Heavy Vehicle Event Data Recorders Canada Best Practices & Guidelines

April 2024 - Informal Working Group DSSAD/EDR

Transport Canada Transports Canada

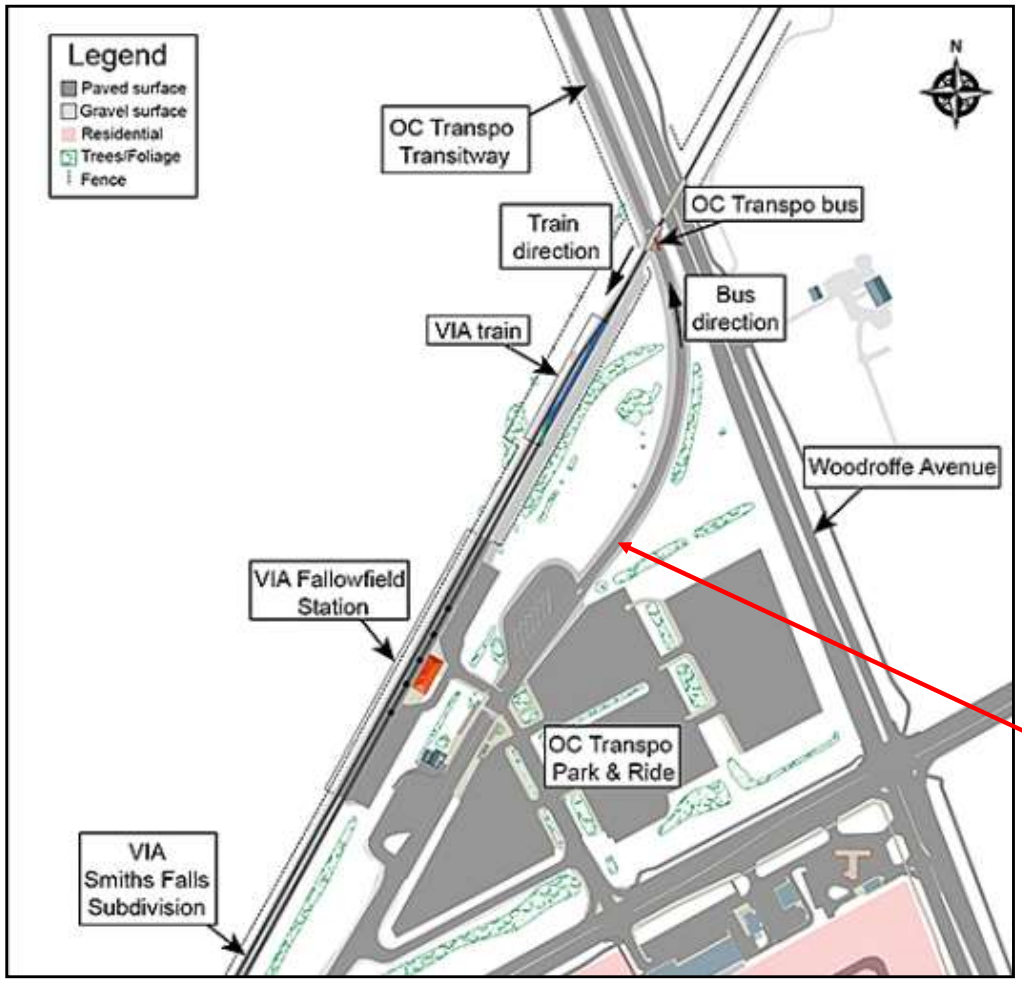
Canada

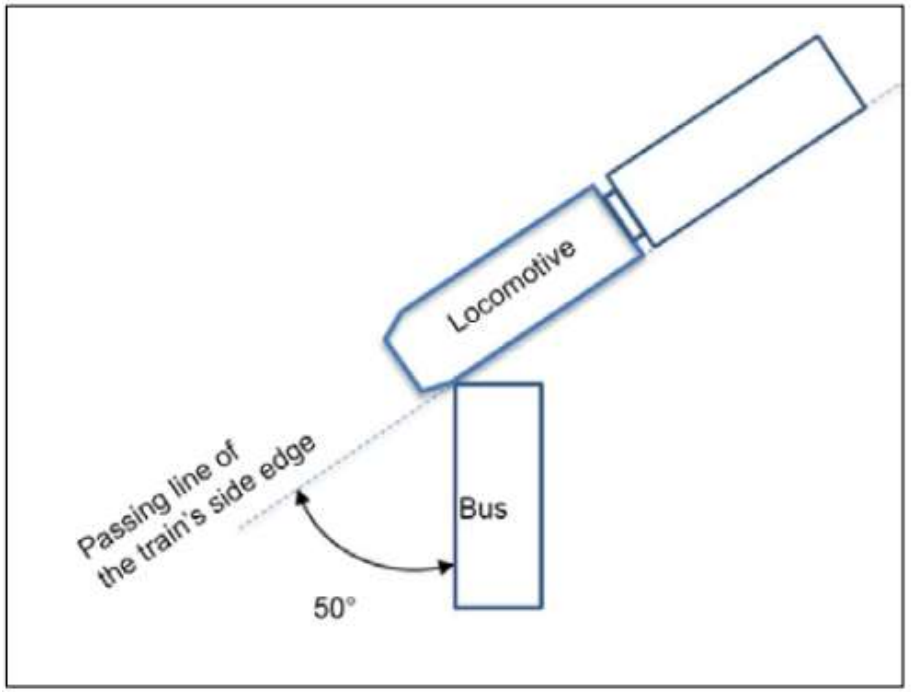
BACKGROUND

September 18, 2013 at 08:48 in the morning;

- A westbound passenger train was travelling 129 km/h (80 mph).
- As the train approached a level grade crossing, the train slowed to 76 km/h (47 mph).
- Realizing a bus was not going to stop at the crossing, the locomotive engineer initiated emergency braking.
- The train entered the crossing at 69 km/h (43 mph).
- A northbound double-decker transit bus was initially travelling at 68 km/h (42 mph).
- The driver was looking upwards at a video monitor when passengers began to shout “stop stop”.
- The driver initiated braking and slowed the bus to about 8 km/h (5 mph) when it struck the train.
- At the time of the collision the crossing lights, bells and gates were activated.
- The bus with a capacity over 100 passengers was full.
- Among the bus occupants, there were 6 fatalities and 9 serious injuries.

