GUIDE FOR THE OPERATIONAL USE OF SPEED AND RED-LIGHT OFFENCE DETECTION TECHNOLOGY

National Police Chiefs' Council

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AMENDMENTS

Version 1.2.1 dated July 2016 contains amendments within the following chapters:

Chapter 1: Home Office Type Approval

Chapter 4: Equipment Classification

Chapter 6: Speed Detection Using a Speedometer Fitted to a Patrol Vehicle

Chapter 8: Radar Speedmeters (across the road)

Chapter 10: Laser Speedmeters

Additional chapter:

Chapter 17: Red-light Enforcement Cameras

Please note:

In April 2015 the National Police Chiefs' Council (NPCC) replaced the Association of Chief Police Officers' (ACPO). This document makes some historic references, where applicable, to ACPO and ACPO approval.

FOREWORD

Efforts of road safety partnerships and police forces across the country are continuing in an attempt to reduce the number of people killed or seriously injured on our road network.

The UK has some of the safest roads in the world and countries around the globe are adopting our approaches to road safety. This success is achieved by using a number of initiatives including preventative road safety activity, enforcement of traffic laws and driver education schemes. Roads policing enforcement technology has developed greatly in recent times and continues to play a crucial role in encouraging motorists to respect traffic laws and in bringing offending drivers to justice.

This guidance is provided to ensure we continue to improve safety on our roads and maintain public confidence in the integrity of the technology being used to identify offending motorists.

Before equipment can be used to provide evidence that can be made admissible in court, Home Office Type Approval (HOTA) of this technology is required. Equipment is thoroughly tested and is not submitted for approval until scientists are satisfied with the integrity of the technology. HOTA provides an assurance of the technical accuracy and reliability of all approved devices.

This document, produced by the National Police Chiefs' Council (NPCC), provides guidance for those using enforcement technologies on how Type Approved equipment should be operated and an understanding of what may affect its performance. It also provides an understanding of the reasons behind the advice in the manufacturers' instruction manuals, as well as practical advice to improve operational use.

Maintaining public confidence in enforcement technology is key to ensuring the public's continued trust in the technologies used in helping reduce offending on our roads and making them safer.

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NPCC lead, Roads Policing Enforcement Technology

CONTENTS

CONTENTS

INTRODUCTION

The Road Traffic Offenders' Act 1988 (amended by the Road Traffic Act 1991) allows for the Type Approval of devices to be used for the detection of the speed of motor vehicles. The Home Office's Centre for Applied Science and Technology (CAST) and National Police Chiefs' Council (NPCC) Roads Policing Enforcement Technology (RPET) group specify and operate the Type Approval process to assure that equipment that attains the award of Type Approval is of the required accuracy and is resistant to error. Testing is challenging and rigorous, making the UK Type Approval one of the most exacting and sought after certifications of police enforcement equipment available worldwide.

The evidence from Type Approved equipment is therefore of high integrity and inherently reliable. The purpose of this guide is to allow operators of Type Approved equipment to achieve a consistent standard wherever it is used to support prosecutions for speed and red-light offences.

Calibration of equipment is not a condition of Type Approval within the meaning of the Road Traffic Offenders' Act Section 20(4) and, therefore, failure to prove calibration does not affect the admissibility of evidence. While it is not a condition, it is recommended that calibration is performed on an annual basis as normal routine maintenance of the device.

The speed of traffic is a significant factor in the severity of injury in road traffic collisions. Government and industry research has shown that the use of excess and excessive speed is common, making the requirement for speed management a necessary measure in the reduction of the volume of road traffic-related injuries. While education and engineering are important in the treatment of traffic system casualty rates, enforcement of speed limits remains an important and immediate requirement in support of those measures for the foreseeable future.

This guide provides advice on operating practices to maintain a consistent speed enforcement facility to drive down casualties and provide public confidence in police-led road traffic enforcement.

The devices referred to in this guide are subject to rigorous field and laboratory testing to ensure the accuracy and reliability of their measurements and to prevent the possibility of spurious measurements being produced. Manufacturers' instructions should be followed to ensure results meet Home Office Type Approval and those proven during testing.

Manufacturers' instructions are assessed along with the equipment during the Type Approval process. They are later changed only with the permission of CAST, after an amendment request is received along with the amended manual. The manufacturers' instructions therefore form the most relevant operating procedures to be carried out when operating each piece of equipment. This guide explains the reasoning behind some of the instructions in operator manuals but is subservient to them.

The advice in this guide should be used to enhance the operators' understanding of the principles used by the equipment and to avoid misuse, which has the potential to affect accurate speed measurement of target vehicles.

While the practice described in this manual assists users in the trouble-free operation of roads policing enforcement equipment, there is no legal requirement that the guide is followed; however, the practice contained herein will reduce the potential for mistakes in procedure.

NOTE:

Compliance with the guidance in this document is not a condition of Type Approval. Non-compliance with the suggested practice herein by a police officer, partnership, or representative of a partnership does not mean that any speed measurement obtained is necessarily inaccurate.

1 HOME OFFCE TYPE APPROVAL

1.1 What is Home Office Type Approval (HOTA)?

HOTA is a process that is designed to ensure devices are accurate, reliable and robust and provide accurate evidence leading to safe convictions.

HOTA is granted for enforcement devices that are intended for police use and have been manufactured or supplied to meet the strict criteria laid down in handbooks produced by CAST. If the device meets the criteria and is successful in Type Approval testing the supplier and the Home Office enter into a Type Approval agreement. This places a strict contractual obligation on the supplier to ensure all devices supplied for roads policing enforcement in England, Northern Ireland, Scotland and Wales comply exactly with the devices tested. Evidence from equipment that is awarded HOTA is admissible in court by way of certification of the record in accordance with Section 20 of the Road Traffic Offenders' Act 1988, Speeding Offences etc: admissibility of certain evidence. Prescription Orders in the form of Statutory Instruments (SI) describe devices in a generic way. HOTA of individual makes and models fitting that description are then made by a Ministerial Approval for equipment that passes the CAST and RPET testing.

Day-to-day management of the HOTA process is provided by Road Safety Support (RSS).

1.2 Roads Policing Enforcement Technology (RPET) group

RPET has a nominated chief police officer who is a member of the NPCC Roads Policing Business Area. The NPCC lead meets with the Home Office Road Crime Section at a strategic level to address RPET operational and Type Approval challenges. The NPCC lead neither recommends nor makes decisions on Type Approval; this is a Home Office responsibility. The secretariat to the NPCC lead is provided by RSS.

RPET also operates a user forum, chaired by RSS, which addresses issues affecting the use, testing and development of roads policing technology.

The forum has no decision-making power, and any issues raised through the group will be brought to the attention of the NPCC lead through the chair of the group.

Delegates for the user forum are drawn from:

1 Roads policing officers/road safety partnership staff

2 Home Office

3 CAST

4 Crown Prosecution Service (CPS)

5 Industry and suppliers

Other persons can be co-opted onto the user forum to provide technical, legal or operational expertise. The user forum meets regularly to progress issues arising from its terms of reference.

In between meetings RSS continues to progress issues relating to devices undergoing HOTA testing and provides a liaison between the operational officer, manufacturers, Government agencies and NPCC.

The first point of contact for any query relating to roads policing enforcement equipment should be the secretariat to the NPCC lead for RPET, RSS at: RPET Secretariat, Road Safety Support, PO Box 10092, Billericay, Essex, CM12 9UY or email: typeapproval@roadsafetysupport.co.uk

1.2.1 RPET group terms of reference

Secretariat - provided through RSS:

- The secretariat support to the NPCC lead for RPET will manage the day-to-day business of the user forum
- Provide a full secretariat from staff suitably qualified to deal with technical testing and legal problems
- Interface with the enforcement technology industry and manage all approvals through the HOTA process
- Supervise and arrange all police operational testing
- Work with the Home Office Road Crime Section and CAST to deliver fully tested reliable devices to recommend to full HOTA
- Ensure the NPCC lead for RPET chair is fully briefed on any potential issues relating to technology or legal challenges to technology or HOTA
- Maintain the NPCC Guide for The Operational Use Of Speed And Red-Light Offence Detection Technology
- Represent RPET at all events and with industry
- Provide an expert prosecution witness in cases where expert defences are raised in relation to the HOTA of a device
- To examine, review and make recommendations on technical aids for roads policing enforcement technology to the police service
- To examine and introduce new technology for casualty reduction
- To consider and report on any roads policing enforcement technology matter referred to the Home Office Roads Crime Section Type Approval Strategic Group

The RPET group:

- To examine, review and make recommendations on technical aids for roads policing enforcement technology to NPCC and, where HOTA is to be granted, to the Home Office based on advice from CAST and the RPET secretary
- To examine and introduce new technology for casualty reduction
- To consider and report on any roads policing enforcement technology matter referred to the group
- A sub group called the Safety Camera Administration Group is managed by the RPET secretary. It provides policy advice on the use of speed and red-light enforcement equipment. All guidance produced is submitted and approved through the RPET group before it is issued

1 HOME OFFICE TYPE APPROVAL

For England and Wales

- To consider legal issues arising from the use of technology
- To consider legal issues around the use of existing and new technologies

1.3 Where can information on HOTA be found?

Any person or organisation can obtain a copy of a statutory instrument from HM Stationery Office, or copies of orders issued from January 1998 onwards can be obtained from the Home Office.

