

To obtain accurate performance measures for the right-turn movement, it is highly recommended that the first sensor upstream of the stop bar be connected to a separate vehicle detector to the other sensors. The controller personality would use the "detector diode" function to combine the sensors internally to control the demand for the right-turn movement. Refer to Standard Drawing 1701 Traffic Signals - Detector loops counting/right turn loops and diode connection details for details.

For installations where there are spare detector sensor inputs in the controller, all the sensors may be separated into individual detectors and the "detector diode" function in the personality may be used to combine these sensors internally to control the demand for the right-turn movement. This allows the individual sensors to be monitored and faults detected much quicker.

Red light camera loops can be installed at the same approach.

6.1.4 Mid-block crossing sensors

Vehicle detection sensors used in mid-block (or school) pedestrian crossing are to be placed upstream of the stop-line as shown on Standard Drawing 1425.

6.1.5 Advance detection sensors

Advance detection sensors are strategically located upstream of the stop-line well in advance to measure headways (the time period between successive sensor actuations), or gap time, to terminate the traffic signal phase earlier under free flow conditions.

Advance detection sensors are to be used when approach speed is high or when there is a large proportion of heavy vehicles. They are to be located to suit the required stopping distance for the 85th percentile approach speed, at 35 metres (for 50 km/h speed limit) to 40 metres (60 km/h) upstream of the stop-line.
6.1.6 Mid-block measurement sensors

Mid-block measurement sensors are installed to measure traffic flow characteristics between intersections. These sensors are to be located between one-third and half way from the depart side of one intersection to the stop-line of the next downstream intersection.

6.1.7 Depart-side sensors

Depart-side sensors are installed to determine turning volumes of shared lanes and to detect downstream link congestion, in the absence of mid-block measurement sensors. These sensors are to be located downstream of the stop-line past the shared centre area of an intersection.

6.1.8 Red light camera sensors

Traffic violation sensors are installed in conjunction with a red light camera and flash unit to enable red light traffic violations to be detected and photographed. Sensors are installed in exclusive through lanes and shared lanes where there is no left or right-turn green arrow displayed in conjunction with the full red signal.

6.1.8.1 Red light camera sensor placement and configuration

Red-light camera (traffic violation) installations shall use inductive loops. The placement and configuration of these loops are as shown on both Standard Drawing 1425 Traffic Signals - Detector loops placement details and Standard Drawing 1702 Traffic Signals - Detector loops motorways management placement details:

a) Installed with edges parallel to both the stop line and approach/departure kerb, where the stop line is not perpendicular to the kerb, the shape of the loop shall be a parallelogram.

b) Installed so that no part of the loop shall be any closer than 1.2 m to the trajectory of cross or turning traffic of another phase. This will prevent false actuations, and

c) For intersections that are connected to STREAMS, it is recommended that detector 16 be connected to the camera unit so that camera alarms, such as no film, camera faults, etc., can be reported to STREAMS. Therefore, detector 16 should not be used as a normal detector when a red light camera is installed at such an intersection. Note that controller software version 2.4 or later allows for the status of up to 24 vehicle detectors to be returned to STREAMS, so detector 24 may be used for this purpose where this software is installed.

6.1.9 Bicycle sensors

Bicycle sensors are to be installed within bicycle lanes/paths only. These sensors are to be placed upstream of the stop-line. Where inductive loop is used for the detection of bicycles, the centre of the loop is to be marked longitudinally with six diamonds (100 mm x 100 mm at 300 mm centres) as shown on Standard Drawing 1425.

6.2 Motorway detection sensors

Motorway detection sensors refer to sensors located either on the motorway, entry-ramps or exit-ramps. These vehicle detection sensors are used to increase the safety and performance of the road network through incident detection and management, ramp signalling and determining traveller information.
6.2.1 On motorways

Vehicle detection sensors on motorways are to be located as follows:

1. immediately upstream from an entry-ramp nose
2. immediately downstream from an exit-ramp nose, and
3. at 500 m maximum spacing.

Designers should refer to ITS placement guideline

6.2.2 Ramp signalling

The department’s ramp signalling model is based on ramp signalling algorithms.

There are four different types of entry-ramps supported by this model as described below:

- Simple entry-ramp types
  - This type of entry-ramp involves a simple ramp of one or more general traffic lanes where the stop bar extends across ALL lanes of the entry-ramp.

- Complex entry-ramp types
  - Two lanes of metered traffic, plus a priority lane
  - Two lanes of metered traffic, plus a metered priority lane
  - Motorway to motorway entry-ramps.

