

**EDR Performance Elements Appropriate for  
Adoption in 1958 and 1998 Agreement  
Resolutions or Regulations**

## EVENT DATA RECORDERS

### 1. Scope.

The performance elements contained in this document provide uniform specifications for vehicles equipped with Event Data Recorders (EDRs) concerning the minimum collection, storage, and retrievability of motor vehicle crash event data. It also contains specifications for vehicle manufacturers to make tools and/or methods commercially available so that crash investigators and researchers can retrieve data from EDRs.

These performance elements apply to all vehicles of Category 1-1, and 2, with a gross vehicle mass (GVM) of 3,855 kilograms or less. (OICA draft for 58 agreement specification used M1 ≤ 3,5 t and N1 ≤ 2,5 t)

### 2 Purpose.

The purpose of these performance elements is to ensure that EDRs record, in a readily usable manner, data valuable for effective crash investigations and for analysis of safety equipment performance (e.g., advanced restraint systems). These data will help provide a better understanding of the circumstances in which crashes and injuries occur and will facilitate the development of safer vehicle designs.

### 3. Definitions.

*ABS activity* means the anti-lock brake system (ABS) is actively controlling the vehicle's brakes.

*Air bag warning lamp status* means whether the warning lamp required by national air bag regulations (if any) is on or off.

*Capture* means the process of buffering EDR data in a temporary, volatile storage medium where it is continuously updated at regular time intervals.

*Delta-V, lateral* means the cumulative change in velocity, as recorded by the EDR of the vehicle, along the lateral axis, starting from crash time zero and ending at 0.25 seconds, recorded every 0.01 seconds.

*Delta-V, longitudinal* means the cumulative change in velocity, as recorded by the EDR of the vehicle, along the longitudinal axis, starting from crash time zero and ending at 0.25 seconds, recorded every 0.01 seconds.

*Deployment time, frontal air bag* means (for both driver and right front passenger) the elapsed time from crash time zero to the deployment command, or for multi-staged air bag systems, the deployment command for the first stage.

*Disposal* means the deployment command of the second (or higher, if present) stage of a frontal air bag for the purpose of disposing the propellant from the air bag device.

*End of event time* means the moment at which the resultant cumulative delta-V within a 20 ms time period becomes 0.8 km/h (0.5 mph) or less, or the moment at which the crash detection algorithm of the air bag control unit resets.

*Engine RPM* means

- (1) For vehicles powered by internal combustion engines, the number of revolutions per minute of the main crankshaft of the vehicle's engine; and
- (2) 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.
- [(3) For vehicles not powered by internal combustion engines, the number of revolutions of the output shaft from the device supplying motive power.]

*Engine throttle, percent full* means the driver-requested acceleration as measured by the throttle position sensor on the accelerator pedal compared to the fully depressed position.

*Event* means a crash or other physical occurrence that causes the trigger threshold to be met or exceeded, or any non-reversible deployable restraint to be deployed, whichever occurs first.

*Event data recorder (EDR)* means a device or function in a vehicle that records the vehicle's dynamic time-series data during the time period just prior to a crash event (e.g., vehicle speed vs. time) or during a crash event (e.g., delta-V vs. time), intended for retrieval after the crash event. For the purposes of this definition, the event data do not include audio and video data.

*Frontal air bag* means an inflatable restraint system that requires no action by vehicle occupants and is used to meet the applicable national frontal crash protection requirements.

*Ignition cycle, crash* means the number (count) of power cycles applied to the recording device at the time when the crash event occurred since the first use of the EDR.

*Ignition cycle download* means the number (count) of power cycles applied to the recording device at the time when the data was downloaded since the first use of the EDR.

*Lateral acceleration* means the component of the vector acceleration of a point in the vehicle in the y-direction. 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.

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

*Maximum delta-V, lateral* means the maximum value of the cumulative change in velocity, as recorded by the EDR, of the vehicle along the lateral axis, starting from crash time zero and ending at 0.3 seconds.

