SURFACE VEHICLE RECOMMENDED PRACTICE

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Event Data Recorder - Output Data Definition

RATIONALE

This SAE Recommended Practice is being revised to remove references to automated driving system (ADS) Level 3, 4, and 5 and SAE J3016, which will now be covered in SAE J3197, and to make updates based on recent discussions in the SAE EDR Committee.

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TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

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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 vehicle crash and crash-like events that meet specified trigger criteria. The document is intended to govern data element definitions, to provide a minimum data element set, and to specify EDR record format as applicable for light-duty motor vehicle Original Equipment applications.

1.1 Purpose

EDR records have several potential uses. These include providing operational information on the vehicle's occupant/pedestrian protection system and other vehicle systems for the purpose of aiding in crash reconstruction and supporting improved highway safety. Creating standard definitions for the data elements in the EDR record reports should help facilitate these uses.

For data elements described in this document, it is understood that individual manufacturers may incorporate unique hardware in vehicles which require modified data element format, range, units, and sampling rate. It is expected that in such cases, the manufacturer continues to capture the data element in the EDR record, but the format may be altered to capture the most appropriate content.

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 issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J211-1	Instrumentation for Impact Test - Part 1 - Electronic Instrumentation
SAE J670	Vehicle Dynamics Terminology
SAE J1698	Event Data Recorder
SAE J1698-2	Event Data Recorder - Retrieval Tool Protocol
SAE J1698-3	Event Data Recorder - Compliance Assessment
SAE J2948	Keyless Ignition Control Design
SAE J3016	Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles

2.1.2 Other Publications

Electronic 2010 Fatality Analysis Reporting System (FARS) Coding and Validation Manual, U.S. Department of Transportation, National Highway Traffic Safety Administration,
https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/811530

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 Code of Federal Regulations (CFR) Publications

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

49 CFR Part 563 Event Data Recorders

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 can be in progress at any given time.

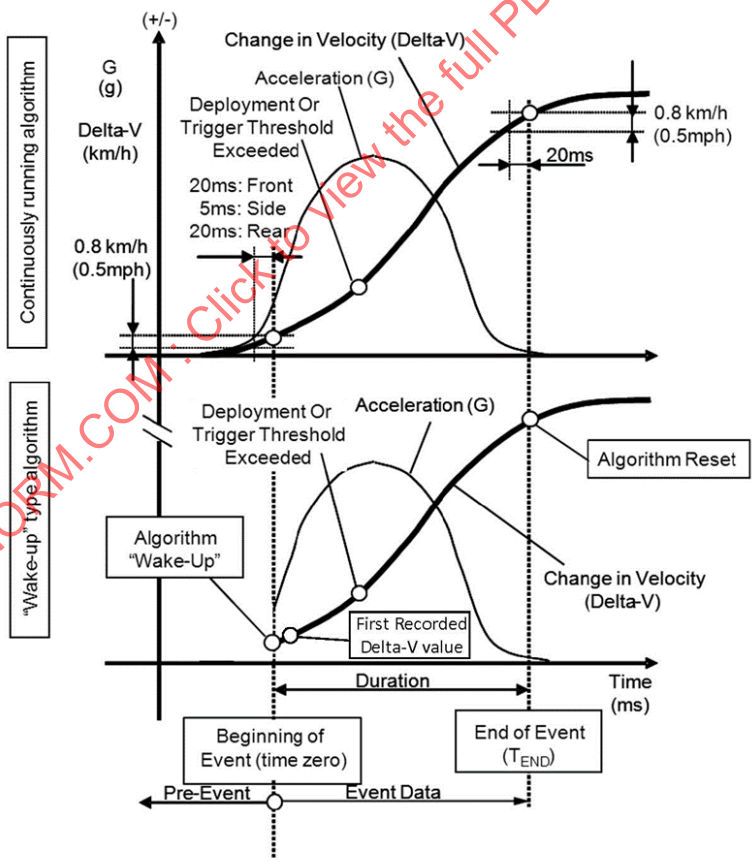

Figure 1 - Common referencing data points of an impact event[1]

[1] This figure is a very simplified image of event data to illustrate common referencing data points and it is not drawn to scale. Depending on the direction of impact, delta-V and/or acceleration data may be in either positive or negative values. Refer to SAE J211 and SAE J670 for sign conventions.

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	≥ +0.8 km/h within 20 ms	≥ +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 (T_{END}) is dependent upon the type of occupant protection control algorithm.

(1) For “wake-up” occupant protection control algorithms, T_{END} 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, T_{END} may be defined as the last recorded data point.

or

(2) For continuously running occupant protection control algorithms, T_{END} 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, T_{END} 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 (T_{END}). 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 EDR.

4.2 Pedestrian Impact Event

Pedestrian protection utilizes multiple technologies, some of which are resettable or reversible. There may also be instances of misapplied deployments. 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 can 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 (T_{END}) is dependent upon the type of control algorithm.

(1) For “wake-up” pedestrian protection control algorithms, T_{END} 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, T_{END} may be defined as the last recorded data point.

or

(2) For continuously running pedestrian protection control algorithms, T_{END} 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, T_{END} 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 (T_{END}). 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 EDR.

4.3 Rollover Event

A rollover event is a physical occurrence in which the occupant protection control algorithm initiates deployment of a rollover occupant protection system. For purposes of recording event data, only one rollover event can be in progress at any given time.

Due to the complex nature of rollover events, crash prevention and mitigation countermeasures for rollover events vary significantly among vehicle types, manufacturers, and event circumstances. Therefore, rollover events must be evaluated with caution since each vehicle may use a different temporal reference point for its rollover event.

4.3.1 Beginning of Rollover Event

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

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

or

(1b) For continuously running occupant protection control algorithms, the time at which the event is determined to have started as defined by the specific Original Equipment Manufacturer (OEM) and occupant protection control system supplier (for example, accumulated angle or angular rate).

or

(2) A rollover occupant protection system deployment occurs. This does not include the deployment of subsequent stages of a multi-stage deployable protection device.

The beginning of a rollover event also does not mark the condition that determines whether to record the event data associated with the event for subsequent retrieval.

In addition, the beginning of a rollover event may not necessarily be coincident with the moment at which the subject vehicle starts to roll.

4.3.2 End of Rollover Event

The end of a rollover event (T_{END}) is dependent upon the type of control algorithm.

1. For “wake-up” occupant protection control algorithms, T_{END} 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, T_{END} may be defined as the last recorded data point.

