

# J3197 – SURFACE VEHICLE RECOMMENDED PRACTICE

## AUTOMATED DRIVING SYSTEM DATA LOGGER

J. Bielenda, SAE EDR Main Committee Chairman  
3/30/2021

# Agenda

EDR/Data Logger Task Force Members & Experience

EDR Main Committee Published Documents

J1698-1 Approach & Data Elements

J3197 Rationale/Scope/Purpose

- Event Types
- Annotated Image
- Data Elements

Summary

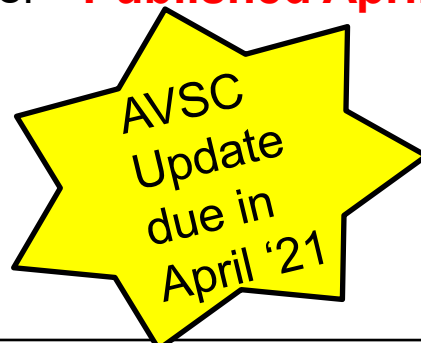
# SAE EDR Committee Membership

- Established a Data Logger Task Force in 2016
- Roster contains 51 people with expertise in:
  - Vehicle Manufacturing (11 different OEMs)
  - Suppliers
  - ADS Design/Development
  - Accident Reconstruction
  - Research
  - EDR Tool Manufacturer
  - Liaisons
  - SAE Staff
- Over half of committee voting members have been participating for 10+ yrs.

# SAE EDR Committee Published Standards

- SAE J1698-1 - EDR - Output Data Definition - Updated May 2018
  - Added data elements relative to Automated Driving Systems (**\*Class IV**)  
ADS Mode, Fallback Ready User Intervention, Failure Mitigation Activated, Steering Input Requested
- SAE J1698-2 - EDR - Retrieval Tool Protocol - Reaffirmed March 2018
- SAE J1698-3 - EDR - Compliance Assessment - Revised December 2015
- SAE J3197 - Automated Driving System Data Logger - **Published April 2020**
  - Governs data element definitions
  - Provides a minimum data element set
  - Specifies a common ADS data logger record format

**\*Class IV** - Data elements pertaining to Level 2, 2+ Automated Driving System (ADS) features.



# **Event Data Recorder Output Data Definition J1698-1**

## **Approach to new EDR data elements (Minimum set)**

For systems like Forward Collision Warning, Blind Spot Detection, Lane Keep Assist, Lane Departure and Automated Emergency Braking:

- System ON/OFF
- System Intervening/engaged
- Warning (HMI/Audible)
- System Faulted

# J1698-1 – EDR Data Elements

**Class I - Data elements currently found either in the ECU(s) or on the communications bus in most vehicles across the industry except some low volume vehicles.**

## J1698-1 Minimum Data Element Set:

- Longitudinal Delta-V
- Maximum Recorded Longitudinal Delta-V
- Time to Maximum Recorded Delta V, Longitudinal
- Speed, Vehicle Indicated
- Revolution Per Minute (RPM)
- Engine throttle Position, Percent Full (or Accelerator Control (Pedal) Position, Percent Full)
- Service Brake, On and Off
- Ignition Cycle at Event
- Ignition Cycle at Imaging
- Safety Belt Status, Driver
- Occupant Protection System Warning Lamp Status
- Occupant Protection Device Deployment Time (for Driver Frontal Air Bag 1<sup>st</sup> Stage Deployment)
- Occupant Protection Device Deployment Time (for Passenger Frontal Air Bag 1<sup>st</sup> Stage Deploy)
- Multi-Event, Number of Events
- Time from Event X to Y
- Event Data Recording Complete

# J1698-1 – EDR Data Elements

**Class II - Data elements currently found either in the ECU(s) or on the communications bus in some vehicles but not industry wide.**

## **Additional Data Elements should be recorded if they are available.**

- Lateral Acceleration
- Longitudinal Acceleration
- Normal Acceleration
- Lateral Delta-V
- Maximum Recorded Lateral Delta-V
- Time to Maximum Recorded Delta-V, Lateral
- Time to Maximum Recorded Delta-V, Resultant
- Roll Rate (or Roll Angle)
- Antilock Brake System
- Traction Control Status
- Electronic Stability Control System Status
- Steering Input
- Safety Belt Status, Front Passenger
- Frontal Air Bag Suppression Switch Status, Front Passenger
- Event type
- Gear Position
- Tire Pressure Monitoring System Warning Lamp Status
- Manifold Absolute Pressure (MAP)
- Mass Airflow
- Yaw Rate
- Vehicle Identification Number
- Pedestrian Protection Pressure Sensor
- Pedestrian Protection Pressure Rate of Change



# J1698-1 – EDR Data Elements

**Class II - Data elements currently found either in the ECU(s) or on the communications bus in some vehicles but not industry wide.**

