Event Data Recorder

An Overview

Senior Trooper Steven T. Kean Virginia State Police



EVENT DATA RECODER-

An Overview

Airbag systems have become standard safety equipment in passenger vehicles dating back to 1997. The module that controls the airbag system and may contain crash related data and is often mistakenly referred to as a "black box." "Black box" is a term

that most often refers to a flight data recorder, which records specific aircraft performance and is used during aircraft crash investigations. The flight data recorder records information on a continuous loop.

The module in a motor vehicle, an
Airbag Control Module (ACM), may record
certain data in the event of a crash which results
in the deployment of the airbag(s) or seatbelt



Picture 1: Airbag Control Module.

pretensioners. Unlike the flight data recorder the ACM does not continuously record. Some of the following data elements may be recorded:

- Delta V (Crash severity)
- Pre Crash
 - Speed
 - o Brake
 - o Throttle
 - o RPM
- Seatbelt status

Data may also be available in a non-deployment event. A non-deployment event is when the module "wakes up" and decides if a deployment of the airbag(s) or seatbelt pretensioner(s) is needed. Typically a non-deployment event is not locked by the module, and much of the same information you can obtain from a deployment level event is available. A non-deployment event can be over-written.

A module may contain multiple events such as a deployment and a non-deployment.

Proper analysis is required to determine if both events are from the same crash.

Terms

Airbag Control Module (ACM)

ACM is a generic name for a module; each manufacturer has a unique name for the ACM.

- **RCM**: Restraint Control Module (FORD)
- **PCM**: Powertrain Control Module (FORD)
- **SDM**: Sensing Diagnostic Module (GM)
- **ORC**: Occupant Restraint Control (Chrysler)
- **ACU**: Airbag Control Unit (Nissan)
- ACSM: Advanced Crash Safety Module (BMW)
- CABS: Center Air Bag Sensor (Toyota)

EVENT DATA RECORDER (EDR)

National Highway Traffic Safety Administration United States Code of Federal Regulation (CFR) Title 49 Part 563 defines an EDR as:

The term "EDR" can be used to describe many different types of devices. For this final rule, the term EDR means a device or function in a vehicle that captures 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), such that the data can be retrieved after the crash event. For the purposes of this definition, the event data does not include audio and video data.

The data available varies from manufacturers, year and model. The federal government has set forth a ruling that is intended to standardize the data elements. Some of the elements required by the CFR Part 563 rule are:

Data elements required for vehicles equipped with an Event Data Recorder (EDR).

- Delta-V, longitudinal 0 to 250ms, every 10ms
- Maximum delta-V, longitudinal 0-300ms
- Time, maximum delta-V 0-300ms
- Speed, vehicle indicated (5 sec, 2 samples per second)
- Engine throttle, % full (or accelerator pedal % full) (5 sec, 2 samples per second)
- Service brake, on/off (5 sec, 2 samples per second)
- Ignition cycle, at time of crash
- Ignition cycle, at time of download
- Safety belt status, driver
- Frontal air bag warning lamp, on/off
- Frontal air bag deployment, time to deploy (driver/passenger/stages)
- Multi-event, number of events
- Time from "event 1" to "event 2"
- Complete file recorded (yes/no)

(United States Code of Federal Regulation Title 49 Part 563 Issued 2006, amended 2008 Effective Sept. 2012).

PART 563—EVENT DATA RECORDERS www.ecfr.gov

Below are a few key points of the ruling:

- The regulation does not require vehicles to have an EDR. (see EDR definition)
- Standardized the data elements in vehicle's that have an EDR.
- It also requires vehicle manufacturers "to ensure the commercial availability of the tools necessary to enable crash investigators to retrieve data from the EDR."
- For vehicles equipped with an EDR, vehicle manufacturers must include a specified statement in the owner's manual to make the operator aware of the presence, function and capabilities of the EDR.

- Compliance is required for all "light vehicles."
 - O The regulation applies to passenger cars, multipurpose passenger vehicles, trucks, and buses with a gross vehicle weight rating (GVWR) of 3,855 kg (8,500 pounds) or less and an unloaded vehicle weight of 2,495 kg (5,500 pounds) or less, except for walk-in van-type trucks or vehicles designed to be sold exclusively to the U.S. Postal Service.

HOW THE DATA IS RETRIVED

The data stored on the ACM/EDR is normally retrieved by crash investigators using the Bosch Crash Data Retrieval Tool (CDR). The CDR is used to image the data stored in the EDR. This is commonly referred to as downloading the data. The data will remain on the module; the CDR tool will image the data without changing the data stored within the EDR.

