



Home Office

The prohibited lane enforcement camera handbook (first edition)

A guide to type-approval procedures for prohibited lane enforcement cameras used for road traffic law enforcement in Great Britain

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Executive summary

This handbook describes the technical requirements for Home Office type approval of certain types of prohibited lane enforcement cameras which are prescribed devices for the purposes of road traffic legislation. It has been written specifically to deal with red X signs, which indicate that passage through the lane is prohibited for all except emergency vehicles.

The handbook is intended to be a reference for manufacturers wishing to develop or sell existing products for use in the enforcement of prohibited lanes in Great Britain. The handbook contains not only a list of technical requirements but also guidance on methods of measurement. The process of type approval shall be managed through the Home Office Centre for Applied Science and Technology (CAST). The final type approval will be given by or on behalf of the Home Secretary.

Some standards, in particular those relating to electromagnetic immunity, are updated.

Terminology and abbreviations

Term	Meaning
ACPO	Association of Chief Police Officers, replaced in 2015 by the National Police Chiefs' Council.
Automatic camera	A prohibited lane enforcement camera which once set up, works by itself without direct and continuing human intervention.
Back-office facility	The facility of the enforcing authority where information from the roadside detector is received, decrypted and processed.
Camera	A digital still image or video camera.
CAST	Home Office Centre for Applied Science and Technology
Continuity image	An image showing the vehicle at a point after the initial detection image , and demonstrating that the vehicle has proceeded in the prohibited lane.
Datum point	A fixed point that the location and orientation of all system components are defined with respect to.
Detection image	An image showing the vehicle in the forbidden lane.
Detection zone	The section of a prohibited lane where the detection system is capable of detecting the presence of a vehicle.
External aspect verification (EAV)	Verification of the aspects displayed on variable message signs on a gantry or roadside pole operating with an enforcement device by automatic recognition of the displayed aspect from an external aspect verification image .
External aspect verification image	A digital image showing all variable message signs on a gantry or roadside pole operating with an enforcement device used for EAV and recorded with the evidence of a lane infringement offence.
Failure	A prohibited lane camera may, at the discretion of the Home Office, be considered to fail if it does not meet all of the relevant requirements described in this guidance.
HE	Highways England; works with the Department for Transport to operate, maintain and improve England's motorways and major A roads.

Term	Meaning
HOSDB	Home Office Scientific Development Branch, formerly known as the PSDB , and renamed in 2011 to CAST .
Matrix sign image	A still image, taken from a still or a single frame from a video camera, which shows a vehicle in advance of the red X sign and establishes that the offending driver could have seen the red X display.
Offence video recording	A video recording showing the offending vehicle approaching the forbidden lane display and passing through the detection zone . This may be used to identify extenuating circumstances and establish that the offending driver could have seen the red X display.
Offence viewing and decision system (OVDS)	Defined in other Home Office guidance, this is a computer in the back-office facility that is isolated from public networks and is used to decrypt, view and make enforcement decisions about evidence gathered from remote enforcement devices. It is the OVDS that is used to verify and export the record from the type-approved device.
PSDB	Police Scientific Development Branch, renamed to HOSDB .
Red X	Signage displayed above or at the roadside near to a prohibited lane as defined in item 33 in schedule 14 part 2, and items 14 and 15 in schedule 15 part 2 of the Traffic Signs Regulations and General Directions 2016 legislation.
Unattended operation	Equipment mounted in an appropriate housing and designed to operate automatically.
Vehicle detector	A system capable of identifying a vehicle within the prohibited lane.
Violation record	The official Road Traffic Offenders Act 1988 section 20 record containing the evidence of an offence produced by a prohibited lane enforcement camera.

