NZ POLICE
CALIBRATION UNIT

Speed Detection Operators Module

PHRIS Code 2277

DUT 244

Table of Contents

1. About this module

Goal

This module is designed to provide the theoretical basis for the safe and efficient operation of speed enforcement equipment.

Objectives

When you have completed this module you will be able to:

- identify the requirements of the Code of Operations
- explain:
  - pre-deployment testing
  - site selection
  - safety requirements
  - tracking history
- outline the evidential requirements for speeding offences.

Module Content

This module contains the following sections:

- background
- radar speed detection
- laser speed detection
- operating guidelines
- evidential requirements
- speed detection Code of Operations
- best practice guidelines for specified units
- practical training
- self-paced test answers.

Module and operators manual

The manufacturer's operational manuals for radar and laser speed detection systems used by the NZ Police are inappropriate for the New Zealand environment. For this reason this module and the New Zealand Operators Manual are the only documents detailing the manner of operation New Zealand operation.

Information

Should you have any questions or comments regarding this module please contact:

Inspector Ron Phillips
Calibration Unit
Office of Commissioner
Phone 04 2372484 or Extn 42590

2. Background

Introduction

Research has shown that speed is a major contributor to fatal and injury-causing road crashes. The Government has identified increasing road safety as an important and core part of police business. Significant improvements have been made in enhancing road safety in the last few years. The aim of the NZ Police is to ensure this trend continues by using a range of tools including speed detection equipment.

Trained operators

For police members to use speed detection equipment they must first be certified as a trained operator.

To become a certified operator you must:
- complete this module
- achieve a minimum of 70% in the module theory test
- undergo 20 hours' practical instruction with a qualified instructor who will assess your competence
- be certified as a trained operator by the Traffic Operations Support Group (Office of Commissioner).

Twenty hours have been allocated for practical training. The suggested breakdown of hours is 16 hours for radar training and 4 hours for laser training.

Speed enforcement detection module

The speed detection operators' module focuses on the use of speed detection equipment. It provides an overview of the operating principles and policy guidelines governing the use of speed detection equipment. Evidential and administrative requirements are covered to ensure all operators are able to follow correct procedure.

Within the module there are two short tests. These are designed so that you can measure your progress. At the end of the module you must sit a formal theory test that will be administered by district training staff. To pass the test you must gain a mark of at least 70%. If you do not achieve this you will need to revise the module and sit another test.

District training staff will keep a record of your test results and enter them in your training records.

Practical

Once you have passed the test you will need to gain practical experience operating the speed enforcement equipment. This will take at least 20 hours and needs to be completed with a qualified instructor. Your district trainer has a record of approved instructors.

The practical part of the training is very important and provides an opportunity for you to apply the theory in a practical setting.

The qualified instructors have a training checklist they will use with you to guide your training and to assess your competence. A copy of this checklist is at the end of the module.

When you have completed the practical training and demonstrated your competence in each area. The instructor will forward evidence of this to the district trainer. This will be entered in your training records.

Certified as a trained operator

Once you have successfully completed all parts of the training you will be certified. The district trainer will provide evidence of your training to the district strategic traffic manager who will advise the Traffic Operations Support Group (Office of Commissioner) who will issue you a numbered certificate and enter your details onto the national database of trained operators.

You must be certified by the Traffic Operations Support Group and receive a certificate confirming you are a certified operator before you can use speed detection equipment.

If for any reason you require an additional copy of this certificate you should contact the Traffic Operations Support Group directly.

Manufacturer's manual

The manufacturer's operational manuals for the various speed detection systems used by NZ Police are inappropriate for the New Zealand environment. They do not require a code of operations, ongoing device calibration, daily device testing, operator training, or a tracking history.

Code of Operations

In the interests of fairness, professionalism and accuracy the Measurement Standards Laboratory New Zealand Limited and the NZ Police have agreed to a Code of Operations that governs the operation of all speed detection equipment used by the NZ Police. The Code of Operations 2001 is the current code and a copy is contained in this module.

Using this module

This module focuses on two types of speed detection equipment:

- radar
- laser.

Radar and laser describe the scientific methodology used to detect vehicle speed Although there are some similarities between the devices there are also some fundamental differences. For this reason this module looks at each type separately. The first part of the module deals with radar and the second with laser. It is important that you note the similarities and differences between the two types of device.

Key information

The module contains a reasonable amount of detail. This is to provide depth to your understanding of how the devices operate. You do not need to remember all the information contained in the module. However, there are some important things that you must know. To help you identify the critical information, the relevant sections are marked ***key information*** in the left-hand column.

Self-paced tests

Through the module you will find two self-paced tests. These are available for you to test your own learning. The answers to these tests are found at the end of the module.

When you have finished the module and feel you have understood and can remember all the ***key information*** material, you need to sit the assessment test.

Assessment test

The assessment test is available from your district trainer. The test is administered in exam conditions — this means you will not have the module to help you and you will not be able to discuss the questions with others.

You need to achieve a mark of at least 70% to pass the test. If this does not happen you will be required to resit the test, which will differ from the previous test.

PHRIS

PHRIS coding for the module is 2277.

PHRIS coding for practical training is 2287.

3. Radar speed detection

Introduction

Radar is an acronym for **RA**dio **D**etection **A**nd **R**anging.

Radar means the transmission of radio waves that have the ability to detect and provide the distance the object is away from the transmission source.

History

The concept of radar was first discovered in 1904, but it was during the Second World War that significant progress was made in this area of research. New Zealand scientists who had worked in this field during the war returned to work for the Department of Science and Research and extended the technology.

The world's first working traffic speed detection radar was developed in New Zealand in the late 1940s. In 1947 the first traffic speed radar was trailed in Wellington.

From these humble beginnings radar devices have become an integral part of the New Zealand road safety scene.

Although the models have changed and will continue to change, the operating principles of radar devices remain the same.

The use of radar as a speed enforcement tool is not restricted to New Zealand. Radar speed detection devices are widely used; each year over 50 million enforcement notices are issued to speeding drivers around the world.

Use of radar

Radar is present in everyday life; when we make a telephone call, use the internet or watch television the information is carried, at least part of the way, by microwave. (Microwave is the radio frequency at which radar operates.)

Radar theory

The principle of primitive radar is can be explained simply. A beam of microwave electromagnetic energy is generated at super high frequency. This energy is radiated into free space through a antenna at the speed of light. If the energy strikes an object, part of the scattered energy is returned to the radar through the antenna. The unit processes the return signals and displays the information, the distance the object was from the antenna.

Traffic radar

Traffic radar uses very low-powered, continuous microwave energy. The receiver monitors the transmitter frequency and compares the returned frequency with the transmitted frequency. The change of frequency is displayed as the speed check.
The frequency change is due to the doppler shift, which is explained later in the module. The receiver's electronics change the frequency into speed readings.

Radar components

There are three basic components to traffic radar:

- transmitter
- receiver
- antenna.

Key information ***The three components that make up traffic radar are the transmitter, receiver and antenna.***

To understand how traffic radar operates it helps to know the function of each of component.

The transmitter

The transmitter generates radio energy in the microwave spectrum from a low power gunn diode unit (this is the device used to make microwave energy). This energy is then channelled to the antenna with a small portion sent to the receiver for a comparison between the original transmitted signal and the received reflected signal.