Several methods to download the data are available to the crash investigator. The method to retrieve the data will depend on several factors such as vehicle damage, weather and available power sources.

As with any evidence collection crash investigators must have the authority to obtain/seize it. The Code of Virginia § 46.2-1088.6 "Motor vehicle recording devices", addresses accessing of the data. (See appendix for full text of § 46.2-1088.6)

The preferred method to download data from an **ACM** is to connect to the vehicle's Diagnostic Link Connector (DLC). This port, typically found below the steering column, is frequently used by mechanics.



Picture 2: Download via DLC.

The CDR technician may not be able to access the DLC as a result of the vehicle damage.



Picture 4: Vehicle damaged in which the DLC cannot be accessed.

The technician should then locate the module and attempt to image the data with the ACM still bolted to the vehicle. (Note: location of module varies.)



Picture 6: Close up of module.

The third option is to remove the module from the vehicle and then image the data. While

not the preferred method, this option allows law enforcement to maintain the module as evidence.

Direct to module is the preferred method for Ford Powertrain Control Modules.



Picture 7: Module removed from vehicle, in order to download data.

VEHICLE COVERAGE

The Bosch CDR tool kit (formerly Vetronix) is a commercially available system to image the data, from most vehicle manufacturers.

The Bosch CDR kit currently supports:

(As of February 2015)

Toyota
Chevrolet
Honda
Ford
Chrysler
Cadillac
Acura
Buick
Dodge
Nissan
Pontiac
Jeep

Hummer

➤ Infiniti

Oldsmobile
Fiat
GMC
Mercury
Saturn
Scion
Lincoln
Lexus
Volvo
SRT
BMW
Rolls Royce

RAM

Mercedes-Benz

To determine if a vehicle is supported by the Bosch CDR kit, check the CDR help files. For a current list of supported vehicles go to: www.cdr-system.com

According to the NHTSA, "64 percent of model year 2005 passenger cars and other light vehicles have some recording capability, and that more than half record data elements such as crash pulse data." This number will grow with the recent federal ruling regarding Event Data Recorders. In response to the federal ruling and its requirements, most manufactures chose to use the Bosch CDR kit for the retrieval of EDR data. Hyundai and Kia both released a tool made by Global Information Technology.

THE CDR REPORT

Once the data is imaged from the EDR, it should be saved by the user. The original file with the file extension . *CDRx* should be retained. This file can only be opened, translated and read by the CDR program. It is possible that a file collected by an

earlier version of the program may not translate some data that is translatable by a more

current version.

CDR File Information

User Entered VIN	JTKJF5C77B3*****
User	S.T. Kean
Case Number	
EDR Data Imaging Date	08/01/2011
Crash Date	06/12/2011
Filename	TOTY NO VIN.CDRX
Saved on	Monday, August 1 2011 at 09:05:10
Collected with CDR version	Crash Data Retrieval Tool 4.1
Reported with CDR version	Crash Data Retrieval Tool 11.0
EDR Device Type	Airbag Control Module
Event(s) recovered	Front/Rear (2), Side (2)

Often times a PDF file will also be saved from the .*CDRx* file. A .pdf file will not be able to be opened by the CDR program using a more current version and could lead to possible questions if the .*CDRx* file is not retained and made available.

A FREE reader version is available from the Bosch website that will allow a file to be opened in the most recent version of the program.

The report can vary in length from 4-5 pages to more than 20 pages. The report is to be used <u>along with</u> all the crash evidence. The CDR report can provide very accurate and useful data that can be used in the analysis of a crash but, it can be misinterpreted if not understood. There are several circumstances that the speed reported may not agree with the scene evidence. An example of this could be crash data could be from an old event such as a non-deployment that has not been overwritten.

The first page of each report will be similar in that it will have a CDR File Information block, followed by Comments and Data limitations.





IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN	2G1FP22K0Y2******
User	S.T. Kean
Case Number	
EDR Data Imaging Date	09/12/2013
Crash Date	
Filename	2000 CHEV CAMERO.CDRX
Saved on	Thursday, September 12 2013 at 09:38:28
Collected with CDR version	Crash Data Retrieval Tool 11.1
Reported with CDR version	Crash Data Retrieval Tool 11.1
EDR Device Type	Airbag Control Module
Event(s) recovered	Non-Deployment

Comments

2000 Chev Camero Weathered Module

Data Limitations

Recorded Crash Events:

There are two types of Recorded Crash Events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event may be overwritten by another Non-Deployment Event. This event will be cleared by the SDM, after approximately 250 ignition cycles. This event can be overwritten by a second Deployment Event, referred to as a Deployment Level Event, if the Non-Deployment Event is not locked. The data in the Non-Deployment Event file will be locked, if the Non-Deployment Event occurred within five seconds before a Deployment Event. A locked Non Deployment Event Event cannot be overwritten or cleared by the SDM.