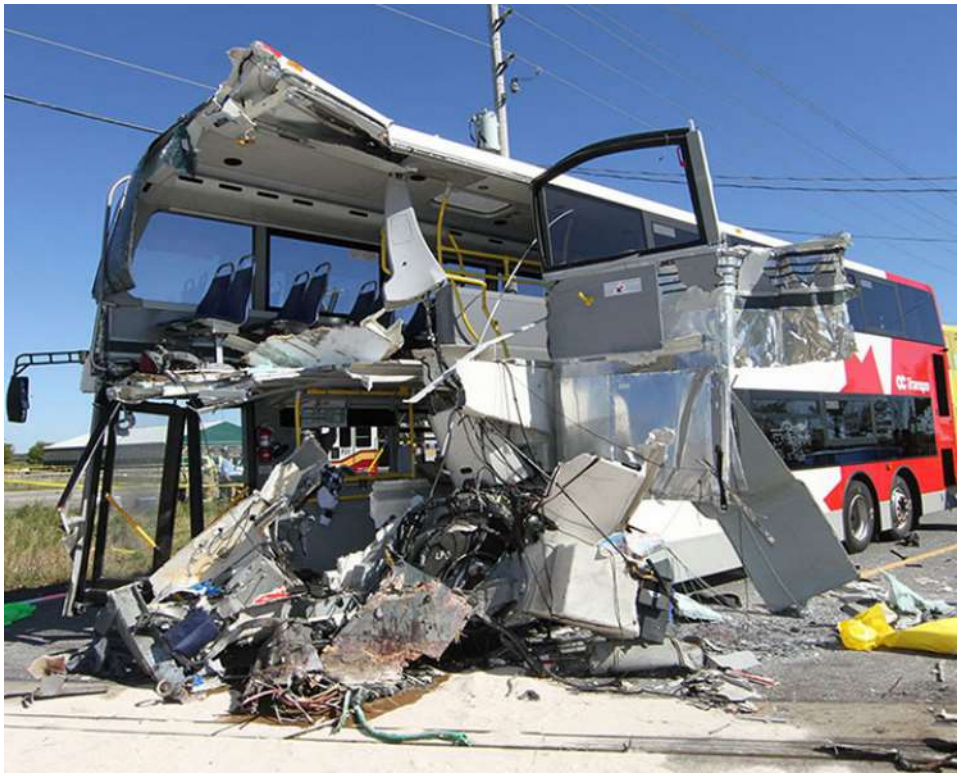
SITE DIAGRAM





Dedicated Bus Transitway
Posted Speed Limit 60 km/h (37 mph)

2012 ALEXANDER DENNIS 42-FOOT DOUBLE DECKER BUS



Lower Deck seating capacity of 27 and standing capacity of 25, Upper Deck seating capacity of 55

CANADA TRANSPORTATION SAFETY BOARD - RECOMMENDATIONS

In December 2015, the TSB released its final report on the collision investigation involving an OC Transpo double decker bus and a VIA Rail passenger train, which occurred in September 2013. The report included three recommendations relating to road safety which Transport Canada (TC) has taken great strides to address.

	Recommendation R15-01	Recommendation R15-02	Recommendation R15-03
Description	In consultation with the provinces, develop comprehensive guidelines for the installation and use of in-vehicle video monitor displays to reduce the risk of driver distraction.	Develop and implement crashworthiness standards for commercial passenger buses to reduce the risk of injury.	Require commercial passenger buses to be equipped with dedicated, crashworthy, event data recorders.

TSB Recommendation R15-01

TSB Recommendation R15-02

TSB Recommendation R15-03

CANADA TRANSPORTATION SAFETY BOARD - VEHICLE EVENT DATA RECORDERS

While, in this case, the recovered ECM data were useful, when compared to locomotive event recorder (LER) data, the ECM data lacked sufficient detail to conduct a meaningful analysis. Specifically;

- there was no meaningful time stamp;
- no distance travelled was recorded;
- the recorded time interval of 1 second was not sufficient for detailed analysis;
- the operation of the anti-lock brake system and emergency brake was not identified;
- the brakes had been applied, but no other meaningful braking information was recorded; and
- there was no brake line air pressure recorded to determine the amount of force applied to the brakes.

PHASE I - TRANSPORT CANADA - HVEDR FEASIBILITY STUDY (2017)

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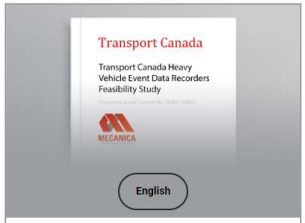
FOR IMMEDIATE RELEASE May 5, 2017

Mecanica Scientific Services Corp. Awarded Feasibility Study for Event Data Recorders Contract with Canadian Government

Camarillo, CA, April 25, 2017 – Mecanica Scientific Services Corp. (Mecanica), a Camarillo, California based scientific and engineering consulting firm, was awarded a contract by Transport Canada to conduct a feasibility study of Event Data Recorders (EDR) for commercial buses. Transport Canada, based in Ontario, Canada, is the federal agency within the Canadian government which is responsible for developing regulations and policies pertaining to all modes of transportation in Canada. Transport Canada is similar to the National Highway Traffic Safety Administration in the United States. Mecanica is to study whether Event Data Records (EDR) are feasible and necessary for commercial buses in Canada. The EDR, like a black box, is an electronic function that can be added to a vehicle's pre-existing Electronic Control Units to leverage pre-existing sensors and data to record data related to vehicle crashes or accidents.

TRANSPORT CANADA - COMMERCIAL BUS HVEDR FEASIBILITY STUDY



Deliverable No. 1/2

List of technical and scientific reports/papers and validation studies on the accuracy, reliability and limitations of commercial vehicle EDRs.

Deliverable No. 3

Summary report of the facts, based on analysis of the documents reviewed and any other criteria/methodologies required by the Project Authority.