1.4 What is the HOTA process?

The process for acquiring Home Office Type Approval has two parts: a Roads Policing Enforcement Technology part followed by a Home Office part.

RSS coordinates the process as well as making assessments of the equipment's suitability to meet the operational needs of the UK police forces. When the equipment is accepted into the process and after CAST has made its technical assessments, RSS arranges with a number of police forces to test mobile and fixed devices under operational conditions. This includes assessing whether the equipment is easy and simple to use and produces consistently accurate readings without special skills. A device that produces a mixture of accurate and inaccurate readings in normal use will fail the Type Approval testing. A device that produces a mixture of accurate and no readings will pass unless the quantity of "no readings" suggests it is too difficult and therefore impractical for use by operational officers.

CAST makes a detailed technical assessment of devices, as well as technical and operational documentation, to ensure they are compliant with the requirements of the speedmeter handbook relevant for the prescribed sort of equipment. They also submit the equipment to one of a number of approved independent test houses for functional testing of the equipment to ensure it meets the required specifications in the speedmeter handbook.

If the equipment has met the requirements by passing the assessment and testing by CAST, the police forces and an independent test house, a recommendation from CAST is given to the Home Office Minister for the issue of a Type Approval Agreement. The Type Approval Agreement is a contract between the Home Office and the supplying company to set out the terms which each must observe. Breach of a term of the agreement by a supplier could potentially lead to suspension or revocation of the approval. Once the Type Approval Agreement is signed, the Type Approval is signed by the Home Office Minister.

The details of the HOTA process are laid down by CAST.

1.5 Does the RPET group act as a consultancy or provide design advice?

The strict answer is no, but realistically one must accept that suppliers may glean some guidance through RSS, the secretariat support, from the discussions around their demonstrations.

However, the RPET secretary works within 'commercial in confidence' terms. This means that no member may openly discuss any aspect of any device or component (including software) not already placed in the public domain by the commercial concern.

Thus, the RPET secretary cannot, and will not give advice to a commercial concern in respect of research and development issues. They will comment on the operational acceptability of devices under demonstration or test, but market research and product placement are wholly issues for the commercial concern.

The adherence to 'commercial in confidence' also means members cannot advise any person or organisation of the suitability or performance of devices which are, or have been, within the HOTA process.

1.6 What is the advantage of HOTA?

Section 20 of Road Traffic Offenders' Act 1988 allows for the evidence from Type Approved and prescribed devices to be admissible in court by way of certification. The approval process gives the public and the courts reassurance that measurements from a particular device can be relied upon as evidence.

1.7 ACPO approved devices

Some devices do not have HOTA; instead, these time/distance devices are ACPO approved. The main reason for this is their extreme level of operator interaction and attention during operation.

The devices themselves can perform calculations with 100% accuracy but the speed will only be as accurate as the data from which it did the calculation; i.e. the skill of the operator in pressing switches at exactly the right time. The police officer has to enter the time and distance travelled and is often in a position to correlate the derived speed with that shown on the police vehicle speedometer.

With these devices, the more likely legal challenge is to the accuracy of the operator rather than that of the device, but without the protection of Type Approval its operator will need to be able to explain in basic nontechnical terms how the device works.

1 HOME OFFICE TYPE APPROVAL

ACPO no longer approves roads policing enforcement technology. Any approval granted by ACPO ceased to be effective after December 2012. After that date these devices no longer have ACPO approval.

1.8 Non-approved equipment

As far as the law is concerned, the only stipulation is that one person's opinion of a vehicle's excessive speed is insufficient without corroboration (Section 89(2) Road Traffic Regulation Act 1984), with the exception of motorways where only one witness is required. That corroboration can be from another witness who is of the same opinion or from any electrical or mechanical device where accuracy and reliability can be established.

There is no requirement in law for corroboration to come from a HOTA or ACPO approved device or only from devices being used strictly in accordance with their handbook or this guide. A pre-measured distance plus a witness with a stopwatch is still legally valid.

The difference that HOTA makes is that the court will assume the device is reliable and accurate and allow its 'record', if any, to be entered by way of a certificate. For all other devices a witness will have to satisfy the court of the equipment's reliability and accuracy.

1.9 What could invalidate HOTA?

Once HOTA is granted unauthorised changes should not be made to the device by the manufacturers, manufacturers' agents or operators.

Examples include a change or addition to:

- The device hardware or software
- Any enclosure constructed to house the device during operational use
- An unauthorised connection to an unapproved power source
- The method of secondary check

This means devices should only be used with agreed power sources, enclosures, software and approved leads or connections. They can only be used within the enclosures approved for that specific device. Nothing should be placed in an enclosure that is not included within Type Approval when the device is being used for enforcement purposes. If these rules are not followed a court may decide that it is no longer the Type Approved device, thereby removing the presumption it is reliable and accurate and potentially rendering its evidence inadmissible (Breckon v DPP [2007] EWHC 2013 (Admin)).

Changes to devices may be made by manufacturers and manufacturers' agents on application to and approval by CAST.

1.10 Can HOTA devices be altered at all?

HOTA devices can be altered but only after strict agreement with CAST and The Home Office. At any time the supplier may apply to CAST to make additions or amendments to the device, its software or any other component parts, or to the operators' manual. The supplier cannot make the change without prior written agreement. Some minor changes may be agreed on the supply of technical specifications and explanations to CAST but other changes may require full or partial re-testing. CAST will specify the tests required.

1.11 Who is responsible for maintaining HOTA standards?

The Home Office, NPCC lead for RPET, the equipment suppliers and the operators share responsibility for ensuring devices remain within the specification agreed for the HOTA.

For the Home Office, NPCC lead for RPET and the operator it is a matter of the integrity of the process; for the supplier it is a contractual obligation. The Home Office reserves the right to suspend or revoke Type Approval.

The operator should check to ensure a device is calibrated annually. Annual calibrations can only be carried out by the manufacturer or organisations approved by CAST. Devices used for speed enforcement which are not mechanical and, therefore do not wear, do not have to be regularly adjusted to maintain accuracy. Annual calibration is not a condition of HOTA but it is good practice to use equipment that has a calibration that is in date.

Type Approved devices will have a sticker applied to them showing the date of the last calibration and the due date of the next calibration. It is acceptable for devices to display the date of the next calibration on their data screen in lieu of a sticker.

The annual calibration should not be confused with the periodic confidence checks of devices against known distances or speeds. These periodic checks are an optional or required part of the operators' procedures and are detailed in the operators' handbooks for the equipment.

2 HEALTH AND SAFETY ACT

Roads policing enforcement must be carried out in compliance with legislation and guidance.

All devices referred to within this guide have been tested and conform to current safety parameters. Operators and road users may be exposed to unnecessary danger when technology is used inappropriately or outside guidelines.

All personnel must remain aware of the hazardous nature of such policing activity and the constant need for safe working practices.

Risk assessments must be completed for all enforcement activity and where the advent of new technology or changes in the working environment dictates such a need.

Specific instructions or health and safety precautions for individual technologies and equipment types are shown within the “Precautions/Health and Safety” sections of each technology element of this manual.

2.1 Roadside enforcement precautions

When carrying out roadside enforcement activity that has the potential to bring the enforcement officer to conflict or contact with traffic the following should be observed:

1 High visibility clothing manufactured to a recognised standard should be worn. The British Standard and European Standard for high visibility warning clothing is BS EN 471

2 In speed limits up to and including 40mph a visibility of a minimum of 60 metres should be maintained

3 In speed limits above 40mph a visibility of a minimum of 100 metres should be maintained. The guidance above is intended to allow oncoming motorists to avoid collision with enforcement personnel. Failure to follow it will not render the evidence of the officer inadmissible or provide any defence

3 OPERATIONAL TRAINING

All training should be documented and a robust audit trail maintained to assist in the rebuttal of any challenge to the competency of operators.

3.1 Objectives for training enforcement device operators

NPCC recommendations are that the duration of training should be sufficient to enable an operator to qualify for the award of Certificate of Competence.

At the conclusion of the course the student will:

1 Understand the basic principles of roads policing enforcement technology as outlined in this document and manufacturers' instructions

2 Demonstrate their ability to safely carry out checking, accuracy tests and operating techniques applicable to devices used

3 Be competent in the presentation of evidence

3.2 Additional training objectives for time/distance devices

It is recommended that all training be carried out using similarly equipped vehicles with car-to-car communications.

At the conclusion of the course students will:

1 Demonstrate an understanding of the principles and safe operation of the in-car speed detection device(s)

2 Be able to calibrate the device(s) when required

3 Be able to carry out calibration checks

A trained police operator must be aware of the basic technical functions of the device. However, it is not necessary for them to be technically qualified to give evidence on principles of the system nor the internal workings of the device. If such evidence is required, then the Crown Prosecution Service (CPS) in England and Wales, the COFPS in Scotland and PPS in Northern Ireland should ensure an expert witness is called liaising with the RPET group secretariat to provide an expert.