Designers must consult with the department’s Network Operations and Performance (NOP) unit on the placement of sensors for complex ramp signalling. Refer to TRUM Manual Volume 1, Part 9, 8.2-1 for further details. The ramp signalling algorithms require vehicle detection sensors to be placed at various locations to optimise motorway flow. The required locations are described in Figures 6.2.2(a) to 6.2.2(d), and Section 6.2.2.1.

Figure 6.2.2(a) – Simple entry-ramp, 2 lanes of metered traffic
Figure 6.2.2(b) – Simple entry-ramp, 2 lanes of metered traffic and an added lane

Figure 6.2.2(c) – Complex entry-ramp, 2 lanes of metered traffic and a priority lane
6.2.2.1 Sensor placement and configuration

Unless otherwise specified, all sensors used for the purpose of ramp signalling shall permit measurement of traffic volume (counting), speed, headway, occupancy and vehicle length.

Main line sensors

The sensors on the mainline provide the data required for the ramp signalling algorithms to ensure the ramps are metered appropriately to optimise the motorway flow. These sensors are to be placed outside the merging area as follows:

- upstream mainline sensors are to be placed before the ramp nose, and
- downstream mainline sensors are to be placed at the end of the final merge taper, or
- downstream mainline sensors are to be placed at minimum of 320 m from the ramp nose for entry-ramps with a single added lane situation without a merge.

The upstream mainline sensors are used for traffic counting and monitoring of motorway performance. These sensors can also be used by the ramp signalling algorithm as a backup if the downstream mainline sensors become unavailable for any reason.

These mainline sensors shall form part of the regular array of mainline vehicle sensors.

Stop line sensors

Sensors are to be placed immediately upstream of the stop line to enable cycling of the ramp signals when the ramp signalling system is active.

Sensors are also to be placed immediately downstream of the stop line for vehicle counting associated with the ramp signalling algorithms.

When inductive loops are used as sensors, they are to be placed as follows:

- loop to be placed 2.5 metres (trailing edge of loop) upstream of the stop-line, and
- loop to be placed 2.5 metres (leading edge of loop) downstream of the stop-line.
Ramp queue sensors

Sensors are to be placed at the ramp entrance and at the midpoint between the stop line and the start of the ramp for queue length estimates and queue management by the ramp signalling algorithms.

Midpoint sensors are not required for an unmetered priority access lane. However it is recommended that midpoint sensors be installed on unmetered priority access lanes for future consideration.

Where a ramp is very short relative to the desirable storage, additional sensors may be required so as to detect queues on the arterial roads leading on to the ramp.

6.2.2.2 Motorway-to-motorway entry-ramps

Motorway-to-motorway ramps provide connections between high speed facilities where drivers may not expect to stop, nor expect to encounter a queue of stopped vehicles. Therefore, signalling motorway-to-motorway entry-ramps should be avoided wherever practicable. When this is not possible, adequate storage should be catered for in the geometric design of these ramps. The principles mentioned in Section 6.2.2.1 shall be applied on such ramps for effective ramp signalling.

6.2.2.3 Non-metered entry-ramps

Where ramp metering is not specified, the entry-ramps must have their flow measured for traffic volume (counting), speed, headway, occupancy and vehicle length. The sensors required to measure these parameters are to be located adjacent to the sensors measuring the mainline motorway flow immediately upstream of the entry-ramp nose.

6.2.2.4 Exit-ramps

All exit-ramps must have their flow measured for traffic volume (counting), speed, headway, occupancy and vehicle length. The sensors required to measure these parameters are to be located adjacent to the sensors measuring the mainline motorway flow towards the start of the start of the exit-ramp so that queues can be detected and prevented from extending on to the motorway. Typically, these vehicle detection sensors are located at the one-third point along the ramp measured from the gore area. This may be adjusted depending on the situation.
6.3 **Loop placement for vehicle identification**

Vehicle Identification Detection (VID) system is removed as the technology is no longer in use.

7 **Sensor installation**

7.1 **Numbering of sensors**

7.1.1 **Intersection sensors**

For the purpose of design and installation of traffic signals at an intersection, the numbering of sensors is recommended to be in a clockwise direction starting from the controller.

7.1.2 **Isolated detector loops**

For isolated loops that are not related to any intersection, the loops shall be numbered from the pit with the pit number as the prefix, e.g. Pit 1, Loop 1 shall be Loop 11; Pit 12, Loop 6 shall be Loop 126, and so on.

Each detector shall be assigned a number for identification. This number shall be allocated according to which system of traffic control or counting the detector belongs to.

7.2 **Inductive loop installation**

Vehicle detection loops are to be located as shown on Standard Drawing 1424 *Traffic Signals - Detector loops installation details asphalt pavement* and Standard Drawing 1425 *Traffic Signals - Detector loops placement details*.