2. For continuously running occupant protection control algorithms, T_{END} occurs when the event is determined to have ended as defined by the specific OEM and occupant protection control system supplier (for example, accumulated angle or angular rate). If this condition has not been met by the end of the recording period, T_{END} may be defined as the last recorded data point.

The end of a rollover event shall not be interpreted as the moment when the subject vehicle comes to a complete stop.

4.3.3 Duration of Rollover Event

The duration of a rollover event is the time interval between the beginning of the rollover event (time zero) and the end of the rollover event (T_{END}).

Duration of a rollover event is not a pre-determined time interval and can vary significantly for each event. The duration of a rollover event may exceed the time recording capability of the EDR.

4.4 Data Capture Requirements

The EDR must capture and record the data elements for events in accordance with the following conditions and circumstances:

a. For front, side, or rear events:

   1. Capture and record the data when a change in vehicle velocity, in the longitudinal direction, that equals or exceeds 8 km/h within a 150 ms interval.

   2. For vehicles that record “delta–V, lateral,” capture and record the data when a change in vehicle velocity in either the longitudinal or lateral direction that equals or exceeds 8 km/h within a 150 ms interval.

   3. For both cases above, if the event is less than 150 ms in duration, capture and record the data when a change in vehicle velocity that equals or exceeds 8 km/h since the most recent time zero.

b. For front, side, rear, rollover, or pedestrian protection events:

   1. Capture and record the data when a deployment of any non-reversible protection device occurs.

c. In an air bag deployment event (frontal, side, rear, rollover), capture and record the current deployment data. The memory for the air bag deployment event must be locked to prevent any future overwriting of the data in subsequent events. Events that result in the deployment of a reversible device do not need to be locked.

d. In an event that does not meet the criteria in (c), capture and record the current event data.

e. The types of events described in the event definitions (4.1 through 4.3) may be recorded separately in different records and/or different electronic modules.

f. The EDR shall be capable to record at least two events, subject to the following conditions:

   1. If an EDR record void of previous event data is available, the current event data is recorded.

   2. If an EDR record void of previous event data is not available and the current event deployed an air bag, the manufacturer must overwrite a previous event that did not deploy an air bag, if one exists. If the current event did not deploy an air bag, the manufacturer may choose to either overwrite any previous event data that did not deploy an air bag with the current event data or to not record the current event data. If all previous events deployed air bags, the manufacturer will not be able to record the current event.

   3. EDR records containing previous air bag deployment event data (frontal, side, rear, rollover) must not be overwritten by the current event data.

g. The EDR has the ability to store at least one pedestrian impact event, if equipped with a pedestrian protection system.

4.5 Data Record Management

This recommended practice does not recommend a specific method or location for EDR, subject to the following recommendations:

a. The ECU containing the EDR should be located in an area of the vehicle which protects against physical damage that would prevent the retrieval of the data.

b. The ECU containing the EDR should be tamper-resistant and/or tamper-evident.

5. DATA ELEMENTS

5.1 Data Element Availability

The data elements listed in this recommended practice are only relevant if the specific vehicle is equipped with the associated sensor and/or vehicle system and their status is received by the EDR via its vehicle communication bus. While each OEM can determine which data elements are applicable to their vehicle EDR, the OEMs are referred to Section 7 for recommended data element recording methodology.

5.2 Data Element Types

5.2.1 Time Series Data

Dynamic vehicle data collected at a specified frequency with more than one data point necessary to complete the data set.

5.2.2 Static Data

Any data element that is recorded only once per event.

5.3 Data Element Values

5.3.1 Data/Signal Not Available

“Data/signal not available” indicates the condition when a specific data value does not exist in the output data set. A unique value should be used to indicate this condition (e.g., $FF, $FFFF, etc., for unsigned data or $81, $8001, etc., for signed data).

5.3.2 Invalid Data

“Invalid data” indicates that the originating source (e.g., ECU/sensor) is unable to generate valid data. A unique value should be used by the originating source to indicate this condition (e.g., $FE, $FFFE, etc., for unsigned data or $80, $8000, etc., for signed data).

5.3.3 Status of the Data Element

The reported status of a data element, that is sent over a vehicle’s communication bus or is assessed via an electrical circuit, is not necessarily the actual physical state of the switch or sensor. For data elements that receive information from a communication bus message (e.g., door lock status), they indicate the commanded state of the associated switch or sensor. For data elements assessed via an electrical circuit (e.g., safety belt status), they indicate the status of the electrical circuit which includes the associated switch or sensor.

5.4 Data Element Accuracy

Accuracy requirement as listed for each data element only applies within the range of the associated physical sensor. If the measured quantity exceeds the design range of the sensor, the reported data element must indicate when the measurement first exceeded the design range of the sensor.

6. RECOMMENDED MINIMUM EVENT DATA RECORDER DATA ELEMENTS

6.1 Minimum Data Element Set

The following data elements (which will be defined in Section 7) are the recommended minimum set of data elements that should be recorded.

6.1.1 Longitudinal Delta-V

6.1.2 Maximum Recorded Longitudinal Delta-V

6.1.3 Time to Maximum Recorded Delta V, Longitudinal

6.1.4 Speed, Vehicle Indicated

6.1.5 Engine throttle Position, Percent Full (or Accelerator Control (Pedal) Position, Percent Full)

6.1.6 Service Brake, On and Off

6.1.7 Ignition Cycle at Event

6.1.8 Ignition Cycle at Imaging

6.1.9 Safety Belt Status, Driver

6.1.10 Occupant Protection System Warning Lamp Status

6.1.11 Occupant Protection Device Deployment Time (for Driver Frontal Air Bag First Stage Deployment)

6.1.12 Occupant Protection Device Deployment Time (for Passenger Frontal Air Bag First Stage Deployment)

6.1.13 Multi-Event, Number of Events

6.1.14 Time from Event X to Y

6.1.15 Event Data Recording Complete

6.2 Additional Data Elements

The following data elements (which will be defined in Section 7) should be recorded if they are available.