- Occupant Protection Device Deployment Time (for Driver Frontal Air Bag Additional Stages)
- Occupant Protection Device Deployment Time (for Passenger Frontal Air Bag Add'l Stages)
- Occupant Protection Device Deployment Time (for Driver Side Air Bag)
- Occupant Protection Device Deployment Time (for Front Passenger Side Air Bag)
- Occupant Protection Device Deployment Time (for Driver Side Curtain/Tube Air Bag)
- Occupant Protection Device Deployment Time (for Passenger Side Curtain/Tube Air Bag)
- Occupant Protection Device Deployment Time (for Driver Pretensioner)
- Occupant Protection Device Deployment Time (for Front Passenger Pretensioner)
- Seat Track Position Switch; Forward Status, Driver
- Seat Track Position Switch; Forward Status, Front Passenger
- Occupant Size Classification, Driver
- Occupant Size Classification, Front Passenger
- ECU Part Number
- ECU Serial Number
- ECU life timer at event
- ECU life timer at image
- PCM MIL
- Passenger Frontal Airbag Disabled Indicator Status

# J1698-1 – EDR Data Elements

**Class III** ▀ Data elements either (1) not found in the ECU(s) or on the communications bus in any current vehicles or (2) only found in a small percentage of vehicles.

- Accident date Y/M/D
- Time – H/M/S
- Adaptive Cruise Control Status
- Ambient Temperature
- Anti-Lock Brake System Status
- Blind Spot System
- Automated Emergency Braking (AEB)
- Brake Pedal Position
- Brake System Internal Pressure
- Braking Request
- Collision Warning System
- Cruise Control System Status
- ECU Software Part Number
- ECU Power applied
- Electronic Start /Stop
- Front wiper status
- Gear Selection
- Pedestrian Protection Acceleration
- Hazard Flasher Status
- Headlamp Status
- Ignition Button Counter per key cycle
- Brake Warning Indicator Status
- Occupant/Pedestrian Protection System Warning Lamp on Time
- Number of Cycles Occupant/Pedestrian Protection System Warning Lamp Has Been On
- Lane Departure System
- Latitude
- Longitude
- Minutes in Operation at Event
- Parking Brake Status
- Partial Driving Automation Operating Status (driving automation system level 2)
- Propulsion Source Torque
- Yaw Angle
- Sensor Design Range Exceeded, XX
- Pre-Event Synchronization Timer
- Turn Signal Status
- Vehicle Mileage
- Rollover Restraint System Disabled Indicator Status

# **Automated Driving System Data Logger J3197**

# J3197 – Automated Driving System Data Logger

**J3197 Rationale** - Automated driving systems (ADS) 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.

Data Logger purpose is for accident reconstruction

# J3197 – Automated Driving System Data Logger

**Scope** - This 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.

The data elements defined in this document are unique to **Levels 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 (Accident Reconstruction).

# J3197 – Automated Driving System Data Logger

**Scope (Cont.)** The data from sensors such as camera(s), Radar, 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 EDR record **and traditional accident reconstruction analysis**. The event data recorder (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 sensing sensors for up to 250 milliseconds.

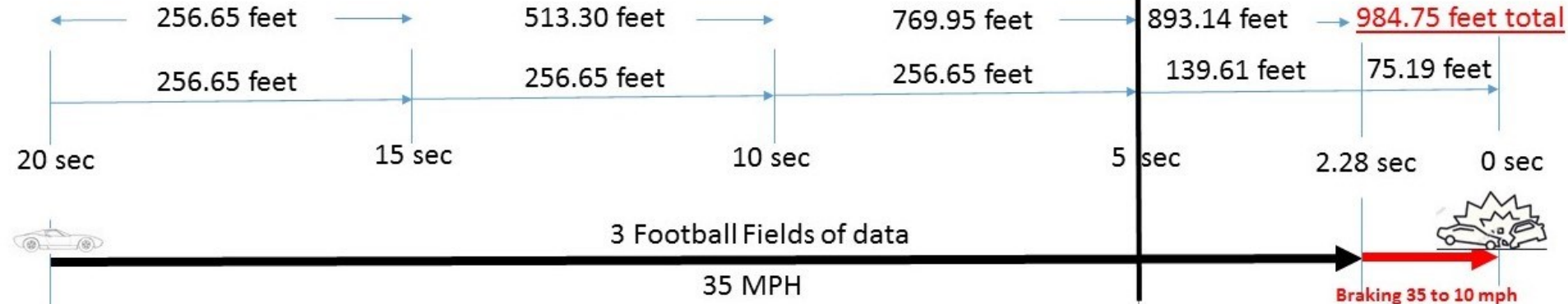
# J3197 – Automated Driving System Data Logger

## Intersection Accident Scenario: 35 mph panic brake to 10 mph impact

Note: 35 mph = 51.33 ft/sec x 20 sec = 1107.94 ft. (3+ Football Fields)  
75 mph = 110 ft/sec x 20 sec = 2200 ft. (7+ Football Fields)

### Proposed EDR - 20 sec

### Current EDR - 5 sec



# J3197 – Automated Driving System Data Logger

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.