Key information ***The transmitter generates energy. Most of the energy is channelled to the antenna, a small amount goes to the receiver.***

The antenna

A narrow-beam, horn antenna is used to direct the microwave energy and collect the reflected signal . The antenna is aimed at the area to be monitored. The size of the antenna depends on the frequency or signal wavelength used.

Key information ***The antenna is used to aim the microwave beam at the area being monitored.***

The receiver

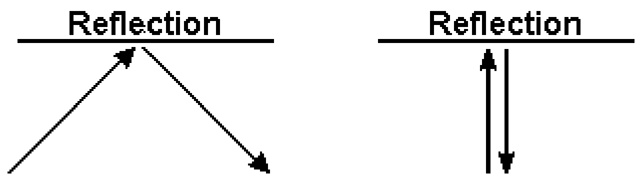
The receiver is the device tuned to the transmission frequency that picks up the waves generated by the transmitter. It amplifies the small signal detected and produces the information as a speed readout.

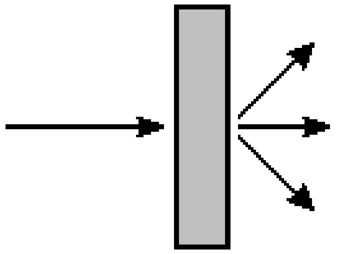
Key information ***The receiver is the unit that displays the speed readout.***

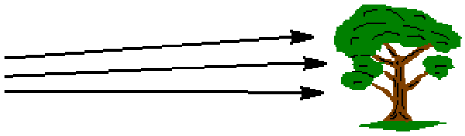
The radar beam

The beam of energy transmitted from the radar antenna is like a torch beam. The radar signal continues outward from the antenna until it is reflected (shined back), refracted (bent, like a pencil placed in a glass of water) or absorbed.

The following diagrams demonstrate what happens to the radar beam.



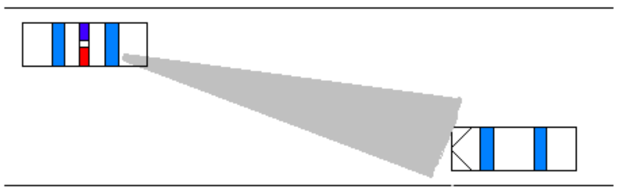




Key information ***The radar beam continues outward until it is reflected, refracted or absorbed.***

Radar beam angle

The width of the radar beam is normally 12 degrees. This is known as the main signal beam. The further the beam extends from the transmitter the wider it becomes.



Key information ***The main signal beam becomes wider the further from the transmitter it becomes.***

Beam range

The radar beam could continue outward from the antenna for an indefinite distance. However, in reality the beam range is the distance that the radar signal can be reflected back from a target to the receiver. The range differs depending on the site. Under ideal conditions the device should be able to detect targets at a distance of one kilometre.

Key information ***The range of the radar beam differs depending on the site.***

Factors affecting range

Atmospheric conditions such as rain, mist and fog will affect the radar range and the return signal. Local terrain such as hills, corners, fences and buildings will also have some effect.

All radar units have a range or sensitivity control that can be adjusted to control the level of received return signal. By adjusting the range you can reduce the target vehicle distance.

Key information ***Radar range can be affected by atmosphere and terrain. Operators can alter the range by adjusting the target range control.***

Target reflectivity

The size and shape of the target vehicle's surface will affect the information sent back to the radar unit for processing into speed readings. The bigger the target the better it will reflect the signal back to the radar unit.

A target vehicle that is small and aerodynamically designed is a poor reflector of a radar signal. This means it will need to be closer to the unit to be picked up clearly.

Key information ***The size and shape of the target vehicle affects the strength of the reflected signal.***

Doppler effect

The speed radar detects a movement between the transmitted and received signal. This change in frequency is known as the doppler effect.

Simply, the radar unit determines the frequency difference between the signal transmitted from the radar unit and the signal reflected back from the moving target vehicle.

Key information ***The change in frequency between the signal transmitted and the signal reflected back is the doppler effect.***

Tuning forks

Vibrating objects produce sound waves. A tuning fork illustrates how a vibrating object can produce sound. The fork consists of a handle and two tines. When the tuning fork is hit, the tines begin to vibrate causing disturbances in the surrounding air molecules and producing a ringing sound.

This is why tuning forks are used as part of the calibration and daily testing of the radar unit. A particular speed reading is confirmed when the sound (frequency) the fork produces is the same as the doppler frequency required. Each fork is stamped with an operating band (frequency) and the speed the fork will produce at that frequency.

It is important to note that because the movement of air molecules from the fork goes from left to right you should always present the side of the tine to the antenna.

Tuning forks should not be hit against hard objects as the tines will bend out of shape and lose their ability to vibrate. The new flat type of fork can be flicked by a finger or lightly struck against another fork to produce the required signal level to conduct daily testing.

Key information ***Tuning forks are used to simulate speed. Each fork is stamped with an operating band (frequency) and the speed the fork will produce at that frequency. They are used to check the accuracy of the speed reading.***

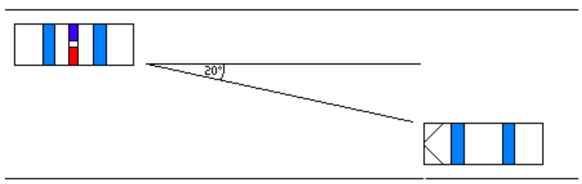
Cosine angle effect

In both stationary and moving modes a cosine angle effect occurs when vehicles pass at an angle through the beam rather than directly in line with it. The cosine angle is the angle between the operator and the beam.

The effect is that measured speed will always be less than true speed. This occurs because the measured speed will be equal to the true speed less than the cosine of the angle between the beam and direction of travel of the target vehicle.

The larger the cosine angle the lower the speed. At 90 degrees there will be no reading as there is no relative motion between the axis of the antenna and the target. The cosine of a target travelling in a lane opposite the radar unit will always present a lower reading than is true, as the target will be off to the side of the main beam pointing down the road.

The following table and diagram demonstrate the effect of the cosine angle.



100 km/h true speed of target

Radar antenna off set angle to the target vehicle	Speed in km/h
0	100
10	98.48
20	93.96
30	86.60
40	76.6

As the table shows, for every degree the radar is off-set to the target vehicle the speed reading registers less than the true speed of the target vehicle.

The difference will always be in favour of the target vehicle.

Key information ***Aiming the radar beam so that the cosine angle is minimised gives a more accurate reading. Any speed difference between true speed and the recorded speed will always be in the favour of the target vehicle.***

Radar – Stationary mode

Site selection is extremely important when operating radar in a stationary mode. An operator must consider both operation and safety considerations when selecting a location.

An ideal site is straight for about 200 meters or more, with the road surface slightly rising away from the radar unit and free from undulations. Undulations will cause fading of the return signal.

Key information ***When selecting a site operation and safety must be considered.***

The radar beam is like a torch light beam. When setting up, the operator should aim the antenna slightly towards the right-hand side of the road. They should listen to the doppler tone to ensure any targets are free from the fading that results if the antenna is poorly aimed or a poor site has been selected. The aiming of the beam is important to minimise the cosine effect and to obtain a greater return signal.