6.2.1 Lateral Acceleration

6.2.2 Longitudinal Acceleration

6.2.3 Normal Acceleration

6.2.4 Lateral Delta-V

6.2.5 Maximum Recorded Lateral Delta-V

6.2.6 Time to Maximum Recorded Delta-V, Lateral

6.2.7 Time to Maximum Recorded Delta-V, Resultant

6.2.8 Revolution per Minute (rpm)

6.2.9 Roll Rate (or Roll Angle)

6.2.10 Antilock Brake System Status

6.2.11 Electronic Stability Control System Status

6.2.12 Steering Input

6.2.13 Safety Belt Status, Front Passenger

6.2.14 Frontal Air Bag Suppression Switch Status, Front Passenger

6.2.15 Occupant Protection Device Deployment Time (for Driver Frontal Air Bag Additional Stages)

6.2.16 Occupant Protection Device Deployment Time (for Passenger Frontal Air Bag Additional Stages)

6.2.17 Occupant Protection Device Deployment Time (for Driver Side Air Bag)

6.2.18 Occupant Protection Device Deployment Time (for Front Passenger Side Air Bag)

6.2.19 Occupant Protection Device Deployment Time (for Driver Side Curtain/Tube Air Bag)

6.2.20 Occupant Protection Device Deployment Time (for Passenger Side Curtain/Tube Air Bag)

6.2.21 Occupant Protection Device Deployment Time (for Driver Pretensioner)

6.2.22 Occupant Protection Device Deployment Time (for Front Passenger Pretensioner)

6.2.23 Seat Track Position Switch; Forward Status, Driver

6.2.24 Seat Track Position Switch; Forward Status, Front Passenger

6.2.25 Occupant Size Classification, Driver

6.2.26 Occupant Size Classification, Front Passenger

7. DATA ELEMENT DEFINITIONS

As the technology used to accelerate the vehicle may vary, the unit, minimum resolution, minimum range, and minimum accuracy for the following data elements may be defined by the system developer.

7.1 Acceleration Data

7.1.1 Lateral Acceleration

The y-component of the vector acceleration of a point in the vehicle. The lateral acceleration is positive from left to right, from the perspective of the driver when seated in the vehicle facing the direction of forward vehicle travel.

Unit	G
Minimum Resolution	0.5
Minimum Range	-5 to +5
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0 to 250 ms relative to time zero
Minimum Recording Frequency	500 samples/second

NOTE: Due to the potential for accelerometer saturation during certain events, this data element may not be suitable for use in event reconstruction. However, this data element may be useful for other purposes such as deployment analysis.

7.1.2 Longitudinal Acceleration

The x-component of the vector acceleration of a point in the vehicle. The longitudinal acceleration is positive in the direction of forward vehicle travel.

Unit	G
Minimum Resolution	0.5
Minimum Range	-50 to +50
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0 to 250 ms relative to time zero
Minimum Recording Frequency	500 samples/second

NOTE: Due to the potential for accelerometer saturation during certain events, this data element may not be suitable for use in event reconstruction. However, this data element may be useful for other purposes such as deployment analysis.

7.1.3 Normal Acceleration

The z-component of the vector acceleration of a point in the vehicle. The normal acceleration is positive in a downward direction.

Unit	G
Minimum Resolution	0.5
Minimum Range	-5 to +5
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0 to 250 ms relative to time zero
Minimum Recording Frequency	500 samples/second

NOTE: Due to the potential for accelerometer saturation during certain events, this data element may not be suitable for use in event reconstruction. However, this data element may be useful for other purposes such as deployment analysis.

7.1.4 Peripheral Acceleration

The acceleration of a point in the vehicle. The SAE J211-1 sign convention should be used to define orientation of the accelerometer.

Unit	G
Minimum Resolution	2
Minimum Range	-100 to +100
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0 to 50 ms relative to time zero
Minimum Recording Frequency	500 samples/second

NOTE: Due to the potential for accelerometer saturation during certain events, this data element may not be suitable for use in event reconstruction. However, this data element may be useful for other purposes such as deployment analysis.

7.2 Event Date

7.2.1 Event Date - Year

Year when the event occurred.

Unit	Year
Minimum Resolution	1
Minimum Range	2000 to 2253
Minimum Accuracy	±1
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data should be used in combination with 7.2.2 and 7.2.3. The accuracy of this data may be affected by the data source providing it.

7.2.2 Event Date - Month

Month when the event occurred.

Unit	Month
Minimum Resolution	1
Minimum Range	1 to 12
Minimum Accuracy	±1
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data should be used in combination with 7.2.1 and 7.2.3. The accuracy of this data may be affected by the data source providing it.

7.2.3 Event Date - Day

Day when the event occurred.

Unit	Day
Minimum Resolution	1
Minimum Range	1 to 31
Minimum Accuracy	±1
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data should be used in combination with 7.2.1 and 7.2.2. The accuracy of this data may be affected by the data source providing it.

7.3 Event Time

7.3.1 Event Time - Hour

Hours portion of the time of the day when the event occurred.

Unit	Hour
Minimum Resolution	1
Minimum Range	0 to 23
Minimum Accuracy	±1
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data should be used in combination with 7.3.2 and 7.3.3. The accuracy of this data may be affected by the data source providing it.

7.3.2 Event Time - Minute

Minutes portion of the time of the day when the event occurred.

Unit	Minute
Minimum Resolution	1
Minimum Range	0 to 59
Minimum Accuracy	±1
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data should be used in combination with 7.3.1 and 7.3.3. The accuracy of this data may be affected by the data source providing it.

7.3.3 Event Time - Second

Seconds portion of the time of the day when the event occurred.

Unit	Second
Minimum Resolution	1
Minimum Range	0 to 59
Minimum Accuracy	±1
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data should be used in combination with 7.3.1 and 7.3.2. The accuracy of this data may be affected by the data source providing it.

7.4 Ambient Temperature

The estimated exterior ambient air temperature as measured by the vehicle system.

Unit	Degrees in Celsius
Minimum Resolution	1
Minimum Range	-40 to +80
Minimum Accuracy	At the option of the manufacturer
Recording Reference Time	-1.1 to 0 second relative to time zero

7.5 Antilock Brake System Status

Operating status of the antilock brake system.

Unit	Not applicable
Minimum Resolution	Engaged, faulted, or non-engaged*
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: The mapping from the above terms to the NHTSA Part 563 nomenclature:

Engaged = Actively controlling = On

Non-Engaged = On but not controlling = Off

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.6 Blind Spot System

Operating status of the side blind spot system.

Unit	Not applicable
Minimum Resolution	On but not warning, off, faulted, or warning
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.7 Brake Application

Either or both of the following data elements may be used to indicate driver intended brake application.

7.7.1 Automated Emergency Braking (AEB)

A braking system which may automatically apply the brakes to assist in preventing or reducing the severity of a crash.

Unit	Not applicable
Minimum Resolution	Active or not active
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.7.2 Brake Pedal Position

Indicator of brake pedal position within the range from not depressed to fully depressed.

Unit	Percentage
Minimum Resolution	5
Minimum Range	0 to 100
Minimum Accuracy	±10% of the full range
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: It is recommended that the automobile manufacturer explain in the EDR Retrieval Tool Report the fact that the vehicle's braking system may achieve 100% brake application when the brake pedal position is less than 100%.

