

Proposal to amend document ECE/TRANS/WP.29/2020/100

Draft Guidance on Event Data Recorder (EDR) Performance Elements Appropriate for Adoption in 1958 and 1998 Agreement Resolutions or Regulations

0. Foreword

- 0.1. The performance elements contained in this document provide guidance and/or specifications for vehicles equipped with Event Data Recorders (EDRs) concerning the minimum collection, storage, and crash survivability of motor vehicle crash event data. These performance elements do not include specifications for data retrieval tools and methods as that is subject to national/regional level requirement.
- 0.2. 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.
- 0.3. Contracting parties may but are not required to make EDR requirements mandatory for M₁ or N₁ vehicles.

1. Scope

- 1.1. This document applies to all passenger cars and light duty vehicles (i.e., 1958 agreement M₁ and N₁ vehicle categories and Category 1-1 vehicles and Category 2 vehicles).
- 1.2. This document is without prejudice to requirements of national or regional laws.
- 1.3. The following data elements are excluded from the scope: VIN, associated vehicle details, location/positioning data, information of the driver, ~~and~~ date and time of an event, **and [placeholder for potential data elements tbd]**.
- ~~1.4. Nothing in these performance elements applies to retro fitted or aftermarket systems. Nothing in these performance elements requires the fitment of sensors or systems not currently present in the vehicle, as manufactured, or activation of sensors or systems that are inactive at the time of manufacture.]~~
- 1.5. If systems or sensors from which the data required to be recorded and stored under section 3 would originate, **are not operational at the time of recording, are not fitted in the vehicle or inactive at the time of manufacture**, this document requires neither recording of such data nor fitting or ~~activating~~ **making** such systems or sensors **operational**. However, if the vehicle is **fitted with an original equipment manufacturer** equipped with such a sensor or system, then it is mandatory to record the data element in the specified format when the sensor or system is **operational** ~~activated~~. **In the case the reason for not being operational at the time of recording is a failure of this system or sensor, this failure state shall be recorded by the EDR as defined in the data elements Annex 1. Data elements.**

2. Definitions

[Note – Some of these definitions refer to data elements that are still under consideration and yet agreed upon]

For the purposes of these performance elements:

- 2.1. "ABS activity" means the anti-lock brake system (ABS) is actively controlling the vehicle's brakes.
- ~~2.x. ["Active/inactive"]~~
- 2.2. "Capture" means the process of buffering EDR data in a temporary, volatile storage where it is continuously updated at regular time intervals.
- 2.3. "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.~~

- 2.4. "*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.~~
- 2.5. "*Deployment time, frontal air bag*" means (for both driver and 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.
- 2.6. "*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.
- 2.7. "*End of event time*" means the moment at which the cumulative delta-V within a 20 ms time period becomes 0.8 km/h or less, or the moment at which the crash detection algorithm of the air bag control unit resets.
- 2.8. "*Engine RPM*" means:
- (a) For vehicles powered by internal combustion engines, the number of revolutions per minute of the main crankshaft of the vehicle's engine, and
 - (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, and
 - (c) For vehicles not powered by internal combustion engines at all, the number of revolutions per minute of the output shaft of the device(s) supplying motive power.
- 2.9. "*Engine throttle, percent full*" means the driver-requested acceleration as measured by the throttle position sensor on the accelerator control compared to the fully depressed position.
- 2.10. "*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.
- 2.11. "*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 an 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.
- 2.12. "*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.
- [2.13. "*Frontal air bag warning lamp status*" means whether the warning lamp required by national air bag regulations (if any) is on or off.]
- 2.14. "*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.
- 2.15. "*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.
- 2.16. "*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.
- 2.17. "*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.
- ~~2.x. "*Mandatory, if operational equipped*" [means it is mandatory to record the data element if the vehicle is equipped with the relevant sensors or system is fitted to the vehicle and operational. , if applicable, has been [unlocked by the manufacturer for use]. Data elements from optional fit systems are also mandatory to record if those systems have been selected by the driver.]~~
- 2.18. "*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.~~
- 2.19. "*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.~~
- 2.20. "*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.

