

PAS 1882:2021

Data collection and management for automated vehicle trials for the purpose of incident investigation – Specification



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Foreword

This PAS was sponsored by the UK's Centre for Connected and Autonomous Vehicles (CCAV). Its development was facilitated by BSI Standards Limited and it was published under licence from The British Standards Institution. It came into effect on 31 March 2021.

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Relationship with other publications

PAS 1882 has been developed as part of a wider programme sponsored by CCAV in conjunction with the Department for Transport (DfT), the Department for Business, Energy and Industrial Strategy (BEIS), Innovate UK and Zenzic. This PAS is intended for use by organizations conducting automated vehicle trials. It is informative for other stakeholders including emergency services, insurers, legal service providers, and road/highways authorities. This PAS is intended to be read in conjunction with:

- PAS 1881, PAS 1883, PAS 1885, PAS 11281, BS 10754-1, the Code of Practice: Automated Vehicle Trialling (2019) and the Collision Deformation Classification Code SAE MAR80 J224 CDC; and
- current legislation which applies to the testing of automated vehicles on UK roads.

Information about this document

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Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

Use of this document

It has been assumed in the preparation of this PAS that the execution of its provisions shall be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. “organization” rather than “organisation”).

Contractual and legal considerations

This Publicly Available Specification does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a Publicly Available Specification cannot confer immunity from legal obligations.

In particular, attention is drawn to the following specific regulations:

- The Road Traffic Regulation Act 1984 [1]
- The Police and Criminal Evidence Act 1984 [2]
- The Criminal Justice (Scotland) Act 2016 [3]
- The Road Vehicles (Construction and Use) Regulations 1996 [4]
- The Road Traffic Act 1988 [5]
- The General Data Protection Regulation (EU) 2016/679 as it forms part of the law of England and Wales, Scotland and Northern Ireland by virtue of section 3 of the European Union (Withdrawal) Act 2018 [6]
- The Data Protection Act 2018 [7]
- The Automated and Electric Vehicles Act 2018 [8]
- The Privacy and Electronic Communications Directive [9]
- Health and Safety at Work, etc. Act 1974 [10]
- Control of Substances Hazardous to Health Regulations 2002 (COSHH) [11]
- The Workplace (Health, Safety and Welfare) Regulations 1992 [12]
- The Management of Health and Safety at Work Regulations 1999 [13]
- The Provision and Use of Work Equipment Regulations 1998 (PUWER) [14]
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 (RIDDOR) [15]
- Corporate Manslaughter and Corporate Homicide Act 2007 [16]

0 Introduction

0.1 Background

Incident investigations are an integral part of safety management for safety-critical technologies. While the approach to incident investigation in aviation, rail and marine is systems-focused, the approach to incident investigation on UK roads has, to date, focused on the driver and vehicle.¹⁾ The rapid advancements in technology and the advent of automated vehicles introduce an opportunity for a more systems-based approach to the investigation of incidents on UK roads.

The development of automated vehicle technologies and automated vehicle trials has the potential to overhaul incident investigation through the provision of an additional and reliable information source. The vast quantities of information collected by automated vehicles could significantly assist with criminal and civil investigations, but, vitally, automated vehicles can also provide a valuable source of information for fact-finding safety investigations.

Incident investigations are based on information collected about the incident. The technological advances in automated vehicles mean that there is an unprecedented pool of information available to support the adoption of a systems-based approach to incident investigation in automated vehicle trials.

The information requirements for incident investigation set out in this PAS have been developed specifically for automated vehicles being trialled on publicly accessible sites (i.e. all land where the public has access).

