

LITTLE KNOWN SECRETS OF THE BLACK BOX: HVEDR EQUIPMENT, DATA & EXTRACTIONS: CUMMINS, CATERPILLAR, VOLVO

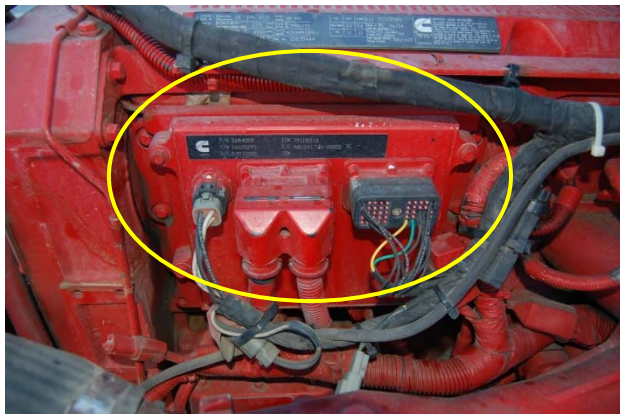
The last e-mail of this series will explore the three remaining engine manufacturers: Cummins, Caterpillar, & Volvo. As you have already seen with Detroit Diesel, Mercedes Benz, and Mack, each engine manufacturer's EDR capabilities are specific to the engine model and its programming configuration.



Cummins HVEDR Equipment

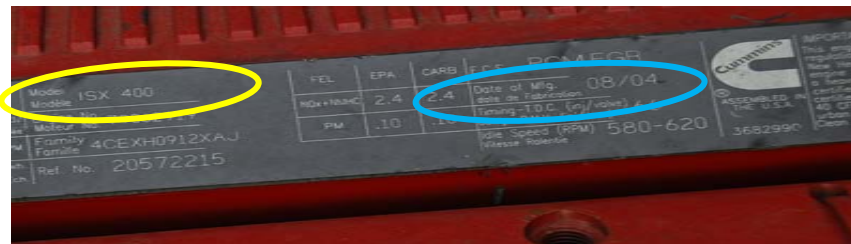
Cummins added HVEDR technology to their ECMs in November 2004. However, ECMs going back to 2002 can record sudden deceleration data if the ECM software has been updated. Therefore, one should assume that HVEDR data can be available in any 2002 or newer Cummins ECM. HVEDR data may be present on even older engines if the truck is

equipped with a Cummins RoadRelay, which is a dash-mounted driver information system.



Above photo: The yellow circle highlights the ECM location on this Cummins ISX 400 engine. Note the red engine color. Cummins engines are typically red or black in color.

Below photo: Circled in yellow is the location of the engine model number on the engine ID plate. The blue circle indicates the location of the engine's date of manufacture.



RoadRelay 4, the most recent version, became available in October 1998. The device provides a digital source of engine parameters and trip data. RoadRelay 4, may contain up to five sudden deceleration incident reports.



Above: The yellow arrow is pointing out the dash mounted RoadRelay 4 system.

Cummins HVEDR Extractions

The two most commonly used software programs to extract Cummins incident related data are INSITE and PowerSpec. INSITE is used to download engine settings, vehicle parameters, trip data, audit trail, and fault code snapshots. To extract sudden deceleration data, PowerSpec is needed. It is important to note that most shop technicians do not use PowerSpec, and therefore, would be unable to download sudden deceleration data.



Above: The laptop above is using PowerSpec to access Cummins ECM.

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Cummins Incident Data Reports

The following incident related reports are most commonly used by accident reconstructionists: Fault Code and Sudden Deceleration Reports. The table below describes and provides an example for both reports, as well as lists their triggers and required download software.