Key information ***Correct aiming of the antenna minimises the cosine effect.***

Range control

Adjust the range control to the required level to monitor target vehicles.

Key information ***The range control should be adjusted to suit operational conditions.***

Site safety

When setting up a stationary site the operator should do so without interfering with other traffic movements. The site should allow the operator room to stop the offender using hand signals without the need for pursuit. Safe and legal parking should be available for the vehicles stopped.

The operator must make sure they and the target vehicle and driver are safe when stopping them.

Reflective jackets maximise the operator’s visibility to road users and enhance safety. They should be worn at all times.

Key information ***The operator is responsible for their safety and the safety of other road users.***

Radar – Moving mode

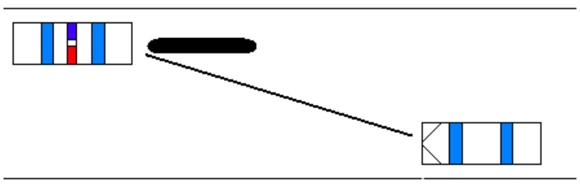
The basics of stationary radar apply to radar used in moving mode. However, there are some additional factors that must be considered.

As a stationary radar, the antenna receives only one signal. However, in moving mode there are two received signals both with different doppler return frequencies.

Opposite lane mode

The operating principles of "opposite lane mode" are simple. A single radar frequency is transmitted from the moving patrol vehicle. A portion of this signal is reflected off the ground about 15 metres directly in front of patrol vehicle and returned to the antenna. This is called "ground speed" and is displayed in the patrol speed window as low doppler frequency shift.

The approaching target vehicle reflects a portion of the transmitter signal, which is high doppler shift. As both vehicles are moving towards each other the doppler shift frequencies combine.



Example: A patrol vehicle travelling at 90 km/h and a target vehicle travelling at 130 km/h produce a combined speed of 220 km/h. However, within the radar's electronic processor circuits, the radar unit subtracts the patrol ground speed from the combined speed. This results in a target speed of 130 km/h.

It is very important that ground speed is obtained before any target vehicle enters the beam. Without a ground speed reading the unit cannot produce a target vehicle reading. Operators must constantly monitor the patrol vehicle's calibrated speedometer to ensure the radar unit is displaying the correct ground speed.

Ground speed may be lost during heavy rain as the rain droplets may absorb the radar signal. In this case operation of the device should cease until the rain eases or stops.

Ground speed

For the radar to operate in moving mode it must be able to detect the ground speed of the patrol vehicle. There are times when the traffic radar is unable to process ground speed and when this happens the unit will show no speed readings. Ground speed will be lost if:

- the vehicle being detected is travelling at the same speed as the patrol vehicle
- there is heavy rain
- the patrol vehicle is following a large vehicle, in which case the ground speed beam may not obtain a reflection off the road
- the range control is turned down too low.

Key information ***Ground speed must be obtained before any target vehicle enters the beam.***

Same-lane mode

Same-lane mode is used for vehicles travelling ahead of and in the same direction as the patrol vehicle. The unit calculates the difference between the ground speed of the patrol vehicle and the target vehicle and this is depicted on the speed readout.

Deployment

Tracking history

Obtaining a proper tracking history of the target will effectively eliminate errors. Tracking history for all radar contains three main elements:

- visual observation
- audio confirmation
- radar verification.

Visual observation

There are three parts to visual observation, the operator must:

1. identify the target vehicle and continue to monitor its travel
2. confirm the target vehicle is within the radar's range
3. estimate the target vehicle's speed.

Audio confirmation

There are three parts to audio confirmation, the operator must:

1. listen for a clear doppler tone
2. check the tone is consistent with the speed
3. check the level of the signal heard is strong and not fluctuating in audio content.

Radar verification

There are four parts to radar verification:

1. the initial reading is consistent with the operator's visual observation and operator-estimated speed
2. a steady target reading
3. readings consistent with visual observation and audio tone
4. ground speed readings confirmed by patrol speedometer.

When the operator is satisfied the target vehicle is producing the correct reading they should lock the reading and take the appropriate enforcement action. It is not always possible to lock the target vehicle's speed. However, failure to lock the speed will not prevent normal enforcement action being taken.

Possible sources of interference

In the super high frequencies of the spectrum where traffic radar operates (24-38 GHz) the environment is relatively free of noise and other non-natural sources of interference. However, interference may be experienced and it is important to know how this occurs and what to do to eliminate it.

Many articles have been written about the types of interference that will cause traffic radar to produce erroneous readings, including:

- street lighting systems
- radar detectors
- high voltage power lines
- motor vehicle radiator fans
- power transformers
- neon signs
- aircraft radar
- microwave ovens.

These theories concerned the NZ Police and the Measurement Standards Laboratory of New Zealand (MSLNZ). Tests were conducted to determine if the potential interference sources listed above had any effect on the traffic radar equipment used by the NZ Police. No affects were found. A point to consider is that aeroplanes contain more sensitive radar equipment than traffic radar units. If the items listed above generated significant interference radar would be too dangerous for planes to use.

Even though some conditions may cause occasional intermittent readings, most interference sources do not produce any doppler tone. If a clear doppler tone is obtained this will help to eliminate possible sources of interference. By listening to the audible signal the officer can determine:

- when the target entered the beam
- if the estimated speed of the target is consistent with doppler tone

Note the higher the tone, the faster the target vehicle.

Radio transmitters

Radio energy detected near the traffic radar unit will blank off any target readings, displaying "**rfi**". This tells the operator that radio energy is present.

The radio energy from a patrol car radiotelephone or cross-link will prevent readings when the radiotelephone is transmitting.

Radio jammers

Over the years many people have tried to defeat radar speed equipment. Most of these radio jamming devices do not work and are nothing more than gimmicks. Units that do work require large amounts of radar energy to be transmitted and are prohibited in New Zealand by the Radio Communications regulations.

Radar detectors

Radar detectors have a receiver that picks up the radar unit's transmitted energy and alerts the driver.

Operating the radar in hold mode means the transmitter is turned off until required by the operator. The motorist with a radar detector cannot be alerted to the radar when it is operating in hold mode.

The operator can take the unit out of hold mode to obtain a speed check and produce a valid speed-reading before the driver has time to react.

4. Self-paced test – Radar

1. What are the three units that comprise traffic radar?

2. There are three things that can happen to a radar wave, what are they?

3. How can you minimise the cosine effect when using radar?

4. Who is permitted to use radar speed enforcement equipment?

5. What is the antenna component of traffic radar used for?

6. Does the width of the beam remain the same the further from the transmitter it is emitted?

7. What factors can affect the radar range?

8. How can an operator reduce the target range?

9. What affect does vehicle size and shape have on the strength of the reflected signal?

10. There are two major things that you need to consider when selecting a stationary operating site, what are they?

11. Establishing tracking history for all radar speed checks requires three elements, what are they?

12. Within each of the three elements required to establish tracking history there are a number of parts. Detail what these are for each tracking history element.

13. What are the tuning forks used for?

14. What is the doppler shift?

15. Why is a certified speedo required when operating traffic radar?

16. What reasons are there for loss of ground speed?

17. Is it a requirement to lock every speed reading when conducting an enforcement stop?

5. Laser speed detection

Introduction

Laser is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation. A laser is a concentration of light energy into a narrow beam.