4 EQUIPMENT CLASSIFICATION

Roads policing enforcement equipment use is classified in groups according to the operating method of each device. Some equipment is Type Approved for use in more than one operating method. The groups are described as follows:

4.1 Attended actively operated

Equipment designed to be set up and actively operated by a trained user. The accuracy of the evidence from such equipment is verified by the operator in every case at the time of the offence. Such equipment may or may not record an image of an offending vehicle, but its operations are at all times supervised by the operator, whose own evidence of the offence is crucial.

Examples:

1 Hand-held laser

2 Hand-held radar

3 Mobile automatic radar

For all attended actively operated devices, the primary evidence is the measurement and record, if any, made by the device. The function of the operator is to be the human secondary check to verify that the speed recorded is consistent with what was seen at the time.

For 3, the function of the operator is to visually confirm that what appears to have automatically triggered the device was indeed travelling above the pre-set threshold, and at roughly the speed indicated, thereby providing a secondary check in locations with no marks on the road surface. The operator then resets the device to allow its continuous operation or notes any apparent discrepancies.

Operators should record evidence concerning the target vehicle, such as speed, direction of travel etc. Additionally, they should note any other significant factor that may have a bearing on the speed reading produced by the device. This may take the form of photographic or video records, or for basic hand-held operation may simply be a written note e.g. on a fixed penalty ticket.

4.2 Automatic operation

A speedmeter which, once set up, works by itself without direct and continuing human intervention and operates with an approved secondary check. Such equipment shall record an image of a speeding vehicle together with the time, date, speed and, if operated with a variable speed limit sign, direct evidence of the speed limit in force and displayed at that time.

4.3 Unattended automatic operation

Equipment mounted in an appropriate housing and designed to operate automatically. When the secondary check of speeds acquired with this type of equipment requires manual intervention to make a speed calculation to verify the primary speed, that check must be operated for each individual offence.

Examples:

1 Roadside loop operated speedmeter

2 Automatic average speed system

4.4 Supervised automatic operation

Equipment designed to operate automatically but supervised to protect the equipment and the integrity of the evidence.

Examples:

1 Portable roadside radar speedmeter

2 Portable roadside laser speedmeter

3 Portable loop operated speedmeter

5 COSINE EFFECT

5.1 What is it?

When a laser or radar speedmeter is used to detect the speed of a vehicle, the angle between the beam and the direction of travel of the vehicle will have the effect of reducing the speed that the speedmeter will sense from the target.

Since it is usually impractical to place the speedmeter directly into the path of the target vehicle, hand-held and fixed devices will be used from the side of or above the carriageway. There are occasions where devices may be directly in front of a target vehicle, such as on a bend; in these cases all of the target vehicle speed will be measured.

The angle of offset is controlled by how far the speedmeter is away from the path of the target vehicle, and the cosine of this angle approximates to the reduction in measured speed below the true speed.

Speedmeters are checked for accuracy so they show an accurate indication of the target vehicle; if the speedmeter is used at an angle that is large, i.e. the speedmeter is used at a distance that is a long way from the side of the road, the speedmeter cannot indicate a speed that is a good representation of the speed of the target vehicle. The accuracy of a reading from a target vehicle may therefore be compromised by its operating position.

To reduce this effect and make it easy to measure a good representation of target speed a "rule of thumb" method can be used.

5.1.1 Rule of thumb

The distance to the target vehicle should be approximately 10 times the speedmeter offset from the centre line of the target vehicle path or above the road.

This will reduce the effect to allow a minimum of 99.5% of the vehicle speed to be measured. Exceeding the suggested offset in this rule of thumb, provided the device is kept steady, simply creates a greater reduction in the measured speed as well as making a target more difficult to acquire.

Note:
A ratio of 10 to one (10:1) for offset from side of the road to the distance the vehicle is measured will mean that a minimum of 99.5% of the vehicle speed will be sensed by the laser or radar speedmeter.

Cosine 5.7° = 0.995

100mph x 0995 = 99.5mph

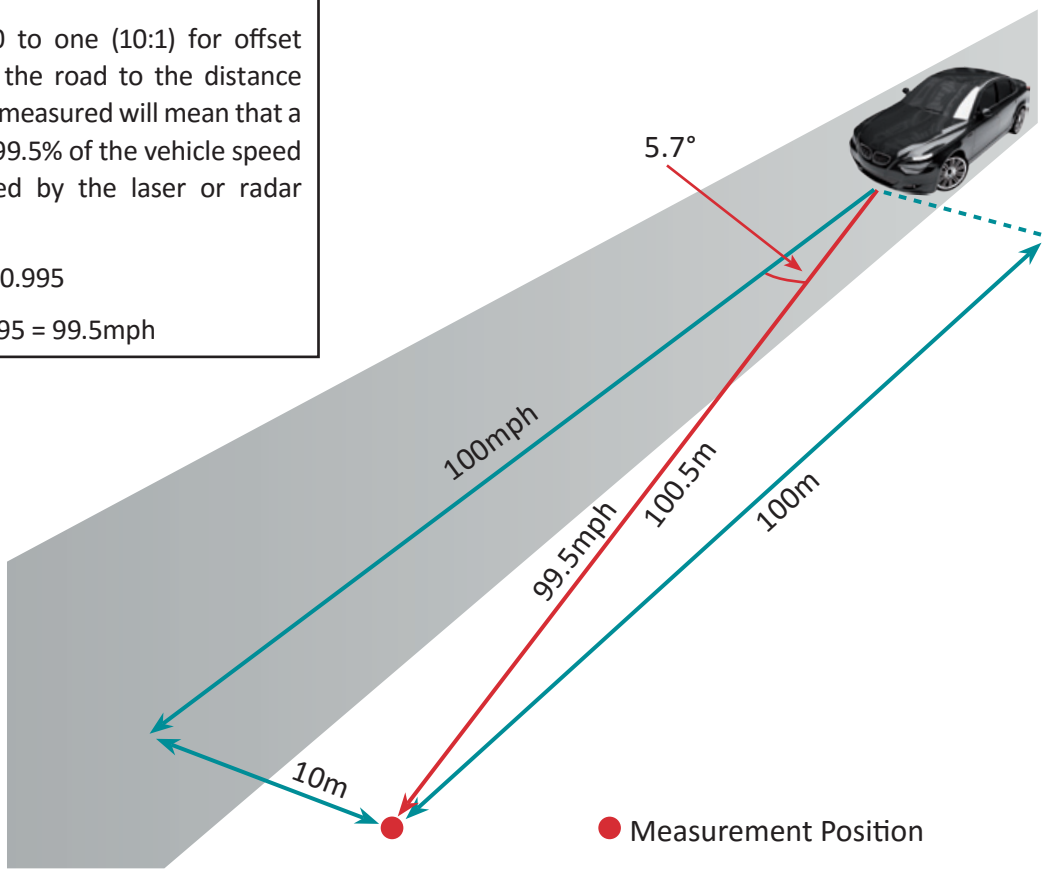

Figure 1 Practical illustration of the "rule of thumb" for reducing Cosine Effect

5.2 How does it work?

The laser speedmeter can only sense the distance travelled towards itself, not the distance being travelled along the road.

5 COSINE EFFECT

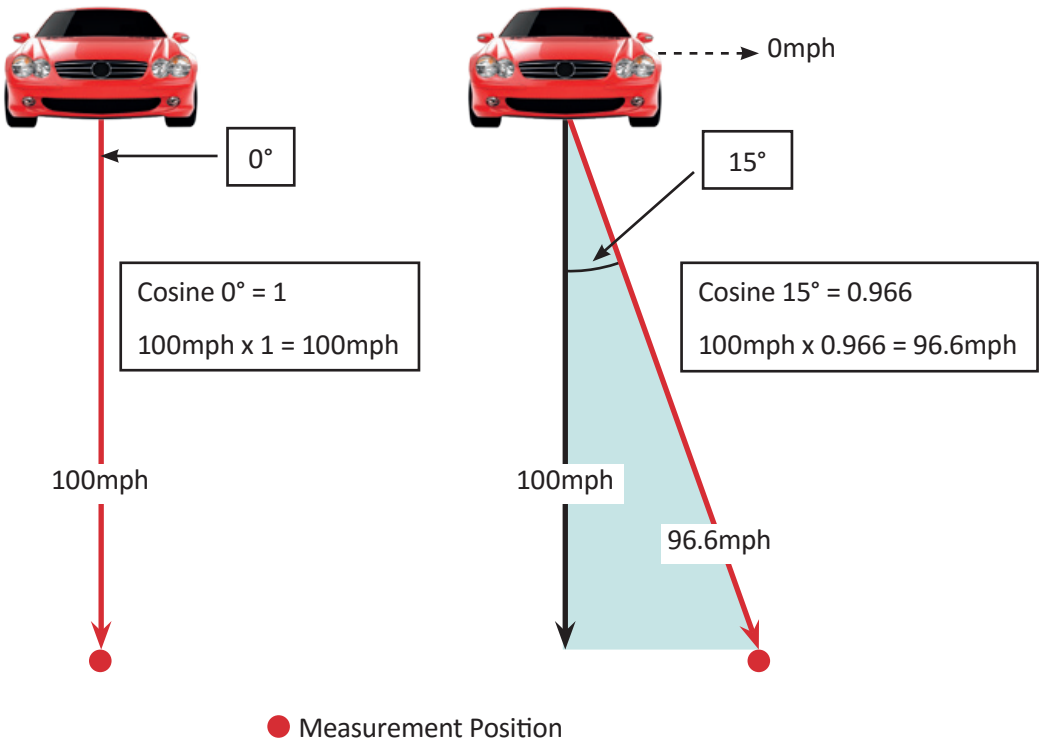

Figure 2 Cosine illustration one

The left-hand side of figure 2 shows the position required to measure the true speed of a target vehicle. In practice the speedmeter will be used at the side of the road with the operator positioned in a lay-by, observation point or verge.

