



SURFACE VEHICLE RECOMMENDED PRACTICE

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Automated Driving System Data Logger

RATIONALE

This document is being revised in order to harmonize, where applicable, with information from the Automated Vehicle Safety Consortium (AVSC) Best Practice for Data Collection for Automated Driving System - Dedicated Vehicles (ADS-DVs) to Support Event Analysis.

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1. SCOPE

This SAE Recommended Practice provides common data output formats and definitions for a variety of data elements that may be useful for analyzing the performance of automated driving system (ADS) during an event that meets the trigger threshold criteria specified in this document. The document is intended to govern data element definitions, to provide a minimum data element set, and to specify a common ADS data logger record format as applicable for motor vehicle applications.

Automated driving systems (ADSs) perform the complete dynamic driving task (DDT) while engaged. In the absence of a human “driver,” the ADS itself could be the only witness of a collision event. As such, a definition of the ADS data recording is necessary in order to standardize information available to the accident reconstructionist. For this purpose, the data elements defined herein supplement the SAE J1698-1 defined EDR in order to facilitate the determination of the background and events leading up to a collision in an ADS-operated vehicle.

The data elements defined in this document are unique to Level 3, 4, or 5 ADS features, as defined by SAE J3016, and provide additional background of the events leading up to a crash or crash-like event. The data from sensors such as camera(s), LiDAR(s) etc. will provide information in the absence of a human driver. The data included in the ADS data logger is expected to be used in conjunction with the SAE J1698 event data recorder (EDR) record and traditional accident reconstruction analysis. The EDR and ADS data logger will capture information leading up to the triggered event, at a minimum. There are no facts to support that recording data for greater than 5 seconds pre-event would change the outcome of any crash analysis. Thus, the recommended recording duration for a data logger is 5 seconds pre-event, same as an EDR. Due to the potential for sensor and/or communication failure during a crash event, the recommendation is that data should be collected post-crash for impact and rollover sensors for up to 250 ms.

ADS technology is still being developed and is not yet commercially deployed. Therefore, this SAE Recommended Practice is intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances.

1.1 Purpose

ADS data loggers record the specified data elements for the purpose of understanding the salient operating environment of an ADS-operated vehicle (as captured by the ADS), and the subsequent vehicle motion control actions taken by the ADS, leading up to an event that meets the trigger threshold criteria specified in this document. Creating standard definitions for the data elements in the ADS data logger record report supports this purpose.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issues of SAE publications apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), website www.sae.org.

SAE J211-1 Instrumentation for Impact Test - Part 1 - Electronic Instrumentation

SAE J670 Vehicle Dynamics Terminology

SAE J1050 Describing and Measuring the Driver's Field of View

SAE J1698 Event Data Recorder

SAE J1698-1 Event Data Recorder - Output Data Definition

SAE J2331 Operator's Field of View - Engineering Evaluation

SAE J3016 Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles

3. GENERAL TERMS AND DEFINITIONS

Refer to SAE J1698 for definitions.

4. EVENT DEFINITIONS

4.1 Front/Side/Rear Impact Event

A front/side/rear impact event is a crash or other physical occurrence that causes a front/side/rear impact trigger threshold to be met or exceeded, or any non-reversible deployable restraint to be deployed, whichever occurs first. For purposes of recording event data, only one front/side/rear impact event may be in progress at any given time.