*Maximum delta-V, longitudinal* means the maximum value of the cumulative change in velocity, as recorded by the EDR, of the vehicle along the longitudinal axis, starting from crash time zero and ending at 0.3 seconds.

*Maximum delta-V, resultant* means the time-correlated maximum value of the cumulative change in velocity, as recorded by the EDR or processed during data download, along the vector-added longitudinal and lateral axes.

*Multi-event crash* means the occurrence of 2 events, the first and last of which begin not more than 5 seconds apart.

*Non-volatile memory* means the memory reserved for maintaining recorded EDR data in a semi-permanent fashion. Data recorded in non-volatile memory is retained after loss of power and can be retrieved with EDR data extraction tools and methods.

*Normal acceleration* means the component of the vector acceleration of a point in the vehicle in the z-direction. The normal acceleration is positive in a downward direction and is zero when the accelerometer is at rest.

*Occupant position classification* means the classification indicating that the seating posture of a front outboard occupant (both driver and right front passenger) is determined as being out-of-position.

*Occupant size classification* means, for the right front passenger, the classification of the occupant as a child (as defined National occupant classification requirements) or not as an adult (as defined in National occupant classification requirements), and for the driver, the classification of the driver as being a 5th percentile female (as defined in National occupant classification requirements) or larger.

*Pretensioner* means a device that is activated by a vehicle's crash sensing system and removes slack from a vehicle safety belt system.

*Record* means the process of saving captured EDR data into a non-volatile device for subsequent retrieval.

*Safety belt status* means the feedback from the safety system that is used to determine that an occupant's safety belt (for both driver and right front passenger) is fastened or unfastened.

*Seat track position switch, foremost, status* means the status of the switch that is installed to detect whether the seat is moved to a forward position.

*Service brake, on or off* means the status of the device that is installed in or connected to the brake pedal system to detect whether the pedal was pressed. The device can include the brake pedal switch or other driver-operated service brake control.

*Side air bag* means any inflatable occupant restraint device that is mounted to the seat or side structure of the vehicle interior, and that is designed to deploy in a side impact crash to help mitigate occupant injury and/or ejection.

*Side curtain/tube air bag* means any inflatable occupant restraint device that is mounted to the side structure of the vehicle interior, and that is designed to deploy in a side impact crash or rollover and to help mitigate occupant injury and/or ejection.

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

*Stability control* means any device that complies with National, "Electronic stability control systems."

*Steering input* means the angular displacement of the steering wheel measured from the straight-ahead position (position corresponding to zero average steer angle of a pair of steered wheels).

*Suppression switch status* means the status of the switch indicating whether an air bag suppression system is on or off.

*Time from event 1 to 2* means the elapsed time from time zero of the first event to time zero of the second event.

*Time, maximum delta-V, lateral* means the time from crash 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.

*Time, maximum delta-V, longitudinal* means the time from crash 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.

*Time, maximum delta-V, resultant* means the time from crash time zero to the point where the maximum delta-V resultant occurs, as recorded by the EDR or processed during data download.

*Time to deploy, pretensioner* means the elapsed time from crash time zero to the deployment command for the safety belt pretensioner (for both driver and right front passenger).

*Time to deploy, side air bag/curtain* means the elapsed time from crash time zero to the deployment command for a side air bag or a side curtain/tube air bag (for both driver and right front passenger).

*Time to first stage* means the elapsed time between time zero and the time when the first stage of a frontal air bag is commanded to fire.

*Time to nth stage* means the elapsed time from crash time zero to the deployment command for the nth stage of a frontal air bag (for both driver and right front passenger).