Cummins ECM Incident Data Records													
Record Name	Recorded Data	Number of Records	Download Software	Report Example									
Fault Code - Triggered whenever an engine sensor receives a signal outside of its normal operating range.	Records vehicle activity at the time of the fault occurrence, including vehicle speed.	Snapshots are only retained for the first and last occurrence of each fault code.	INSITE & PowerSpec	Fault Code	Status	Count	Lamp	Description	PID	SID	J1587 FMI	J1939 FMI	SPN
					Fault Parameters	First	Last	Units					
Sudden Decelerations - Triggered by speed decrease that exceeds a threshold. (Factory set threshold is 9mph/sec.).	Records 59seconds prior and 15 seconds after the event. (Reported in one second intervals.) However, the intervals may actually be 0.2 second for some ECMs, but reported as one second intervals.	Stores the 3 most recent sudden deceleration records. Vehicles equipped with RoadRelay 4 can record five sudden decelerations.	PowerSpec	Data Extraction Date	8/7/2007 3:15:02 PM		Total Engine Run Time	7502863					
				Air Temp at Event	0		Occurrence Distance	105007.4					
				Vehicle Speed	40	60	mph						
				Time (Seconds)	Vehicle Speed (mph)	Engine Speed (rpm)	Engine Load (%)	Throttle (%)	Brake Status	Clutch Status	Cruise Status	Lamp Status	
				-59	36	1096	0.0	0.0	-	-	-	-	
				-58	36	1086	0.0	0.0	-	-	-	-	
				-57	35	1054	0.0	0.0	On	-	-	-	
				-56	34	1016	0.0	0.0	On	-	-	-	



Caterpillar HVEDR Equipment

In 1995, Caterpillar added some features to their ECMs that resulted in the ability to record data when the triggering threshold was met. Although, that feature was not factory enabled and the truck owner had to initiate reprogramming of the ECM to record quick stop data. In 2007, CAT ECMs were default programmed from the factory to generate these reports. Caterpillar ceased production of diesel engines for trucks at the end of 2009. However, many trucks on the road still contain Caterpillar engines.

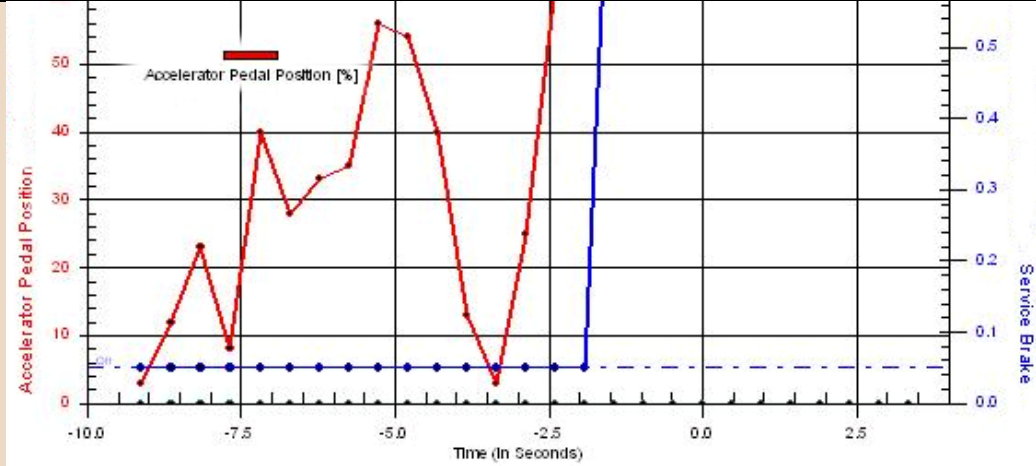
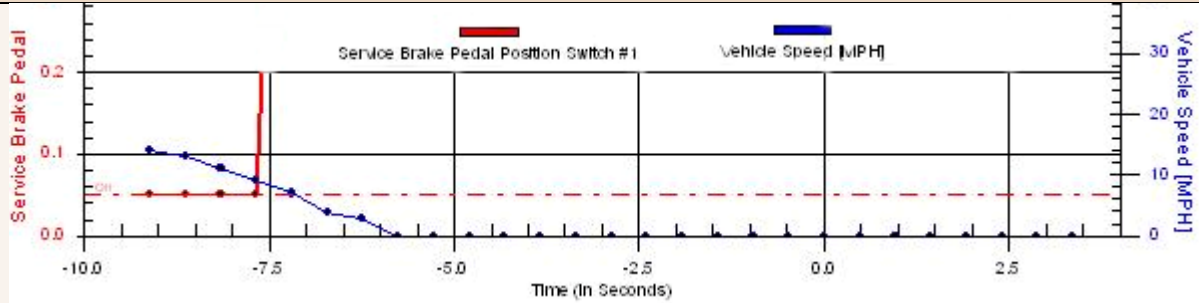


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Caterpillar HVEDR Extractions

Caterpillar Electronic Technician is the tool most commonly used to access the incident specific data. The reports shown below are both from Electronic Technician.