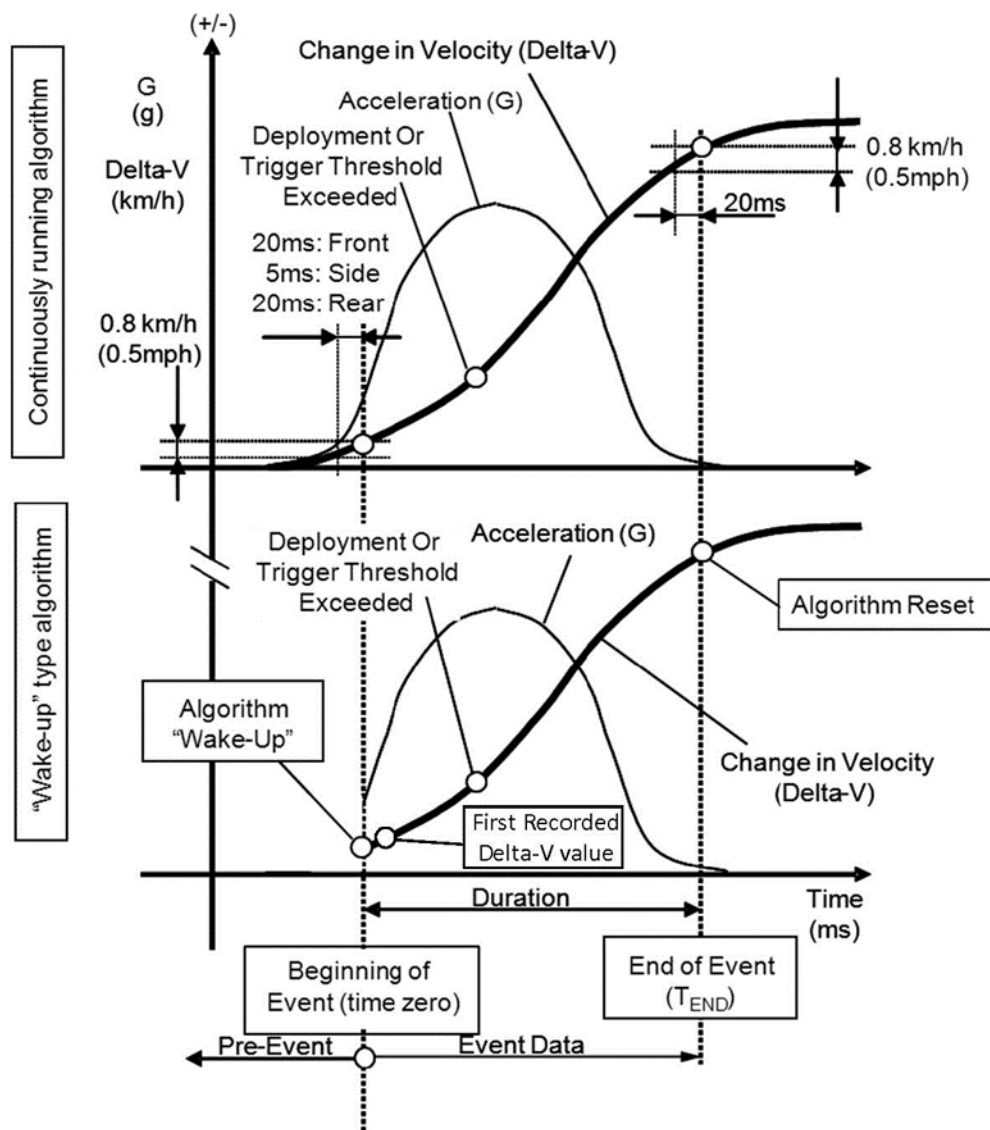


Figure 1 - Common referencing data points of an impact event

Therefore, depending on the circumstances, a front/side/rear impact event can result in either a deployment or non-deployment of an occupant protection system. In the case of events which include vehicle rotation (relative to any axis), there is the possibility that the vehicle is not parallel to the ground throughout an impact event.

Due to the complex nature of automobile crashes, crash prevention and mitigation countermeasures for impact events vary significantly among vehicle types, manufacturers, and event circumstances. Therefore, the beginning/end/duration of impact events must be evaluated with caution since each vehicle represented in an impact event may use a different temporal reference point for that event.

4.1.1 Beginning of Impact Event (Time Zero)

The beginning of an impact event (time zero) is defined by:

- 1a. For systems with “wake-up” occupant protection control algorithms, the time at which the occupant protection control algorithm is activated.

Or

- 1b. For continuously running occupant protection control algorithms, the time when the cumulative delta-V of over 0.8 km/h (0.5 mph) is reached within a 20 ms time period in the longitudinal direction for a frontal/rear event or within a 5 ms time period in the lateral direction for a side impact event.

Or

2. A deployment of a non-reversible deployable protection device occurs. This does not include the deployment of subsequent stages of a multi-stage deployable protection device.