The right-hand side of figure 2 shows that the measurement point is now offset from the track of the vehicle. If the vehicle is still travelling at 100mph along its indicated track on the road and the speedmeter is operated from the side of the road creating an angle of 15° between the vehicle and the speedmeter, only a proportion of the vehicle's speed will be measured.

The vehicle can be thought of as travelling at 100mph in the direction of its travel but at 0mph at 90° to its travel or sideways; this is quite obvious. It is difficult, however, to make an assessment of the speed at an angle that is towards the speedmeter without resorting to some trigonometric calculations. The Cosine of 15°, in the example in the right-hand side of figure 2, can be used to calculate the speed towards the speedmeter position.

Further examples of this are shown in figure 3.

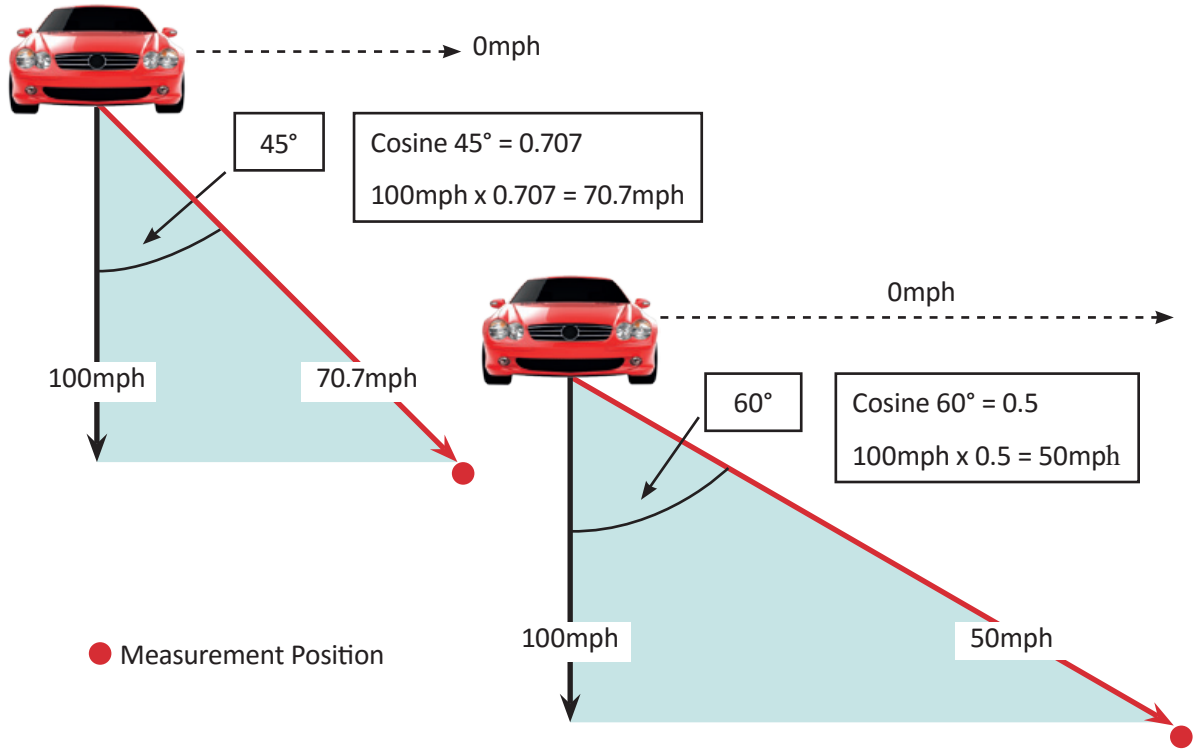

Figure 3 Cosine illustration two

Figure 3 shows that as the speedmeter is moved further and further away from the vehicle track or the side of the road, the angle between the vehicle track and the speedmeter position increases; as the angle increases the speed sensed by the speedmeter decreases. If the speedmeter was at an angle of 90° pointing at the side of the vehicle, the speed sensed would be 0 mph.

5.3 Good practice

5.3.1 Hand-held and portable speedmeters

It is not practical for officers to make trigonometric calculations at every site so use the rule of thumb as described at 5.1.1 above.

If the speedmeter is too far from the carriageway the speed sensed by the speedmeter is reduced to a percentage that would mean that the speed reading is no longer representative of the speed of the target. If the rule of thumb is observed then the speed indicated will correspond to more than 99% of the speed of the target vehicle and is therefore representative of the true speed.

5 COSINE EFFECT

5.3.2 Fixed cameras/speedmeters

Fixed devices using laser or radar are designed to work at a fixed angle to the road and usually have a fixed value set in their system to compensate for the angular offset to the road, and hence vehicle track. When the fixed system is installed the angle to the road and the fixed compensation will be set by the commissioning engineer for that installation. When the site is commissioned the supplier will check the site for accuracy. If desired, additional drive through tests to those performed by suppliers during commissioning may be undertaken by the police to confirm that the fixed installation is reading as expected.

Note: Unlike hand-held devices that do not have built-in compensation, it is possible for a fixed camera using compensation to over-read if the installation is not done correctly, so it is important that the system is checked after first commissioning.

5.4 Additional considerations

In practice a speedmeter will be at an angle to the target vehicle in the horizontal and vertical planes and the effects of both will work in combination to reduce the speed sensed from the target vehicle by the speedmeter. The rule of thumb works for horizontal and vertical offsets. If a speedmeter is being used above and to the side of a vehicle track the reduction of the two offsets can be multiplied to approximate the effect of the speedmeter position.

For example:

99.5% (10m horizontal offset) x 99.5% (10m vertical offset) at a target range of 100 metres will result in approximately 99% of the target speed. This is an acceptable difference between the true and measured speed.

It should be noted that any effect will reduce the speed and differences in speed between that of the vehicle and that measured will always be to the advantage of the motorist.

6 SPEED DETECTION USING A SPEEDOMETER FITTED TO A PATROL VEHICLE

This type of check, commonly known as the 'follow check,' has been used by police forces for a number of years and is readily accepted by the courts and motoring public alike. If the speedometer is used to support the suspicion of the officer then it is recommended that it is tested as detailed below.

6.1 Means of check

It is preferred that a roads policing vehicle should be fitted with a certified calibrated speedometer that is regularly tested in accordance with force instructions. The use of non-calibrated speedometers is not ideal but readings from them may still be acceptable in court, especially if the margin by which the limit is exceeded is notable and the non-calibrated speedometer would not be reasonably considered to be so inaccurate that the reading could not be relied upon.

The checking vehicle should be positioned to the rear of the suspected offending vehicle so as to maintain, throughout the check, an even distance between the vehicles.

Speedometer readings should be observed throughout and check start and end points related to readily identifiable features.

6.2 Minimum distance

2/10 of a mile is the minimum distance recommended by NPCC for such a check.

6.3 Speedometer accuracy

The patrol vehicle speedometer should be checked for accuracy at the end of a tour of duty after detection of an offending vehicle.

It is recommended that speedometer accuracy is checked using verifiable means.

It is recommended that the speedometer reading should be within ±2mph (plus or minus 2mph) of the reading on the Type Approved device for calibrated speedometers. A record of the result should be made in an equipment log or a pocket notebook so the check result can be evidenced when required.

If a non-calibrated speedometer is used for a speed check the difference between it and the Type Approved device should be noted for later use in evidence of the assessed speed of the target vehicle.

7 RADAR SPEEDMETERS (HAND-HELD)

7.1 Radar speedmeter technology description

The term RADAR is an acronym for Radio Aid to Detection And Ranging; a radar transmitter sends electromagnetic radiation or radio waves from the device to the target vehicle and, provided the target vehicle is reflective to radio waves, these are reflected back to the radar receiver.

The frequency of the transmitted radio wave is known. A detector in the radar device can be made to compare the frequencies of the received and transmitted radio waves. If the frequency of the received radio wave is the same as that of the transmitted radio wave then the detector will show the speed of the reflecting target as being stationary. When the frequency of the received radio wave is higher or lower than that of the transmitted wave, the detector can be made to calculate a speed of the reflecting target. As the speed of the target increases the change in frequency becomes further from the original transmitted frequency. This works when a target is approaching or receding from the radar speedmeter.

The effect described above is known as the Doppler Effect.

Radar speedmeters use radio frequency emissions that are at a low power level so they will not interfere with the equipment in a target vehicle or other vehicles that come into the field of the radar.

Radar speedmeters will typically acquire, quality check, calculate and display the speed of a target vehicle in one to three seconds, with the operator being required to track and maintain a steady indicated speed for more than one measurement cycle of the radar speedmeter.