0.2 Structure of the PAS

This PAS is separated into two sections:

- Normative requirements (Clause 4 to Clause 6)
 Clause 4 to Clause 6 set out the requirements for the information that a Trialling Organization (TO) needs to collect or explicitly justify not collecting in a trial's information management plan. The requirements are deemed essential to the safe operation of the automated driving system; this includes information the system or TO might receive, generate or hold but is not used for the direct operation of the vehicle.
- Informative Annex A

Annex A sets out recommendations for additional information that for a TO to aim to collect, where reasonably practicable. The aim of the annex is to encourage a move towards best practice. The informative annex lists recommendations based on the current framework for incident investigation on UK roads. The TO can choose whether or not to collect the information identified in this annex.

The UK government remains committed to supporting TOs and the trialling of automated vehicles, and it is recognized that the cost of collection of data should not place an excessive burden on TOs. Separating the core requirements from the additional recommendations recognizes that not all TOs would be able to meet the full set of requirements. The two-layer structure of the PAS is meant to encourage TOs towards best practice without placing on them requirements that would be too burdensome.

The PAS also takes into account that at this time there is no independent accident investigation branch for highways.

0.3 Context on incident investigation

This PAS is aimed at encouraging best practice.

This PAS operates separately from the existing incident or accident investigation processes which apply where there is an incident or accident on the public roads. Background context on these processes is set out in Annex B.

This PAS sets out information that might be relevant to an incident investigation that seeks to ascertain the cause of the incident. This PAS is not an exhaustive statement of the information that might be relevant to an incident investigation and TO's need to be aware that additional information might be requested. An incident investigation conducted by an authority with statutory power to conduct such investigations is entirely separate to the purpose of this PAS.

¹⁾ C. Jackson and N. Kyle, "RAC Foundation: A Highways Accident Investigation Branch – What Lessons Can Be Learnt from the Rail Industry and the Cullen Inquiry?", April 2018. [17]

1 Scope

This PAS specifies requirements for the collection, curation, storage and sharing of information during automated vehicle trials and advanced trials in the UK in relation to information collected or received by the trial system. This PAS covers all automated and co-operative automated driving vehicle trials on any land with public access.

The requirements relate to data deemed essential to the operation of the automated driving system (ADS). This also includes information the system or Trialling Organization (TO) might receive, generate or hold but which is not used for the direct operation of the vehicle.

In addition to the main requirements, the PAS includes recommendations for additional information for a TO to seek to collect, if possible.

The aim of the PAS is to promote consistency in information collection across TOs wherever practicable and to improve safety across all trials being undertaken in the UK.

This PAS builds on the requirements of PAS 1881, *Assuring the safety of automated vehicle trials and testing – Specification*, which provide the safety case framework for such trials by supporting operational safety assurance through the development of information requirements for incident investigation. This PAS recognizes that developments in automated vehicle technologies and associated information capture have the potential to answer key questions in fact-finding safety investigation, including, for example:

- What were the elements of the system and the system boundary at the time of the event?
- Was the vehicle operating within its operational design domain (ODD)?
- What was the internal state of the vehicle? Were any capabilities failed or degraded?

- What was the state of external sources of information/control? Were any capabilities failed or degraded?
- Was the system subject to active security attack?
- When did the system realize that an event was about to occur? How did it become aware?
- What functions were active at the time of the event?
- What actor was in charge of the vehicle at the time of the event? When did the last handover occur?
- Can the system provide detail about how the crash occurred?
- What were the weather conditions at the time?
- What was the vehicle's road position at the time of the event? What lane was each vehicle in?
- What actions did the vehicle intend to take next?
- What was the road layout at the time?
- Which other road users were nearby and what were those road users doing?
- Did either vehicle try to swerve or slam on their brakes?
- How fast was each vehicle travelling?
- Where did the vehicles travel after the incident?
- Was there debris from either vehicle or damaged property?
- Were there any other persons or vehicles nearby who might be witnesses?