Principles of laser energy

To better understand how laser energy operates it helps to understand the principles of light. Light is defined in wavelengths similar to radio waves. The shorter the wavelength, the higher the frequency. Visible light falls into a fairly narrow section of the electromagnetic wave spectrum with infra-red light at one end with the longest wavelength, and ultraviolet light at the other end with the shortest wavelength.

As with radio waves, light waves can be reflected, refracted or absorbed. Reflection of light is commonly seen in day-to-day life. Refraction is when light is bent. Absorption is when light is incorporated into the surroundings.

Key information

A laser is a concentration of light energy into a high intensity narrow beam.

Lasers

To build a laser we begin with a light source. This is placed in a small cavity with two mirrors facing each other with the light source in between. As the light reflects from one mirror to the other, it passes through the light source and concentrates its energy.

Laser light is found only in technology, never in nature. The beam used is very narrow, much narrower than other light sources such as a torch. It is also monochromatic (a single wavelength and colour) and its narrow beam expands only slightly over distance.

Traffic laser

While the traffic laser and traffic radar have much in common there are also many differences. Similarities and differences are highlighted throughout this section of the module.

The traffic laser is an adaptation of laser to measure vehicle speed. From the traffic laser unit laser light is directed through focusing lenses toward the intended target.

The traffic laser beam is very small. Instead of radiating out like a torchlight (or radar beam) the line of laser light is very straight with little divergence. This allows the operator to aim the traffic laser at target vehicles much further away than when using a traffic radar with very high levels of accuracy.

Components

Unlike the traffic radar, the traffic laser is one unit. This laser unit transmits the laser beam and receives it. The internal computer calculates the target vehicle's speed from the changing distance readings received.

How it works

The operator aims the traffic laser at the target vehicle using the unit aiming device. The laser beam is emitted in pulses. When each laser pulse makes contact with the target vehicle the laser beam is reflected back to the laser unit. The internal computer calculates the time between each pulse and the change in distance between the unit and target vehicle. This enables the computer to accurately calculate the change in each pulse (time/distance) and provide a readout of the target vehicle's speed.

The traffic laser can be used to check the speed of vehicles approaching the laser and vehicles that are moving away from the laser. Where vehicles are moving away from the unit this is indicated by a – sign in the display.

Beam range

In theory the laser beam will continue outward for an indefinite distance. However, in reality the beam range is the distance that the laser beam can be reflected back from the target to the laser unit, normally about 800 metres.

Measurement of distance

Traffic laser devices can be used to measure distance. The accuracy of this type of device is limited to +/- 1 metre over all distances displayed. It may be used in this way at crash scenes and for engineering purposes.

Key information ***The laser beam extends outwards for an indefinite distance unless it is reflected or refracted.***

Site selection

There are a number of things that need to be taken into account when selecting a laser operating site, including:

- the cosine angle
- having a clear line of sight
- weather conditions
- whether the operation is from inside the patrol vehicle
- movement of the unit.

Key information ***When selecting an operating site the operator needs to consider:***

- ***the cosine angle***
- ***having a clear line of sight***
- ***weather conditions***
- ***whether the operation is from inside the patrol vehicle***
- ***movement of the unit.***

Cosine angle

As explained in the radar section, the cosine angle is the angle between the operator and the beam. The position of the traffic laser to the roadway creates an angle that reduces the speed reading of the target vehicle. The greater the angle the greater the effective speed reading. While the angle can not be eliminated (to do so the operator would need to be in the middle of the road), it can be minimised by the operator's careful positioning and aim.

Key information ***Correct sighting of the laser minimises the cosine effect.***

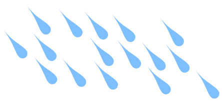
Clear line of sight

The operator **must** have a clear line of sight to the target vehicle.

That means the operator must see the target vehicle clearly throughout the speed check. If their line of site is blocked or temporarily interfered with the computer will disregard all data and no speed reading will be displayed. If the operator can see the object, the laser can see the object; if the operator cannot see the object, the laser will not see it either.

Key information ***There must be a clear line of sight to the target vehicle.***

Weather conditions



Weather conditions are an important consideration in the operation of the traffic laser. Fog, snow and heavy rain have the potential to interfere with the laser's operation. Therefore, traffic laser is not to be used in fog, snow or heavy rain.

Key information ***Traffic laser is not to be used in fog, snow or heavy rain.***

Operation from inside vehicles

The windscreen and side windows of the patrol vehicle can affect the maximum range of the traffic laser. While the system is designed to operate through windows, window tinting, infrared and ultraviolet protections can reduce the effective range of traffic laser. However, while range is affected, the accuracy of the speed reading is not.

The best way to use the traffic laser is outside the vehicle or through an open vehicle window.

Movement of vehicle

Operator movement will affect the traffic laser. Where the device is not held firm, keeping motion to a minimum, the unit will not display a speed reading. The reading will return when the device is stabilised.

Other factors

A **sweep effect** occurs when an operator changes aiming points while conducting a vehicle speed check. When this happens, the unit will not display a reading. To prevent this happening the operator must aim at a single point on the target vehicle for the entire check.

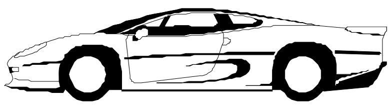
Reflection influences occur on very hot days by heat rising and causing reflection off the road, or from water lying on the road. To avoid this influence, the operator should aim at the vehicle and pay attention to any changes in the speed reading. A good tracking history will verify the speed readings are correct.

Night operation and headlights will reduce the range of the traffic laser. The headlights of newer model cars emit high levels of infrared light, so may interfere with the laser's ability to detect the reflected laser pulse. To avoid this problem the operator should aim between the headlights at the number plate area on the target vehicle.

Target vehicle

Similar to using the traffic radar, the range of the laser beam will depend on the target vehicle's size and shape.

A large flat truck acts as a very good reflector of signals.



Sports cars with an aerodynamic design act as poor reflectors.

6. Traffic laser

Introduction

The traffic laser can be operated only as a stationary device.

It may be used from inside or outside the patrol vehicle.

Key information ***The traffic laser can be used only as a stationary device.***

Operating procedures

To maximise the deterrent effect of speed detection through laser and ensure the safety of the public, the occupants of the target vehicle and police, the following guidelines have been developed.

Where traffic volumes are heavy only vehicles travelling on the same side as the parked patrol vehicle are to be targeted.

Motorcycle use

Lasers are *not* to be operated from motorcycles.

Tracking history

Like the radar, the traffic laser is only a tool used by the officer. To establish that the speed check is accurate the operator must establish a tracking history for the target vehicle. Tracking history is obtained by three elements:

- visual estimation of speed
- audio tone confirmation
- comparison of the digital readout with the operator estimate of speed.

Key information ***Tracking history must be established using:***

- ***visual estimation of speed***
- ***audio tone confirmation***
- ***comparison of the digital readout with the operator estimate of speed.***

Sources of interference

Unlike radar devices, interference sources such as radios and power lines do not have any effect on laser speed devices. Anything the operator can see, the laser can see. If the operator cannot see, the laser cannot see, for example, if smoke is blowing across the road and blocking the operator’s view, the laser will be prevented from detecting a target through the smoke.