The divergence angle of the beam is relatively narrow for a radar beam; typically between 12° to 20°. The beam width at the target increases as shown in the table below. Because the beam width is wider than the width of a typical vehicle at ranges as short as 50 metres, an operator should ensure that the vehicle being targeted is the vehicle in the beam of the radar speedmeter, and that is the vehicle causing the speed to be shown on the instrument.

Table 1 Beam width at typical target ranges

	Target Range (m)				
Beam Angle	100	200	300	400	500
15°	27	54	80	107	134
20°	36	73	109	146	182

The radar beam width in meters is shown in the shaded area of the table for beam angles of 15° and 20°.

7.2 Confidence checks

7.2.1 Sight alignment

The sighting mechanisms of radar speedmeters are rigid and are generally not adjustable; no alignment is required beyond that which is done by the manufacturer or supplier.

It may be useful to mark the approximate angle of the beam on the top of the radar speedmeter where possible to do so. This will give the operator a reasonable estimation of the approximate extent of the beam as the range to target increases.

7.2.2 Speed accuracy

Radar speedmeters are not user adjustable and are not subject to wear that could cause a significant drift in speed accuracy. They may, however, be periodically tested for speed accuracy with the aid of a tuning fork that will vibrate and cause a pre-determined speed to be read by the radar speedmeter when the tuning fork is held in the measuring radar beam. The tuning fork test will allow the instrument to be checked to confirm that no changes have occurred to the measuring accuracy of the instrument since its last calibration and servicing. The manufacturers' handbook should be observed.

7.3 Typical use

Radar speedmeters are typically used as hand-held devices; all of which are attended actively operated devices.

The speedmeter is aimed at the target vehicle at the front or rear with the radar beam being directed towards a target vehicle.

The vehicle will need to be tracked with the aiming sight to allow the instrument to make a satisfactory speed measurement of the target. Tracking of the vehicle should be maintained for a period of not less than three seconds. At the same time the operator should consider whether the speed observed matches that indicated by the speedmeter. The speed can either be constant or show an accelerating or decelerating reading that is commensurate with the operator's observations. When satisfied the reading is representative of the observations made the speed is locked into the device and recorded.

7.4 Precautions

7.4.1 General

Care should be taken to ensure that the radar speedmeter is used in a way that it only acquires reflections from the intended target vehicle. If there are two or more vehicles in the range of the radar then the strongest reflected signal will be the one that is used to indicate the speed to the operator.

7 RADAR SPEEDMETERS (HAND-HELD)

Radar speedmeters can be used by operators that are within a vehicle; however, the speedmeter must be at an open aperture and not be within the body of the vehicle to avoid reflections.

Sites for operation of radar speedmeters should be checked for possible sources of Radio Frequency Interference (RFI). This can be done by operating the radar on the site when there are no vehicles present and making sweeps through 180° and 360°, ensuring the received signal strength is blank or the RFI indicator is not indicating unacceptable levels of interference.

Sites should also be checked to ensure that there are no radar reflective objects, such as metallic hoardings or signs that could cause unintended targets to be acquired by way of a reflected beam.

Sites in the vicinity of obvious radar sources, such as airports or military establishments, should be avoided. Sites in the vicinity of mobile telephone masts do not present sources of RFI of sufficient strength to interfere with Type Approved radar speedmeters; it is good practice to avoid operating radar speedmeters within 50 metres of such masts even though adjacent operation would not present a source of error.

7.4.2 Health and safety

Radar devices having United Kingdom HOTA comply with standards that are designed to ensure personal safety when operating the device. The maximum level of radiation when transmitting is below the UK recommended level and the devices can be considered absolutely safe for police use. No particular precautions are considered necessary. However, to avoid even low-level exposure it is recommended that the radar aerial should not be held closer than 25cms to the body.

7.4.3 Evidence

The speed of the target vehicle should be noted on all occasions of a speed measurement.

8 RADAR SPEEDMETERS (ACROSS THE ROAD)

8.1 Technology description

Across the road speedmeters use the Doppler Effect to determine vehicle speed, however, unlike hand-held radar speedmeters (see the previous section) the across the road speedmeter has a fixed radar device that shines a radar beam across the road at a fixed angle. Because the angle to the road is known and, therefore the angle at which a target vehicle crosses that beam, a correction can be made in the speedmeter electronics to correct the Cosine Effect and record the vehicle speed.

Vehicle speeds are read directly from the speedmeter without further correction needing to be applied.

8.2 Confidence checks

8.2.1 Alignment

The fixed housing is aligned to the road and vehicle track at a site that is within limits of curvature that will have a minimum predicted effect on the measured speed of the vehicle after correction for Cosine Effect. The fixed housing is then equipped with a camera and radar, either permanently or on a scheduled basis. The fixed housing is constructed in a way that allows a camera technician to set the radar and camera in a fixed position that is aligned to the housing and hence the track of the vehicle.

Portable devices are aligned to the road by an alignment procedure at the start and end of the speed enforcement session.

8.2.2 Distance and speed accuracy

Across the road speedmeters are checked at calibration and upon commissioning for speed accuracy and can be relied upon to be accurate, especially when the radar speed is checked against the secondary check.

Secondary checks should normally fall within a band of ±10% (plus or minus 10%) of the primary reading. This will be a simple pass or fail if the vehicle can be seen to be within the band; calculation of an exact speed from the secondary check is not required to be given in evidence to support the primary evidence.

8.3 Typical use

Across the road radar speedmeters can be a permanent installation (automatic unattended) or portable devices (supervised automatic or attended actively operated).

Permanent across the road radar speedmeters are generally unattended automatic devices that have some form of secondary check of the vehicle speed that has been acquired by the radar speedmeter.

Portable devices generally have no secondary check marks on the road, so the speed reading must be verified by the opinion of the operator that the speed recorded was consistent with what was seen at the time. The operator becomes the secondary check.

8 RADAR SPEEDMETERS (ACROSS THE ROAD)

8.4 Precautions

8.4.1 General

If the secondary check speed is outside of the aforementioned tolerance then the evidence should be examined to determine the possible source of the error.

A possible source of error is that the vehicle is either accelerating or decelerating while in the field of the radar and secondary check areas. If two or more vehicles are in the secondary check area then the evidence should be examined to determine which vehicle is the source of the radar speed acquired by the speedmeter. If the vehicle causing the speed reading cannot be determined with confidence then the reading should be disregarded.

8.4.2 Health and safety

The operator should always choose a site which affords them and users of the road maximum safety with regard to any potential hazard, and must consider the minimum distance a driver will take to react and come safely to a standstill when stopping alleged offenders. High visibility clothing should be worn when the potential for contact with vehicles is possible (see chapter 2).

Satisfactory operation of the device depends on the correct positioning and alignment of the radar. It should be positioned as near to the traffic flow of interest as is convenient.

8.4.3 Evidence

Across the road radar evidence from automatic devices is recorded by either a ‘wet-film’ camera or a digital camera. Evidence from prescribed HOTA devices can be supported by way of certification in accordance with Section 20 of the Road Traffic Offenders’ Act 1988. Records of the loading and unloading of the film should be recorded for continuity and listed on the unused material schedule, providing the record does not undermine the prosecution case.

9 PARABOLIC RADAR

9.1 Technology description

Parabolic radar is used in over the road speedmeter systems where the beam is used to illuminate a specific section of road; typically one lane from equipment suspended over the surface of the road on a gantry. The system uses the Doppler principle and the Cosine correction is calculated to correct the angle at which the system is set to illuminate the road surface.

9.2 Confidence checks

9.2.1 Alignment

Same as across the road radar.

9.2.2 Distance and speed accuracy

Same as across the road radar.

9.3 Typical use

The most common use is in Smart Motorway applications where the radar is used in conjunction with variable speed limit signs co-located with the speedmeter.

Further use of parabolic radars is as virtual loops in place of sub-surface loops in red-light, level crossing and speedmeter systems.

9.4 Precautions

9.4.1 General

Same as across the road radar.

9.4.2 Health and safety

Over the road radar gantries are attended by specialist installation and service engineers; untrained personnel should not attend the sites or attempt to service the equipment located on such gantries.

9.4.3 Evidence

Over the road radar is largely digital in nature and does not require regular attention other than by the manufacturers' or suppliers' staff. The evidence is acquired and written to write-once permanent media for reading in back office IT equipment.

Evidence from prescribed HOTA devices can be supported by way of certification in accordance with Section 20 of the Road Traffic Offenders' Act 1988. Records of the loading and unloading of the film should be recorded for continuity and listed on the unused material schedule providing the record does not undermine the prosecution case.

10 LASER SPEEDMETERS

10.1 Laser speedmeter technology description

The term laser is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation; a laser emits light by that process.

Light sources, such as incandescent light bulbs, emit incoherent white light from which the waves are difficult to steer into a useful narrow beam. Laser light is usually generated in a way that causes the light to be emitted in a narrow beam, or the light can be converted into a narrow beam with the help of optical lenses. Lasers mostly emit light with a narrow frequency spectrum, or more commonly termed as a single colour that scientists call monochromatic light.