1. Introduction

- 1.1 Managed motorway systems, as operated by Highways England (HE), use electronic signage to indicate to oncoming drivers which lanes of a multi-lane road may or may not be used. This signage may display a red X to indicate when a specific lane may not be used by non-emergency vehicles. The Traffic Signs Regulations and General Directions (2016) legislation stipulates that when a red X visibly applies to a certain lane, no vehicle may enter or proceed within that lane between the red X sign and a sign that shows the red X in that lane no longer applies. The sign requirements are given in item 33 in schedule 14 part 2 and items 14 and 15 in schedule 15 part 2. With reference to the control of moving traffic in a red X lane, the legislation states:

SCHEDULE 15 Matrix signs and light signals for the control of moving traffic on motorways and dual carriageway roads

PART 1

3.—(1) The significance of a light signal provided for at item 14 or 15 is that it conveys to vehicular traffic that such traffic—

(a) must not proceed in the lane or actively managed hard shoulder to which the sign relates; and

(b) must not enter that lane or hard shoulder until one of the signs mentioned at sub-paragraph (2), or the legend “END”, is displayed on a matrix sign in relation to that lane or hard shoulder.

- 1.2 Technological systems may be used to detect vehicles which contravene this legislation. This handbook has been written to provide guidance to help manufacturers develop systems which provide reliable and robust evidence to prosecute infringements of the legislation.
- 1.3 Adherence to these guidelines will allow the systems to be type approved by the Secretary of State and therefore provide evidence which may be presented to court under Section 20 of the Road Traffic Offenders Act 1988. Under this act, Home Office type-approved automatic systems may be used without the need for corroborating evidence. Further history of this type approval mechanism may be found in The Speedometer Handbook (Fourth Edition) 2005 (Home Office Publication 15/05).
- 1.4 The tests will be completed on one or more units of a single variant of the device that is offered for approval by the manufacturer or appointed agent. The actual testing is carried out by an independent testing laboratory, and is paid for by the manufacturer or their agent. The formal steps necessary to seek approval are described in other guidance.
- 1.5 The technical procedures described in this document are intended as a guide to manufacturers and their agents. The procedures may be updated periodically and amended versions of this guide will be issued.

2. Scope

- 2.1 The test procedures described here are applicable to prohibited lane cameras to be used for law enforcement. Prohibited lanes are indicated by the presence of a red X on a sign at the beginning of the prohibited section. The sign may be placed either directly above the affected lane or on a sign that is adjacent to the carriageway that uses one sign to show requirements for all lanes. The scope of the procedures covers cameras mounted in fixed site installations. Fixed site equipment should detect offences only when the prohibited lane is so indicated and vehicles are detected in the prohibited section of the lane. Equipment shall be designed for automatic unattended use, and used with cameras to record an offending vehicle in the prohibited section of the lane. The system will then produce a Road Traffic Act 1988 section 20 compliant record.
- 2.2 If the device also provides evidence of other types of offences, such as speed, then the device will need to satisfy additional requirements from the relevant handbook.
- 2.3 The device may simultaneously provide evidence of another offence in addition to the red X infringement. Any additional offence detection should comply with the relevant Home Office guidance.
- 2.4 Home Office authorisation will be required to use the device for any purpose other than the declared offences defined in section 20(2) of the Road Traffic Offenders Act 1988. The operator must additionally comply with other relevant legislation such as the Protection of Freedoms Act 2012.
- 2.5 This handbook presumes that the legal requirement is to demonstrate both presence of a vehicle and procession within the prohibited lane. At least three images must be provided showing the presence of the vehicle in at least three consecutive locations.
- 2.6 This handbook should be read alongside other relevant guidance issued by the Home Office, currently including but not limited to:
 - The Speedmeter Handbook (Fourth Edition) (HOSDB Publication 15/05) by Dr S.R. Lewis
 - Home Office and ACPO Traffic: Outline Requirements and Specification for Automated Traffic Enforcement Systems (PSDB Publication 3/96) by Dr S.R. Lewis
 - Requirements for the Remote Recording from and Control of Unattended Home Office Type Approved Traffic Enforcement Devices (25th July 2002) by Dr S.R. Lewis
 - Home Office requirements for the protection of digital evidence from type approved automatic unattended traffic enforcement devices (12th October 2005) by Dr S.R. Lewis
 - HO Type Approval Process v1.0 (pending)
 - EMC test requirements: The Speedmeter Handbook (Fourth Edition) sections 7.4 and 8.6¹

¹ This version is under revision and updated requirements will be issued in due course.