Deliverable No. 4

Summary report of all commercial vehicle-based systems, engine-based systems as well as global positioning systems developed both by original equipment manufacturers and after-market suppliers. This should include equipment requirements, operational requirements and technical specifications

Deliverable No. 5

Summary report of all available international commercial vehicle EDR industry standards and recommended practices including interviews notes with key government stakeholders such as NHTSA and TSB in the US.

Deliverable No. 6

Discussion paper on the feasibility of developing a commercial passenger bus EDR standard for Canada.

Deliverable No. 7

Final report including all appropriate documentation.

Published May 2018

https://transcanadahvedr.ca/

PHASE II - TRANSPORT CANADA - HVEDR: BEST PRATICES (2021)

1. Report No. T8080-210526 MSSC	2. Report Date March 31, 2023	3. Published Date November 22, 2023
4. Title and Subtitle Heavy Vehicle Event Data Recorders: Best Practices		5. Deliverables Development of Heavy Vehicle Event Data Recorders: Best Practices
		6. Performing Organization Code
7. Author(s): Wesley Grimes, John Grindey, Bradley Higgins, John Isbister, John Kolter, Kristina Lombardi, Henry Ramirez, Henry Schmoker, and John Steiner of Mecanica Scientific Services Corporation; Steven Anderson; Jean-Louis Comeau		8. Performing Organization Report No. T8080-210526 MSSC
9. Performing Organization Name and Address Mecanica Scientific Services Corp 3051 Sturgis Rd Oxnard, California 93030		10. Work Unit No.
		11. Contract No. T8080-210526
12. Sponsoring Agency Name and Address Transport Canada Road Safety and Vehicle Regulations 330 Sparks Street Ottawa, ON, Canada, K1A 0N5		13. Type of Report
		14. Sponsoring Agency Routing Symbol ASFCA - Collision Investigations and Research
15. Supplementary Notes		

16. Abstract

In May 2018, Mecanica Scientific Services Corp (Mecanica) submitted the initial Transport Canada T8080-160062 Feasibility Study of Event Data Recorders for Commercial Buses. Building upon this submission, the current T8080-210526 Heavy Vehicle Event Data Recorders: Best Practices (HVEDR Best Practices) aims to provide background information, research references and a summary of best practices and guidelines for event data recorders installed in medium- and heavy-duty trucks, motorcoaches, and buses. Transport Canada encourages vehicle manufacturers, Tier 1 suppliers of engines, transmissions, and vehicle safety systems, as well as service tool manufacturers to review and take advantage of this document when designing HVEDRs or developing service tools for HVEDRs.

The HVEDR Best Practices also serve as a comprehensive reference document for collision investigators, law enforcement agencies, government agencies, researchers and fleet managers.

17. Acknowledgements

The Mecanica Scientific research team would like to acknowledge and thank Lt. Timothy Austin, Mr. Timothy Cheek, Mr. Matt DiSogra, Mr. David Plant, and Mr. Greg Wilcoxson for their contributions, expertise, and guidance in this project. The team would like to acknowledge and thank the Mecanica Scientific Services team for their contribution in releasing this document.

DRAFT Published

Nov 2023

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HVEDR - BEST PRACTICES

BEST PRACTICES
SAE J2728-1 HVEDR Event Triggers
OEMs should implement the event triggers outlined in SAE J2728-1 as a baseline. Additionally, OEMs are encouraged to consider incorporating additional event triggers relevant to their specific vehicle systems, safety features, and control mechanisms to enhance the capabilities of the HVEDR.
SAE J2728-1 HVEDR Data Elements
OEMs should incorporate the data elements from Table 2 of the J2728-1 document as a minimum requirement, where they apply, and as much as possible, while also considering including additional data elements beyond the recommended list.
SAE J2728-1 HVEDR Data Sampling Rate and Recording Duration
OEMs should ensure that their HVEDRs adhere to the minimum requirements outlined for data sampling rate and recording duration. It is important to note that while meeting the minimum requirements is essential, manufacturers are encouraged to develop HVEDRs with greater capacities to provide enhanced data capture capabilities.