*Time zero* means whichever of the following occurs first:

- (1) For systems with “wake-up” air bag control systems, the time at which the occupant restraint control algorithm is activated; or
- (2) For continuously running algorithms,
  - (i) The first point in the interval where a longitudinal cumulative delta- V of over 0.8 km/h (0.5 mph) is reached within a 20 ms time period; or
  - (ii) For vehicles that record “delta-V, lateral,” the first point in the interval where a lateral cumulative delta-V of over 0.8 km/h (0.5 mph) is reached within a 5 ms time period; or
  - (iii) Deployment of a non-reversible deployable restraint.

*Trigger threshold* means a change in vehicle velocity, in the longitudinal direction, that equals or exceeds 8 km/h within a 150 ms interval. For vehicles that record “delta-V, lateral,” trigger

threshold means a change in vehicle velocity in either the longitudinal or lateral direction that equals or exceeds 8 km/h within a 150 ms interval.

*Vehicle roll angle* means the angle between the vehicle's y-axis and the ground plane.

*Volatile memory* means the memory reserved for buffering of captured EDR data. The memory is not capable of retaining data in a semi-permanent fashion. Data captured in volatile memory is continuously overwritten and is not retained in the event of a power loss or retrievable with EDR data extraction tools.

*X-direction* means in the direction of the vehicle's X-axis, which is parallel to the vehicle's longitudinal centerline. The X-direction is positive in the direction of forward vehicle travel.

*Y-direction* means in the direction of the vehicle's Y-axis, which is perpendicular to its X-axis and in the same horizontal plane as that axis. The Y-direction is positive from left to right, from the perspective of the driver when seated in the vehicle facing the direction of forward vehicle travel.

*Z-direction* means in the direction of the vehicle's Z-axis, which is perpendicular to the X- and Y-axes. The Z-direction is positive in a downward direction.

#### 4. Performance Specifications.

Performance specifications for vehicles equipped with an EDR include data elements, data format, data capture, and crash test performance and survivability.

#### 5. Data elements.

- (a) *Data elements required for all vehicles.* Each vehicle equipped with an EDR must record all of the data elements listed in Table I, during the interval/time and at the sample rate specified in that table.

TABLE I—DATA ELEMENTS REQUIRED FOR ALL VEHICLES EQUIPPED WITH AN EDR

Data element	Recording interval/time <sup>1</sup> (relative to time zero)	Data sample rate (samples per second)
Delta-V, longitudinal	0 to 250 ms or 0 to End of Event Time plus 30 ms, whichever is shorter.	100
Maximum delta-V, longitudinal	0–300 ms or 0 to End of Event Time plus 30 ms, whichever is shorter.	N/A
Time, maximum delta-V	0–300 ms or 0 to End of Event Time plus 30 ms, whichever is shorter.	N/A
Speed, vehicle indicated	-5.0 to 0 sec	2
Engine throttle, % full (or accelerator pedal, % full)	-5.0 to 0 sec	2
Service brake, on/off	-5.0 to 0 sec	2
Ignition cycle, crash	-1.0 sec	N/A

Ignition cycle, download	At time of download <sup>3</sup>	N/A
Safety belt status, driver	-1.0 sec	N/A
Frontal air bag warning lamp, on/off <sup>2</sup>	-1.0 sec	N/A
Frontal air bag deployment, time to deploy, in the case of a single stage air bag, or time to first stage deployment, in the case of a multi-stage air bag, driver.	Event	N/A
Frontal air bag deployment, time to deploy, in the case of a single stage air bag, or time to first stage deployment, in the case of a multi-stage air bag, right front passenger.	Event	N/A
Multi-event, number of event	Event	N/A
Time from event 1 to 2	As needed	N/A
Complete file recorded (yes, no)	Following other data	N/A

<sup>1</sup> Pre-crash data and crash data are asynchronous. The sample time accuracy requirement for pre-crash time is -0.1 to 1.0 sec (e.g., T = -1 would need to occur between -1.1 and 0 seconds.)

<sup>2</sup> The frontal air bag warning lamp is the readiness indicator specified in S4.5.2 of FMVSS No. 208, and may also illuminate to indicate a malfunction in another part of the deployable restraint system.

