



Centre for Connected
& Autonomous Vehicles

Code of Practice: Automated vehicle trialling



February 2019

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Department for Transport
Great Minster House
33 Horseferry Road
London SW1P 4DR
Telephone 0300 330 3000
Website www.gov.uk/dft
General enquiries: <https://forms.dft.gov.uk>



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1. Introduction

- 1.1 The UK Government recognises and welcomes the growing appetite to test and trial automated vehicle technologies and services in the UK. New technologies will have a major impact on traditional mobility business models, and the changing landscape of the passenger and freight services markets. The Government believes that automated road vehicle technologies and services have the potential to offer benefits of increased safety and accessibility to the travelling public and create new opportunities for UK industry. Therefore, the Government wishes to support and facilitate the safe development and introduction of these technologies to the UK's roads.
- 1.2 Trialling any level of automated vehicle technology is possible on any UK road if carried out in line with UK law. Trialling organisations do not need to obtain permits or pay surety bonds when conducting trials in the UK. As part of complying with the law, they will need to ensure that they have:
 - A driver or operator, in or out of the vehicle, who is ready, able, and willing to resume control of the vehicle;
 - A roadworthy vehicle; and
 - Appropriate insurance in place.
- 1.3 The Code also notes that those planning tests should speak with the road and enforcement authorities, develop engagement plans, and have data recorders fitted.
- 1.4 The Government acknowledges the desire to conduct advanced trials on public roads. Such trials may not readily fit within current UK legislation, so the Department for Transport's motoring agencies will introduce and operate a process to support those looking to safely conduct advanced trials. This process will be available to support industry when they are ready to do such trials. Those planning to conduct advanced trials should contact the Centre for Connected and Autonomous Vehicles in advance (see Annex A for contact details).
- 1.5 **Failure to follow the Code may be relevant to liability in any legal proceedings. Similarly, compliance with the expectations set by the Code does not guarantee immunity from liability in such circumstances.**

Purpose of the Code

- 1.6 This Code is primarily intended to be used by organisations or individuals planning to trial or pilot automated vehicle technologies and services.
- 1.7 This Code aims to:
 - Support and promote the safe trialling and use of automated vehicle technologies and services on public roads or in other public places in the UK and build public confidence in automated vehicle technologies and services;

- Support cooperation between trialling organisations and those responsible for the management of traffic, infrastructure, law enforcement, and other areas to support maximum road safety; and
 - Encourage sharing of information to help uphold and develop the highest standards of safety in the UK and internationally.
- 1.8 Information in this Code might also be useful for local authorities, highways authorities, emergency services, licensing authorities and others that are looking for guidance on how to engage with trialling organisations.
- 1.9 This Code seeks to facilitate trialling a wide range of road vehicles, from new types of road vehicles such as smaller automated pods and shuttles, through to more conventional vehicle types such as passenger, goods, and public service vehicles.
- 1.10 This Code has not been developed with a view to the testing and development of driver assistance systems (such as adaptive cruise control) or to trials and pilots carried out on private test tracks or other areas not accessible by the public. Those undertaking such trials are nonetheless encouraged to consider whether the guidelines may be relevant.

Approach

- 1.11 The guidance in this document does not seek to prejudge routes to market, or commercial and operating models for automated vehicle technologies and services. The aim is to support flexibility and innovation while providing greater clarity to trialling organisations.
- 1.12 **During trials, it is a legal requirement that there is a safety driver or safety operator ready and able to override the vehicle, though not necessarily within the vehicle.** Trialling organisations can test any level of technology, with the proviso that the safety driver should be monitoring both the road traffic environment, and vehicles systems so that they may resume proper control if necessary, even if the system does not issue a takeover demand.
- 1.13 This Code should be used by trialling organisations in conjunction with detailed knowledge of the legal, regulatory and technological landscape, ensuring they are compliant with all relevant UK law.
- 1.14 Responsibility for ensuring that trials of these technologies and services on public roads or in other public places is conducted safely always rests with those organising the trial. Compliance with the Code is one of many possible steps that trialling organisations should take to minimise risk.

Updates to the Code

- 1.15 This Code of Practice is an update to an earlier document, *The Pathway to Driverless Cars: A Code of Practice for Testing*¹, published by the Department for Transport in July 2015. This established the UK as a global leader for trialling automated vehicle technologies and services on public roads. Based on lessons learnt from real world trials in the UK, updates to the 2015 Code of Practice are now necessary to provide

¹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/446316/pathway-driverless-cars.pdf

further guidance to support organisations to conduct safe and responsible trials in the UK, as well as to maintain the UK position as a world leader in this industry.

1.16 Updates include:

- Detail on engagement strategies, including safety cases, and ways of working with relevant bodies and the public;
- Improved understanding of technical developments, such as the need to access vehicle data; and
- Development of a process to support advanced trials on public roads.

1.17 While this version updates and replaces the Code of Practice published in 2015, **it does not introduce any new legal requirements or barriers**. This update provides greater clarity on the Government's expectations for responsible trials of automated vehicle trials and services.

1.18 The updates to this Code form part of a broader programme of activities designed to support the future development, sale and use of automated vehicle technologies and services in the UK. Alongside further updates to this Code, a three-year project has been set up with the Law Commission² to identify, consult upon and recommend longer term legal reform. This project will provide a modern regulatory framework to further support and ensure the safe deployment of all levels of automated vehicle technologies and services in the UK.