# J3197 – Automated Driving System Data Logger

**Purpose** - ADS data loggers record the specified data recording 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.

Do not drive technology required for an Automated Driving System. Allow different technologies to be used by OEMs. No data element should force a specific technology.

## ADS Task Force Approach –

Rather than copy all the data elements from J1698-1 into the Data Logger Best Practice, we envisioned the Data Logger would work in conjunction with the EDR currently in the vehicle. Depending on vehicle architecture, this may or may not be the best approach for a specific application (L4, L5). It may be better to combine all data elements from J1698-1 and J3197 into a data logger.

Due to number of recorded data elements with their frequency and time duration, the memory & energy reserve required to store this information may not be supported by a regular EDR. Most EDR records are managed by the Air Bag Control Module whose main task is to deploy the restraint system devices. The EDR function may interfere/compromise this task.

# J3197 – Automated Driving System Data Logger

## Event Types

- Frontal
- Side
- Rear
- Roll-Over
- Pedestrian Protection

## Consistent Definitions

**J3016** - Taxonomy/Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles

**J3164** - Taxonomy/Definitions for Terms Related to Automated Driving System Behaviors and Maneuvers for On-Road Motor Vehicles

# J3197 – Automated Driving System Data Logger

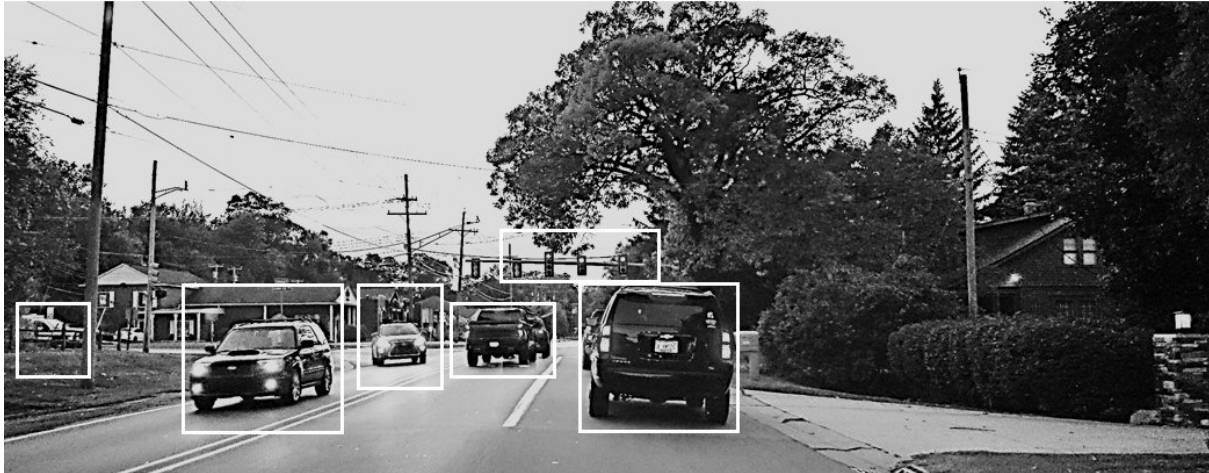
**Annotated Image** - An annotated image is a visual representation of the scene relative to the vehicle's perspective (vehicle's salient operating environment) which contains a snapshot of the field of view along with overlaid visual boxes or other means of identification for the salient objects.

**The annotations on the images may not represent all salient objects being considered by the ADS.** The ADS may annotate the image itself or may require that the output tool annotate the image based on the ADS recorded positional data of the salient object(s) relative to the subject

# J3197 – Automated Driving System Data Logger

An **Annotated image** was selected as it gives the OEM the ability to show what the vehicle “saw” and what the system was monitoring with out giving away any Intellectual Property (IP).

**Image** - An image is a visual representation of the scene relative to the vehicle’s perspective which contains a snapshot of the field of view.



# J3197 – Automated Driving System Data Logger

The series of images may convey information such as:

- The motion and direction of an object relative to the subject vehicle or ground
- Emergency vehicle brake light status
- Emergency vehicle light status
- Other vehicle hazard flasher status
- Other vehicle turn signal status
- Roadway/lanes
- Traffic control device state
- Vehicle back up light status
- Vehicle Brake light status

# J3197 – Automated Driving System Data Logger

## Data Capture Recommendations

**Triggers** -The ADS data logger should capture and record the data elements for events in accordance with the following conditions and circumstances:

1. In a deployment event (frontal, side, rear, rollover), capture and record the current deployment data.
2. In an impact event where the longitudinal or lateral cumulative delta-V exceeds 8 km/h within a 150 ms time window.
3. In a pedestrian impact event
4. Any additional triggers as defined by the ADS data logger system supplier.