3. General requirements for eligibility for type approval

- 3.1 The supplier shall provide free of charge a written technical description of the prohibited lane enforcement camera, its operation and intended use, and full circuit diagrams to CAST when the device is accepted for the practical assessment. They shall also provide free of charge a copy of this information together with a prohibited lane enforcement camera of the type intended for sale to the testing laboratory carrying out the type approval.
- 3.2 No liability for breakage or damage will be accepted by the Home Office or its agents.
- 3.3 The model type shall be indelibly marked on the outside of the device, together with a serial number which shall be unique to that instrument.
- 3.4 All production models, if approved, shall be numbered consecutively.
- 3.5 Any system software or firmware shall be labelled with a version number, and a complete copy of the program shall be left with CAST.
- 3.6 Once type approval has been granted, the manufacturer or their agent shall not change any hardware or software part of the type-approved system without prior permission of the Home Office, obtained through CAST. This shall include, but is not limited to, electronic components, communication mechanisms, hardware enclosures, pre-programmed software and the contents of the violation record.
- 3.7 The prohibited lane enforcement camera shall be calibrated annually, and a certificate should be issued to this effect and held by the police or the enforcement authority. The certificate should contain assurance that the system continues to conform to type-approval conditions. A visible sticker showing the date of testing should be fixed to the meter. This sticker must be sufficiently robust to prevent it from becoming unreadable due to time and environmental conditions while it is in force.
- 3.8 Any repair or calibration shall be carried out by the manufacturer, their appointed agent, or a suitably qualified technician offering appropriate evidence of technical and professional competence, and explicitly authorised by the manufacturer or agent to conduct repair or calibration. Such persons shall keep accurate records which shall be open to inspection by CAST.
- 3.9 All equipment used for calibration (but not repair) shall be certificated annually by a competent body with equipment traceable to national standards
- 3.10 A handbook or a set of written instructions for the use of the test house operator shall be provided with the instrument when it is accepted for the practical assessment. A copy will also be provided to CAST. The instructions shall be dated and any

subsequent changes agreed with CAST, and sent to all users, including the Home Office.

- 3.11 To be acceptable for use in a type-approved device, goods or materials used in its construction shall comply with one of the following:
- i) A relevant standard or code of practice of a national standards body or equivalent body of any member state of the European Community.
 - ii) Any relevant international standard recognised for use in any member state in the European Community.
 - iii) A relevant technical specification acknowledged for use as a standard by a public authority or any member state of the European Community.
 - iv) Traditional procedures of manufacture of a member state of the European Community where these are the subject of a written technical description sufficiently detailed to permit assessment of the goods or materials for the use specified.
 - v) A specification sufficiently detailed to permit assessment for goods or materials of an innovative nature (or subject to an innovative process of manufacture such that they cannot comply with a recognised standard or specification) and which fulfil the purpose provided by the specified standard, provided that the proposed standard, code of practice, technical specification or procedure of manufacture provides in use equivalent levels of safety, suitability and fitness for purpose.

4. Operational requirements

4.1 General

- 4.1.1 All vehicle detection cameras shall have an angle of view sufficient to ensure that the offending vehicle can be clearly identified in relation to the enforced area. It shall also show a field of view that provides sufficient information so the circumstances of the incident can be assessed by a verifier who views the record in the offence viewing and decision system (OVDS).
- 4.1.2 Every image of the offence shall be inextricably linked with the following information:
- The date in day, month and year.
 - The time in hours, minutes and seconds, including an indication of the local time zone (GMT or BST).
 - Clear identification of the enforced lane.
 - A code representing the location.
 - A number indicating the position of the image in the sequence of images comprising the evidence.
- 4.1.3 Each image of the offence shall also show the recognised enforcement configuration and the time the red X recognised as having changed in hours, minutes and seconds.
- 4.1.4 The data shall be recorded with the image or images at the time of the offence as part of the same violation record. Only complete offence records shall be displayed or output.
- 4.1.5 Each violation record shall show:
- the detection image where the vehicle is clearly identified within the prohibited area;
 - the continuity image where the vehicle is clearly identified as having proceeded in the prohibited area;
 - one matrix sign image where the vehicle is clearly identified approaching the red X display and at a distance and angle where it was possible for the driver to have seen the lane prohibition – this may be obtained from a still image camera or a single frame from a video; a physical or electronic marker shall help establish the position of the vehicle with respect to the red X display.
- 4.1.6 The violation record must be sent to the back-office facility, adhering to the requirements given in the Requirements for the Remote Recording from and Control of Unattended Home Office Type Approved Traffic Enforcement Devices (Lewis, 2002). The record must be verified by an operator of the OVDS before it is allowed to be exported from the OVDS.