1.19 This Code will be subject to future updates, based on feedback from users and the public, and increased understanding of the technology. A timetable for the frequency or magnitude of future updates has not been set to retain maximum flexibility and respond appropriately to any feedback and/or technological development. This allows the Code to balance the need to keep up to speed with technological developments while providing continuity and certainty for those carrying out trials. We are seeking views on the content of the Code. Please refer to the invitation to comment document for further details on how to provide feedback.

² <https://www.lawcom.gov.uk/project/automated-vehicles/>

2. General Requirements

2.1 This chapter sets out the legal requirements for conducting public trials of automated vehicle technologies and service in the UK, as well as guidance and best practice for responsible trials of such technologies and services.

Legal requirements

2.2 As stated in the introduction to this Code, conducting public trials of automated vehicle technology is possible in the UK at any level, provided the following legal requirements are met:

- A driver is present, in or out of the vehicle, who is ready, able, and willing to resume control of the vehicle;
- The vehicle is roadworthy; and
- Appropriate insurance in place.

2.3 It is the responsibility of those carrying out trials to ensure that their trials comply with all relevant legal requirements. Deploying a service may require appropriate licensing.

Insurance

2.4 UK law requires the use of motor vehicles to be insured, and this statutory requirement still applies when trialling automated vehicles. Therefore, any trialling organisation conducting activities on public roads and / or other public places must make sure that they have appropriate insurance, or otherwise comply with the statutory requirements. See Section 143 RTA (*and for Northern Ireland, Part VIII, Article 90, Road Traffic (Northern Ireland) Order 1981*) users of motor vehicles to be insured or secured against third-party risks; failure to do so is an offence.

Advanced trials

2.5 It is already possible to conduct trials without a human safety driver or operator in the vehicle, however there must be a safety driver or operator who can use a remote-control function to be able to exercise proper control of the vehicles if necessary (see section 5.8-5.11 for more information on remote-control operation).

2.6 The Government is aware of the growing desire to conduct more advanced trials on public roads. Such trials may currently be outside of the law and may require support and facilitation from the Department for Transport to proceed. As a result, the Department's motoring agencies will develop and operate a process to support advanced trials on public roads. This process will be available for trialling organisations that are ready to conduct such trials. **Those planning such trials should contact CCAV as far in advance as possible.**

Safety cases

2.7 Trialling organisations are expected to develop a detailed safety case before conducting trials which demonstrates that the trial activity can be conducted safely (with safety defined as the absence of unreasonable risk). Those conducting trials are expected to develop a safety case which is proportionate to the trial activity, and representative of any associated risks. The list below outlines the issues that should be covered by a safety case. It is not exhaustive, and those carrying out trials should build on this basic foundation.

- Information on the specific trial activity, vehicles, and operational domain of the trial;
- Evidence that the trial activity can be performed safely, whether with a safety driver in the vehicle or with a remote safety operator;
- Safety driver or operator training;
- Processes for managing the trial activity, and organisational responsibilities for managing the trial;
- How the trial aligns with legislation and regulations;
- Evidence of engagement with relevant bodies, authorities, and other road users; and
- Updates on milestones and progress reports of specific trial activity.

2.8 Those carrying out trials are expected to develop and maintain a robust safety case and continue to assess the safety of any trial activity. Such safety cases are recommended to be made available to the public (see section 3.10).

2.9 Trialling organisations should consider safety standards and principles when developing a safety case, such as BSi PAS 11281:2018 (Connected automotive ecosystems. Impact on security of safety – code of practice³).

Passenger and freight services

2.10 Developing a service for passengers or freight is possible, organisations seeking to trial the use of automated vehicle technologies for passenger or freight services must comply with the current regulatory regimes. Those looking to run such services are encouraged to engage with the Department and CCAV at the earliest opportunity. The Department can provide guidance and advice to help ensure that any pilots or trials are compatible with existing licensing and regulatory regimes, or to provide information on the relevant licensing body.

Data access

2.11 Trialling organisations are strongly recommended to develop plans for police investigators and relevant organisations to readily and immediately access data relating to an incident in a way that maintains the forensic integrity, security, and the preservation of the data. This may include agreement with emergency services prior

³ <https://shop.bsigroup.com/ProductDetail?pid=000000000030365540>

to trial activity, such as service level commitments for responding to incidents or requests for information.

2.12 Presentation of such data should be intelligible and not require complex analysis or interpretation techniques. Where data is not immediately intelligible, it is expected that trialling organisations will fully support investigators as part of any requests for access.

Software versions

2.13 Automated vehicle technologies and related systems rely on the operation and interaction of multiple computers and electronic control modules. It is important that:

- Software versions and revisions running on each vehicle to be trialled are clearly documented and recorded; and
- All software and revisions have been subjected to extensive and well documented testing. This should typically start with bench testing and simulation, before moving to trials on a closed test track or private road. Only then should trials or pilots be conducted on public roads or other public places.

Data protection

2.14 Trials are likely to involve the processing of personal data. For example, if data is collected that enables individuals to be personally identified, this will amount to the processing of personal data under the Data Protection Act 2018. Trialling organisations must ensure that they comply with data protection legislation, including the requirements that the personal data is used fairly and lawfully, kept securely and for no longer than necessary.