**NOTE:** These triggers are not part of SAE J1698-1 and thus will not automatically trigger an EDR record. If EDR data is desired, the ADS data logger system supplier will need to address this condition by creating a new trigger for the EDR or by including the desired EDR data in the ADS data logger.

# J3197 – Automated Driving System Data Logger

**Minimum Data Element Set:** The following data elements are the recommended minimum set of data elements that should be recorded.

1. Time Stamp of Initial Data Record
2. Data Record Trigger Type
3. Environmental Input
  - a. Emergency Vehicle Warning Flag
  - b. Location Data - Latitude
  - c. Location Data - Longitude
  - d. Vehicle Heading
4. Annotated Image
5. Passenger-Initiated Emergency Stop (PES) (if equipped)



# J3197 – Automated Driving System Data Logger

## 6. ADS Action - Vehicle Motion Control

### a. ADS Requested Braking

NOTE: If negative longitudinal acceleration is included in ADS Requested Longitudinal Vehicle Motion Control, then this data element is optional.

### b. ADS Requested Gear

### c. ADS Requested Hazard Flashers

### d. ADS Requested Headlights

### e. ADS Requested Lateral Vehicle Motion Control

### f. ADS Requested Longitudinal Vehicle Motion Control

### g. ADS Requested Turn Signal

## 7. ADS Mode - (DDT (nominal),ADS Operated DDT Fallback Maneuver, Minimal Risk Condition, Dis-engaged),

# J3197 – Automated Driving System Data Logger

8. ADS Reference Vehicle Speed
9. Record Complete Flag
10. Request to Intervene
11. Vehicle Indicated Status
  - a. Hazard Flasher Status
  - b. Headlight Status
  - c. Steering Position Actual
  - d. Turn Signal Status

# J3197 – Automated Driving System Data Logger

## ADS Data Logger Task Force – Next Steps to address:

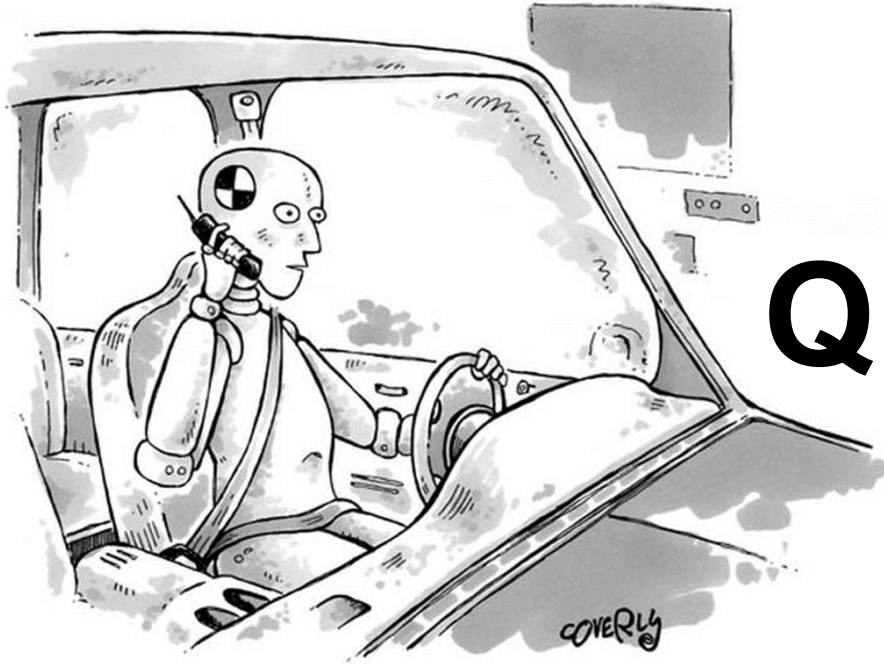
- Survivability
- Compliance Testing

# J3197 – Automated Driving System Data Logger

## Summary:

- Over 3 years of work done by OEM, Supplier & ADS Experts with a peer check done by the Automated Vehicle Safety Consortium (AVSC)
- Accident reconstruction should be the first Scope for the Regulation/Standard
- Utilize the J3016 & J3164 ADS Definitions (Standardize the language)
- Push for a common International standard (OEMs cannot support regional specific EDR/Data Logger)
- Ensure regulation allows the OEM to record more elements/resolution
- Ensure regulation allows using different sensor technologies
- Allow OEMs the freedom to develop their systems (minimum set)
- J3197 is a good starting point for a DSSAD regulation

# J3197 – Automated Driving System Data Logger



# QUESTIONS?

*“Well, I’d better go now. I’m almost at the wall.”*