- 4.1.7 If a video recording of the offence is obtained it shall be sent to the back-office facility with the violation record.
- 4.1.8 The video recording is subject to the same data security requirements as the rest of the evidence.

- A video recording must be included in the violation record.
- The video must show the offending vehicle approaching the red X display and passing through the detection zone, and it must show the vehicle and the illuminated red X display at a point where the driver could have seen the red X display.
- The time between video frames shall not exceed 100 milliseconds (ms).
- The OVDS software cannot allow the operator to continue processing the offence without indicating that he or she has watched the video.

- 4.1.9 Violation records must be numbered sequentially so that missing records can be easily identified.

4.2 Test signal

- 4.2.1 The instrument shall be provided with an in-built test to simulate the recording of an offence. The test shall be capable of checking the function and accuracy of all circuits using simulated inputs. The test may operate automatically when the equipment is switched on, but it shall also be available for manual operation. When the test signal operates, the recorded images shall clearly show that a test signal has been generated.

4.3 Offence data storage

- 4.3.1 The data to be used as evidence of an offence shall be recorded on a removable digital storage medium which provides a physical record of the data and, once written, cannot be amended. The media may have new data appended to it until full but, once written, no data can be changed or removed.
- 4.3.2 Any image compression shall be single frame dependent and acceptable to the Home Office.
- 4.3.3 All digital data shall be stored in violation records with security codes generated using Home Office published standards for data protection. The required data protection shall be applied immediately after capture within the tamper-resistant cabinet. There shall be no external means of accessing the data without the protection being applied. The data shall be written to write-once media either at the roadside or after transmission to the back-office facility, adhering to the requirements given in the Requirements for the Remote Recording from and Control of Unattended Home Office Type Approved Traffic Enforcement Devices (Lewis, 2002).

4.4 Multiple detection point cameras

- 4.4.1 Multiple cameras must be synchronised to within 10 ms.

- 4.4.2 On power up the device shall not commence enforcement until this synchronisation has been established. Enforcement shall stop whenever synchronisation is not maintained or is not confirmed.
- 4.4.3 Where the vehicle is identified automatically, reduced images from all cameras shall also be shown in the violation record. These shall show the registration plate and surrounding vehicle area used in any automatic identification of the offending vehicle. It shall also display the precise system time they were captured in hours, minutes, seconds and milliseconds. All of the data shall be recorded with the violation record at the time of detection.

4.5 Variable message signs

- 4.5.1 The device will enforce only when:
- the variable message sign satisfies The Traffic Signs Regulations and General Directions 2016 (TSRGD) Schedule 15 part 4 paragraph 6 – in particular the lanterns must be flashing at a rate within the prescribed limits;
 - the new enforcement configuration has been displayed for one minute or longer (this delay shall be variable to at least five minutes).
- 4.5.2 Whenever a change in the display indicates a change in the enforcement configuration, a single photograph shall be taken which will show the date in day, month and year and the time in hours, minutes and seconds when the display changed, and the new enforcement configuration. Where there is external aspect verification (EAV), this photo should show the display.
- 4.5.3 To ensure that no vehicles are prosecuted after the extinguishment of the red X display and before recognition of the change by EAV, there shall be a retrospective purging of all violations up to a time determined by the manufacturers to exceed any possible latency in aspect recognition. This time must not be less than 15 seconds and shall be variable up to one minute.

5. Constructional requirements

5.1 Components

- 5.1.1 The prohibited lane enforcement camera shall be constructed of good quality components which shall be clearly marked with their type number, or value either in writing or by a recognised code. Any sensor cables shall also be marked with an identifying mark.