2.15 Guidance for organisations on complying with the data protection laws can be found on the Information Commissioner's Office's website at www.ico.org.uk⁴. Trialling organisations should consider whether to undertake a privacy impact assessment as described in the Information Commissioner's Office's Code of Practice⁵. Trialling organisations should be familiar with the principles, including principle 7: "the storage and transmission of data is secure and can be controlled."

2.16 While undertaking a privacy impact assessment is not a legal requirement, it is a useful tool to help a project comply with data protection laws. As recognised in the Information Commissioner's Office's Code of Practice, the privacy impact assessment can be developed flexibly and proportionately, depending on how complex or straightforward the privacy issues are for a particular trial or pilot.

Cyber security

2.17 Manufacturers providing vehicles, and other organisations supplying parts for trials will need to ensure that all vehicle systems have appropriate security measures to manage data security and the risk of unauthorised data access. Trialling organisations are recommended to follow the UK Government's *Key Principles of*

⁴ www.ico.org.uk

⁵ <https://ico.org.uk/for-organisations/guide-to-data-protection/data-sharing/>

*Cyber Security for Connected and Automated Vehicles*⁶ and should also consider adopting BSi PAS 1885 (The fundamental principles of automotive cyber security - specification⁷) in addition to the other relevant standards and guidance that are referenced in each of these documents. These consider the development and production of trial vehicles, in addition to organisational factors that would contribute to the overall security of the operation.

2.18 Trialling organisations should consider adopting the security principles set out in BS 10754-1:2018 (Information technology – Systems trustworthiness. Governance and management specification⁸).

Contingency planning

2.19 Trialling organisations should agree contingency measures with the appropriate authorities in the event of an unintended situation or incident. Agreements on the following are encouraged:

- Plans for public communications including agreed statements, releases, and any other publications where appropriate across relevant organisations during an investigation or incident response;
- Plans for scaling down, pausing, or terminating activities during investigations or following an incident;
- Identifying single points of contact in relevant organisations (such as those identified in section 3.2 below);
- Internal planning and rehearsal of contingency measures; and
- Service level agreements for facilitation of any investigatory efforts (such as access to vehicle data).

2.20 The availability of technical advice to the emergency services should be discussed and agreed in advance of the trial so that in the event of an incident those attending are aware of any unusual features of the vehicles under trial.

⁶ <https://www.gov.uk/government/publications/principles-of-cyber-security-for-connected-and-automated-vehicles/the-key-principles-of-vehicle-cyber-security-for-connected-and-automated-vehicles>

⁷ https://shop.bsigroup.com/ProductDetail/?pid=000000000030365446&_ga=2.267667464.704902458.1545217114-2008390051.1545217114

⁸ <https://shop.bsigroup.com/ProductDetail/?pid=000000000030351844>

3. Engagement

3.1 This chapter provides guidance on engaging with the relevant bodies and authorities, and the public. Engaging with the right people and organisations, consistently and openly, before and during public trial activity can have major benefits for organisations conducting trials.

Minimum engagement

3.2 **Trialling organisations should inform the Centre for Connected and Autonomous Vehicles before conducting any public trials. Contact details can be found in Annex A of this document.**

3.3 Those planning a trial should engage with all relevant organisations with responsibility for the trial area(s) at the earliest opportunity, including, where relevant, those listed below. The list is not intended to be exhaustive; trialling organisations will need to take full responsibility for understanding those that may be affected.

- Land owners;
- Members of the public;
- Highways authorities;
- Transport authorities and local authorities, including: county councils, district councils, unitary authorities, metropolitan districts;
- Traffic Commissioners for Great Britain;
- Police; and
- The Centre for Connected and Autonomous Vehicles.

3.4 The authorities listed above may be able to provide guidance and support including:

- Advice on proposed route(s) and impact / integration with the existing public transport network;
- Information about planned issues on the network such as roadworks or road closures;
- Advice about local policies that might apply, for example the existence of low emission zones;
- Advice on applying for operating licences if, for example, the trial includes piloting a public service or private hire vehicle;
- Guidance on what to do in the event of a reportable incident;
- Support with public communications and / or media coverage; and
- Feedback from the public.

3.5 Specific infrastructure requirements that are considered necessary to support a trial, for example traffic signing or parking adjustments, will need to be agreed with the

appropriate authorities responsible for the roads. Trialling organisations should engage with the relevant highways authorities before conducting any trials. Highways authorities have obligations to protect road users from any activity being planned on their network. Those planning trials should ensure that trials meet these requirements.

- 3.6 Any reportable incidents are expected to be communicated to the police. Depending on the specific incident, police and any other organisation relevant to an investigation may require access to relevant vehicle data. For guidance on data access, see section 2.10.
- 3.7 Trialling organisations should maintain engagement throughout the duration of trial activity and beyond where necessary. It is recommended that trialling organisations establish a single point of contact to facilitate this engagement, which is publicly and easily accessible for those looking to engage with those responsible for the trial.

Public communications

- 3.8 Trialling organisations should develop a public relations and communications strategy. This can have many benefits, such as mitigating risks and potential issues that may arise during public trials. Developing a public relations and communications strategy can help those conducting trials to:
 - Educate the public regarding the potential benefits of the trial and technology;
 - Explain the general nature of the trial to be undertaken;
 - Understand and explain the implications for other road users and develop appropriate mitigation measures;
 - Consider how to provide special consideration for more vulnerable road users including those with reduced mobility, those with visual or hearing impairments, pedestrians, cyclists, motorcyclists, children and horse riders; and
 - Respond proactively to any incidents which may occur during a trial.
- 3.9 To encourage greater cooperation with relevant bodies and the public, it is recommended that trialling organisations publish a public-facing version of their safety case (see section 2.7).