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.7.3 Brake System Internal Pressure

Indicator of applied brake (master cylinder side).

Unit	kPa
Minimum Resolution	100
Minimum Range	0 to 10000
Minimum Accuracy	±10% of the full range
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.7.4 Braking Request

Application of the brake system by the driver or vehicle.

Unit	Not applicable
Minimum Resolution	Yes or no
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.7.5 Service Brake, On and Off

Status of the switch that is used to detect whether or not the brake pedal was pressed by the driver.

Unit	Not applicable
Minimum Resolution	On or off
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.8 Collision Warning System

Operating status of the collision warning system.

Unit	Not applicable
Minimum Resolution	On but not warning, off, faulted, or warning
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.9 Cruise Control System Status (Driving Automation System Level 0)

Operating status of the cruise control system.

Unit	Not applicable
Minimum Resolution	Actively controlling, faulted, commanded off, or on but not controlling
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.10 Delta-V (Change in Velocity)

7.10.1 Lateral Delta-V

Change in lateral vehicle speed during an event. Lateral Delta-V is only the lateral component of the total Delta-V.

Unit	km/h
Minimum Resolution	1
Minimum Range	-100 to +100
Minimum Accuracy	±10 km/h
Minimum Recording Interval	0 to 250 ms, relative to time zero OR 0 to end of impact event time plus 30 ms, whichever is shorter
Minimum Recording Frequency	100 samples/second

7.10.2 Longitudinal Delta-V

Change in longitudinal vehicle speed during an event. Longitudinal Delta-V is only the longitudinal component of the total Delta-V.

Unit	km/h
Minimum Resolution	1
Minimum Range	-100 to +100
Minimum Accuracy	±10 km/h
Minimum Recording Interval	0 to 250 ms, relative to time zero OR 0 to end of impact event time plus 30 ms, whichever is shorter
Minimum Recording Frequency	100 samples/second

7.10.3 Maximum Recorded Lateral Delta-V

The maximum value of the cumulative change in velocity, as recorded by the EDR, of the vehicle along the lateral axis.

Unit	km/h
Minimum Resolution	1
Minimum Range	-100 to + 100
Minimum Accuracy	±10 km/h
Recording Reference Time	A data point within a minimum of 0 to 300 ms (relative to time zero)

NOTE: This data should be used in combination with 7.10.6.

7.10.4 Maximum Recorded Longitudinal Delta-V

The maximum value of the cumulative change in velocity, as recorded by the EDR, of the vehicle along the longitudinal axis.

Unit	km/h
Minimum Resolution	1
Minimum Range	-100 to + 100
Minimum Accuracy	±10 km/h
Recording Reference Time	A data point within a minimum of 0 to 300 ms (relative to time zero)

NOTE: This data should be used in combination with 7.10.7.

7.10.5 Maximum Recorded Resultant Delta-V

The time-correlated maximum value of the cumulative change in velocity, as recorded by the EDR or processed during data imaging along the vector-added longitudinal and lateral axes.

Unit	km/h
Minimum Resolution	1
Minimum Range	-100 to + 100
Minimum Accuracy	±10 km/h
Recording Reference Time	A data point within a minimum of 0 to 300 ms (relative to time zero)

NOTE: This data may not be recorded by the ECU but may be calculated by the EDR Retrieval Tool at time of imaging from data recorded in the ECU.

This data should be used in combination with 7.10.8.

7.10.6 Time to Maximum Recorded Delta-V, Lateral

The time from time zero to the point where the maximum value of the cumulative change in velocity is found, as recorded by the EDR, along the lateral axis.

Unit	ms
Minimum Resolution	2.5
Minimum Range	0 to 300 or 0 to end of impact event time plus 30, whichever is shorter
Minimum Accuracy	±3
Recording Reference Time	Time zero

NOTE: This data should be used in combination with 7.10.3. This data element is not relevant in events that achieve a minimal level of lateral velocity change (e.g., full frontal barrier events).

7.10.7 Time to Maximum Recorded Delta-V, Longitudinal

The time from time zero to the point where the maximum value of the cumulative change in velocity is found, as recorded by the EDR, along the longitudinal axis.

Unit	ms
Minimum Resolution	2.5
Minimum Range	0 to 300 or 0 to end of impact event time plus 30, whichever is shorter
Minimum Accuracy	±3
Recording Reference Time	Time zero

NOTE: This data should be used in combination with 7.10.4. This data element is not relevant in events that achieve a minimal level of longitudinal velocity change (e.g., a purely lateral moving barrier test).

7.10.8 Time to Maximum Recorded Delta-V, Resultant

The time from time zero to the point where the maximum delta-V resultant occurs, as recorded by the EDR or processed during data imaging.

Unit	ms
Minimum Resolution	2.5
Minimum Range	0 to 300 or 0 to end of impact event time plus 30, whichever is shorter
Minimum Accuracy	±3
Recording Reference Time	Time zero

NOTE: This data should be used in combination with 7.10.5.

7.11 ECU(s) Information

7.11.1 ECU(s) Hardware Part Number(s)

Part number(s) of the ECU(s).

Unit	Not applicable
Minimum Resolution	Not applicable
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	At imaging

NOTE: There may be more than one ECU in a vehicle.

7.11.2 ECU(s) Serial Number(s)

Serial number of the ECU(s).

Unit	Not applicable
Minimum Resolution	Not applicable
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	At imaging

NOTE: There may be more than one ECU in a vehicle.

7.11.3 ECU(s) Software Part Number(s)

Software part number(s) of the ECU(s).

Unit	Not applicable
Minimum Resolution	Not applicable
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	At imaging

NOTE: There may be more than one ECU in a vehicle. There may be more than one ECU software part number per ECU.

7.11.4 ECU(s) Power Applied

Value of voltage applied to (present at) the ECU.

Unit	V
Minimum Resolution	0.1
Minimum Range	0 to 15.0
Minimum Accuracy	±10% of full range
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: There may be more than one ECU in a vehicle.

7.11.5 ECU(s) Life Timer

7.11.5.1 ECU(s) Life Timer at Event

ECU(s) cumulative power on time.

Unit	Minute
Minimum Resolution	1
Minimum Range	0 to 5256000
Minimum Accuracy	±10% of the reading
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: There may be more than one ECU in a vehicle.

7.11.5.2 ECU(s) Life Timer at Imaging

ECU(s) cumulative power on time.