Locking on speed

Operators should lock on the speed reading and maintain it on the device until the offender has had the opportunity to view the reading. The only exception to this is when another officer is operating the device and is remote from the officer stopping the offender. In this case a note should be made of the registered number of the vehicle, vehicle speed and/or distance and time.

Recording speed readings	The speed and distance at which the vehicle was checked should be recorded on all offence notices, for example 130km/h at 400 metres.
Targeting vehicles	Officers should target vehicles travelling on the same side of the road as the parked police vehicle in areas where traffic volumes are heavy.
Operating position	Officers may operate the device from any position, provided a second patrol in radio contact is stationed on the road and is responsible for stopping the offender.
Targeting traffic travelling both ways	On roads with low traffic volumes and speeds restricted to no more than 70 km/h, officers may target vehicles travelling in any direction provided the method employed to stop the offender is safe for all parties.

7. Self-paced test – Laser

1. What sort of beam does a laser use?

2. When selecting a site for operating a traffic laser what factors should be taken into consideration?

3. The traffic laser should not be used in certain weather conditions. Name these conditions.

4. What happens to the range if the laser is used through the windscreen of a patrol vehicle?

5. What effect does using the laser through the windscreen of a patrol vehicle have on the accuracy of the unit's speed reading?

6. Where on a target vehicle should the laser be aimed?

7. What effect do power lines have on laser units?

8. When operating a laser how can the cosine effect be minimised?

9. What effect does operator movement have on the target vehicle's speed reading?

10. When operating laser devices at night, what additional factors should operators consider?

11. Describe the effect that vehicle size and shape have when a traffic laser is operated.

12. Which mode may the traffic laser be operated in? Stationary mode, moving mode or both?

13. What elements are required to establish tracking history?

8. Operating guidelines

Accuracy

All speed enforcement devices used by the NZ Police are required to have regular accuracy checks. The following details what checks are carried out and when they occur.

Certificate of accuracy

Section 146 of the Land Transport Act 1998 requires all operational speed detectors' certificates of accuracy be issued within 12 months of the date the device is to be used in the detection of offences. Only units with current certificates of accuracy may be operated.

A series of electronic and road tests form the basis of the certificate of accuracy. The responsibility for testing and certification rests with the Police Calibration Unit, an International Standards Accredited Laboratory, based in Wellington.

All speed enforcement devices are calibrated every year on a district-by-district basis or when a device has been serviced. Whenever a device is serviced the unit is re-calibrated before being placed back in service.

Key information

A certificate of accuracy is required for all speed enforcement units. This must be issued within 12 months of the date the device is to be used.

The unit must be checked to see if currently certified before it is deployed.

Speedo certificate

All police vehicles being used in conjunction with radar speed detection must have a current speedo certificate of accuracy. Section 146 of the Land Transport Act 1998 requires all speedo certificates of accuracy to be issued within 12 months of the date the device is used in the detection of offences.

Operators using radar devices must check that the vehicle they are using has a current certificate of accuracy. This check is to be carried out before deployment. Deployment is the commencement of each shift.

Key information

A speedo certificate of accuracy is required for all vehicles used to operate radar units. This must be issued within 12 months of the day the vehicle is being used in conjunction with radar equipment.
The speedo certificate of accuracy must be checked before the unit is deployed.

Testing

At the beginning of each shift operators must conduct the series of tests prescribed in the best practice guidelines to ensure the device is operating correctly. This means at the beginning of *every* shift.

Pre-deployment tests include internal circuitry tests and other tests specified in the best practice guidelines for each device. A copy of the best practice guidelines for each device is at the end of this module.

The operator must record the test results in the device logbook. If the speed detection unit fails any checks it is not to be used.

Key information

The operator must complete the pre-deployment tests before using the device. Results of the tests must be recorded in the logbook. If the unit fails any checks it must not be used.

Logbooks

Operators must complete the following information in the unit logbook:

- member's name and QID
- date and time of operations
- test results
- location
- total hours of use
- signature of operator

The operator must fill in a separate log sheet for each day of operation.

Faulty units

If the device fails any tests it should not be used. The unit must be returned to the New Zealand service agent who has been appointed by the manufacturer.

When an instrument used in the testing of a speed enforcement device (for example, a tuning fork) malfunctions then both the unit and all testing equipment should be packaged together and sent to the New Zealand service agent.

Details of the authorised service agents can be obtained from the Police Calibration Unit.

After servicing by the agent, the unit will be re-calibrated by the Police Calibration Unit before being returned to the district. All costs associated with repair will be charged to the district.

9. Evidential requirements

Documentary evidence

To comply with evidential requirements the operator will need:

- a copy of the speed device logbook relating to the day in question
- a copy of the certificate of accuracy issued within a year of the date of the offence
- a copy of the certificate of accuracy for the patrol vehicle used in the operation of the radar device or
- a copy of the certificate of accuracy for the patrol vehicle used for the weekly check in the case of a laser device.

Evidence in court

The operator must be able to give in evidence that:

- they are an approved speed enforcement operator
- they conducted the required tests for the unit and found it to be working correctly
- a tracking history was established for the target vehicle
- the code of operations was complied with.

10. Speed detection Code of Operations

This Code of Operations governs the operation of all speed detection equipment used by the New Zealand Police. It has been jointly prepared and agreed to by the Measurement Standards Laboratory of New Zealand (MSLNZ) and the New Zealand Police.

Operators

1 Trained Operators

Except for the purposes of instruction, speed detection equipment is to be operated only by members of the NZ Police who have:

- completed the speed detection operators module
- achieved a minimum of 70% in the module theory test
- undergone 20 hours, practical instruction with a qualified instructor and demonstrated competence
- been certified as a trained operator by the Traffic Operations Support Group (Office of Commissioner).

Former members of the Traffic Safety Service who completed training in the use of speed detection equipment prior to 1992 are deemed to be qualified operators. This covers members whose identification numbers begin E002 up to and including F116.

2 Qualified Instructors

District Strategic Traffic Managers have the authority to appoint qualified instructors. To be appointed as a qualified instructor, staff must have been certified as a trained operator and:

- Have spent at least two years consistently operating speed detection equipment
- are currently using speed detection equipment as part of their duties
- have the ability to train others

Qualified instructors ***must*** be registered with the Traffic Operations Support Group (Office of Commissioner) before taking up a qualified instructor role.

Equipment

3 Certificate of Accuracy

Section 146 of the Land Transport Act 1998 requires all operational speed detectors certificates of accuracy to be issued within 12 months of the date used in the detection of offences. Only units with current certificates of accuracy may be operated.

A series of electronic and road tests form the basis of the issue of the certificate of accuracy. The responsibility for testing and certification rests with the Police Calibration Unit, an International Standards Accredited Laboratory, based in Wellington.

4 Speedo Certificate

All police vehicles being used in conjunction with radar speed detection and the field testing of laser speed detection equipment must have a current speedo certificate of accuracy. Section 146 of the Land Transport Act 1998 requires all speedo certificates of accuracy to be issued within 12 months of the date used in the detection of offences.

5 Servicing

Repairs and servicing are only to be carried out by authorised service agents. Details of authorised service agents are maintained by the Calibration Unit.