Publishing safety cases

- 3.10 **Trialling organisations should develop a detailed safety case before conducting trials, and make an abridged, public version freely available.** Research carried out by Transport Systems Catapult recommends that trialling organisations should publish an abridged, public, version of their safety case. Publishing a safety case for public consumption can help educate and inform other road users, as well as providing assurance on the safety of the trial. It can also provide those affected by the trial with useful information, contact points, and reassurance. Any published safety case should also be sent to CCAV. Safety cases should be regularly updated where possible.

Reporting

3.11 Trialling organisations should keep reports on the performance of the trial vehicle, such as through regular reporting on trial outcomes, which may also include any incidents or issues encountered during the trial. Providing reports of trial performance can help to inform and educate the public and is a useful communication tool to increase transparency and engagement. This may be satisfied through the publication of milestones and reports within a public safety case.

Local Authorities

3.12 To aid the Government's understanding and examination of potential future routes to market and the possibilities for long term legal reform, this Code hopes to contribute to, and support, a sustainable, responsible and communicative ecosystem of trialling and early stage piloting. This will only be possible with the cooperation of numerous public bodies. To support the industry's interaction with public authorities, local authorities are encouraged to adopt a principle of pragmatic, proportionate administration while prioritising the safety of passengers, other road users, and the wider public.

3.13 Should a local authority consider any proposed trial activities to be unsuitable, local authorities are encouraged to consider and propose possible alternatives. To facilitate engagement and collaboration, it is recommended that local authorities establish a single point of contact within their organisation, for the team or individual(s) who will have responsibility for automated vehicle policy, trials, and use.

Freedom of Information Act

3.14 Information held by public authorities, such as those listed in section 3.2, is subject to applications for disclosure under the Freedom of Information Act 2000 (FOIA)⁹. The presumption of the Act is in favour of disclosure, unless there is a good reason to withhold information.

3.15 To withhold information following a request being made, the information must fall under one of the exemptions listed under Part II of the FOIA. Most exemptions are subject to a public interest test. Some examples of exemptions for withholding information are where to release the information would prejudice the conduct of public affairs; or prejudice a person or companies' commercial interests; or inhibit full and frank advice and discussion between an organisation/interested party and government. Trialling organisations should consider such applications for disclosures when sharing information with public authorities.

⁹ <https://www.legislation.gov.uk/ukpga/2000/36/contents>

4. Safety Driver and Operator Requirements

- 4.1 This chapter provides guidance on the expected behaviour and competence of safety drivers and operators, as well as guidance on the legal requirements for those carrying out trials. Safety drivers and operators, at all levels of automated vehicle technologies, must be able to take control of the vehicle at all times and are required to have a full view of the road ahead. Trialling organisations should consider the use of more than one safety driver or operator ready and willing to take control of the vehicle to provide as a high a level of safety as possible.

Requirements to oversee trials

- 4.2 During automated vehicle trials on public roads or in other public places, **a suitably licensed and trained safety driver or safety operator should supervise the vehicle at all times, ensuring the vehicle is observing traffic laws, and should be ready and able to over-ride automated operation if necessary.** The safety driver or operator may be outside of the vehicle, as long as they have the necessary capability to be able to resume control of the vehicle.
- 4.3 For remote-controlled tests, safety drivers or safety operators should understand any risks associated with remote access. This includes handling any communication or control latency and mitigating and responding to any network problems.
- 4.4 The safety driver or safety operator is responsible for ensuring the safe operation of the vehicle at all times whether it is in a manual or automated driving mode. The safety driver or operator should be familiar with and understand the systems under trial, their capabilities and any limitations, and be able to anticipate the need to intervene and resume manual control if necessary.
- 4.5 The safety driver or safety operator should be authorised to perform this role by the organisation responsible for conducting the trial. Trialling organisations should have robust risk management process and training procedures in place and should ensure that safety drivers and operators hold the appropriate UK driving licence or recognised equivalent.
- 4.6 **Safety drivers and safety operators must still observe the road traffic laws that apply when vehicles are used in public places that are not public roads. This includes the traffic laws that protect the public from careless or dangerous driving and restrict where vehicles can be driven.**
- 4.7 In locations other than public roads, and where the vehicle's maximum speed is limited to a maximum of 15 mph, trials should be overseen by a safety driver or operator who can, as a minimum, apply an emergency stop control.

Licence requirements

- 4.8 **The safety driver or operator must hold the appropriate category of driving licence for the vehicle under trial if on a public road.** This is true even if the trial vehicle is operating entirely in an automated mode. It is strongly recommended that the licence holder also has several years' experience of driving the relevant category of vehicle.
- 4.9 In the case of a prototype vehicle which cannot easily be categorised, the nearest equivalent conventional category of licence is expected to be held.
- 4.10 The trialling organisation should not use safety drivers or operators whose driving history indicates that they may present a risk to public safety.
- 4.11 For trials not conducted on the public road, it is strongly recommended that the safety driver or safety operator still holds the appropriate category of licence for the vehicle, even though this is not a legal requirement.