This PAS is intended for use by organizations conducting automated vehicle trials. It is informative for other stakeholders including emergency services, insurers, legal service providers, and road/highways authorities.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document.²⁾ For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 10754-1, *Information Technology – Systems trustworthiness, governance and management – Specification*

PAS 1881:2020, *Assuring the safety of automated vehicle trials and testing – Specification*

PAS 1883:2020, *Operational Design Domain (ODD) taxonomy for an automated driving system (ADS) – Specification*

PAS 1885, *The fundamental principles of automotive cyber security – Specification*

PAS 11281, *Connected automotive ecosystems – Impact of security on safety – Code of practice*

Other publications

[N1] CENTRE FOR CONNECTED AND AUTONOMOUS VEHICLES, DEPARTMENT FOR BUSINESS, ENERGY & INDUSTRIAL STRATEGY and the DEPARTMENT FOR TRANSPORT. *Guidance Code of Practice: Automated vehicle trialling*, London: DfT, 6 February 2019.

²⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

3 Terms, definitions and abbreviations

For the purpose of this PAS, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1 automated driving system (ADS)

hardware and software that are collectively capable of performing the entire dynamic driving task on a sustained basis, regardless of whether it is limited to a specific operational design domain

NOTE This term is used specifically to describe a Level 3, 4 or 5 driving automation system.³⁾

3.1.2 automated vehicle

vehicle fitted with an automated driving system (ADS) that uses both hardware and software to perform dynamic driving tasks associated with moving the vehicle within a defined operational design domain (ODD)

[SOURCE: PAS 1881:2020, 3.3]

3.1.3 incident

occurrence within a specified time window encompassing the operation of a trial in which:

- a) at least one person sustains an injury that requires medical assistance as a result of being in the vehicle, direct contact with any part of the trial vehicle (including parts which have become detached from the trial vehicle or gasses being emitted by the vehicle) or a third party having their actions adversely affected by the actions of the trial vehicle; and/or
- b) at least one animal (e.g. dogs, horses, livestock) is fatally injured as a result of being in the vehicle, direct contact with any part of the trial vehicle (including parts which have become detached from the trial vehicle or gasses being emitted by the vehicle); and/or
- c) the vehicle, other vehicles or stationary objects sustain damage

NOTE 1 The term “incident” here is used as an encompassing term. Sometimes, a distinction is made between the concept of an accident and an incident relating to the degree of harm caused. The data collection and management requirements in this PAS relate to all events that cause at least the specified degree of harm. Therefore, for example, death or loss of vehicle are covered within this definition.

NOTE 2 Different trials encompass different time windows for the purposes of this PAS. For example:

- A vehicle on a public road would not be subject to this PAS when being driven to the trial activity using the donor car’s native capabilities. The transition of the vehicle into automated driving for the trial, operation of the trial and transition back to the donor vehicle’s native capability would be included in the time window to which this PAS is applicable. Any disengagement and reengagement within the trial activity are subject to this PAS.
- A trial involving specialist vehicles such as pods moving to and from the trial site is covered by this PAS. The pod may be remotely operated by a control centre. If it is being transported on a truck, being trailered or being towed and its systems are not active, this activity is not covered by this PAS.

NOTE 3 “A third party having their actions adversely affected by the actions of the trial vehicle” relates to scenarios such as a sudden unexpected manoeuvre by a trial vehicle causing another road user to take evasive action which leads to impact and injury. Damage to the adversely affected third-party’s vehicle is covered under clause item c).

NOTE 4 “Damage” in item c) relates to damage caused as a result of either low-speed or high-speed events. The information management plan might define a level of de minimis damage that is not considered to be part of an incident. For example, a small paint chip from road debris might be considered outside of this scope.

3.1.4 incident response plan

systematic and documented method of approaching and managing situations resulting incidents

³⁾ SAE levels as defined in the “Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles”, J3016_201806.