- ~~[2.x. "Memory locking" means that event data elements recorded in the EDR, corresponding to a specific event will be prevented from being overwritten by subsequent events].~~
- 2.21. "Multi-event crash" means the occurrence of a minimum of 2 events, the first and last of which begin not more than 5 seconds apart.
- 2.22. "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 a loss of power and can be retrieved with EDR data extraction tools and methods.
- 2.23. "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.
- 2.24. "Occupant position classification" means the classification indicating that the seating posture of a front outboard occupant (both driver and front passenger) is determined as being out-of-position.
- 2.25. "Occupant size classification" means, for front passenger, the classification of an occupant as an adult and not a child, and for the driver, the classification of the driver as not being of small stature.
- 2.xx "Operational" means that the system or sensor, at the time of the event, is active or can be activated/deactivated by the driver.**
- 2.26. "Pretensioner" means a device that is activated by a vehicle's crash sensing system and removes slack from a vehicle safety belt system.
- 2.27. "Record" means the process of saving captured EDR data into a non-volatile storage for subsequent retrieval.
- 2.28. "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 front passenger) is fastened or unfastened.
- 2.29. "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.
- ~~2.x. "Secondary safety protection system" means a system that helps to mitigate the consequences of a collision, such as an airbag or a pop-up bonnet.~~
- ~~2.x. "Secondary safety system" means a deployable vehicle system designed to reduce injury consequences by offering protection during a collision, such as a pop-up bonnet or airbag.~~
- 2.30. "Service brake, on and 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.
- 2.31. "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.
- 2.32. "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.
- 2.33. "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.
- 2.34. "Stability control" means any device that complies with national, "Electronic stability control systems".
- 2.35. "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).
- [2.36. "Suppression switch status" means the status of the switch indicating whether an air bag suppression system is on or off]
- [2.37. "Time from event 1 to n²" means the elapsed time from time zero of the first event to time zero of the nth second event.]
- 2.38. "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.
- 2.39. "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.

- 2.40. "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.
- 2.41. "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 front passenger).
- 2.42. "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 front passenger).
- 2.43. "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.
- 2.44. "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 front passenger).
- 2.45. ["Time zero" is the time reference for the EDR data timestamps of an event. means the starting point of an event]
- 2.46. "Trigger threshold" means the appropriate physical parameter has met the conditions for recording an EDR event.
- ~~2.x. "Unlocked event" means an EDR record that does not meet the locking condition. It may be overwritten by subsequent events.~~
- 2.47. "Vehicle roll angle" means the angle between the vehicle y-axis and the ground plane.
- 2.48. "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.
- 2.x. **"Vulnerable road user secondary safety system" means a deployable vehicle system outside the occupant compartment designed to mitigate injury consequences to vulnerable road users during a collision.**
- ~~2.x. "Vulnerable road user (VRU)" means a person using no vehicle, such as a pedestrian, or using a vehicle without protective occupant compartment, such as a pedal cyclist, micro-vehicle user or motorcycle.~~
- 2.49. "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.
- 2.50. "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.
- 2.51. "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.

3. Performance specifications

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

- 3.1. Data elements
- 3.1.1. Each vehicle equipped with an EDR shall record the data elements specified as mandatory and those required under specified minimum conditions during the interval/time and at the sample rate specified in Annex 1, Table 1.
- 3.2. Data format
- 3.2.1. Each data element recorded shall be reported in accordance with the range, accuracy, and resolution specified in Annex 1, Table 1.
- 3.2.2. Acceleration Time-History data and format: the longitudinal, lateral, and normal acceleration time-history data, as applicable, shall be filtered either during the recording phase or during the data downloading phase to include:
- 3.2.2.1. The Time Step (TS) that is the inverse of the sampling frequency of the acceleration data and which has units of seconds;
- 3.2.2.2. 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;
- 3.2.2.3. 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