Pre-deployment

6 Testing

At the beginning of each deployment operators must conduct the series of tests prescribed in the best practice guidelines to ensure that the device is operating correctly. The operator must record test results in the device logbook. If the speed detection unit fails any checks it is not to be used.

Deployment

7 Tracking History

A tracking history of a vehicle must be established. Tracking history for all speed detection units contains three main elements:

- visual observation
- audio confirmation
- verification by a speed detector.

To eliminate errors effectively, all three elements must be present for each speed check.

For radar units operated in moving mode, the vehicle ground speed must be confirmed by certified speedometer.

8 Multiple Vehicles in Beam

Where there is more than one vehicle in the beam, enforcement action may be taken, providing the operator can give evidence relating to the tracking history of other vehicles and the offender's speed.

9 Fairness

Operators must use their training and experience to ensure that there are no significant sources of reflection or interference in the vicinity of the offence. If there is ever any doubt concerning the speed check or the operation of the speed detection unit, no action is to be taken.

…………………………………………….	………………………………………………
Dr Tim Armstrong Manager Time and Frequency Standards Measurement Standards NZ Ltd	Steve Fitzgerald National Manager, Road Safety NZ Police
Date : 25 September 2001	Date : 25 September 2001

11. Best practice guidelines - Radar

Pre-deployment tests

These are tests that are carried out before commencing speed enforcement patrol.

- Check the device is certified. A sticker is attached to the unit that needs to be visually checked to confirm the date for next calibration is in the future.
- Check the speedo of the patrol vehicle has a current certificate of accuracy. This provides the speedo readings are the true speed readings for the patrol vehicle.
- Switch on the device. Ensure all segments of the display are operating. As the unit is turned on it will automatically run through a series of internal tests. If these tests fail or if any segment of the unit readout is not operating check to see the power source and connections are in place. Turn the device on again. If these tests fail again remove the unit from service and forward it to the service agent.
- Complete the tuning fork tests. The details of how these tests are completed are contained in each device's NZ Police Operators Manual. Record the results in the logbook. Tuning fork tests are completed for each antenna.

Note: all antennas must be checked.

Deployment tests

These are the tests that are completed while the unit is being used in moving mode:

- Confirm patrol vehicle speed is consistent with the speed readout on the unit within +/- 3 km/h. This is achieved by travelling at a consistent speed, appropriate to the speed limit being operated in, and checking that the true speed (according to the certificate of accuracy) is the one displayed on the readout. Record the results in the logbook.

12. Best practice guidelines - Laser

Pre-deployment tests

These are tests that are carried out before commencing speed enforcement patrol.

- Check the device is certified. A sticker is attached to the unit that needs to be visually checked to confirm the date for next calibration is in the future.
- Turn the unit on and check all display segments are operating. The device will conduct a number of self-tests, commencing automatically. If the device is not operating or if readout displays are not functioning check the power supply and retest the unit. If these tests fail again remove the unit from service and forward it to the service agent.
- Conduct the sight alignment test. This is carried out every day the device is used. Select a pole or similar fixed point marker and aim the unit sighter to the centre of the fixed object; record the distance. Move the aim of the laser to the left-hand side of the fixed point and check that the unit ceases the reading on the fixed point as soon as the aim is moved. Repeat this test but instead of moving the aim left, move to the right-hand side of the fixed point. Repeat twice more, moving the aim above and below the fixed point. The measurement displayed on the readout unit must be recorded in the logbook.

Weekly testing

- On a weekly basis the laser unit readout needs to be checked using a drive though by a patrol vehicle with a certified speedo. This is carried out by having the driver of the vehicle drive at a steady speed towards the laser operation area. The speed will be relevant to the area of operation. The driver should flash their headlights or advise using the radio when the vehicle speed is steady and the laser operator will check the speed. The member using the laser will advise the vehicle driver of the results of the speed check. The driver will advise the speed they were travelling at after checking the certificate of accuracy to determine the true speed. Where the margin of error exceeds +/- 3 km/h the unit is to be withdrawn for servicing. The results of the check must be recorded in the logbook (vehicle speed/checked speed), for example 64/65; 46/46; 75/75.

13. Practical application - Radar

Training

The code of operations requires members to receive 20 hours' practical training in the operation of speed enforcement equipment. This consists of both radar and laser training. The suggested breakdown of hours is 16 hours for radar and 4 hours for laser. The following provides details of what operators must be able to demonstrate before they can be assessed as competent users.

Pre-deployment tests

Pre-deployment refers to the beginning of each shift.

Certification

The operator must:

- Check the certification sticker on the side of the device for the expiry date.
- Explain that if the date is current the device can be used, otherwise the device must be recertified before use.
- Identify who carries out recertification.
- Check the certificate of accuracy for the speedo of the patrol vehicle and determine its status — the test date must be within 12 months from the date of operation.
- Identify the difference, if any, between true vehicle speed and actual vehicle speed readings.
- Explain that for speed enforcement the true speed as described in the certificate of accuracy is the speed used for testing the device.

Unit testing

The operator must:

- Assemble the radar device and install it in the vehicle.
- Connect cables and power supply correctly.
- Turn the device on and allow it to run its internal testing sequence.
- Check all readings are displayed completely, that means there are no missing portions of letters or numbers.
- Explain how to recheck and retest the device if the power supply or readout does not work, by:
  - rechecking cables
  - checking connections
  - confirming the power source connection
  - turning the device off and restarting it
  - proceeding with the internal test sequence.

Tuning fork tests
The operator must:
- Remove the tuning fork from storage.
- Confirm the serial numbers on the tuning fork are the same as listed on the certificate of accuracy for the radar device.
- Record the tuning fork's serial numbers in the logbook.
- Conduct the tuning fork test sequence as detailed in the unit operators manual.
- Record the results of the tuning fork tests in the logbook.
- Conduct the testing sequence for each antenna.

Deployment tests

Moving mode
The operator must:
- Confirm the patrol vehicle speed is consistent with the speed readout on the unit within +/-3 km/h. This is achieved by travelling at a consistent speed, appropriate to the speed limit of the area and checking that the true speed (according to the certificate of accuracy) is the one displayed on the readout.
- Record the results in the logbook.

Target identification

The operator must identify the target vehicle when it comes into the beam.

Tracking history

The operator must demonstrate that they are able to establish the tracking history of a vehicle. This means they:
- See the target vehicle and specify what it looks like, for example, a red Toyota or blue Mazda.
- View the readout on the unit and identify to which vehicle it relates.
- Hear the change in audio (doppler tone) to indicate an increase or decrease in speed.

Cosine effect

The operator must:
- Identify the target vehicle (using tracking requirements).
- Use the antenna to demonstrate how a change in cosine angle affects the speed reading.

Speed checks

The operator needs to be able to gauge the speed of vehicles visually.

Day
- In stationary mode, the instructor covers the speed readout and the operator estimates the speed. The instructor checks this against the readout. The difference between the two speeds needs to be within +/- 8 km.
- The operator must achieve 10 consistent speed confirmations within +/- 8km.
- Repeat this exercise, with the operator covering the readout with the doppler tone turned down. The difference between the speeds needs to be within +/- 8 km.

- The operator must achieve 10 consistent speed confirmations within +/- 8km.