3.1.5 information

data that can be relevant to an incident investigation including but not limited to:

- a) written, electronic, photographic or other records;
- b) any digital data from an Event Data Recorder (EDR) and/or any other recording equipment, including but not limited to video and audio recording systems;
- c) data that allows the internal state of the autonomous system to be determined to explain the actions of the vehicle;
- d) any data from vehicle, infrastructure, sensor equipment, geo-location, connectivity and remote command systems;
- e) any personal, personnel, medical or other similar record or document; and
- f) any other data which an investigating stakeholder has a legal basis to request from:
 - 1) the Trialling Organization (TO);
 - 2) the original equipment manufacturer (OEM); or
 - 3) any other manufacturer or supplier of equipment, components or services to the TO

NOTE Relevant information can include information created by and/or stored by third parties.

3.1.6 information management (IM)

functions of controlling the acquisition, analysis, curation, retrieval and distribution of information all within an information management system (IMS)

[SOURCE: ISO/IEC 20944-1:2013, 3.6.6.1, modified]

3.1.7 information management manual (IMM)

coherent and consistent reference for a TO's approaches, policies and procedures to manage incident information for their trial activities

3.1.8 information management plan (IMP)

plan which sets out the information management activities that are to be in place for incident information for a given trial

3.1.9 information management system (IMS)

information system used to collect, curate and navigate incident information for a given trial

3.1.10 investigation

process conducted for the purpose of incident prevention which includes the gathering and analysis of information and the drawing of conclusions, including determination of causes

NOTE "Causes" refers to the actions, omissions, events or conditions, or a combination thereof, which led to the incident.

3.1.11 metadata

data that define and describe other data

3.1.12 minimal risk manoeuvre (MRM)

tactical or operational manoeuvre triggered and executed by the user or the ADS to achieve the minimal risk condition

[SOURCE: PAS 1883:2020, 3.1.8]

3.1.13 near miss

event that did not result in injury, illness, loss or damage, but had the potential to do so

[SOURCE: PAS 1881:2020, 3.14]

3.1.14 stakeholder

person, group or organization that could impact or be impacted by the trial and, for the purposes of this PAS, as identified by the TO in its information management plan

3.1.15 trial

series of tests or assessments of performance

3.1.16 trialling organization (TO)

organization responsible for the automated vehicle testing, trial or service being provided

[SOURCE: PAS 1881:2020, 3.25]

NOTE In a consortium, the lead partner might assume the role of "trialling organization".

3.2 Abbreviations

ABS	anti-lock braking system
ADAS	advanced driver-assistance system
ADS	automated driving system
ADV	advanced digital video
AEB	automatic emergency braking
AIB	accident investigation branch
CAV	connected and automated vehicles
CCTV	closed-circuit television
CRASH	collision reporting and sharing
CRUD	create, read, update and delete
DSS	data collection and data storage system
DSSAD	automated driving vehicles
EDR	event data recorder
ESP	electronic stability programme
GPS	global positioning system
HVAC	heating, ventilation and air conditioning
IM	information management
IMM	information management manual
IMP	information management plan
IMS	information management system
LIDAR	light detection and ranging
MAP	mobile application part protocol
MIB	Motor Investigation Bureau
MDR	metadata registry
MRC	minimum risk condition
MRM	minimal risk manoeuvre
ODD	operational design domain
OEM	original equipment manufacturer
RAIDS	road accident in-depth study
SAE	Society of Automotive Engineers
SPAT	signal phase and timing
SRM	slot revision message
SSM	standards schedule message
TO	trialling organization

4 Data sources

COMMENTARY ON CLAUSE 4

The data sources and specifications in this PAS relate only to those required for incident investigation. However, stakeholders, such as the police or relevant road incident investigation authorities, might deem that a near miss, or a set of near misses, are to be investigated as if they were an incident. As a result, trialling organizations should make the data collected in accordance with this PAS available to relevant stakeholders. Similarly, a TO might declare that an event is investigated as if an incident had occurred. This could be due to a number of related near misses or as a result of an internal investigation of a single event.