Lasers can use light in the visible or invisible parts of the light spectrum; for practical reasons police enforcement equipment uses invisible light in the infra-red spectrum. It will not, therefore, interfere with drivers' or operators' vision.

Laser speedmeters determine speed by shining laser light at a target vehicle in a way that illuminates reflective parts of the vehicle. Depending on the reflective properties of the parts of the vehicle some of the light is returned to the receiver of the laser speedmeter.

By using a series of light pulses the laser speedmeter can, by sensing the movement between pulses, be made to calculate the speed of the target vehicle.

In operation, laser speedmeters employ sophisticated techniques to measure the quality of reflected laser light, as well as predicting when the light will be returned to the device after an initial period of acquisition of a target vehicle. It is necessary to reflect light from the target back to the laser speedmeter in a predictable and reliable manner. The vehicle's retro-reflective surfaces, such as the registration plate, headlamps and rear reflectors are the best, but not the only items, to aim at when making a speed reading with a laser speedmeter.

Laser speedmeters will typically acquire, quality check, calculate and display the speed of a target vehicle in less than 0.5 seconds.

10.2 Confidence checks

10.2.1 Sight alignment

The sighting mechanisms of laser speedmeters are rigid and some are adjustable; the adjustment should only be performed at the service centre rather than by an operator. The sighting mechanisms may be checked for alignment through the use of the built-in test facility, and it is recommended that verification is carried out before and after each speed enforcement session. This is because the less frequently the checks are made, the more days of enforcement will need to be cancelled when a defect is found; not because the devices are prone to misalignment.

10.2.2 Distance and speed accuracy

Most laser speedmeters are not mechanical devices subject to wear that could cause them to drift out of their expected speed accuracy. They are not user adjustable, but for operator confidence they may be periodically tested for range or speed accuracy. This should be done on a target of known speed or distance, to ensure there has been no change to the instrument since it was last calibrated and serviced. The manufacturers' handbook should give details of this type of check.

10.3 Typical use

Laser speedmeters are typically used as hand-held or tripod mounted devices; all of which are attended actively operated devices.

The speedmeter is aimed at the target vehicle at the front or rear, with the illuminating beam being made to cover as many retro-reflecting surfaces as possible. For example, the registration plate, lights or light covers and rear-reflectors.

The vehicle will need to be tracked with the aiming sight to allow sufficient reflected light to return to the receiver to make a speed measurement.

The operator is not restricted in his choice of target, only measuring vehicles which he has already assessed to be exceeding the speed limit, but must assess any reading obtained and compare it with his own view of the apparent speed of the vehicle as it was being measured.

10.4 Precautions

10.4.1 General

Laser speedmeters must not be used through glass or plastic screens to avoid diffraction or scattering of the laser beam. While vehicle screens pass light with minimum diffraction, elements within vehicle screens, as well as their cleanliness, makes the path of laser light less predictable so it is discouraged in law enforcement devices. They can be used from within vehicles through an open aperture, such as a window.

Take care that lenses are not damaged or dirty by not placing the instrument in a position where this can occur. Make a visual inspection of the equipment for damage before use.

10.4.2 Health and safety

The output power of laser speedmeters is required to be in the Class 1 (eye-safe) recommendations as laid down in British Standard BS EN 60825-1: 2001. In addition users should not point the devices into a person's eye at short range and for a long period of time. Use for the measurement of vehicle speed will not present a hazard to anyone in the transmitted light beam.

10 LASER SPEEDMETERS

10.4.3 Evidence

Handheld devices not producing a record – the speed of the target vehicle should be noted on all occasions that a speed measurement is taken which exceeds the speed limit in which enforcement is taking place by the intended margin for that enforcement. The range measurement may also be noted if the circumstances allow a note to be made of the range.

Devices which produce a record – no separate note need be made of the speed of the target vehicle. The record will be the primary evidence of speed and range and the role of the operator is to verify that reading at the time it was made by making an assessment as to whether the apparent speed of the vehicle corresponded to that reading. If it did not, then enforcement should cease until the device has been checked.

10.5 Laser speedmeter check range

10.5.1 Description

A range of known distance between a marked target and operating point can be constructed to carry out periodic confidence checks.

A mark should be made on the ground or by a fixed object to allow accurate positioning of the laser speedmeter (the operating position) when it is to be tested. A target marked with paint, a road sign or other flat object should be placed in a fixed position and oriented vertically so the laser speedmeter can be aimed to cause a reflection back to its receiver. When correctly positioned the laser should confirm the known distance to the target and, in some cases, confirm a speed of 0mph for the test target.

A note can be made of the results of the check either in a pocket note book, a statement or in a log book that is kept with the equipment.

10.5.2 Range set-up

Decide on a safe location with an uninterrupted laser targeting line between the aiming point and the target.

Measure the distance between the aiming point and the target with either:

1 Two laser speedmeters (both must agree)

2 A calibrated measuring wheel

3 A steel rule or steel tape rule

4 Another distance measuring device with established accuracy

Note the distance and record the evidence of the range set-up or measurement in a statement form for later use in court.

Officers can check an existing range using any of the methods above so that they can evidence the details of the range measurements themselves in a statement, if required to do so in court.

11 SITING CONSIDERATIONS FOR AUTOMATIC UNATTENDED SPEEDMETERS

11.1 Site surveys

The following should be considered as good practice when installing any fixed sites for the unattended use of HOTA enforcement technology:

- Sites where radar or laser installations are being considered should be examined to avoid any large reflective surfaces, such as street signs in the path of the measurement beams
- Radio Frequency Interference (RFI) checks should be considered at all laser and radar sites where radio interference may be of concern, to ensure no interference is present and records retained as part of a site file

11.2 Unattended site set up

- For all unattended sites, photographic records covering a 360 degree view of the site should be taken and retained for future reference in case of site changes. These reference images should be periodically checked to ensure no installations have been completed at sites that may interfere with the device
- Evidence produced from unattended sites should have either a secure site location ID on as part of the evidence produced, or a mark on the road surface that appears in the image to identify the location
- Where the location of a device is such that the site can be clearly determined within the image, ie a road where permanent features such as buildings or road junctions appear in the image, then no markings or electronic ID will be necessary
- Where the location is on a motorway and no physical features exist, markings or automatically programmed electronic ID should be provided such as GPS coordinates

12 IN-CAR DISTANCE/TIME DEVICES

12.1 Technology description

The detection of speeding offences using the equation:

Speed = Distance divided by Time

This is a long established practice, initially carried out by the use of a certified stopwatch and the odometer of the patrol car. While this principle remains, technology has allowed for the introduction of sophisticated equipment, which has proved to be far more efficient and accurate. The operation of the devices simply involves the operation of a distance switch and a time switch, in the appropriate sequence. This calls for a high level of operator accuracy and, in order to achieve it, appropriate training is required.

Where a vehicle is, in the opinion of a police officer, travelling at an excessive speed the device is used to corroborate that opinion.

12.2 Confidence checks

12.2.1 Sight alignment

There are no alignments of sights required with this type of equipment, however, some equipment is supplied with a video camera that should be aligned to the vehicle being checked at the time the record is made.

12.2.2 Distance and speed accuracy

Because these devices rely in part on the mechanical components of a vehicle, which are subject to wear, these devices must be regularly calibrated in accordance with the manufacturers' instructions. Full calibration must be carried out:

1 On initial installation,

2 Following removal and reinstatement,

3 Following the fitment of new tyres, and

4 At weekly intervals

In order to establish the on-going accuracy of the device all of those listed above should be recorded in a log book for the device with the identification of the officer calibrating being made clear.

If the device is found to be inaccurate the defect must be remedied and any offences detected since the previous accuracy check should be reviewed; as it may not be known at what point the equipment became defective.

12.3 Typical use

12.3.1 Overview

The checking of a target vehicle's speed can be done by checking its movement between two references, either permanent or temporary, on or near the carriageway, such as:

- a moving shadow on a stationary object or a mark on the road surface
- a moving object on a stationary shadow or a mark on the road surface
- a shadow-to-shadow contact
- physical contact of vehicle wheels with reference point
- when both vehicles are side by side

By using reference points that fit this, or are similar to this definition, any uncertainty can be eliminated.

It is important to remember the police vehicle **must** pass between the same points as the target vehicle. This is essential as the distance information is taken from the police vehicle.

When the police vehicle has travelled between the two points and the distance switch operated, on at the first point and off at the second point, the device then knows the distance between the points. As the target vehicle travels between the same two points, the time switch is operated. The time switch is switched on at the first point and off at the second point. The device now knows the time the target vehicle took to travel between the two points.

The device now has both parts of the equation required to calculate the target vehicle's average speed. This is done in a fraction of a second and the result is then visible on a digital display.

If, for any reason, the operator has any doubt as to the validity of the check, it must be abandoned.

12.3.2 Follow check

This type of check is carried out when the police vehicle is following the target vehicle. As the target vehicle passes the first reference point, the time switch is turned on. As the police vehicle passes the same reference point, the distance switch is turned on. As the target vehicle passes the second reference point, the time switch is turned off.

The device now knows the time the target vehicle took to travel between the two reference points. As the police vehicle passes the second reference point, the distance switch is turned off. The device now knows the distance between the two reference points that the target vehicle has travelled.