Night
- In stationary mode, the instructor covers the speed readout and the operator estimates the speed. The instructor checks this against the readout. The difference between the two speeds needs to be within +/- 8 km.
- The operator must achieve 10 consistent speed confirmations within +/- 8km.
- Repeat this exercise, with the operator covering the readout and the doppler tone turned down. The difference between the speeds needs to be within +/- 8 km.
- The operator must achieve 10 consistent speed confirmations within +/- 8km.

Site selection

The operator must select a site for operation of the radar in stationary mode. Selection must include the following considerations.

Parking
The operator must consider:
- Legal parking for the patrol vehicle.
- Location safety for the patrol vehicle, including the officer's ability to open the patrol car door safely, exit the patrol car, approach the offending vehicle, and conduct an enforcement stop.
- The range of radar operation within 250 metres of any change in speed limit.
- Legal parking in which to stop vehicles.
- Safe parking for offending vehicles, including the ability of the driver to safely exit their vehicle and a safe approach for the officer.
- Day-time and night-time operation issues.

Site
The site must:
- Be straight enough to allow vehicles to be detected for at least 100 metres.
- Provide sufficient distance to allow the speed to be checked and the operator to exit the vehicle and conduct an enforcement stop.

Unit set up

Aim
The operator must check the unit antenna:
- is aimed and set up to:
  - detect vehicles
  - minimise the cosine angle and
- the range is adjusted so that it is appropriate for the site

Moving mode	The operator must: ❑ Identify ground speed on the readout. ❑ Confirm the ground speed and speedo readout are consistent (given the certificate of accuracy). ❑ Place the unit in hold mode using the hold button. ❑ Release the lock button for device operation. ❑ Identify the target vehicle and its speed. ❑ Establish a tracking history for the target vehicle using the three elements - visual, audio and readout. ❑ Lock the target vehicle speed on the unit. ❑ Indicate the difference between multiple vehicles in the beam and a single vehicle.
Patrol stops – moving mode	**Same lane** The operator must: ❑ Identify a target vehicle where its speed exceeds the posted speed limit. ❑ Establish a tracking history by telling the instructor how it meets audio, visual and readout requirements. ❑ Lock on the target vehicle's speed. ❑ Activate red and blue lights. ❑ Pull out into the flow of traffic safely. ❑ Indicate to the target vehicle to stop. ❑ Park safely. ❑ Ensure the reflectorised jacket is worn. ❑ Exit the patrol vehicle after checking for traffic. ❑ Approach the target vehicle's drivers door. ❑ Keep following traffic in line of sight when speaking with the driver.
Patrol stops – moving mode	**Opposite lane** The operator must: ❑ Identify a target vehicle where its speed exceeds the posted speed limit. ❑ Establish tracking history by telling the instructor how it meets audio, visual and readout requirements. ❑ Lock on the target vehicle's speed. ❑ Activate red and blue lights. ❑ Complete a U-turn safely and with due consideration to minimise stress on the patrol vehicle (for example, speed is reduced before turning, the kerb is not mounted when turning). ❑ Indicate to target vehicle to stop. ❑ Park safely. ❑ Ensure reflectorised jacket is being worn. ❑ Exit patrol vehicle after checking for traffic. ❑ Approach target vehicle's drivers door. ❑ Keep following traffic in line of sight when speaking with driver.
Issuing notice	The operator must: ❑ Record the driver's details on the notice. ❑ Identify the appropriate offence. ❑ Check the infringement fee is correct for the charge. ❑ Record the appropriate precedent code.

- Record the unit details accurately on the notice.
- Record a summary of the offence on the reverse of the notice.
- Complete all parts of the notice.

14. Practical application - Laser

Training

The code of operations requires members to receive 20 hours' practical training in the operation of speed enforcement equipment. This consists of both radar and laser training. The suggested breakdown of hours is 16 hours for radar and 4 hours for laser. The following provides details of what operators must be able to demonstrate before they can be assessed as competent users.

Pre-deployment tests

Certification

The operator must:

- Check the certification sticker on the side of the device for the expiry date.
- Explain if the date is current the device can be used, otherwise the device must be recertified before use.
- Identify who carries out recertification.

Unit testing

The operator must:

- Connect the unit to the power supply correctly.
- Turn the device on and allow it to run its internal testing sequence.
- Check all readings are displayed completely, that means no missing portions of letters or numbers.
- Explain how to recheck and retest the device if the power supply or readout does not work by:
  - rechecking cables
  - checking connections
  - confirming the power source connection
  - turning the device off and restarting it
  - proceeding with the internal test sequence.

Pre-deployment

Pre-deployment refers to the beginning of each shift.

Sight alignment test

The operator must:

- Select a pole or fixed post object.
- Aim the sighting device at the object and gain a distance reading, this is the reading between the device and the fixed point.
- Obtain a distance reading and advise the instructor of that reading.
- Move the laser aim from the fixed point to the left away from the point, and check the distance reading ceases on movement from the aimed point.
- Move the laser aim from the fixed point to the right away from the point, and check the distance reading ceases on movement from the aimed point

- Move the laser aim from the fixed point above the point, and check the distance reading ceases on movement from the aimed point.
- Move the laser aim from the fixed point below the point, and check the distance reading ceases on movement from the aimed point.
- Record the test results in the unit logbook.

Weekly testing

The operator must provide instructions to the driver of a patrol vehicle to conduct the weekly drive-through test. The operator must:

- Establish that the vehicle has a current certificate of accuracy.
- Instruct the driver to drive towards the unit at a constant speed.
- Instruct the driver to flash their headlights or advise using the radio when the check to commence.
- Lock on the speed of the target patrol vehicle.
- View the readout and ask the driver of the target patrol vehicle for their true speed.
- Confirm the target patrol vehicle speed and the readout on the unit is within +/- 3 km/h.
- Record the test results in the logbook.

Target identification

The operator must identify which vehicle is being detected when a vehicle comes into the beam.

Tracking history

The operator must establish a tracking history of a vehicle. This means:

- Seeing the target vehicle and specifiying what it looks like, for example a red Toyota.
- Viewing the readout on the unit and identifying to which vehicle it relates.
- Hearing the change in audio that indicates an increase or decrease in speed. Prolaser II and III do not give true audio tracking.

Cosine effect

The operator must establish the target vehicle (using tracking requirements).

Speed checks

The operator must gauge visually the speed of vehicles.

- The instructor covers the speed readout and the operator estimates the speed. The instructor checks this against the readout. The difference between the two speeds needs to be within +/- 8 km/h.
- The operator needs to achieve 10 consistent speed confirmations within +/- 8km/h.
- The instructor repeats this exercise with the operator covering the readout and the audio tone turned down. The difference between the speeds needs to be within +/- 8 km/h.
- The operator needs to achieve 10 consistent speed confirmations within +/- 8km/h.

Night

- The instructor covers the speed readout and the operator estimates the speed. The instructor checks this against the readout. The difference between the two speeds needs to be within +/- 8 km/h.
- The operator needs to achieves 10 consistent speed confirmations within +/- 8km/h.
- The instructor repeats this exercise with the operator covering the readout and the audio tone turned down. The difference between the speeds needs to be within +/- 8 km/h.
- The operator achieves 10 consistent speed confirmations within +/- 8km/h.

Site selection

The operator must select a site for operation of the laser in stationary mode. Selection must include the following considerations.