- 3.2.2.4. 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.
- 3.3. Data capture
- The EDR non-volatile memory buffer shall accommodate the data related to at least [two/three] different events.
- The data elements for every event shall be captured and recorded by the EDR, as specified in section 3.1 in accordance with the following conditions and circumstances:
- 3.3.1. Conditions for triggering recording of data
- An event shall be recorded by the EDR if one of the following threshold values is met or exceeded:
- 3.3.1.1. Change in longitudinal vehicle velocity more than 8 km/h within a 150 ms or less interval.
- 3.3.1.2. Change in lateral vehicle velocity more than 8 km/h within a 150 ms or less interval
- 3.3.1.3. Activation of Non-reversible occupant restraint system.
- 3.3.1.4. Activation of **Vulnerable road user VRU** secondary safety ~~protection~~-system
- If a vehicle is not equipped with any **Vulnerable road user Road User (VRU)** secondary safety ~~protection~~ system, this document requires neither recording of data nor fitting of such systems. However, if the vehicle is equipped with such a system, then it is mandatory to record the event data following activation of this system whenever the Contracting Party so requires.
- 3.3.2. Conditions for triggering locking of data
- In the circumstances provided below, the memory for the event shall be locked to prevent any future overwriting of the data.
- 3.3.2.1. In all the cases where a non-reversible occupant restraint system is deployed.
- 3.3.2.2. In the case of a frontal impact, if the vehicle is not equipped with a non-reversible restraint system for front impact, when the vehicle's velocity change in x-axis direction exceeds 25 km/h within 150ms or less interval.
- ~~3.3.2.3. [In the case of a rear impact, [if the vehicle is not equipped with a non-reversible restraint system for rear impact], when the vehicle's velocity change in x axis direction exceeds [xx] km/h within 150ms or less interval. [In circumstances, where a deployable restraint system is present the manufacturer can choose whether to trigger on restraint system deployment or the conditions above.]]~~
- 3.3.2.4. Activation of **Vulnerable road user VRU** secondary safety ~~protection~~-system
- 3.3.3. Conditions for establishment of time zero
- Time zero is established at the time when any of the following first occurs:
- 3.3.3.1. For systems with "wake-up" air bag control systems, the time at which the occupant restraint control algorithm is activated; or
- 3.3.3.2. For continuously running algorithms,
- 3.3.3.2.1. The first point in the interval where a longitudinal, cumulative delta-V of over 0.8 km/h is reached within a 20 ms time period; or
- 3.3.3.2.2. 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 is reached within a 5 ms time period; or
- 3.3.3.3. Deployment of a non-reversible deployable restraint or activation of VRU secondary safety protection system.
- 3.3.4. Overwriting
- 3.3.4.1 If an EDR non-volatile memory buffer void of previous-event data is not available, the recorded data shall, subject to the provisions of paragraph 3.3.2., be overwritten by the current event data, on a first-in first-out basis, or according to different strategies decided by the manufacturer and made available to the relevant authorities of Contracting Parties.**
- [3.3.4.2 However, in any case, data recorded for at least [two/three events] [mandatory number of events referred to in paragraph 3.3.] following any of the trigger thresholds referred to in section 3.3.1 being reached can be overwritten only by data to be recorded following one of such trigger thresholds being reached and shall always overwrite data that have been recorded otherwise than following any of such trigger thresholds being reached.]**

3.3.4.3 Furthermore, if an EDR non-volatile memory buffer void of previous-event data is not available, data originating from non-reversible restraint system or VRU secondary safety system deployment events referred to in paragraph 3.3.2 shall always overwrite any other data.

3.3.5. Power failure

Data recorded in non-volatile memory is retained after loss of power.

3.4. Crash test performance and survivability

3.4.1. Each vehicle subject to the requirements of National or regional frontal crash test regulations, shall conform with the specifications in paragraph 3.4.3.

3.4.2. Each vehicle subject to the requirements of National or regional side impact crash test regulations, ~~that meets the conditions specified in section 3.3.1 are met a trigger threshold or has a [frontal] air bag deployment,~~ shall conform with the specifications of paragraph 3.4.3.

3.4.3. The data elements required by paragraph 3.1, shall be recorded in the format specified by paragraph 3.2, exist at the completion of the crash test and the complete data recorded element shall read “yes” after the test. Elements that are not operating normally in crash tests (e.g., those related to engine operation, braking, etc.) are not required to meet the accuracy or resolution requirements in these crash tests.