Unit	Minute
Minimum Resolution	1
Minimum Range	0 to 5256000
Minimum Accuracy	±10% of the reading
Recording Reference Time	At imaging

NOTE: There may be more than one ECU in a vehicle.

7.11.6 Event Data Recording Complete

Status of whether or not a complete set of static and time series data, up to 300 ms post time zero, was successfully recorded and stored in the ECU.

Unit	Not applicable
Minimum Resolution	Yes or No
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	End of Recording

7.12 Electronic Stability Control System Status

Operating status of the electronic stability control system.

Unit	Not applicable
Minimum Resolution	Actively controlling, faulted, commanded off, or on but not controlling*
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: The mapping from the above terms to the NHTSA Part 563 nomenclature:

Actively controlling = Engaged

On but not controlling = On

Commanded off = Off

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.13 Electronic Stop Start

Operating status of the electronic stop start system.

Unit	Not applicable
Minimum Resolution	Start, run, electrical and accessory, and stop
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: Please refer to SAE J2948 for more details.

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.14 Event Type

Non-deployment indicates that the algorithm wakeup or threshold conditions were achieved but no device was commanded while Deployment indicates a deployment threshold has been satisfied.

Unit	Non-deployment/deployment
Minimum Resolution	NA
Minimum Range	NA
Minimum Accuracy	NA
Minimum Recording Interval	End of event
Minimum Recording Frequency	Event

7.15 Front Wiper Status

Status of the front wiper system.

Unit	Not applicable
Minimum Resolution	Low, high, off, or auto
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: The OEM may choose to record the front wiper switch status, the front wiper activation status, or both.

7.16 Frontal Air Bag Suppression Switch Status, Front Passenger

Status of the frontal air bag suppression switch, front passenger indicating whether the front passenger air bag suppression system is on or off.

Unit	Not applicable
Minimum Resolution	On or off
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data element should be used in conjunction with the occupant size classification, front passenger data element if the vehicle is equipped with an automatic suppression system.

7.17 Gear Position

The operative transmission gear.

Unit	Not applicable
Minimum Resolution	As applicable per transmission (typical values are drive, park, reverse, neutral, etc.)
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.18 Gear Selection Status

The driver selected transmission gear.

Unit	Not applicable
Minimum Resolution	Park, reverse, neutral, drive or as applicable per transmission
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.19 Ignition Cycle

7.19.1 Ignition Cycle at Event

The number (count) of power cycles applied to the ECU(s) at the time when the event occurred since the first use of that ECU(s).

An example of a power cycle is when the ignition is switched from the OFF/Accessory mode to the ON/RUN mode, not necessarily the START mode.

Unit	Cycles
Minimum Resolution	1
Minimum Range	0 to 60000
Minimum Accuracy	±1
Recording Reference Time	-1.1 to 0 second relative to time zero

7.19.2 Ignition Cycle at Imaging

The number (count) of power cycles applied to the ECU at the time when the imaging occurred since the first use of that ECU.

An example of a power cycle is when the ignition is switched from the OFF/Accessory mode to the ON/RUN mode, not necessarily the START mode.

Unit	Cycles
Minimum Resolution	1
Minimum Range	0 to 60000
Minimum Accuracy	±1
Recording Reference Time	At imaging

7.19.3 Ignition Button Counter per Power Cycle

Number of times the ignition button has been depressed per power cycle.

Unit	Depressions
Minimum Resolution	1
Minimum Range	1 to 253
Minimum Accuracy	±1
Recording Reference Time	-1.1 to 0 second relative to time zero

7.20 Indicator Status

7.20.1 Brake Warning Indicator Status

The displayed status of the brake warning system.

Unit	Not applicable
Minimum Resolution	On or Off
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

7.20.2 Occupant/Pedestrian Protection System Warning Lamp Status

The status of an indicator in the instrument panel that provides the information to the driver of the existence of an occupant/pedestrian protection system malfunction, when lit.

Unit	Not applicable
Minimum Resolution	On or off
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 second to 0 second relative to time zero

NOTE: This data element may exist for both occupant and pedestrian protection systems combined or for each system individually.

7.20.3 Occupant/Pedestrian Protection System Warning Lamp on Time

The total accumulated amount of time the occupant/pedestrian protection system warning lamp indicator in the instrument panel has been illuminated.

Unit	Minute
Minimum Resolution	1
Minimum Range	0 to 5000000
Minimum Accuracy	±10% of the reading
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data element may exist for both occupant and pedestrian protection systems combined or for each system individually.

7.20.4 Number of Cycles Occupant/Pedestrian Protection System Warning Lamp Has Been On

The number of ignition/run cycles the occupant/pedestrian protection system warning lamp indicator in the instrument panel has been illuminated.

Unit	Cycles
Minimum Resolution	1
Minimum Range	0 to 60000
Minimum Accuracy	±1 prior to time zero
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data element may exist for both occupant and pedestrian protection systems combined or for each system individually.

7.20.5 Passenger Frontal Airbag Disabled Indicator Status

The displayed suppression status of the frontal passenger airbag.

Unit	Not applicable
Minimum Resolution	On (airbag disabled/suppressed) or off (airbag enabled)
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

7.20.6 Powertrain Control Module Malfunction Indicator Status (PCM MIL Status)

Status of PCM MIL lamp indicating that fault code(s) are either active or stored in the powertrain control module.

Unit	Not applicable
Minimum Resolution	On or off
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

7.20.7 Tire Pressure Monitoring System Warning Lamp Status

The status of the indicator in the instrument panel that provides the information to the driver when the on-board tire pressure monitoring system has detected that the tire pressure in one or more tire(s) is low.

Unit	Not applicable
Minimum Resolution	On or off
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

7.21 Lane Departure System

Operating status of the lane departure system.

Unit	Not applicable
Minimum Resolution	On but no action, off, faulted, warning, or intervention
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.22 Latitude

Latitude of the vehicle at the beginning of an event.

Unit	Degrees
Minimum Resolution	0.0001
Minimum Range	-90.0000 to +90.0000
Minimum Accuracy	±0.0001
Recording Reference Time	-1.1 to 0 second relative to time zero

7.23 Longitude

Longitude of the vehicle at the beginning of an event.

Unit	Degrees
Minimum Resolution	0.0001
Minimum Range	-180.0000 to + 180.0000
Minimum Accuracy	±0.0001
Recording Reference Time	-1.1 to 0 second relative to time zero

7.24 Manifold Absolute Pressure (MAP)

Mean gas absolute static pressure in the engine induction manifold.