<sup>3</sup> The ignition cycle at the time of download is not required to be recorded at the time of the crash, but shall be reported during the download process.

(b) *Data elements required for vehicles under specified conditions.* Each vehicle equipped with an EDR must record each of the data elements listed in column 1 of Table II for which the vehicle meets the condition specified in column 2 of that table, during the interval/time and at the sample rate specified in that table.

TABLE II—DATA ELEMENTS REQUIRED FOR VEHICLES UNDER SPECIFIED MINIMUM CONDITIONS

Data element name	Condition for requirement	Recording interval/time <sup>1</sup> (relative to time zero)	Data sample rate (per second)
Lateral acceleration	If recorded <sup>2</sup>	N/A	N/A
Longitudinal acceleration	If recorded	N/A	N/A
Normal acceleration	If recorded	N/A	N/A
Delta-V, lateral	If recorded	0–250 ms or 0 to End of Event Time plus 30 ms, whichever is shorter.	100
Maximum delta-V, lateral	If recorded	0–300 ms or 0 to End of Event Time plus 30 ms, whichever is shorter.	N/A

Time maximum delta-V, lateral	If recorded	0–300 ms or 0 to End of Event Time plus 30 ms, whichever is shorter.	N/A
Time for maximum delta-V, resultant.	If recorded	0–300 ms or 0 to End of Event Time plus 30 ms, whichever is shorter.	N/A
Engine rpm	If recorded	-5.0 to 0 sec	2
Vehicle roll angle	If recorded	-1.0 up to 5.0 sec <sup>3</sup>	10
ABS activity (engaged, non-engaged).	If recorded	-5.0 to 0 sec	2
Stability control (on, off, or engaged).	If recorded	-5.0 to 0 sec	2
Steering input	If recorded	-5.0 to 0 sec	2
Safety belt status, right front passenger (buckled, not buckled).	If recorded	-1.0 sec	N/A
Frontal air bag suppression switch status, right front passenger (on, off, or auto).	If recorded	-1.0 sec	N/A
Frontal air bag deployment, time to nth stage, driver <sup>4</sup> .	If equipped with a driver's frontal air bag with a multi-stage inflator.	Event	N/A
Frontal air bag deployment, time to nth stage, right front passenger <sup>4</sup> .	If equipped with a right front passenger's frontal air bag with a multi-stage inflator.	Event	N/A
Frontal air bag deployment, nth stage disposal, driver, Y/N (whether the nth stage deployment was for occupant restraint or propellant disposal purposes).	If recorded	Event	N/A
Frontal air bag deployment, nth stage disposal, right front passenger, Y/N (whether the nth stage deployment was for occupant restraint or propellant disposal purposes).	If recorded	Event	N/A
Side air bag deployment, time to deploy, driver.	If recorded	Event	N/A



Side air bag deployment, time to deploy, right front passenger.	If recorded	Event	N/A
Side curtain/tube air bag deployment, time to deploy, driver side.	If recorded	Event	N/A
Side curtain/tube air bag deployment, time to deploy, right side.	If recorded	Event	N/A
Pretensioner deployment, time to fire, driver.	If recorded	Event	N/A
Pretensioner deployment, time to fire, right front passenger.	If recorded	Event	N/A
Seat track position switch, foremost, status, driver.	If recorded	-1.0 sec	N/A
Seat track position switch, foremost, status, right front passenger.	If recorded	-1.0 sec	N/A
Occupant size classification, driver	If recorded	-1.0 sec	N/A
Occupant size classification, right front passenger.	If recorded	-1.0 sec	N/A
Occupant position classification, driver.	If recorded	-1.0 sec	N/A
Occupant position classification, right front passenger.	If recorded	-1.0 sec	N/A

- 1 Pre-crash data and crash data are asynchronous. The sample time accuracy requirement for pre-crash time is -0.1 to 1.0 sec (e.g. T = -1 would need to occur between -1.1 and 0 seconds.)
- 2 'If recorded' means if the data is recorded in non-volatile memory for the purpose of subsequent downloading.
- 3 'vehicle roll angle' may be recorded in any time duration; -1.0 sec to 5.0 sec is suggested.
- 4 List this element n - 1 times, once for each stage of a multi-stage air bag system.