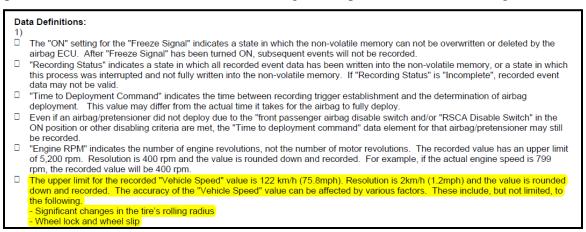
The comments are entered by the CDR technician (the person downloading the data). He/she also will have the opportunity to enter a Case Number and the Crash Date.

The data limitations on most reports will continue onto subsequent pages. It **SHOULD** be read for each report. The information varies depending on the module. An example of the importance of reading the data limitations is below.

Pre-Crash Data, -5 to 0 seconds (Most Recent Event, TRG 8)						
Time (sec)	-4.7	-3.7	-2.7	-1.7	-0.7	0 (TRG)
Vehicle Speed (MPH [km/h])	75.8 [122]	73.3 [118]	73.3 [118]	69.6 [112]	46 [74]	31.1 [50]
Brake Switch	OFF	OFF	OFF	OFF	ON	OFF
Accelerator Rate (V)	0.78	1.91	0.78	0.78	0.78	0.78
Engine RPM (RPM)	4,000	4,000	4,000	3,600	1,200	800

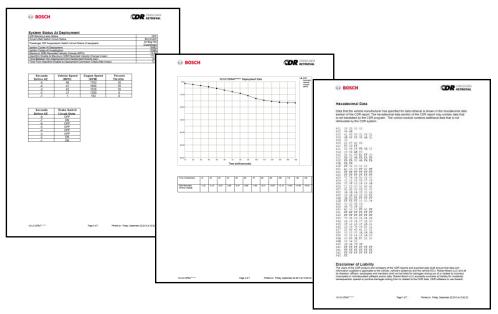
Was the vehicle traveling 75.8 MPH at -4.7 seconds?

On the second page of the Data Limitations (for this particular EDR) it clearly states that for this module the upper limit for the recorded speed is 75.8 MPH. So it is possible for the vehicle to have been traveling at the speed of 75.8 MPH *or* higher.



Having <u>NOT</u> read the data limitations, the reported speed at -4.7 seconds could be mistakenly presented to a court as 75.8 MPH. (*assuming the pre-crash data is from a steady state.)

The following pages contain data and graphs from the EDR and the last page(s) contains the hexadecimal data.



*The EDR is very accurate in a steady state. That is, the vehicle is not braking and going straight ahead. Several studies have been done that show the speed accuracy to be within 1% to 4% accurate. The speed indicated on the report is the wheel speed, which is the how fast the wheel is going, not the ground speed.

Part 563 Table III, requires data elements to be reported in accordance with the range, accuracy and resolution specified. For speed, vehicle indicted the accuracy is to be reported ± 1 km/h (0.62 MPH).

If the CDR report is taken *only* at face value and not used as supporting evidence to the crash reconstruction the data could be misleading.

Below is a portion of a CDR report. If this report was used without a proper crash investigation and analysis of the CDR report, one may argue that at -1 second the vehicle was going 1 MPH.

Maximum SDM Recorded Velocity Change (MPH)	-16.88
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	172.5
Time Between Non-Deployment And Deployment Events (sec)	N/A
Time From Algorithm Enable to Deployment Command Criteria Met (msec)	72.5

Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle
-5	40	1792	10
-4	41	1664	10
-3	42	1536	10
-2	31	1280	0
-1	1	192	0



It is possible to have a speed of 0 MPH when the vehicle is still moving. An example of this would be a driver who locks up the brakes on ice, the wheels stop moving, however the vehicle continues to forward sliding on the ice. This is because the speed sensors measure the wheel speed **NOT** the ground speed.

In the data above, something caused the speed to be reported at 1 MPH. It is the job of the crash investigator and CDR analysts to determine what took place in the crash, and use both the scene evidence along with the report to answer this question.

There are several vehicle operation conditions that could affect the EDR reported speed. They must be ruled out along with equipment alterations before relying on the speed. Some may be mentioned in the Data Limitations.

Data Limitations Recorded Crash Events:

Data

-SDM Recorded Vehicle Longitudinal Velocity Change reflects the change in longitudinal velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Longitudinal Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. For Deployment Events, the SDM will record 100 milliseconds of data after Deployment criteria is met and up to 50 milliseconds before Deployment criteria is met. For Non-Deployment Events, the SDM can record up to the first 150 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.