Unit	kPa
Minimum Resolution	1
Minimum Range	- 101 to + 101
Minimum Accuracy	±10% of the full range
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: In cases with multiple engine manifolds, the OEM may need “MAP X” data element(s) to capture the values of the other engine manifolds.

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.25 Mass Airflow

Measurement of air flow entering the throttle body.

Unit	g/s
Minimum Resolution	2.5
Minimum Range	0 to 630
Minimum Accuracy	±10% of the maximum value
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.26 Minutes in Operation at Event

Number of total minutes when the ignition has been in the ON/RUN mode for the current ignition cycle.

Unit	Minutes
Minimum Resolution	1
Minimum Range	0 to 60000
Minimum Accuracy	±10% of the reading
Recording Reference Time	-1.1 to 0 second relative to time zero

7.27 Multi-Event

7.27.1 Multi-Event, Number of Event

Occurrence of minimum two events, the first and last of which begin not more than 5 seconds apart.

Unit	Not applicable
Minimum Resolution	1
Minimum Range	2
Minimum Accuracy	Not applicable
Recording Reference Time	Time zero

7.27.2 Time from Event X to Y

The elapsed time from start of event X to start of event Y.

Unit	Second
Minimum Resolution	0.1
Minimum Range	0 to 5.0
Minimum Accuracy	±0.1
Recording Reference Time	Time zero

7.28 Occupant Classification Information

7.28.1 Occupant Size Classification, Driver

Classification of the driver as being larger than a 5th percentile female.

Unit	Not applicable
Minimum Resolution	Yes or No
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

7.28.2 Occupant Size Classification, Front Passenger

Classification of the front passenger as smaller than a 5th percentile female.

Unit	Not applicable
Minimum Resolution	Yes or No
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This is equivalent to identifying the passenger as a child.

7.29 Occupant/Pedestrian Protection Device Deployment Information

7.29.1 Occupant/Pedestrian Protection Device Deployment Status

Status of each occupant/pedestrian protection device. Each vehicle occupant/pedestrian protection system device that is reported should be reported independently.

Unit	Not applicable
Minimum Resolution	Yes or No
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	Time zero to T_END

NOTE: For the occupant protection devices, this data should be reported in combination with a specific seating position (SAE J1698 Main Table 1) or reported in a predetermined order. In addition, this data should be used in combination with 7.32.2 to indicate the time of deployment of these occupant/pedestrian protection devices.

7.29.2 Occupant/Pedestrian Protection Device Deployment Time

The elapsed time since the beginning of the event (time zero) until the deployment command was made.

Unit	ms
Minimum Resolution	1
Minimum Range	0 to 250
Minimum Accuracy	±2
Recording Reference Time	Time zero

NOTE: For the occupant protection devices, this data should be reported in combination with a specific seating position (SAE J1698 Main Table 1) or reported in a predetermined order. In addition, this data should be used in combination with 7.32.1 which indicates the status of these occupant/pedestrian protection devices.

7.30 Occupant Protection Pressure Sensor

This parameter reflects the feedback from a pressure sensor converted to mbars. In the case of multiple sensor data, this parameter is for sensors 1 to “n” number of sensors.

Unit	mbars
Minimum Resolution	1
Minimum Range	-10.0 to +50.0 mbars
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0 to +50 ms relative to time zero
Minimum Recording Frequency	250 samples/second

7.31 Occupant Protection Pressure Rate of Change

This parameter is the pressure rate of change relative to rest.

Unit	$\Delta P/P_0$ percentage (%)
Minimum Resolution	1
Minimum Range	100
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0 to +50 ms relative to time zero
Minimum Recording Frequency	250 samples/second

7.32 Parking Brake Status

Status of the parking brake.

Unit	Not applicable
Minimum Resolution	On or off
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.33 Propulsion Source Torque

Torque value at the propulsion source output shaft.

Unit	Nm
Minimum Resolution	10
Minimum Range	0 to 2000
Minimum Accuracy	10% of the full range
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.34 Rotational Angle

7.34.1 Roll Angle

Angle of the vehicle about its X-axis (relative to initial vehicle orientation) prior to and during an event.

Unit	Degrees
Minimum Resolution	10
Minimum Range	-1080 to +1080
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0-250 ms or 0 to end of event time plus 30 ms, whichever is shorter.
Minimum Recording Frequency	10 samples/second

If recorded, it is expected that either “roll angle” or “roll rate” (see 7.39.1) will be recorded and reported, not both.

NOTE: Due to the potential for sensor saturation during certain events, these data may not be available after the deployment decision is made.

7.34.2 Yaw Angle

Angle of the vehicle about its Z-axis (relative to initial vehicle orientation) prior to an event.

Unit	Degrees
Minimum Resolution	10
Minimum Range	-1080 to + 1080
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

If recorded, it is expected that either “yaw angle” or “yaw rate” (see 7.39.2) will be recorded and reported, not both.

NOTE: Due to the potential for sensor saturation during certain events, these data may not be available after the deployment decision is made.

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.35 Rotational Angular Rate

7.35.1 Roll Rate

Change in angle of the vehicle about its X-axis prior to and during an event.

Unit	Degrees per second
Minimum Resolution	1
Minimum Range	-240 to +240
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0-250 ms or 0 to end of event time plus 30 ms, whichever is shorter.
Minimum Recording Frequency	10 samples/second

If recorded, it is expected that either “roll rate” or “roll angle” (see 7.38.1) will be recorded and reported, not both.

NOTE: Due to the potential for sensor saturation during certain events, these data may not be available after the deployment decision is made.

7.35.2 Yaw Rate

Change in angle of the vehicle about its Z-axis prior to an event

Unit	Degrees per second
Minimum Resolution	0.1
Minimum Range	-75 to +75
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

If recorded, it is expected that either “yaw rate” or “yaw angle” (see 7.38.2) will be recorded and reported, not both.

NOTE: Due to the potential for sensor saturation during certain events, these data may not be available after the deployment decision is made.

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.36 Revolution per Minute (rpm)

a. For vehicles powered only by internal combustion engines, the number of revolutions per minute of the main crankshaft of the vehicle’s engine.

b. For vehicles not entirely powered by internal combustion engines, the number of revolutions per minute of the motor shaft at the point at which it enters the vehicle transmission gearbox.

NOTE: In cases with multiple power sources, the OEM may need a “rpm 2” data element to capture the values of the second power source.

Unit	rpm
Minimum Resolution	100
Minimum Range	0 to 10000
Minimum Accuracy	±100
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.37 Safety Belt Status

Status of the seatbelt buckle switch.