J2728(1) - Event Trigger

3.1 Event Trigger

The event trigger is a set of criteria, which, if met, cause an HVEDR event record to be saved to non-volatile memory. The HVEDR should save an event record if any of the following sets of conditions occur:

- Acceleration trigger: Vehicle speed changes at a rate higher than the programmable threshold set between 8.0 km/h/s (5.0 mph/s) and 22.5 km/h/s (14.0 mph/s). The vehicle speed change can be either positive or negative, and persists beyond that threshold for at least 0.5 second. The acceleration event start will be the time that the threshold is crossed. A common threshold setting is 11.3 km/h/s (7.0 mph/s).

- Last stop trigger: The intent of this trigger is to capture an event when the vehicle has come to a complete stop for a period of time. The last stop event start will be the time the threshold is crossed. A suggested threshold is when the vehicle speed falls below 3.0 km/h (1.9 mph) for 15 seconds or more. To prevent last stop events from being overwritten due to the movement of the vehicle after an incident of interest, the last stop trigger cannot reoccur until the vehicle speed reaches a speed of 24.0 km/h (14.9 mph) or more for a minimum of 6 seconds. The act of turning the ignition off will not directly trigger a last stop event. See also the discussion in 3.2.2 regarding the last stop event buffer.

- Safety system trigger: Systems that are installed for control or driver alerts from safety systems should trigger an event record. Recommended trigger signals from known systems are listed in Table 1:

Table 1 - Safety systems triggers

System	Message	Trigger
Safety restraint system	PGN 61483/SPN 4973 CN.Crash Type	Non-zero crash type
ABS system	PGN 61441/SPN 563 EBC1.ABSActive	ABS active
Adaptive cruise control/automated braking	PGN 64964/SPN 2918 EBC5.XBR Active Control Mode	External brake request
Electronic stability control	PGN 65103/SPN 1819 VDC1.YCBrakeControl = 1 PGN 65103/SPN 1818 VDC1.ROPBrakeControl = 1	Yaw control or roll over brake control

J2728(1) - Data Elements (partial list)

- Header Data
- Vehicle State
- Antilock Braking System
- Cruise Control System
- Collision Warning
- Automated Braking
- Lane Departure Warning
- Stability Control
- Blind Spot
- Occupant Safety Systems

Data Element	Description	Comment	Use
Front axle, left wheel speed	ABS wheel based vehicle speed.	PGN 65134 SPN 1592 (or PGN 65215 SPN 904 if HRW not available)	Pre-event Post-event
Front axle, right wheel speed	ABS wheel based vehicle speed.	PGN 65134 SPN 1593 (or PGN 65215 SPN 904 if HRW not available)	Pre-event Post-event
Rear axle, left wheel speed	ABS wheel based vehicle speed.	PGN 65134 SPN 1594	Pre-event Post-event
Rear axle, right wheel speed	ABS wheel based vehicle speed.	PGN 65134 SPN 1595	Pre-event Post-event
Retarder torque mode	State signal which indicates which retarder torque mode is currently generating, limiting, or controlling retarder torque.	PGN 61440 SPN 900	Pre-event Post-event
Brake status - parking	Indicates the status of the switch that is installed to detect whether or not the parking brake has been applied.	PGN 65264 SPN 70	Pre-event Post-event
Brake status - service	Indicates the status of the switch that is installed in brake system to detect whether the service brake has been applied. This switch is usually used to turn on the brake lamps.	PGN 65264 SPN 597	Pre-event Post-event
Engine speed	Rotational speed of the engine output shaft.	PGN 61444 SPN 190	Pre-event Post-event
Engine load	Percent of available engine torque being generated	PGN 61444 SPN 513	Pre-event Post-event
Clutch switch	Indicates the status of the switch that is usually installed in or connected to the clutch pedal to detect whether or not the clutch pedal is depressed.	PGN 65264 SPN 598	Pre-event Post-event
Accelerator pedal position	Ratio of the throttle pedal opening (driver's operation) in percent.	PGN 61443 SPN 91	Pre-event Post-event

J2728(1) - Data Sampling Rate and Recording Duration

3.2.4 HVEDR Data Sampling and Write Rates

The HVEDR should sample and store its data elements to the event record at a minimum of 10 Hz. Recorded data rates of 10 Hz not only offer valuable insight into the vehicle's operating state surrounding an event, but also give insight into vehicle-operator interaction during that time period. The minimum 10 Hz sampling rate is not intended to preclude devices with higher sampling rates.