Note TF currently working to further clarify that this does not apply to low speed test (e.g., bumper) that would not meet established trigger thresholds.

The data shall be retrievable even after an impact of a severity level set by UN-R94, /95 or/137, or other relevant national crash test procedures.

[Annex 1**Data elements and format**

Table 1

<i>Data element</i>	<i>Condition for requirement¹</i>	<i>Recording interval/time² (relative to time zero)</i>	<i>Data sample rate (samples per second)</i>	<i>Minimum range</i>	<i>Accuracy³</i>	<i>Resolution</i>
Delta-V, longitudinal	[Mandatory]					
Maximum delta-V, longitudinal	Mandatory					
Time, maximum delta-V	Mandatory					
Speed, vehicle indicated	Mandatory					
Engine throttle, % full (or accelerator pedal, % full)	Mandatory					
Service brake, on/off	Mandatory					
Ignition cycle, crash	Mandatory					
Ignition cycle, download	Mandatory	⁴				
Safety belt status, driver	Mandatory					
Frontal air bag warning lamp, on/off ⁵	Mandatory					

¹ **“Mandatory” is subject to the conditions detailed in section 1.**

² 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.)

³ 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 shall indicate when the measurement first exceeded the design range of the sensor.

⁴ 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.

⁵ The frontal air bag warning lamp is the readiness indicator specified in national air bag requirements, and may also illuminate to indicate a malfunction in another part of the deployable restraint system.

<i>Data element</i>	<i>Condition for requirement¹</i>	<i>Recording interval/time² (relative to time zero)</i>	<i>Data sample rate (samples per second)</i>	<i>Minimum range</i>	<i>Accuracy³</i>	<i>Resolution</i>
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.	Mandatory					
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, front passenger.	Mandatory					
Time from event 1 to 2	Mandatory					
Complete file recorded (yes, no)	Mandatory					
Time maximum delta-V, lateral	[If recorded]					
Time for maximum delta-V, resultant.	[If recorded]					
Engine rpm	If recorded Mandatory if equipped with ICE engine					
ABS activity (engaged, non-engaged).	If recorded Mandatory					
Stability control (on, off, or engaged).	If recorded Mandatory					
Steering input	If recorded Mandatory					

<i>Data element</i>	<i>Condition for requirement¹</i>	<i>Recording interval/time² (relative to time zero)</i>	<i>Data sample rate (samples per second)</i>	<i>Minimum range</i>	<i>Accuracy³</i>	<i>Resolution</i>
Safety belt status, front passenger (buckled, not buckled).	If recorded Mandatory					
Frontal air bag suppression switch status, front passenger (on, off, or auto).	If recorded Mandatory					
Frontal air bag deployment, time to nth stage, driver ⁴ .	Mandatory if if equipped with a driver's frontal air bag with a multi-stage inflator.					
Frontal air bag deployment, time to nth stage, front passenger ⁶ .	Mandatory if if equipped with a front passenger's frontal air bag with a multi-stage inflator.					
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	Yes or No	N/A	Yes or No.
Frontal air bag deployment, nth stage disposal, front passenger, Y/N (whether the nth stage deployment was for occupant restraint or propellant disposal purposes).	If recorded	Event	N/A	Yes or No	N/A	Yes or No.

⁶ List this element n - 1 times, once for each stage of a multi-stage air bag system.

<i>Data element</i>	<i>Condition for requirement¹</i>	<i>Recording interval/time² (relative to time zero)</i>	<i>Data sample rate (samples per second)</i>	<i>Minimum range</i>	<i>Accuracy³</i>	<i>Resolution</i>
Side air bag deployment, time to deploy, driver.	If recorded Mandatory					
Side air bag deployment, time to deploy, front passenger.	If recorded Mandatory					
Side curtain/tube air bag deployment, time to deploy, driver side.	If recorded Mandatory					
Side curtain/tube air bag deployment, time to deploy, passenger side.	If recorded Mandatory					
Pretensioner deployment, time to fire, driver.	If recorded Mandatory					
Pretensioner deployment, time to fire, front passenger.	If recorded Mandatory					

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