Parking

The operator must consider:

- Legal parking for the patrol vehicle.
- Location safety for the patrol vehicle, including the officer's ability to open the patrol car door safely, exit the patrol car, approach the offending vehicle, and conduct an enforcement stop.
- The range of laser operation is not within 250 metres of any change in speed limit.
- Legal parking in which to stop vehicles.
- Safe parking for offending vehicles, including the ability for the driver to safely exit their vehicle, and a safe approach for the officer.
- Day-time and night-time operation issues.

Site

The operating site must be straight for approximately 250 metres.

Unit set up

Aim

The operator must check the unit is:

- aimed and set up to
  - detect vehicles
  - minimise the cosine angle, and
- the range is adjusted so it is appropriate for the site.

Issuing notice

The operator must:

- Record the driver's details on the notice.
- Identify the appropriate offence.
- Check the infringement fee is correct for the charge.
- Record the appropriate precedent code.
- Record the unit's details accurately on the notice.
- Record the summary of the offence on the reverse of the notice.
- Complete all parts of the notice

15. Answers for self-paced test – Radar

1. What are the three units that comprise traffic radar?
Transmitter, receiver and antenna.

2. There are three things that can happen to a radar wave, what are they?
A radar wave can be reflected, refracted or absorbed.

3. How can you minimise the cosine effect when using radar?
Aiming the radar beam so that the angle between the radar and the target vehicle will minimise the cosine effect. Any speed difference between true speed and the recorded speed will always be in the favour of the target vehicle.

4. Who is permitted to use radar speed enforcement equipment?
Only police members who have been certified as trained operators are permitted to use radar speed enforcement equipment. This requires the member to have completed this module, achieved a minimum score of 70% in the test, undertaken 20 hours' practical instruction with an approved instructor who will certify the member's competence, and been issued a certificate from Traffic Operations Support Group (Office of Commissioner).

5. What is the antenna component of traffic radar used for?
The antenna is used to aim the microwave beam at the area being monitored.

6. Does the width of the beam remain the same the further from the transmitter it is emitted?
No, the further the beam extends from the radar the wider it becomes.

7. What factors can affect the radar range?
Weather conditions such as rain, mist and fog will affect the radar range. Local terrain such as hills, corners, fences and buildings will also have some effect. Road undulations will also reduce the range and cause fading to the return signal.

8. How can an operator reduce the target range?
The range control is used to reduce range.

9. What affect does vehicle size and shape have on the strength of the reflected signal?
The size and shape of the target vehicle's surface will affect the information sent back to the radar unit. The bigger the target the better it will act to reflect the signal back to the radar unit. A target vehicle that is small and aerodynamically designed is a poor reflector, which means it will need to be closer to the unit to be picked up clearly.

10. There are two major things that you need to consider when selecting a stationary operating site, what are they?
Operation and safety are the two major considerations when selecting a site for stationary mode operation.

11. Establishing tracking history for all radar speed checks requires three elements, what are they?

- ***visual observation***
- ***audio confirmation***
- ***radar verification.***

12. Within each of the three elements required to establish tracking history there are a number of parts. Detail what these are for each tracking history element.

- ***visual observation***
  1. ***identify the target vehicle and continue to monitor its travel***
  2. ***confirm the target is within the radar's range***
  3. ***estimate the target's speed***
- ***audio confirmation***
  1. ***listen for a clear doppler tone***
  2. ***check the doppler tone is consistent with the speed.***
  3. ***check the level of the signal heard is strong and not fluctuating in audio content***
- ***radar verification***
  1. ***check the initial reading is consistent with visual observation and the operator estimated speed***
  2. ***ensure a steady target reading***
  3. ***check the readings are consistent with both visual observation and audio tone***
  4. ***confirm ground speed readings by patrol speedometer***

13. What are the tuning forks used for?
Tuning forks are used to simulate speed. Each fork is stamped with an operating band and speed and the fork will produce this when struck. It is then used to test that the unit is detecting the speed accurately.

14. What is the doppler shift?
The speed radar detects a movement between the transmitted and received signal. This change in frequency is known as the doppler shift. Simply, the radar unit determines the frequency difference between the signals transmitted from the radar unit and the signals reflected from the moving target vehicle. The change in the tone in the speaker is the doppler shift frequency.

15. Why is a certified speedo required when operating traffic radar?
As part of the accuracy testing of the unit the speed of the patrol vehicle is checked against the patrol speed detected by the radar unit. Before using the unit the match between the patrol speed and the speed detected by the unit must be within +/- 3 km/h. This is used to confirm unit accuracy.

16. What reasons are there for loss of ground speed?
Ground speed may be lost because of rain, a wet road surface, a badly sighted antenna, or when the hold button is released without a clear road in front (the device becomes confused and no reading is shown).

17. Is it a requirement to lock every speed reading when conducting an enforcement stop?
While it is preferred that the target vehicle speed is locked on before an enforcement stop, this is not essential.

16. Answers for self-paced test – Laser

1. What sort of beam does a laser use?
A laser is a concentration of light energy into a high intensity beam.

2. When selecting a site for operating a traffic laser what factors should be taken into consideration?
The operator must consider:

- ***the cosine angle***
- ***a clear line of sight***
- ***weather conditions***
- ***whether the operation is from inside the patrol vehicle***
- ***movement of unit***
- ***other factors, such as sweep effect, reflection influences and night operation.***

3. The traffic laser should not be used in certain weather conditions. Name these conditions.
The traffic laser should not be operated in fog, snow and heavy rain.

4. What happens to the range if the laser is used through the windscreen of a patrol vehicle?
Range is reduced if used through the windscreen of a patrol vehicle.

5. What effect does using the laser through the windscreen of a patrol vehicle have on the accuracy of the unit's speed reading?
Although range is reduced there is no effect on the accuracy of speed readings.

6. Where on a target vehicle should the laser be aimed?
The operator should aim the laser between the headlights at the number plate of the target vehicle.

7. What effect do power lines have on laser units?
Power lines have no effect on laser units.

8. When operating a laser how can the cosine effect be minimised?
The position of the traffic laser to the roadway creates an angle that reduces the speed reading of the target vehicle. While the angle cannot be eliminated entirely (to do so the operator would need to be in the middle of the road), it can be minimised by the operator reducing the angle to a minimum.

9. What effect does operator movement have on the target vehicle's speed reading?
Operator movement cause the laser unit speed reading to disappear. The speed reading will return when the device is stabilised.

10. When operating laser devices at night-time, what additional factors should operators consider?
Night operation and headlights will reduce the range of the traffic laser. Headlights of newer cars may also interfere with the laser's ability to detect the reflected laser pulse. To avoid this, the operator should aim between the vehicle's headlights at the number plate area.

11. Describe the effect that vehicle size and shape have when a traffic laser is operated.
The larger the vehicle the easier it is to detect. Small, aerodynamically designed vehicles are harder to detect and will be closer to the laser before a reading is obtained.

12. Which mode may the traffic laser be operated in? Stationary mode, moving mode or both?
Laser is operated in stationary mode only.

13. What elements are required to establish tracking history?
Tracking history is established using:

- ***visual estimation of speed***
- ***audio tone***
- ***comparison of the digital readout with the operator estimate of speed.***