4.1 Incident response plan

4.1.1 The TO shall have an incident response plan which addresses, as a minimum:

- a) policies and procedures for triggering and undertaking internal incident investigations and for triggering and undertaking incident investigations involving stakeholders recognizing that there are three types of investigations: criminal investigations, civil investigations and safety fact-finding investigations;

***NOTE 1** All analysis undertaken for a fact-finding investigation is likely to be relevant and thus disclosable to any civil or criminal investigation. Therefore, different stakeholders might require different policies and procedures.*

- b) a detailed schedule for information collection and management;
- c) the means by which the TO undertakes incident investigation, including appropriate analysis tools; and

- d) the TO's definition of a near miss which shall be defined by reference to the attributes set out in this PAS and in the trial IMP. The TO shall have an investigation plan for near misses. It shall also have a policy stating the criteria identifying when near misses will be treated as incidents for lessons learnt investigation purposes.

***NOTE 2** A near miss threshold can also be defined with respect to the distance between the target vehicle and an object, for example, the vehicle passing with 50 cm of an object. A near miss can also be defined with respect to the time before impact, for example, the trial vehicle came within 1 second of impact. Or, a near miss may be defined in terms of multiple activations of a vehicle trigger, for example, multiple revisions back to the safety driver during trials of a given feature.*

4.1.2 The schedule for information collection and management shall identify information that is deemed by the TO to be relevant to the investigation of an incident from the following sources:

- a) data that describe and/or identify the specific incident;
- b) data that exist on or around the vehicle immediately after the incident;
- c) data that exist on or around the vehicle immediately prior to the incident;
- d) data that originate from trial vehicles, such as vehicle sensor data;
- e) data imported and exported by vehicle users, using laptops and mobile phones;
- f) data received from sources external to trial vehicles, for example, remote operating centres, third-party apps, infrastructure data; and
- g) data that exist to certify, approve or employed as part of the safety functions of the vehicle and the specific trial operation.

4.1.3 The TO shall justify in the IMP any data that shall be collected or shall not be collected, with respect to items a) to g) in 4.1.2.

4.1.4 For key pieces of data identified in the IMP for each trial scenario, the TO shall:

- a) collect a timestamped record of the incident;
- b) record the data interface mechanisms employed;
- c) record the data received from sources external to the test vehicle and where possible collect the data sent by the external source;
- d) record any conflict between a vehicle-produced piece of data and an externally sourced piece of data; it shall further record which data item was used by the TO;
- e) record any indicators of confidence and quality (accuracy, age of data, etc.) supplied with data; and
- f) record any indicators of integrity to give confidence that the data are authentic and have not been maliciously modified or corrupted.

NOTE Data can be received before, during or after an incident.

4.2 Information management plan (IMP)

4.2.1 The TO shall develop an IMP that identifies the relevant data to be collected and how these data are to be managed for an automated vehicle trial. The TO shall provide sufficient data to derive the causes of the incident as far as is reasonably practicable.

The IMP shall be based on a control and feedback model.

NOTE 1 One example of an IMP control and feedback model is given in Figure 1. It is a simplified diagram for illustrative purposes only. Further information on the development of a control and feedback model is presented in Annex C.

NOTE 2 Trial instances are very diverse. The aim of control and information diagrams is to aid the TO to clearly identify relevant data they are able to collect and when they intend to collect it for their trials. The TO should produce an IMP that is proportionate to the activities being undertaken while still conforming to this PAS.

NOTE 3 In Figure 1, one possible CAV trial control and feedback model for a trial is presented. This diagram is used within the IMP to identify the data and metadata to be collected and when they are to be collected.

NOTE 4 The control and information diagram is also used to inform a justification to collect or not collect each piece of information identified in Clause 4 to Clause 6 of this PAS and Annex A as appropriate for the trial in question. It also allows the TO to identify appropriate accuracy and resolution of data to be collected.

4.2.2 The TO shall identify the timeframes for the information they collect and the amount of data they retain in their IMP.

NOTE There is variation in the data recorders used by TOs and in their data collection policies. For example, some TOs might record continuously, so data collection frequencies should be identified and justified in the trial IMP.