Training

- 4.12 Safety drivers and safety operators supervising public road trials should understand the capabilities and potential limitations of the technologies under trial as completely as possible. They should be familiar with the characteristics of the vehicle, preferably through extensive experience of trials conducted on closed roads or test tracks.
- 4.13 Remote-controlled operation may have associated risks, such as latency and loss of contact with the vehicle. Safety drivers and safety operators should be trained to mitigate and safely respond to any connectivity or control issues.
- 4.14 The responsibility for ensuring safety drivers and safety operators have received the appropriate training and are competent lies with the trialling organisation. Trialling organisations are expected to develop robust procedures to ensure the competency of safety drivers and operators.
- 4.15 There is an expectation that trialling organisations ensure that safety drivers and safety operators undergo continuous development and training. Trialling organisations are recommended to consider how to appropriately measure safety driver/operator performance and availability.
- 4.16 Safety drivers and safety operators should be aware of the situations in which it may be necessary to intervene. Training should cover potentially hazardous situations that may be encountered and the appropriate action to take when resuming manual control of the vehicle.
- 4.17 Training in the process for transitioning between conventional manual control and an automated mode is particularly important. It is critical to safety that those conducting trials are fully aware of exactly how control is passed between the safety driver or safety operator and the vehicle.

Safety driver hours

- 4.18 Safety drivers and safety operators are required to remain alert and ready to intervene if necessary throughout the trial period. Trialling organisations should develop robust procedures to ensure that safety drivers and operators are sufficiently

alert to perform their role and do not suffer fatigue. This could include setting limits for the amount of time that safety drivers and operators perform such a role per day and the maximum duration of any one trial period. Those carrying out trials should consult UK rules for drivers' hours¹⁰.

Behaviour

- 4.19 Trialling organisations should have in place clear rules regarding safety driver and operator behaviour and ensure that these are known and understood. The rules should cover any restrictions on the use of alcohol and drugs, over and above existing legal restrictions. This will help prevent a safety driver or operator's judgement and ability to perform their role from being impaired.
- 4.20 Trialling organisations should consider having a back-up driver or operator, to provide greater assurance of safety to the trial, and to prevent exhaustion or fatigue of a single driver.
- 4.21 **All existing laws regarding driver behaviour must be complied with. For example, complying with speed limits, exchanging insurance details in the event of a collision, as well as the rule that prohibits a driver from viewing a display screen when driving (unless looking at information relevant to the journey, such as routing), continue to apply even if the vehicle is operating in an automated mode.**
- 4.22 Safety drivers and operators should be conscious of their appearance to other road users, for example continuing to maintain gaze directions appropriate for normal driving, to prevent any distraction to other drivers. This may be particularly noticeable and distracting where the vehicle is being remotely-controlled, and trialling organisations should consider the potential negative impact on other road users.

¹⁰ <https://www.gov.uk/drivers-hours>

5. Vehicle Requirements

- 5.1 This chapter provides guidance on the vehicles under trial, as well as the legal requirements for the operation of such vehicles in public roads and public places.

General vehicle requirements

- 5.2 Trialling organisations wishing to trial automated vehicle technologies on public roads (or other places which the public can access) must ensure that the trial vehicles can be used in a way that is compatible with all applicable law.
- 5.3 The vehicle must be roadworthy and must, if used on a public road, meet the relevant national in-service requirements as detailed in the Construction and Use Regulations. A trial vehicle which is over three years old (or four years old in Northern Ireland) must also have a valid MOT certificate. Trialling organisations risk civil and criminal prosecution if a vehicle is not deemed fit for trialling or for driving on public roads. If a vehicle cannot meet such requirements, trialling organisations should contact the Department for Transport for further guidance.
- 5.4 The vehicle, through its sensors or through control by the safety driver or safety operator, will need to appropriately respond to all types of road users and hazards which may typically be encountered during a trial, such as more vulnerable road users and following instructions from those authorised to direct traffic.

In-house trials, progression, and testbeds

- 5.5 While public trials are an important step in developing a fully functioning and safe automated driving system, it is only once sufficient virtual, private testing and prototyping has been conducted that a trialling organisation should move towards trials on public roads or other public places. Public trials should not be relied upon provide the full range of scenarios that an automated driving system will need to respond to safely. Trialling organisations will need to ensure that the vehicles have successfully completed appropriate in-house virtual trials and physical trials on closed roads or test tracks.
- 5.6 As part of their risk management procedures those conducting trials should determine when sufficient in-house trials have been conducted to have confidence that public road trials are possible without creating undue additional risk to road users. Trialling organisations should maintain an audit trail of such evidence and data.
- 5.7 Those looking to carry out public trials as part of a journey towards full deployment should consider the testbed facilities located around the UK. For more information on testbeds, please contact Meridian, who support the development of automated vehicle technology through projects and testbeds by facilitating partnerships across a wide range of sectors. Contact information can be found in Annex A.