## 6. Data format.

(a) The data elements listed in Tables I and II, as applicable, must be reported in accordance with the range, accuracy, and resolution specified in Table III

TABLE III—REPORTED DATA ELEMENT FORMAT

<b>Data element</b>	<b>Minimum range</b>	<b>Accuracy<sup>1</sup></b>	<b>Resolution</b>
Lateral acceleration	At option of manufacturer.	At option of manufacturer.	At option of manufacturer.
Longitudinal acceleration	At option of manufacturer.	At option of manufacturer.	At option of manufacturer.
Normal Acceleration	At option of manufacturer.	At option of manufacturer.	At option of manufacturer.
Longitudinal delta-V	-100 km/h to + 100 km/h.	±10%	1 km/h.
Lateral delta-V	-100 km/h to + 100 km/h.	±10%	1 km/h.
Maximum delta-V, longitudinal.	-100 km/h to + 100 km/h.	±10%	1 km/h.
Maximum delta-V, lateral	-100 km/h to + 100 km/h.	±10%	1 km/h.
Time, maximum delta-V, longitudinal.	0–300 ms, or 0-End of Event Time plus 30 ms, whichever is shorter.	±3 ms	2.5 ms.
Time, maximum delta-V, lateral.	0–300 ms, or 0-End of Event Time plus 30 ms, whichever is shorter.	±3 ms	2.5 ms.
Time, maximum delta-V, resultant.	0–300 ms, or 0-End of Event Time plus 30 ms, whichever is shorter.	±3 ms	2.5 ms.
Vehicle Roll Angle	-1080 deg to + 1080 deg.	±10%	10 deg.
Speed, vehicle indicated	0 km/h to 200 km/h	±1 km/h	1 km/h.
Engine throttle, percent full (accelerator pedal percent full).	0 to 100%	±5%	1%
Engine rpm	0 to 10,000 rpm	±100 rpm	100 rpm.
Service brake	On or Off	N/A	On or Off.
ABS activity	On or Off	N/A	On or Off.
Stability control	On, Off, or Engaged	N/A	On, Off, or Engaged.
Steering input	-250 deg CW to + 250 deg CCW.	±5%	±1%.
Ignition cycle, crash	0 to 60,000	±1 cycle	1 cycle.
Ignition cycle, download	0 to 60,000	±1 cycle	1 cycle.
Safety belt status, driver	On or Off	N/A	On or Off.
Safety belt status, right front passenger.	On or Off	N/A	On or Off.

Frontal air bag warning lamp.	On or Off	N/A	On or Off.
Frontal air bag suppression switch status, right front passenger.	On, Off, or Auto	N/A	On, Off, or Auto.
Frontal air bag deployment, time to deploy/first stage, driver.	0 to 250 ms	$\pm 2$ ms	1 ms.
Frontal air bag deployment, time to deploy/first stage, right front passenger.	0 to 250 ms	$\pm 2$ ms	1 ms.
Frontal air bag deployment, time to nth stage, driver.	0 to 250 ms	$\pm 2$ ms	1 ms.
Frontal air bag deployment, time to nth stage, right front passenger.	0 to 250 ms	$\pm 2$ ms	1 ms.
Frontal air bag deployment, nth stage disposal, driver.	Yes or No	N/A	Yes or No.
Frontal air bag deployment, nth stage disposal, right front passenger.	Yes or No	N/A	Yes or No.
Side air bag deployment, time to deploy, driver.	0 to 250 ms	$\pm 2$ ms	1 ms.
Side air bag deployment, time to deploy, right front passenger.	0 to 250 ms	$\pm 2$ ms	1 ms.
Side curtain/tube air bag deployment, time to deploy, driver side.	0 to 250 ms	$\pm 2$ ms	1 ms.
Side curtain/tube air bag deployment, time to deploy, right side.	0 to 250 ms	$\pm 2$ ms	1 ms.
Pretensioner deployment, time to fire, driver.	0 to 250 ms	$\pm 2$ ms	1 ms.
Pretensioner deployment, time to	0 to 250 ms	$\pm 2$ ms	1 ms.