Unit	Not applicable
Minimum Resolution	On (buckled) or off (unbuckled)
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data should be reported in combination with a specific seating position (SAE J1698 Main Table 1) or reported in a predetermined order.

This data only indicates the status of the seatbelt buckle switch. It does not indicate the existence of an occupant in the seat nor whether the routing of the seatbelt itself is behind or in front of an occupant.

7.38 Seat Track Position Switch; Forward: Status

Status of the switch that is installed into the seat system to detect whether the seat is moved to a position forward of a defined point or not.

Unit	Not applicable
Minimum Resolution	Yes or no
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

NOTE: This data should be reported in combination with a specific seating position (SAE J1698 Main Table 1) or reported in a predetermined order.

7.39 Sensor Design Range Exceeded, XX

Indicates the point in time at which a sensor first reaches the maximum value of the specified range of that sensor.

Unit	ms
Minimum Resolution	Same as the recording frequency of the applicable sensor, XX
Minimum Range	Over the recorded interval of the applicable sensor, XX
Minimum Accuracy	At occurrence or plus one recording frequency of the applicable sensor, XX
Recording Reference Time	Time zero

NOTE: XX is the data element for which the time of saturation is being stated (e.g., longitudinal acceleration, lateral acceleration). The sensor design range exceeded, XX may be applied to any sensor whose data exceeds the range of the sensor. This parameter may not be necessary for a particular data element if the time at which the associated sensor exceeded its design range can be reconstructed from post analysis of the recorded data for that data element.

7.40 Speed Vehicle Indicated

The speed indicated by a manufacturer-designated subsystem designed to indicate the vehicle's ground travel speed during vehicle operation.

Unit	km/h
Minimum Resolution	1
Minimum Range	0 to 200
Minimum Accuracy	±1
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.41 Steering Input

The angular position of the steering wheel where the value of zero (0 degree) indicates its neutral position (i.e., straight). A positive value indicates the steering wheel is turned clockwise (i.e., right).

Unit	Degrees
Minimum Resolution	5
Minimum Range	-250 (counter-clockwise) to +250 (clockwise)
Minimum Accuracy	±5% of the measured value
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.42 Synchronization Timer

7.42.1 Pre-Event Synchronization Timer

Time from last pre-crash data sample to time zero.

Unit	ms
Minimum Resolution	1
Minimum Range	0 to 499
Minimum Accuracy	±2
Recording Reference Time	Time zero

7.43 Throttle Position

7.43.1 Engine Throttle Position, Percent Full (Internal Combustion Engines Only)

Percentage ratio of the engine throttle opening.

Unit	%
Minimum Resolution	1
Minimum Range	0 to 100
Minimum Accuracy	±5
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.43.2 Accelerator Control (Pedal) Position, Percent Full

Percentage ratio of the accelerator control (pedal) position relative to fully depressed position based on the driver's input.

Unit	%
Minimum Resolution	1
Minimum Range	0 to 100
Minimum Accuracy	±5
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.44 Traction Control System Status

Status of traction control system.

Unit	Not applicable
Minimum Resolution	Actively controlling, faulted, commanded off, or on but not controlling
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Minimum Recording Interval	-5.0 to 0 second relative to time zero
Minimum Recording Frequency	2 samples/second

NOTE: This pre-crash data element may be asynchronous relative to other data elements and time zero; therefore, the last data point may have been captured just before time zero but no more than 0.5 second before time zero. All subsequent pre-crash data values are referenced from this data point.

7.45 Vehicle Identification Number

The vehicle identification number (VIN), assigned by the vehicle manufacturer.

Unit	Not applicable
Minimum Resolution	Not applicable
Minimum Range	Not applicable
Minimum Accuracy	Not applicable
Recording Reference Time	-1.1 to 0 second relative to time zero

7.46 Vehicle Mileage

Odometer reading of the vehicle at the beginning of the event.

Unit	km
Minimum Resolution	1
Minimum Range	0 to + 500000
Minimum Accuracy	1
Recording Reference Time	-1.1 to 0 second relative to time zero

8. NOTES

8.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY THE SAE EVENT DATA RECORDER COMMITTEE

APPENDIX A

A.1 SCOPE

SAE J1698-1A creates an appendix to SAE J1698-1. This normative appendix contains EDR record parameters and definitions related to light duty passenger vehicle Pedestrian Protection systems.

A.1.1 Purpose

This appendix establishes pedestrian protection parameters and definitions as outlined in the scope. The data elements shall be those engineering quantities useful in analyzing pedestrian protection system operation or reconstructing pedestrian crashes.

A.2 MULTIPLE AND PARALLEL EVENTS

Pedestrian impact events can be stored within a front/side/rear event or it can be stored as an independent parallel event creating a multi-record event. The system shall be capable of recording at least one pedestrian impact event.

A.3 DATA ELEMENT DEFINITIONS

A.3.1 Acceleration Data (Refer to SAE J1698-1 §7.1)

A.3.1.1 Lateral Acceleration (Refer to SAE J1698-1 §7.1.1)

A.3.1.2 Longitudinal Acceleration (Refer to SAE J1698-1 §7.1.2)

A.3.2 Event Date (Refer to SAE J1698-1 §7.2)

A.3.2.1 Event Date - Year (Refer to SAE J1698-1 §7.2.1)

A.3.2.2 Event Date - Month (Refer to SAE J1698-1 §7.2.2)

A.3.2.3 Event Date - Day (Refer to SAE J1698-1 §7.2.3)

A.3.3 Event Time (Refer to SAE J1698-1 §7.3)

A.3.3.1 Event Time - Hour (Refer to SAE J1698-1 §7.3.1)

A.3.3.2 Event Time - Minute (Refer to SAE J1698-1 §7.3.2)

A.3.3.3 Event Time - Second (Refer to SAE J1698-1 §7.3.3)

A.3.4 Adaptive Cruise Control Status (Driving Automation System Level 1) (Refer to SAE J1698-1 §C.3.4)

A.3.5 Ambient Temperature (Refer to SAE J1698-1 §7.4)

A.3.6 Antilock Brake System Status (Refer to SAE J1698-1 §7.5)

A.3.7 Blind Spot System (Refer to SAE J1698-1 §7.6)

A.3.8 Brake Application. (Refer to SAE J1698-1 §7.7)

A.3.8.1 Brake Pedal Position. (Refer to SAE J1698-1 §7.7.2)

A.3.8.2 Brake System Internal Pressure (Refer to SAE J16978-1 §7.7.3)

A.3.8.3 Braking Request (Refer to SAE J16978-1 §7.7.4)

A.3.8.4 Service Brake, On and Off (Refer to SAE J1698-1 §7.7.5)