Remote-controlled operation

- 5.8 Remote-controlled operation of a vehicle is possible if carried out in line with the legal requirements (see section 2.2) and the guidance set out in this Code. Those looking to undertake a remote-controlled trial of an automated vehicle on public roads or other public places (see section 4.6 for clarity on other public places) will need to assure themselves that the remote-control system is able to deliver the same level of safety as having a driver inside of the vehicle.
- 5.9 Such safety outcomes may be achieved through two-way, real-time communications links and full processes to deal with any failures. Those conducting remote-controlled trials are still required to have real-time supervision of the vehicle and its surroundings.
- 5.10 Remote-controlled trials should have appropriate redundancies in place to handle any failures or disengagements, including warning systems and the ability to allow the safety operator to take control of the vehicle at all times. A full risk assessment should be undertaken to determine whether remote control operation is appropriate.
- 5.11 Those conducting remote-controlled vehicle tests should mitigate and safely respond to risks associated with network access. Remote-controlled operation may fail if there is wider communication network failure, or if access to the communication network is throttled. Trialling organisations should have a full understanding of connectivity in chosen operational domains.

Data recording

- 5.12 Automated vehicles under trial or deployment should be fitted with a data recording device or series of devices capable of capturing data from sensors and control systems associated with the automated features of the vehicle, as well as other information concerning vehicle movement. This is a minimum expectation for trials on public roads to provide safety and assurance to other road users.
- 5.13 This data should, at a minimum, be able to determine who or what was controlling the vehicle. The data should be securely stored. In the event of an incident, such data should also be preserved in full. It is expected that responsible trialling organisations will cooperate fully with the relevant authorities by providing access to any relevant data.
- 5.14 Vehicle trials will typically generate a large amount of data. It is recommended that data recorders should record, at a minimum at 10Hz, the following information:
- Details of the automated system i.e. software version, hardware specifications;
 - Whether the vehicle is operating in manual or automated mode;
 - Longitudinal acceleration in the vehicle's direction of travel;
 - Lateral acceleration when the vehicle moves sideways;
 - Vertical acceleration when the vehicle mounts a kerb, central island, speed hump or other object which causes the vehicle to rise;
 - Vehicle speed;
 - Steering command and activation;

- Braking command and activation;
- Operation of the vehicle's lights and indicators;
- (If applicable) Operation of the vehicle's ignition;
- Geo-location;
- Connectivity, network access, and latency;
- Use of the vehicle's audible warning system (for example a horn);
- Sensor data concerning the presence of other road users or objects in the vehicle's vicinity;
- Remote commands which influence the vehicle's movement (if applicable); and
- Any intervention made by the safety driver or safety operator, including the time of such intervention.

5.15 Video and audio recording systems should be considered for trial vehicles. The video and audio recordings might include data of the vehicle's external and / or internal environment. However, this should not be considered as an alternative to the data recording requirements specified in section 5.14 and should be viewed as an additional means for recording trial and vehicle data.

5.16 In the event of an incident, an event data recorder should be able to capture a suggested minimum period of 30 seconds before the incident, and 15 seconds after. It is recommended that the minimum recording frequency is 50Hz in this scenario. It is for those carrying out trials to develop plans that are proportionate to the trial and vehicle under trial, as well as being sufficiently capable of capturing data for investigation purposes.

Transition between automated and manual (human-controlled) modes

5.17 An important issue for the safety of automated vehicle trials is the management of any transitions from manual control to automated mode and, in particular, from automated mode back to manual control.

5.18 The transition system should:

- Be easily and clearly understood by the safety driver or safety operator. Take-over demands should be audible, visible, and/or haptic as appropriate, and trialling organisations should consider the practicalities of how an alert might work;
- Ensure that the driver is given a clear indication of whether the vehicle is in manual or automated mode;
- Ensure that the driver is given sufficient notice to resume manual control when necessary. Those conducting trials should consider potential hazards, and the parameters of the trial area; and
- Allow the driver to quickly and easily retake control of the vehicle if necessary.

5.19 Ensuring that the transition periods between manual and automated mode reduce risk is an important part of the vehicle development process. This should be

developed and proven during private track testing prior to trials on public roads or other public places.

- 5.20 Trialling organisations should establish a process to monitor the situational awareness of any safety drivers or safety operators and to capture information regarding driver distraction and inattention. This is particularly important in the lead up to any transition, regardless of whether the transition is initiated by the vehicle or the safety driver or safety operator.
- 5.21 A process should also be in place to handle the absence of a response from a safety driver. If the vehicle initiates a demand to transition to manual control and the safety driver or operator does not respond, the vehicle should be capable of achieving, as far as is reasonably possible, a minimum risk condition. This minimum risk condition may vary depending on the operational domain, and could for example include slowing down, coming to a complete stop, or moving to a safe harbour.

Failure warning

- 5.22 In the event of a malfunction or failure of the technology under trial, the safety driver or safety operator should be made aware with an audible warning which may be accompanied by a visual warning. Trialling organisations should also consider the need for other methods of making a safety driver aware of a fault, such as haptic feedback.
- 5.23 The vehicle's automated braking and steering systems, and other systems, should be designed such that, in the event of failure the vehicle can achieve a minimal risk condition explained in earlier paragraphs. which may include manoeuvring to a safe(r) location.

Annex A Contact points

A.1 Trialling organisations are strongly encouraged to engage with the relevant bodies, authorities, and the public when considering a trial on public roads. The information below is a non-exhaustive list of contact points. Trialling organisations are expected to make every effort to determine who might be affected by any trial activity.