12 IN-CAR DISTANCE/TIME DEVICES

12.3.3 Pre-fed distance check

This type of check is carried out when the police vehicle travels between the two reference points. Turn the distance switch on at the first point and off at the second point.

The police vehicle then parks in a position that the two reference points can be clearly seen by the operator.

The device has the distance between the reference points stored. As a target vehicle passes between the points the time switch is turned on and off. The device can then calculate the speed. Providing the distance information is not cleared from the device the police vehicle can remain parked and, by clearing the time information only, another target vehicle can be checked.

12.3.4 Being followed check

This check is carried out when the police vehicle is travelling in front of the target vehicle that is approaching from behind at a speed which is excessive.

The police vehicle will travel between the two reference points, with the operator turning the distance switch on and off. The device now knows the distance travelled.

As the target vehicle, still approaching from the rear, passes the same points the time switch is turned on and off. The device now knows the time taken to travel between the reference points. The device knows the distance and time and can calculate the speed.

12.3.5 Crossing check

This check is started when the police vehicle is stationary.

As the target vehicle passes the first reference point, the time switch is operated. The police vehicle then moves off behind the target vehicle, operating the distance switch as the police vehicle passes the same reference point.

With the police vehicle now following the target vehicle and both time and distance switched on, the completion of the check is the same as the ‘follow check’.

12.3.6 Dial in distance check

This mode enables a known distance previously measured by the device to be fed into the device computer without the need to drive again over the route. Record the distance on the same push button switches as used for calibration purposes. This procedure can also be used with the control module removed from the car and plugged into the portable battery pack.

Particular care must be exercised where shadows are used as these will change with the movement of the sun.

The minimum distance for any check is generally 1/8 or .125 of a mile. However, checks over a shorter distance, down to an absolute minimum of 0.07 of a mile, are permissible under the following circumstances:

a. This minimum distance is only for pre-fed or dial in distance checks
b. The reference points at both the start and end of the check are permanent physical features on or close to the road surface, which provide a clear and visual reference
c. The maximum speed limit at the site does not exceed 40mph

Trainers are to be satisfied that operators carrying out reduced distance checks are capable of performing the function accurately.

12.4 Precautions

12.4.1 General

Police radio transmitters, whether hand-held or car mounted, must not be used at the moment a vehicle speed is being measured. Turn off the in-car and personal radio equipment or set to 'transmit inhibit,' where available, for the duration of the speed measurement unless the device is Home Office Type Approved and is shown to be unaffected by radio interference.

12.4.2 Health and safety

When checks are being made at high speed it is necessary to operate the controls of the device at the same time as the vehicle is being driven. Care should be taken to ensure that the operator/ driver is familiar enough with the equipment controls so the operation of the device does not become a distraction to the maintenance of safe vehicle control.

12.4.3 Evidence

Distance/time device evidence is the speed, time and distance records which should all be noted by the operating officer. If an approved video or data logging device is fitted to the distance/time device, this may be used as the record from the device.

13 AUTOMATIC DISTANCE/TIME DEVICES

13.1 Technology description

This type of speedmeter system uses the distance/time method of average speed calculation; the speedmeter being pre-fed with the distance between the entry and exit points, the 'baseline' with cameras at the same points detecting vehicle identification data, along with an accurate time that the data is collected. The vehicle data and time information is transported to a matching system where the entry/exit data is used to calculate the average speed of the vehicle as it transits the known distance between points of data collection.

The components of the system are connected by a dedicated or public communications channel, with data integrity being assured by encryption when public communications channels are used.

The data collected for an offence is written to write-once media before transfer to a back office facility for adjudication purposes.

The system shows the minimum speed between the entry and exit points because the baseline is required to be set at the minimum possible driving distance between those two points.

13.2 Confidence checks

13.2.1 Site alignment

Automatic distance/time devices have their video imaging systems set to a locked position from which the baseline reference is taken. It is required, therefore, that after commissioning and calibration the camera supplying the video image does not move. To assure that the camera has not moved between calibration periods and an offence, a permanent mark visible to the camera system should be made on the road surface with the position of the mark being visible in the offence overview image. An overview image from the entry and exit positions should be provided along with the calibration certificate for the device. The calibration images should be used as reference images, with the visible marks in the offence images being compared to them to assure that no movement of the cameras detecting the target vehicles has occurred between the time of calibration and the recording of any offence. There is no requirement for a site number or any other identifying mark to be provided at the site but this is not precluded.

13.2.2 Distance and speed accuracy

The distance between the entry and exit point should be measured with a calibrated distance measuring device; the distance being measured a minimum of three times, with each of the results being within 1% of the average of the three measurements. The shortest of the three measurements is then taken as the distance between the points for the average speed calculation. The baseline length shall be measured using a calibrated surveying instrument, such as a theodolite, total station, measuring wheel, steel tape, surveyor's chain or, where there is no restricted view of the sky throughout the length of the base line, with a vehicle mounted GPS system acceptable to CAST or another method acceptable to CAST.

A drive through test can be performed to show accuracy, but this is not a requirement of this type of system.

13.3 Typical use

The system can be configured in a point-to-point arrangement or be arranged for area coverage in a multipoint-to-multipoint arrangement; the latter arrangement allowing any camera to any camera operation on multiple baselines.

13.4 Precautions

13.4.1 General

It is essential that the baselines are correctly identified for each location before enforcement commences.

In roadworks, where frequent changes to the road layout between the entry and exit cameras are possible, the baseline must be re-established for each affecting change with a new calibration certificate being issued by the system supplier or agent.

13.4.2 Health and safety

There are no specific health and safety precautions for this type of equipment.

13.4.3 Evidence

Evidence is written to a write-once permanent medium for transfer to a back office adjudication system. A print of the evidence of the back office system should be certified with a Section 20 certificate for presentation in prosecution files. A statement or calibration certificate evidencing the baseline length between cameras should be kept but will normally be placed on the unused material schedule.

14 CHRONOMETERS

14.1 Technology description

Several types of chronometer were approved by ACPO for use in detecting offences of excess speed. They function by having a known distance pre-fed into them, and the time taken for the target vehicle to cover that distance is then measured in the same manner as a pre-fed check or dial in distance check using time/distance devices.

Since the operator has no means of checking the accuracy of the distance used, chronometers should only be used at locations where:

1 The distance has previously been measured and is verifiable to within 1% of the distance between points, and

2 Both reference points to be used in the check are permanent marks or features clearly visible to the operator

14.2 Confidence checks

14.2.1 Sight alignment

None required.

14.2.2 Timing check

The timing accuracy of chronometers should be checked periodically to show that the timing is performing adequately.

The timing accuracy can be checked against another timing source to show that there are no gross errors in the enforcement equipment; this can be achieved by checking the device over a period of a minimum of two minutes with the readings required to be within one second of each other.

Suitable timing sources are:

1 A speaking clock on a telephone service

2 A timing signal received via a radio service

3 A Home Office Type Approved device that provides timing to a resolution of one second

It is recommended that a log book is kept with the equipment where a record of the checks, who performed them and what reference was used are noted.

14.2.3 Distance and speed accuracy

The distance between the entry and exit point should be measured with a calibrated distance measuring device; the distance being measured a minimum of three times with each of the results being within 1% of the average of the three measurements. The shortest of the three measurements is then taken as the distance between the points for the average speed calculation. The baseline length shall be measured using a calibrated surveying instrument, such as a theodolite total station, measuring wheel, steel tape, surveyor's chain or where there is no restricted view of the sky throughout the length of the baseline, with a vehicle mounted GPS system acceptable to CAST or another method acceptable to CAST.

14.3 Typical use

The chronometer is operated from a vantage point with the operator observing the traffic to be measured from within a vehicle or a roadside position.

14.4 Precautions

14.4.1 General

Electronic chronometers should not be operated in the presence of transmitting police radios.

'Transmit inhibit' should be enabled when carrying out speed checks with this type of equipment.

14.4.2 Health and safety

Normal roadside precautions should be observed.

14.4.3 Evidence

Evidence of the speed reading should be recorded by the operator at the time the speed measurement is made.

15 SENSOR OPERATED ROADSIDE SPEEDMETERS

15.1 Technology description

These devices typically offer a method of checking vehicle speeds on the road by the use of either electrical Piezo Co-Axial cables, or hollow rubber tubes fixed across the carriageway at right angles to the flow of traffic.

The sensors are set at a specified distance apart, and the instrument measures the time taken to cover that distance between the sensors, then computes the average speed of the vehicle.

The piezo sensors may be embedded in housings set in the road surface, with connecting cables leading from these permanent sensors to a post at the roadside where the speedmeter can be connected or to fixed speedmeter systems.

With piezo-electric and hollow-tube types of sensor, the pressure of the vehicle's road wheels passing over it is converted into an electrical pulse used to stop and start timing counters in the device. The values captured are used to calculate and display the average speed.

15.2 Confidence checks

15.2.1 Alignment

Fixed sites will have cameras aligned to the road but the alignment angle does not affect speed accuracy.

Mobile sites will require alignment of any camera system to ensure target vehicle data is correctly captured.

15.2.2 Distance and speed accuracy

The accuracy of these systems is dependent upon the distance between the sensors and the clock accuracy in the attached equipment.