5.2 Power supply

- 5.2.1 Any part intended to connect to the mains supply shall conform to electrical safety regulations currently in force.

5.3 Mains operation

- 5.3.1 This section shall apply only to devices intended to operate from the public mains supply and does not relate to safety legislation which is covered by the provisions of directive 73/23/EEC (Electrical Safety). No inaccurate information shall appear on the recording when the following disturbances are applied:
- a) Variation of power supply voltage from -15% to +20% of nominal value.
 - b) Variation of power supply frequency from -2% to +2% of the nominal value.
 - c) Power supply interruptions to any level down to and including:
 - i. zero voltage for 10 ms or less;
 - ii. 50% of nominal voltage for 20 ms or less;
 - iii. 80% of nominal voltage for 50 ms or less.
 - d) Repetitive electrical fast transients to test level 3 of EN 61000-4-4: 2012.

6. Performance requirements

6.1 Storage

- 6.1.1 The prohibited lane enforcement camera shall, when out of service, be capable of storage in adverse conditions. Further details of this requirement are given below.
- 6.1.2 The device under test shall be held for at least three hours at -25°C and then $+70^{\circ}\text{C}$, with low humidity. The units shall then be allowed to return to room temperature and tested to ensure correct operation.

6.2 Working temperature range

- 6.2.1 The equipment shall function within specification over a temperature range of at least -10°C to $+50^{\circ}\text{C}$, with 80% humidity above 20°C . The temperature shall be varied in 5°C steps, and the equipment left for 30 minutes or longer to obtain thermal equilibrium; the equipment shall function correctly at each temperature step.
- 6.2.2 The equipment shall have some form of sensor to prevent the equipment operating beyond the working temperature range.

6.3 Robustness

- 6.3.1 Equipment shall be so constructed as to be fit for its purpose and in particular, shall be tamper resistant. Opening the enclosure while the equipment is on shall immediately generate a tamper alarm. The equipment shall only be able to operate with the door open if a valid key or code is inserted into the equipment. As stated in the data security requirements, the detection of any unauthorised access shall cause all security keys to be securely deleted.
- 6.3.2 All parts of the equipment which may be exposed to the weather shall comply with the requirement of BS EN 60529 (1992), classification IP 55 for water ingress and dust protection.

6.4 Electromagnetic immunity

- 6.4.1 The equipment shall be capable of operating without indicating any incorrect information in the presence of interference as specified by current Home Office guidance.

6.5 Electrostatic discharge

- 6.5.1 The enforcement device shall be tested in accordance with EN 61000-4-2: 2009. At least ten single discharges shall be applied to the exposed surface of each separate part of the device which is being submitted for type approval.
- 6.5.2 For permanent installations, tests may be performed in the final installed position.

6.5.3 A maximum test voltage of 4 kV shall be employed i.e. at level 2.

6.6 Measuring accuracy

6.6.1 Time

6.6.1.1 Any clock used to record the time of an offence shall be accurate to within one minute over a period of at least seven days at any temperature within the specified range.

6.6.2 Red X lantern flash rate

6.6.2.1 The red X device shall not enforce when the flash rate of the lanterns on the red X display is outside the limits set in the Traffic Signs Regulations and General Directions 2016 (TSRGD).

6.7 Location criteria for image detectors

6.7.1 The manufacturer or agent shall specify the exact position and orientation that may be used for image detection cameras and sensors with respect to their measurement datum point and the position of the enforced signs.

6.8 External aspect verification

6.8.1 Where visibility of the signs is greater than 300 m, the EAV unit shall always correctly recognise the number of variable message signs within the external verification image. For every sign, the EAV shall correctly recognise the aspect displayed, including when a blank aspect is displayed, or recognise when it is unable to make a valid recognition.

6.8.2 The delay shall be measured between the illumination of a red X display on variable messaging signs and the recognition by the EAV of the new enforcement displayed. This delay shall be equal to or less than the delay quoted in the manufacturer's documentation.

6.9 Eye safety

6.9.1 Any use of electromagnetic radiation must satisfy all relevant safety standards. In particular, light sources must satisfy the requirements for laser sources (BS EN 60825-1:2007) or lamp sources (BS EN 62471:2008). Laser output must not exceed class 1 of BS EN 60825-1:2007. Lamp sources must not exceed the exempt emission levels defined in BS EN 62471:2008.