Highways Authorities

A.2 Highways Authorities can provide information relating to roads and routes, and other important information that might affect a trial, such as planned roadworks. Trialling organisations should engage with Highways Authorities as early as possible when considering a public trial, and effort should be made to understand the implications of any such trials on road owners and those responsible for any affected highway or route.

Scotland	info@transport.gov.scot A full list of Local Authorities in Scotland can be found on the Scottish Government website: https://www.mygov.scot/organisations/
Northern Ireland	A full list of Local Authorities in Northern Ireland can be found on Northern Ireland Direct: https://www.nidirect.gov.uk/contacts/local-councils-in-northern-ireland
Wales	transportplanning@gov.wales
England	CAVtestbed@highwaysengland.co.uk for the Strategic Road Network (England's Motorways and Major A roads) A full list of Local Authorities in England and Wales can be found on the Local Government Association website: https://www.local.gov.uk/our-support/guidance-and-resources/communications-support/digital-councils/social-media/go-further/a-z-councils-online

Vehicle registration, standards, approvals, and prototypes

A.3 Trialling organisations seeking clarity or guidance on the registration, use, and construction of their vehicles should contact Department for Transport agencies for further information. Information on prototype vehicles can be found online.¹¹

¹¹ <https://www.gov.uk/government/publications/prototype-vehicles>

- Driver and Vehicle Licensing Agency: avtesting@dvla.gsi.gov.uk
- Driver and Vehicle Standards Agency: cav@dvsa.gov.uk
- Vehicle Certification Agency: enquiries@vca.gov.uk

Regional Transport Bodies

A.4 In some areas local government bodies are responsible for public transport and will therefore be best placed to advise those looking to conduct trials of any potential issues or considerations. Those looking to carry out trials should contact the relevant regional transport body as well as the local authority responsible for any road(s) being considered for trials.

Trials in London

A.5 Transport for London are responsible for the network of principal road routes in London. When conducting trials in London, trialling organisations should contact TfL, who will be able to advise on the use of their road network, as well as any other bodies or authorities responsible for the proposed trial routes.

- Transport for London - CAV@tfl.gov.uk

Testbeds

A.6 The UK is home to several world-leading testbeds and test tracks. Those looking to carry out public trials should first ensure that the technology under trial has undergone extensive private testing.

- Meridian provide coordination for UK testbeds – info@meridianmobility.tech

Midlands Future Mobility	L.Barwick@warwick.ac.uk
Millbrook	http://www.millbrook.co.uk/cav/ info@millbrook.co.uk
Smart Mobility Living Lab: London	https://www.smartmobility.london/
Trusted Intelligent Connect Autonomous Vehicle (TIC-IT)	https://www.horiba-mira.com/

Police

A.7 The police have established a central point of contact to provide guidance and clarity to trialling organisations. Emergency services should be contacted prior to any trial activity.

- CAVTrials.PoliceLiaison@dft.gsi.gov.uk

Centre for Connected and Autonomous Vehicles (CCAV)

A.8 Trialling organisations are encouraged to contact CCAV to seek guidance and advice, particularly with regard to the Code of Practice. CCAV are open to engaging with trialling organisations and other interested parties and will provide advice and guidance where appropriate.

- enquiries@ccav.gov.uk

A.9 General feedback on the Code of Practice is welcomed. Users of the Code should send any feedback or suggested changes to the email address below.

- codeofpractice@ccav.gov.uk

Annex B Definitions

Automated driving system

- B.1 An automated driving system (ADS) is a vehicle system that uses both hardware and software to perform all of the dynamic driving tasks (all the activities associated with moving a vehicle, other than strategic tasks like journey scheduling) needed to undertake a journey. When activated, the vehicle enters automated mode (“self-driving mode”), and the driver does not need to monitor the road traffic environment, or the ADS. The ADS may work within specific driving situations (sometimes referred to as an operational design domain), or in any driving situation. Outside of these situations, a driver is needed to control the vehicle.

Conditionally automated vehicle

- B.2 A vehicle fitted with an ADS that requires a safety driver to act as a fall-back for the system to assure safety while the vehicle is in automated mode. The safety driver must respond to a system takeover demand.

Highly automated vehicle

- B.3 A vehicle fitted with an ADS that does not require a safety driver as a fall-back. The driver does not need to respond to a system takeover demand. The ADS can be activated within specific driving situations such as motorway driving or in low speed conditions. This may represent part of a journey, or all of a journey if it begins and ends within the specified driving situation.

Fully automated vehicle

- B.4 A vehicle fitted with an ADS that does not require a safety driver as a fall-back. The vehicle is capable of safely completing any journey without the need for a driver in all traffic, road and weather conditions that could be managed by a competent human driver.

Driver-assistance system

- B.5 Driver-assistance systems support but do not replace the driver. Such systems include automated lighting, cruise control, lane departure warnings and traction control. These systems are not designed to perform all of the dynamic driving tasks, though some driver-assistance system features may be adapted to perform some of the task, such as lane changing.

Driver, test driver, or safety driver

B.6 A driver, test driver, or safety driver is normally interpreted as the person who is able to control the vehicle's speed and direction. This person may be referred to as the driver even when the vehicle is operating in an automated mode. At all times those undertaking the test must be able to identify the driver who is able to exercise proper control of the vehicle, whether seated in the vehicle or remotely.