For temporary installations, such as mobile systems with pneumatic tubes installed by an operator, the tubes must be installed accurately to the template or measurements supplied in the manufacturers' handbook. Temporary installations should be checked by driving through the system with a vehicle, of which the speed is verified by the use of another HOTA speed measuring device before enforcement takes place.

Permanent sub-surface installations should be checked by the supplier, either annually or once every two years. A drive-through check is recommended at the first commissioning or after replacement of the sensors.

15.3 Typical use

Sub-surface sensors are used for fixed and mobile speedmeter operations. Pneumatic sensors are used for temporary mobile systems only.

15.4 Precautions

15.4.1 General

Operators must be aware of the potential for certain axle configurations to create artificial readings. Compliance with proper operating procedure will ensure no inappropriate prosecutions are mounted.

Where sensor deterioration is observed a drive through check can be carried out at intervals to assure speed accuracy is maintained.

Where serious damage is observed the speedmeter should be taken out of service and the supplier or agent should be contacted for repairs to be carried out.

15.4.2 Health and safety

All operators setting up sites will wear high visibility clothing at all times. Safety goggles should be worn when nailing sensor fixings into the road surface. Operators should ensure that such fixings do not cause danger to other road users and are removed at the end of the check.

It is important that a sufficient and safe stopping distance is allowed between the check site and stopping officers. Distances will vary according to differing site features and weather conditions. Stopping officers will wear high visibility clothing at all times.

15.4.3 Evidence

For temporary mobile sites, the site must be selected so that the operator is in a position to form an opinion that the target vehicle is exceeding the speed restriction for that road. Unless the device has an approved secondary check, the speed registered on the device only corroborates the operator's opinion.

The speed registered by mobile systems should be recorded at the time of the offence unless there is an approved data recording system attached to the speedmeter.

Fixed sites have either a wet-film record or a digital data storage system.

16 CAMERAS

16.1 Technology description

This section deals with evidence and records made from video or camera attachments approved as part of, or for optional use with, specified HOTA and ACPO approved devices.

The devices in these combinations of equipment may be used separately where approval for such separate use has been given.

The absence of a camera will in no way affect the Type Approval of the device should non-photographic operation be decided upon. Where a camera is attached to a HOTA device, the camera must have HOTA for use in conjunction with that particular device.

If a camera attachment is used for recording purposes in the attended mode, one photograph will suffice provided it incorporates all relevant data including the speed reading, as the device only corroborates the witness's opinion. However, where a device is used with a HOTA video recording device, the full record will be the moving image showing the targeting and measurement of the device.

If the device is Type Approved for unattended automatic use, any camera will form part of the HOTA device and will be used in conjunction with an approved second independent method of speed measurement. This secondary check is required in order to provide a further check on the accuracy of the device. No secondary check is required for red-light cameras since the two images required by Type Approval provide sufficient check on the movement of an offender's vehicle.

16.2 Confidence checks

16.2.1 Site alignment

Roadside furniture and equipment must be installed in accordance with manufacturers' instructions and relevant highway safety legislation.

Care should be taken to ensure that the presence of the equipment does not create a road safety problem and that road signs and the like are not obscured, or their effectiveness diminished by the equipment.

Care should be taken to ensure the camera housing is not obscured by signs or foliage to prevent the obscuration of evidence acquired by the system. Visibility of the camera housing will also have the benefit of deterring the use of excess speed by passing motorists.

The use of dummy flash units should receive favourable consideration, as experience has shown they have a deterrent effect and are an excellent accident prevention factor.

Experience has further shown that one camera circulating between up to a maximum of ten sites, and moved at regular intervals, will produce an effective casualty reduction result.

16.2.2 Distance and speed accuracy

HOTA unattended automatic devices will have a second independent method of checking the primary speed measurement. One such method offered by manufacturers is the taking of two photographs of the offending vehicle at a known time apart, which can be compared with the distance travelled within that time interval to arrive at the speed of the vehicle. Only approved methods of secondary checks should be utilised.

A survey of each site by the manufacturer or agent where an unattended automatic device is to be located must be carried out to ensure its suitability with regard to the manufacturers' instructions.

Before enforcement activity commences each installation will be the subject of a commissioning procedure at which the police should be present or the police should verify afterwards. The record of that commissioning will be retained for evidential purposes in case the integrity of the site is questioned.

Any alteration in the configuration of the site will require the site to be recalibrated. Great care should be taken to ensure secondary check marks are replaced accurately after resurfacing work.

16.2.3 Evidence

Evidence from HOTA speedmeters can be recorded by way of visual information recorded that shows the scene of the speeding offence, as well as having the imprint of the offence data upon the image.

Wet-film cameras are required to have an imprint of the offence data on the image.

Digital images are not required to have an imprint of the offence data on the image of the offence; the offence data being verified by the equipment at the time of the offence and in subsequent recording.

Images produced by automatic unattended devices may be used to verify the primary speed measurement by way of providing a secondary speed band that is at or within 10% of the primary speed measurement.

17 RED–LIGHT ENFORCEMENT CAMERAS

17.1 Technology description

Automatic camera systems have been developed that can detect when a vehicle has failed to comply with a traffic sign, particularly traffic signals or traffic lights and the relevant stop line.

Examples of such systems are junctions controlled by traffic lights and level crossings over railway lines controlled by flashing stop signals. The systems for junctions and level crossings are broadly known as red-light cameras.

The systems can be Home Office Type Approved to make evidence from them admissible by way of a certificate produced under Section 20 of the Road Traffic Offenders' Act 1988, containing or accompanying the record from the device.

The majority of approved systems detect the position of a vehicle with loops or piezoelectric strips buried beneath the surface of the road immediately before and immediately after the relevant stop-line. Vehicle presence detectors such as radar, laser or video camera systems using Automatic Number Plate Recognition (ANPR) can also be used to detect vehicle positions in relation to the stop line.

The camera systems are activated by detection of the status of the traffic signal. Violations are detected only after an interlock is completed from the detection of the red-light being illuminated in the relevant traffic signal head, to assure courts that the red-light was showing as the driver approached the traffic signal.

After a pre-determined delay time between the amber and red signal lamps becoming illuminated, vehicles passing the detectors will have one image taken as they pass over the stop line and a second after they have continued past the position shown in the first image.

The images from automatic red-light cameras have within the first overview image the relevant traffic signal head so the illumination status of the green, amber and red lamps at the time of the images and the vehicle passing over the stop line can be evidenced. There is also a specific time for which the amber must be illuminated before changing to red. This is three seconds, plus or minus a quarter of a second, and the actual illumination time of the amber will be contained within the data block to confirm compliance with this requirement.

Red-light camera equipment may, in addition to the position of the vehicle, show an indication of the minimum speed of a vehicle as it has crossed the stop line and the time since the red-light has become illuminated. Red-light cameras which display a speed are tested during Type Approval for accuracy of that speed reading to the same tolerance as a speed camera, but are permitted to display a speed reading "in excess of" a certain figure if they cannot be accurate to the required tolerance above that figure.

The speed can properly be taken into account when setting conditional offer and prosecution thresholds, but currently when operating in red-light mode, the device is not simultaneously operating as a speed camera. Therefore, a prosecution for speeding cannot be based solely on this measurement.

The requirement that interlocks are satisfied, the offending vehicle is shown in images before and after the stop line is crossed and the requirement to show the status of the red lamp in the images, creates a certainty the vehicle identified in the violation record has committed the breach of the stop line.

It is not necessary to make regular checks of the degree of accuracy of the red-light camera beyond the recommended certification period stated by the device manufacturer or agent.

Stop line detection systems can be used or combined with speed detection systems, with functions switched between stop line detection and speed detection being changed by the status of the traffic signals.

'Speed-on-green' camera systems are a typical example of a combined device.

17.2 Confidence checks

17.2.1 Red-light in offence image

There is no requirement for commission checks beyond what the manufacturer carries out in the annual checks and calibration of the device.

It is recommended that the evidence in each offence detected is examined to check the red-light is illuminated and in view when the stop line was crossed, and that no other light is illuminated with the red. If the stop line is obscured (e.g. by snow) then the default position is that the vehicle must not pass the post on which the red-light is mounted. This should also be visible in the photograph.

17.3 Typical use

These systems are used at traffic light junctions and railway crossings with one or more lanes of traffic. Cameras are arranged so the stop line and the traffic signal head and the vehicles travelling past the stop line are visible in the record.

17.4 Precautions

17.4.1 General

Loops and piezo-electric detectors at traffic light junctions are susceptible to wear of the surface of the road. Any wear detected that results in the detectors becoming exposed should be reported to the device supplier and the use of the device suspended until repairs are completed.

17.4.2 Health and safety

When installing portable cameras care should be taken to ensure approaching traffic is able to see operators servicing the camera systems so collisions are avoided.

Installation of fixed equipment at or near railway crossings should be done in a way that prevents the need for access to the railway to install and remove portable equipment.

17.4.3 Evidence

The images from the device will show the position of the vehicle as it crossed the stop line and after the line has been crossed; in cases that are to be heard in court both images should be served in the record from the device. The images forming the record from a Home Office Type Approved device will be admissible when covered or contained within a Road Traffic Offenders' Act 1998 Section 20 certificate.