3.2.5 HVEDR Event Record Duration

The HVEDR must record data collected before and after the event trigger threshold is reached. For this reason, a pre-trigger data buffer must continuously be writing to volatile memory all required data elements that are available prior to an event record being triggered (i.e., event trigger criteria being met) in a continuously updating, first-in-first-out circular buffer. Similarly, the instant an event trigger is reached, the HVEDR should immediately store the remainder of the record of required HVEDR data elements for the remainder of the event as it is defined. By default, the HVEDR must provide a minimum pre-event capacity of 15 seconds, with data written at a 10 Hz rate, and a minimum post-event trigger capacity of 15 seconds, for a total of minimum of 30 seconds of event-related data. The minimum pre- and post-event capacity is not intended to preclude devices with greater capacity.

Many triggers can happen in an event. In order to avoid redundant data collection, further triggers that happen during a post-trigger recording can be ignored if they happen before the last 5 seconds of the post-event capacity, as they should be evident in the recorded data elements. Otherwise, a subsequent event should be started to capture adequate post trigger data.

HVEDR - GUIDELINES

GUIDELINES
HVEDR Access
Collaboration between OEMs and OEM-approved third-party diagnostic tool providers is encouraged. This collaboration can lead to the development of a standardized imaging tool specifically designed for HVEDRs, making data access more efficient and accessible across different commercial vehicle manufacturers.
HVEDR Functionality Across Multiple OEM ECUs
To facilitate standardization, OEMs are encouraged to develop a programming algorithm that consolidates HVEDR-type data to a single ECU. This approach can streamline data collection and retrieval processes, making it easier to access comprehensive HVEDR data from commercial trucks and buses.
HVEDR Survivability - Electrical Power Loss
To improve HVEDR survivability during electrical power loss, OEMs are encouraged to develop triggering algorithms that do not rely on a park brake application or a key-off signal to store data in non-volatile memory. Additionally, OEMs should develop HVEDRs with integrated internal backup power source solutions and devise appropriate strategies to preserve data in the event of an electrical power loss. These measures would help ensure the availability of critical crash data even in challenging circumstances.

HVEDR - GUIDELINES

GUIDELINES
HVEDR Survivability - Fire
Addressing the issue of data loss in post-collision fires is a topic that warrants discussion among OEMs particularly within relevant platforms like the SAE J2728 Truck and Bus Event Data Recorder Committee. By engaging in collaborative efforts, OEMs can contribute to developing effective solutions and design strategies that mitigate the risk of data loss due to post-collision fires.
HVEDR Synchronized Timestamp
OEMs should adopt a synchronized common time clock across all recorded data in HVEDRs. By implementing this approach, OEMs can ensure that incident-specific event data and DTC snapshots or freeze frame records are accurately timestamped, facilitating a more comprehensive analysis and understanding of the recorded events.

INTENDED USE - HVEDR BEST PRACTICES AND GUIDELINES

These guidelines are not intended to apply to vehicles equipped with a compliant Event Data Recorder (EDR), irrespective of whether the vehicle exceeds the maximum Gross Vehicle Weight Rating (GVWR) of 3,855 kg stipulated in the regulation.

The HVEDR guidelines developed by Transport Canada primarily target OEM HVEDRs commonly found in vehicles categorized as Class 3 through 8, which weigh over 4,536 kg (10,000 lb) and are equipped with either the SAE J1708/J1587 serial communications bus or the J1939 CAN communications bus.

SUMMARY

The HVEDR Best Practices have been created with the purpose of offering a structured document that encompasses historical context, background information and an extensive compilation of research on HVEDRs.

The data captured by these devices offer invaluable insights for diverse stakeholders. Ensuring the standardization of HVEDRs is important as it promotes consistency in the data collected from these devices.

SAE Recommended Practices for HVEDR event triggers, HVEDR data elements, and HVEDR data sampling rates and recording duration should form the basis of consideration.

HVEDR designers should also consider the suggested guidelines on access, functionality across multiple ECUs, survivability, and timestamp synchronization.

Questions / Comments?

For more information contact:

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