A.3.9 Collision Warning System (Refer to SAE J1698-1 §7.8)

A.3.10 Cruise Control System Status (Driving Automation System Level 0) (Refer to SAE J1698-1 §7.9)

A.3.11 ECU(s) Information (Refer to SAE J1698-1 §7.11)

A.3.11.1 ECU(s) Hardware Part Number(s) (Refer to SAE J1698-1 §7.11.1)

A.3.11.2 ECU(s) Serial Number(s) (Refer to SAE J1698-1 §7.11.2)

A.3.11.3 ECU(s) Software Part Number(s) (Refer to SAE J1698-1 §7.11.3)

A.3.11.4 ECU(s) Power Applied (Refer to SAE J1698-1 §7.11.4)

A.3.11.5 ECU(s) Life Timer (Refer to SAE J1698-1 §7.11.5)

A.3.11.5.1 ECU(s) Life Timer at Event (Refer to SAE J1698-1 §7.11.5.1)

A.3.11.5.2 ECU(s) Life Timer at Imaging (Refer to SAE J1698-1 §7.11.5.2)

A.3.11.6 Event Data Recording Complete (Refer to SAE J1698-1 §7.11.6)

A.3.12 Electronic Stability Control System Status (Refer to SAE J1698-1 §7.12)

A.3.13 Electronic Stop Start (Refer to SAE J1698-1 §7.13)

A.3.14 Event Type (Refer to SAE J1698-1 §7.14)

A.3.15 Front Wiper Status (Refer to SAE J1698-1 §7.15)

A.3.16 Gear Position (Refer to SAE J1698-1 §7.17)

A.3.17 Gear Selection Status (Refer to SAE J1698-1 §7.18)

A.3.18 Ignition Cycle (Refer to SAE J1698-1 §7.19)

A.3.18.1 Ignition Cycle at Event (Refer to SAE J1698-1 §7.19.1)

A.3.18.2 Ignition Cycle at Imaging (Refer to SAE J1698-1 §7.19.2)

A.3.18.3 Ignition Button Counter per Power cycle (Refer to SAE J1698-1 §7.19.3)

A.3.19 Indicator Status (Refer to SAE J1698-1 §7.20)

A.3.19.1 Brake Warning Indicator Status (Refer to SAE J1698-1 §7.20.1)

A.3.19.2 Occupant/Pedestrian Protection System Warning Lamp Status (Refer to SAE J1698-1 §7.20.2)

A.3.19.3 Occupant/Pedestrian Protection System Warning Lamp On Time (Refer to SAE J1698-1 §7.20.3)

A.3.19.4 Number of Cycles Pedestrian Protection System Warning Lamp Has Been On (Refer to SAE J1698-1 §7.20.4)

A.3.19.5 Powertrain Control Module Malfunction Indicator Status (PCM MIL Status) (Refer to SAE J1698-1 §7.20.6)

A.3.19.6 Tire Pressure Monitoring System Warning Lamp Status (Refer to SAE J1698-1 §7.20.7)

A.3.20 Lane Departure System (Refer to SAE J1698-1 §7.21)

A.3.21 Latitude (Refer to SAE J1698-1 §7.22)

A.3.22 Longitude (Refer to SAE J1698-1 §7.23)

A.3.23 Manifold Absolute Pressure (MAP) (Refer to SAE J1698-1 §7.24)

A.3.24 Mass Airflow (Refer to SAE J1698-1 §7.25)

A.3.25 Minutes in Operation at Event (Refer to SAE J1698-1 §7.26)

A.3.26 Occupant/Pedestrian Protection Device Deployment Information (Refer to SAE J1698-1 §7.29)

A.3.26.1 Occupant/Pedestrian Protection Device Deployment Status (Refer to SAE J1698-1 §7.29.1)

A.3.26.2 Occupant/Pedestrian Protection Device Deployment Time (Refer to SAE J1698-1 §7.92.2)

A.3.27 Parking Brake Status (Refer to SAE J1698-1 §7.32)

A.3.28 Pedestrian Protection Sensor Data

A.3.28.1 Pedestrian Protection Acceleration

The vector acceleration of a point in the vehicle.

Unit	G
Minimum Resolution	0.5
Minimum Range	-50 to +50
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0 to 250 ms relative to time zero
Minimum Recording Frequency	500 samples/second

NOTE: Due to the potential for accelerometer saturation during certain events, this data element may not be suitable for use in event reconstruction. However, this data element may be useful for other purposes such as deployment decision reconstruction.

A.3.28.2 Pedestrian Protection Pressure Sensor

This parameter reflects the feedback from a pressure sensor converted to mbars. In the case of multiple sensor data, this parameter is for sensors 1 to “n” number of sensors.

Unit	Mbars
Minimum Resolution	1
Minimum Range	-50 to +150
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0 to +25 ms relative to time zero
Minimum Recording Frequency	250 samples/second

A.3.28.3 Pedestrian Protection Pressure Rate of Change

This parameter is the pressure rate of change relative to rest.

Unit	$\Delta P/P_0$ percentage (%)
Minimum Resolution	1
Minimum Range	100
Minimum Accuracy	At the option of the manufacturer
Minimum Recording Interval	0 to +25 ms relative to time zero
Minimum Recording Frequency	250 samples/second

A.3.29 Propulsion Source Torque (Refer to SAE J1698-1 §7.33)

A.3.30 Revolution per Minute (rpm) (Refer to SAE J1698-1 §7.36)

A.3.31 Sensor Design Range Exceeded, XX (Refer to SAE J1698-1 §7.39)

A.3.32 Speed Vehicle Indicated. (Refer to SAE J1698-1 §7.40)

A.3.33 Steering Input (Refer to SAE J1698-1 §7.41)

A.3.34 Synchronization Timer (Refer to SAE J1698-1 §7.42)

A.3.34.1 Pre-Event Synchronization Timer (Refer to SAE J1698-1 §7.42.1)

A.3.35 Throttle Position (Refer to SAE J1698-1 §7.43)

A.3.35.1 Engine Throttle Position, Percent Full (Internal Combustion Engines Only) (Refer to SAE J1698-1 §7.43.1)

A.3.35.2 Accelerator Control (Pedal) Position, Percent Full (Refer to SAE J1698-1 §7.43.2)

A.3.36 Traction Control System Status (Refer to SAE J1698-1 §7.44)

A.3.37 Vehicle Identification Number (Refer to SAE J1698-1 §7.45)

A.3.38 Vehicle Mileage (Refer to SAE J1698-1 §7.46)