Vehicle detection loops installed on the department’s road network are to be installed in asphalt or in concrete pavement. Loops installed in bitumen seals are not covered in this document.

When determining the placement of detector loops, the following points should be considered in regard to loop installation:

a) Loop wire needs to be close to the road surface for optimum sensitivity. Minimum distance to surface is 15 mm.

b) Loops cannot be installed over any bridges, culverts, stormwater drains or similar structures unless there is at least 0.8 m of covering pavement.

c) Loops cannot be installed closer than 0.3 m to any ferrous metal object such as a manhole cover, pipe or reinforcing, and

d) The distance between the loop and its sensor unit, normally located in the controller housing, is limited to 300 m.

The location and/or size of any detector loop may vary to suit special circumstances, such as geometry (e.g. driveway, turning lane, parking area), location of expansion joints or ferrous metal objects.
7.2.1 Loop installed in asphalt pavement

For installation in asphalt pavement, the Quadrupole loop takes the form of a "figure-8" as shown on Standard Drawing 1424 Traffic Signals - Detector loops installation details asphalt pavement. The following are the requirements of rectangular and Quadrupole loops installed in asphalt pavement:

a) Loop cable shall comply with AS 2276 – Part 3.

b) Loop feeder cable shall comply with AS 2276 – Part 2.

c) Loop cable shall be continuous, i.e. no joints permitted, between Start (S) and Finish (F).

d) Loop leadings (S and F) to each loop shall be twisted together at approximately 1 turn per 100 mm.

e) Loop inductance connected across its input terminals lies within range 50 uH to 700 uH and a Q factor in the range of:

i. 5 to 50 below 60kHz; and

ii. 3 to 50 above 60kHz

f) Loop detector cables and feeder cables shall be jointed in footpath pits. Each joint shall be separately insulated and sealed to prevent ingress of water.

g) All loop feeders shall be returned to the cable pit in the footpath (or the median of a minimum 2 m wide) except for right-turn presence loops or loops in the two lanes closest to the median in a four or more lane approach which may be returned to a cable pit in the median if a median post is required.

h) All loop cable ends shall be labelled with Helagrip Markers (HG2-5) or equivalent with Start (S), Finish (F) and numbered as per the design plan.

i) All feeder cables shall be labelled with Helagrip Markers (HG4-9), or equivalent, at each end to show the detector number as per the design plan (e.g. 1, 2, etc.), and

j) Fit retaining wedges at 300-400 mm spacing to ensure loop cable does not move while sealant is applied. The wedge material shall be flexible and be resistant to water.

k) The loop shall be sealed in the slots using a polyurethane slot sealant or equivalent.

l) The number of turns for loops shall be: Rectangular/Square (4 turns) and Quadrupole (3 turns). Motorway preformed loops have 5 turns.

m) For feeder cable lengths in excess of 250 m, a 1% variation check is required to determine if another loop turn is needed.
7.2.2 Loop installed in concrete pavement

For installation in concrete pavement, the loop is recommended to be pre-formed and takes the form of a square as shown on Standard Drawing 1424 Traffic Signals - Detector loops installation details asphalt pavement. The following are the requirements of pre-formed square loops installed in concrete pavement:

a) Loops shall be pre-formed, square, measuring 2 m by 2 m, supplied with 5 turns (acceptable inductance range: 50 uH – 700 uH).

b) Pre-formed loops shall be assembled, joined and tested prior to delivery at site. The loops shall be supplied complete with factory-assembled lead-in cables. Cores shall be continuous, jointing of cores is unacceptable.

c) The individual loop cores shall be insulated individually and encapsulated within a flexible sleeve constructed from polypropylene, polyethylene, XLPE or other suitable material.

d) Lead-in cable shall be a continuation of the loop cables. They shall be insulated individually, twisted together at approximately 4 turns per 100 mm and encapsulated within a flexible sleeve.

e) Detector loops shall be installed and sealed into slots cut into the top of a concrete sub-base.

f) Slots for the pre-formed loops shall be cut using conventional loop cutting or milling type equipment. Under no circumstances shall percussion type equipment be used to form the slots. The loop shall be sealed in the slots using an approved slot sealant.

g) All loop feeders shall be returned to the cable pit in the footpath (or the median with a minimum width of 2 m). Length of lead-ins shall be kept to the minimum to extend 0.6 m to 1 m past the top of the pit. Loops in the two lanes closest to the median in a four or more lane approach may be returned to a cable pit in the median.

h) Loop detector cables and feeder cables shall be jointed in pits. Each joint shall be separately insulated and sealed to prevent ingress of water, and

i) Loops in asphalt pavement to be installed to MRTS93 Traffic Signals in dense grade with open grade cover.