The beginning of an impact event (defined herein) shall not be interpreted as the moment when the subject vehicle makes a first physical contact with another object. The beginning of an event also does not mark the condition that determines whether to record the event data associated with the event for subsequent retrieval. The purpose of defining the beginning of an event is to enable the alignment of data elements from multiple recording devices on a vehicle.

**Table 1 - Threshold for beginning of each impact event
(continuously running algorithm)**

	Frontal Impact	Side Impact	Rear Impact
Direction of acceleration data	Longitudinal	Lateral	Longitudinal
Cumulative delta-V within a time period	$\geq +0.8$ km/h within 20 ms	$\geq +0.8$ km/h or ≤ -0.8 km/h within 5 ms	≤ -0.8 km/h within 20 ms

NOTE: The disposal of an additional stage of an airbag does not constitute the beginning of an impact event and thus does not trigger another EDR record.

4.1.2 End of Impact Event

The end of an impact event (TEND) is dependent upon the type of occupant protection control algorithm.

1. For “wake-up” occupant protection control algorithms, TEND occurs at the moment when the occupant protection control algorithm resets itself. If this condition has not been met by the end of the recording period, TEND may be defined as the last recorded data point.

Or

2. For continuously running occupant protection control algorithms, TEND occurs when the longitudinal and lateral (if recorded) cumulative delta-V, within a 20 ms time period, becomes 0.8 km/h (0.5 mph) or less. If this condition has not been met by the end of the recording period, TEND may be defined as the last recorded data point.

4.1.3 Duration of Impact Event

The duration of an impact event is the time interval between the beginning of an impact event (time zero) and the end of the impact event (TEND). Duration of an impact event is not a pre-determined time interval and can vary significantly for each event. The duration of an impact event may exceed the time recording capability of the ADS data logger.

4.2 Pedestrian Impact Event

A pedestrian impact event is a physical occurrence that causes a pedestrian impact trigger threshold to be met or exceeded or any non-reversible deployable pedestrian protection device to be deployed, whichever occurs first. For the purposes of recording event data, only one pedestrian impact event may be in progress at any given time.

4.2.1 Beginning of Pedestrian Impact Event: Time Zero

The beginning of a pedestrian impact event (time zero) is defined by:

- 1a. For systems with “wake-up” pedestrian protection control algorithms, the time at which the pedestrian protection control algorithm is activated.

Or

- 1b. For continuously running pedestrian protection control algorithms, the time when the pedestrian protection control algorithm determines that the specific time zero criteria, as defined for the sensing technology and application, has been met. Pedestrian protection may employ a variety of sensing technologies which require definition of time zero criteria appropriate for their capabilities and particular application.

Or

2. Any non-reversible deployable pedestrian protection device deployment occurs. This does not include the deployment of subsequent stages of a multi-stage deployable protection device.

NOTE: The beginning of an event shall not be interpreted as the moment when the subject vehicle makes a first physical contact with another object. The beginning of an event also does not mark the condition that determines whether to record the event data associated with the event for subsequent retrieval. The purpose of defining the beginning of an event is to enable the alignment of data elements from multiple recording devices on a vehicle.

4.2.2 End of Pedestrian Impact Event

The end of a pedestrian impact event (TEND) is dependent upon the type of control algorithm.

1. For “wake-up” pedestrian protection control algorithms, TEND occurs at the moment when the pedestrian protection control algorithm resets itself. If this condition has not been met by the end of the recording period, TEND may be defined as the last recorded data point.

Or

2. For continuously running pedestrian protection control algorithms, TEND occurs when the event is determined to have ended as defined by the specific OEM and pedestrian protection control system supplier. If this condition has not been met by the end of the recording period, TEND may be defined as the last recorded data point.

4.2.3 Duration of Pedestrian Impact Event

The duration of a pedestrian impact event is the time interval between the beginning of a pedestrian impact event (time zero) and the end of a pedestrian impact event (TEND). The duration of a pedestrian impact event is not a pre-determined time interval and can vary significantly for each event. The duration of a pedestrian impact event may exceed the time recording capability of the ADS data logger.