6.10 Visible flash

6.10.1 When the dark-adapted eye is exposed to intense light from a front-facing flash, visual acuity may be affected and driving performance and hazard-perception impaired. The flash must use a red or far-red filter, preferably an RG665 long-pass filter. The effective intensity, I_{eff} , of the front-facing flash must be measured and must be less

than 700 cd. The effective intensity may be calculated using the Schmidt-Clausen form factor method:²

$$I_{eff} = \frac{I_{max}}{1 + \frac{a}{F * T}}$$

Where F is the form factor given by:

$$F = \frac{1}{T * I_{max}} \int_0^T I(t) dt$$

and I_{max} is the maximum instantaneous intensity $I(t)$

and $a = 0.2$ seconds is the Blondel-Rey constant

² Ohno, Y., Couzin, D., (2002) 'Modified Allard Method for Effective Intensity of Flashing Lights', Proceedings of the CIE Symposium '02 on *Temporal and Spatial Aspects of Light and Colour Perception and Measurements*, 22-23 August, 2002, Veszprém (Hungary)

7. Measuring methods

7.1 General

- 7.1.1 This section describes suitable methods of measurement for carrying out the tests described in previous sections. It is recommended that the methods are followed to ensure uniformity and repeatability of testing. All measuring procedures shall be recorded in the test report.

7.2 Offence simulation

- 7.2.1 The purpose of an offence simulation is to check that the equipment will operate correctly and that the accuracy of the recorded information is maintained under each test condition. During tests, location information should be generated from an appropriate simulator and the camera record an image of a Rugby clock receiver.. For equipment controlled by vehicle detectors, except for electromagnetic compatibility tests, appropriate simulators for the vehicle detectors may be used to trigger a simulated offence recording.

Both an offence started and stopped by a vehicle detection and an offence started by a vehicle detection and stopped after a fixed time duration shall be simulated..

7.3 Vehicle detection

- 7.3.1 For equipment automatically controlled by vehicle detectors, the information content of the resultant images shall be investigated by simulating at least five offences. This shall also show the quality of the resultant images.

7.4 Environmental tests

- 7.4.1 At each temperature step in the working temperature range, the equipment shall be checked by performing an internal test check and recording a simulated offence.
- 7.4.2 Care shall be taken to ensure that any fans, thermostats, or other electronic control devices associated with the environmental chamber, do not cause spurious readings during the testing cycle.

7.5 Electromagnetic immunity

- 7.5.1 Guidance is provided separately. Normal and full operation of the device shall be simulated as closely as possible during the tests.

7.6 Variable message signs

7.6.1 When using a sign with in-built aspect verification or a simulator of the sign connected to the detection device, the following fault conditions shall be simulated while a red X is simulated:

- a) failure of any light source used to illuminate any individual pixel of the red X aspect;
- b) power up of any individual pixel that should not be illuminated.

No enforcement shall occur while these fault conditions are simulated.

7.6.2 When using a variable message sign connected to the device and EAV, the following fault condition shall be simulated while a red X is simulated:

- a) failure of a pattern of bulbs outside the limits set by HE (templates of unacceptable displays may be provided by HE for this purpose).

No enforcement shall occur while this fault condition is simulated.

7.7 Functional tests

7.7.1 Functional tests shall be undertaken for each location and orientation specified (or at the extremes of any continuous ranges) and for extreme positions of target vehicles. If both monitoring directions are to be used, then all tests shall be repeated for each direction. The components of the device shall be installed according to the manufacturer's standard installation instructions.

7.7.2 The red X device shall be assessed by the passage of a minimum of 500 vehicles through a lane with and without a red X indication.

7.7.3 Two hundred and fifty or more passages must be undertaken while a red X is displayed, and 250 or more passages must be undertaken while the red X is not displayed.

7.7.4 Each of 50 passages must take place within 60 seconds of the red X being illuminated.

7.7.5 Each of 50 passages must take place within 15 seconds of the red X being extinguished.

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