7.2.3 Loop cabling standards

Loop cable shall comply with AS 2276.3 Part 3 Vehicle Detector Loop Cable.

Loop feeder cable shall comply with AS 2276.2 Part 2 Vehicle Detector Loop Feeder Cable.

7.2.4 Loop feeder cable

The loop lead-in is the cable between the loop and its nearest pit. The loop feeder cable connects the lead-in cable in the pit to the controller. The total length of the cables from the loop to the controller affects the detector sensitivity and should be kept to the minimum, and in any case, to less than 250 m.
7.2.5 Loop configuration

Table 7.2.5– Transport and Main Roads’ vehicle detector loop configuration

<table>
<thead>
<tr>
<th>Application</th>
<th>Shape</th>
<th>Length*</th>
<th>Turns</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop line</td>
<td>Rectangular</td>
<td>2 m</td>
<td>3</td>
<td>Departing edge of loop is 4 m from the stop line</td>
</tr>
<tr>
<td>Right-turn</td>
<td>Rectangular</td>
<td>1.2 m and 2 m</td>
<td>3</td>
<td>3 or more loops in series spaced at 1.5 m upstream from the stop line and/or at 1 m spacings downstream of the stop line</td>
</tr>
<tr>
<td>Mid-block ped crossing</td>
<td>Rectangular</td>
<td>2 m</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mid-block measurement</td>
<td>Rectangular</td>
<td>2 m</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Advance</td>
<td>Rectangular</td>
<td>2 m</td>
<td>3</td>
<td>35 m – 40 m in advance of the stop line</td>
</tr>
<tr>
<td>Speed#</td>
<td>2 x Rectangular</td>
<td>2 m</td>
<td>4+</td>
<td>Same as speed loops; 4 turns, or 5 turns, if pre-formed</td>
</tr>
<tr>
<td>Motorway</td>
<td>Rectangular</td>
<td>2 m</td>
<td>4+</td>
<td>Same as speed loops; 4 turns, or 5 turns, if pre-formed</td>
</tr>
<tr>
<td>Motorway ramp</td>
<td>2 x Rectangular</td>
<td>2 m</td>
<td>4+</td>
<td>Same as speed loops; 4 turns, or 5 turns, if pre-formed</td>
</tr>
<tr>
<td>Red-light camera</td>
<td>Rectangular/</td>
<td>0.7 m</td>
<td>Leading 4 turns Trailing 3 turns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Skew</td>
<td></td>
<td></td>
<td>Two groups; at the stop line and 2.5 m behind and parallel to the stop line</td>
</tr>
<tr>
<td>Bicycle</td>
<td>Rectangular</td>
<td>1.2 m</td>
<td>3 turns</td>
<td>The centre of the loop is to be marked longitudinally with six diamonds (100 mm x 100 mm at 300 mm centres); Loop width varies to suit (approximately 1 m)</td>
</tr>
</tbody>
</table>

Notes:

(*) Unless specified, width of loop varies with width of traffic lane.
Nominal distance from edge of loop to lane line or median is 0.7 m.
Nominal distance from edge of loop to kerb line is 0.8 m.

(#) Two loops required. Distance between leading edges is 7 m. Where a spacing of exactly 7 m between leading edges is not possible due to pavement constraints, spacing may be increased in 0.1 m increments to a maximum of 8.5 m.

(+) 5 turns if pre-formed.

7.2.5.1 Shape of loop

The requirement to detect all types of vehicles from bicycles and motorcycles to high-bed trailer trucks, while avoiding detection of vehicles in adjacent lanes, has led to a variety of loop designs. Detector loop designs used by the department are Rectangular and Quadrupole as shown in Figure 7.2.5.1.
For speed measurement two identical rectangular loops are used. Refer to Standard Drawing 1702 Traffic Signals - Detector loops motorways management placement details for details on the distance between leading edges of loops.

7.2.5.2 Sizes of loop

Loop sizes determine the detection zone of the loop.

Loop length depends on the dimension of the target vehicle and expected vehicle speed. Loop lengths used by the department vary from 0.7 m to 2.0 m. In some situations, multiple loops are used in series to give an effective loop length much longer than this. Refer to Table 7.2.5 for details of permitted configurations.

Loop width depends on the dimension of the target vehicles to be detected and on the width of the traffic lane. Unless specified otherwise, width of loop varies with the width of the traffic lane. Refer to Note (*) on Table 7.2.5 for details.

7.2.5.3 Number of turns

The number of turns of the conductor making up the loop determines the loop inductance and sensitivity. All loops should have a sufficient number of turns to provide a nominal minimum inductance of between 100 to 700 micro Henries.