fire, right front passenger.			
Seat track position switch, foremost, status, driver.	Yes or No	N/A	Yes or No.
Seat track position switch, foremost, status, right front passenger.	Yes or No	N/A	Yes or No.
Occupant size classification, driver.	5th percentile female or larger.	N/A	Yes or No.
Occupant size classification, right front passenger.	Child	N/A	Yes or No.
Occupant position classification, driver.	Out of position	N/A	Yes or No.
Occupant position classification, right front passenger.	Out of position	N/A	Yes or No.
Multi-event, number of event.	1 or 2	N/A	1 or 2.
Time from event 1 to 2	0 to 5.0 sec	0.1 sec	0.1 sec
Complete file recorded	Yes or No	N/A	Yes or No.

<sup>1</sup> Accuracy requirement only applies within the range of the physical sensor. If measurements captured by a sensor exceed the design range of the sensor, the reported element must indicate when the measurement first exceeded the design range of the sensor.

(b) Acceleration Time-History data and format: the longitudinal, lateral, and normal acceleration time-history data, as applicable, must be filtered either during the recording phase or during the data downloading phase to include:

(1) The Time Step (TS) that is the inverse of the sampling frequency of the acceleration data and which has units of seconds;

(2) The number of the first point (NFP), which is an integer that when multiplied by the TS equals the time relative to time zero of the first acceleration data point;

(3) The number of the last point (NLP), which is an integer that when multiplied by the TS equals the time relative to time zero of the last acceleration data point; and

(4) NLP—NFP + 1 acceleration values sequentially beginning with the acceleration at time NFP \* TS and continue sampling the acceleration at TS increments in time until the time NLP \* TS is reached.

## **7. Data capture.**

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

(a) In a frontal air bag deployment crash, capture and record the current deployment data. In a side or side curtain/tube air bag deployment crash, where lateral delta-V is recorded by the EDR, 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.

(b) In an event that does not meet the criteria in 7(a), capture and record the current event data, up to two events, subject to the following conditions:

(1) If an EDR non-volatile memory buffer void of previous-event data is available, the current event data is recorded in the buffer.

(2) If an EDR non-volatile memory buffer void of previous-event data is not available, the manufacturer may choose to either overwrite any previous event data that does not deploy an air bag with the current event data, or to not record the current event data.

(3) EDR buffers containing previous frontal, side, or side curtain/tube air bag deployment-event data must not be overwritten by the current event data.

## **8. Crash test performance and survivability.**

(a) Each vehicle subject to the requirements of National frontal crash test regulations, must conform with the specifications in subpart (c) of this section.

(b) Each vehicle subject to the requirements of National side impact crash test regulations, that meets a trigger threshold or has a frontal air bag deployment, must conform with the specifications of subpart (c) of this section.

(c) The data elements required by section 5, except for the "Engine throttle, percent full," "engine RPM," and "service brake, on/off," must be recorded in the format specified by section 6, exist at the completion of the crash test, and be retrievable by the methodology specified by the vehicle manufacturer under section 9 for not less than 10 days after the test, and the complete data recorded element must read "yes" after the test.

## **9. Data retrieval tools.**

Each manufacturer of a motor vehicle equipped with an EDR shall ensure by licensing agreement or other means that a tool(s) is commercially available that is capable of accessing and retrieving the data stored in the EDR that are required by this part. The tool(s) shall be commercially available not later than 90 days after the first sale of the motor vehicle for purposes other than resale.