Caterpillar ECM Incident Data Records

Record Name	Recorded Data	Number of Records	Report Example
Quick Stop Triggered by a rapid deceleration. (Factory set threshold is 7mph/sec in 2007 models and newer, but is user programmable.)	Records 44 seconds prior to triggering event and 15 seconds after it. (Reported in one second intervals. Although the time interval may be incorrectly reported on some ECMs.)	One Quick-Stop Record is stored.	 <p>The chart above shows the accelerator pedal position in red and the service brake pedal position in blue.</p>
Diagnostic Snapshots Triggered when a fault code has been generated	Records 9.12 seconds prior and 3.36 after the fault has been triggered. (Reported in 0.48 second intervals. Although the time interval may be incorrectly reported on some ECMs.)	Up to four diagnostic snapshots can be stored. Additionally, up to two externally triggered snapshots can be recorded when the Cruise Control Set/Resume switch is toggled.	 <p>The chart above shows brake pedal activity in red and the vehicle speed in blue after the low oil pressure fault code has been triggered.</p>

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Volvo HVEDR Equipment

Volvo uses a three-component ECM system that includes an Engine Management System (EMS) located on the engine and a Vehicle Control Unit (VCU) and an Information Display (ICECU) found inside the cab. Volvo engines do not typically record incident related data. The only exception may be some available configuration or fault codes that can be downloaded using Premium Tech Tool/VCADS. In vehicles equipped with a driver's airbag, some data may also be recorded in the airbag module in the event of a collision. However, the software to access that data is not publicly available. In 2000, Volvo acquired Mack Trucks, Inc. As a result, there has been industry discussion that at some point, Volvo ECMs may contain incident related data similar to Mack.

Conclusion

Cummins ECMs became equipped to record incident related data in 2002, while Caterpillar engines introduced similar technology in 1995. In early models of both Cummins and Caterpillar HVEDR equipment, the recording of incident related data was not enabled from the factory. Therefore, Cummins engine manufactured from 2002-2005 and on Caterpillar engines manufactured from 1995-2007, it is extremely important that an inspection be done to confirm incident specific recording capabilities. HVEDR potential on Volvo engines is limited to some fault code and configuration data.

Series Conclusion: In the following table, we summarize the HVEDR equipment and data for all engine manufacturers discussed throughout this series.

<u>Manufacturer</u>	<u>Year Introduced HVEDR Technology</u>	<u>Extraction Software</u>	<u>Fault Codes</u>	<u>Speed Data</u>	<u>% Throttle</u>	<u>Brake Status</u>	<u>Last Stop Data</u>
	1995	CAT's Electronic Technician	Yes; Found in Diagnostic Snapshot	Yes; Found in Quick Stop & Diagnostic Snapshots	Yes; Found in Quick Stop & Diagnostic Snapshots	Yes; Found in Quick Stop & Diagnostic Snapshots	No
	1998	Contact a designated Mack Affiliate (DELTA[v])	Yes	Yes	Yes	Yes	Yes
	1998	Detroit Diesel Diagnostic Link & DDEC Reports	Yes; Found in Diagnostic Record	Yes; Found in Last Stop, Hard Brake, Diagnostic Records	Yes; Found in Last Stop, Hard Brake	Yes; Found in Last Stop, Hard Brake	Yes
	2000	Detroit Diesel Diagnostic Link & Electronic Control Reports	Yes; Found in Diagnostic Record	Yes; Found in Last Stop, Hard Brake, Diagnostic Records	Yes; Found in Last Stop, Hard Brake	Yes; Found in Last Stop, Hard Brake	Yes
	2002	INSITE & PowerSpec	Yes	Yes; Found in Sudden Deceleration Report	Yes; Found in Sudden Deceleration Report	Yes; Found in Sudden Deceleration Report	No
	TBD	PT/VCADS	Limited Info Available	Yes; If freeze frame recorded	Yes; If freeze frame recorded	Yes; If freeze frame recorded	Not at this time