Test operator, safety operator, or remote safety operator

B.7 A test operator or safety operator is a driver who oversees testing of an automated vehicle without necessarily being seated in the vehicle, since some automated vehicles might not have conventional manual controls and / or a driver's seat. In this case it is expected that the test operator would still be able to over-ride automated operation of the vehicle at any time.

Minimal risk condition

B.8 A minimal risk condition is where a vehicle undertakes actions, such as performing a manoeuvre or emergency stop to bring itself out of potential hazards or dangers. The specific action taken to achieve a minimal risk condition may vary depending on the operational domain, and could for example include slowing down, coming to a complete stop, or moving to a safe harbour. The manoeuvre or stop should ideally ensure that the vehicle is safely positioned and removes as far as possible any risk or hazards to other road users.

Reportable incident

B.9 Under Section 170 of the Road Traffic Act 1988, drivers have a duty to stop, report, and provide documents and information in the event of an incident. Section 170 covers a number of cases where the duty applies, such as personal injury to a person other than the driver, or where damage is caused to another vehicle, any property, or animals listed in the Road Traffic Act 1988.

Construction and Use Regulations

B.10 In this Code, **Construction and Use Regulations** means, for Great Britain, the Road Vehicles (Construction and Use) Regulations 1986 and, for Northern Ireland, the Motor Vehicles (Construction and Use) Regulations (Northern Ireland) 1999, both as amended.

Annex C Relevant Areas of Road Traffic Law and the Highway Code

- C.1 In most cases it is envisaged that the safety driver is inside the vehicle. If an organisation is considering having a driver outside the vehicle (a 'safety operator') it will need to give this careful consideration. Those conducting trials are expected to provide a credible explanation in a safety case as to how the driver will comply with the relevant road traffic laws and (if applicable) passenger services laws. These are identified below. It is recommended that the organisation seeks a legal opinion as part of this process.
- C.2 In respect of the Highway Code, many of the rules are legal requirements and are mirrored in existing road traffic laws. Such rules are identified in the Highway Code by the use of the words, 'must / must not'. While failure to comply with the other rules of the Code will not in itself cause a person to be prosecuted, this may be used as evidence in any court proceedings under the traffic law to establish liability.
- C.3 NB: the law concerning Northern Ireland and other devolved administrations, where applicable, is highlighted in *italics* below.

Conditions that must be in place before a person drives a vehicle

Road Traffic Act 1988

- C.4 Section 87. Driving without a licence is an offence, as is causing or permitting another person to drive a vehicle on the road without a licence.
Section 3 Road Traffic (Northern Ireland) Order 1981.

Duties and obligations of persons responsible for driving the vehicle, when driving

Road Traffic Act 1988

- C.5 Section 3. Careless and considerate driving: a person must drive with due care and attention and reasonable consideration for other persons using the road/place.
Article 12 Road Traffic (Northern Ireland) Order 1995.
- C.6 Section 15. Onus on the driver to ensure that children under 14 years old are wearing a seatbelt.
Article 24 Road Traffic (Northern Ireland) Order 1995.
- C.7 Section 41D. Driver distraction: no person shall drive (or permit another to do so) if they do not have proper control and full view of the road and traffic ahead;
- C.8 Section 41D. No person shall drive using a hand-held mobile or device.
Regulation 125A Motor Vehicles (Construction and Use) Regulations (NI) 1986.

- C.9 Section 40A. Offence to cause, permit or use a vehicle where its condition, purpose, passengers or load are likely to lead to a danger of injury to any person.
Article 54 Road Traffic (Northern Ireland) Order 1995.
- C.10 Section 170. Requires a driver involved in an accident to stop, provide information (name, address, insurance) and report an accident to the police within 24 hours.
Articles 175 and 176 Road Traffic (Northern Ireland) Order 1981.

Road Vehicles (Construction and Use) Regulations 1986

- C.11 Regulation 104. Driver distraction: no person shall drive (or permit another to do so) if they do not have proper control and full view of the road and traffic ahead.
Regulation 120 Motor Vehicles (Construction and Use) Regulations (NI) 1986.
- C.12 Regulation 107. No person shall leave a running motor vehicle unattended.
Regulation 123 Motor Vehicles (Construction and Use) Regulations (NI) 1986.
- C.13 Regulation 109. Restricts the driver from having a view of a display screen.
Regulation 125 Motor Vehicles (Construction and Use) Regulations (NI) 1986.
- C.14 Regulation 110. No person shall drive using a hand-held mobile or device.
Regulation 125A Motor Vehicles (Construction and Use) Regulations (NI) 1986.

Highway Code

- C.15 Rule 160. Drive with both hands on the wheel where possible to help remain in full control of the vehicle at all times.
NI Highway Code: Rule 160.

Compliance with road traffic directions

Road Traffic Act 1988

- C.16 Section 35. Drivers to comply with traffic directions given by police officer on the road, failure to do so will be committing an offence.
Article 49 Road Traffic (Northern Ireland) Order 1995.
- C.17 Section 36. Drivers to comply with traffic signs or the directions of a traffic survey.
Article 50 Road Traffic (Northern Ireland) Order 1995.

Road Traffic Regulation Act 1984

- C.18 Part VI. Section 89. Compliance with the law relating to speed limits.
Part VI Road Traffic Regulation (Northern Ireland) Order 1997.

Highway Code

- C.19 Rule 238. Operating a vehicle in compliance with road markings
NI Highway Code: Rule 238.