-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.

-SDM Recorded Vehicle Speed accuracy can be affected by various factors, including but not limited to the following:

-Significant changes in the tire's rolling radius

-Final drive axle ratio changes

-Wheel lockup and wheel slip

Other factors that could affect the recorded speed:

- The vehicle's wheels not in contact with ground (airborne).
- Yaw Wheels scrubbing sideways.
- Vehicle in reverse or otherwise going backwards.

Tire size:

If the tires on the vehicle are not what are recommended by the manufacturer, it could affect the speed reported. A much larger than recommended tire will not only underreport the vehicle speed on the speed odometer, but will also be underreported by the EDR. The module can be and should be re-programmed to recognize the new tire size. The recommended tire size can be found on the manufacturer plate on the inside of the driver side door.



Picture 8: Manufacturers plate.

Websites such as 1010tires.com have a tire size calculator that will compare tire sizes. Below is a screen capture, as an example, of the speed change with a much larger tire. (Note the speed variance.)

TIRE SIZE CALCULATOR - TIRE & WHEEL PLUS SIZING

METRIC 265.00 mm 457.2 mm
457.2 mm
- 9 in
828.20 mm
185.50 mm
414.10 mm
2,601.87 mm
.91/mi
133.39 kph
6 too fast.
.39%

www.1010tires.com/Tools/Tire-Size-Calculator

In a crash where one of these circumstances is present, the data may not be useful. **HOWEVER** it may be adjusted for known error conditions such as ABS "wheel slip." Studies have shown the vehicle speed under reported by 5% in ABS braking. (SAE 2010-01-1000). Also, after analysis of the entire crash (scene, vehicle, evidence and CDR report) an analyst can determine if the CDR speed is over or under reported.

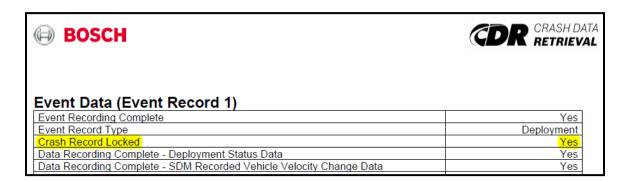
Deployment and Non-deployment

A module may contain more than one recorded event. Many have the capability to record up to three events. It is necessary to determine if the events are related to the crash under investigation or possibly from a prior event.

CDR File Information

User Entered VIN	5GADV23L55D******
User	S.T. Kean
Case Number	
EDR Data Imaging Date	08/02/2011
Crash Date	
Filename	BUCIK NO VIN.CDRX
Saved on	Tuesday, August 2 2011 at 11:19:46
Collected with CDR version	Crash Data Retrieval Tool 4.1
Reported with CDR version	Crash Data Retrieval Tool 6.0
EDR Device Type	Airbag Control Module
Event(s) recovered	Deployment
Eveni(s) recovered	Non-Deployment

A deployment event occurs when the module "wakes up" and commands a deployment. This event will most likely be locked, meaning it cannot be overwritten. The report may indicate if the data is locked.



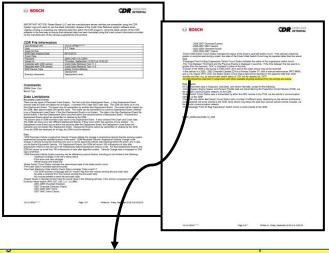
A non-deployment is an event that "woke up" the module, however no deployment was commanded. This event may be overwritten by another event or after a certain time period. It is important to download the data from the EDR even if the crash was not severe enough to deploy the airbag(s). Failing to do so *may* result in crash data relevant to the investigation being lost.

One important and often useful element to look at on the report (IF REPORTED) is the ignition cycles. If the data retrieved at the crash site is from the crash under investigation, the ignition cycle should be equal to or one less than the ignition cycle at investigation, example below.

System Status At Deployment	
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	UNBUCKLED
Passenger Belt Switch Circuit Status (If Equipped)	UNBUCKLED
Driver Seat Position Status (If Equipped)	Forward
Passangar Soat Position Status (If Equipped)	Eonward
Ignition Cycles At Deployment	17713
Ignition Cycles At Investigation	17714
maximum obm recorded velocity enange (mi-11)	-02.02
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	107.5
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	12.5
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	15
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	12.5
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Time Between Non-Deployment And Deployment Events (sec)	0.1
AOS Status at Event Enable (If Equipped)	Suppressed
Event Recording Complete	Yes

Otherwise it may be possible to account for multiple ignition cycles. The vehicle may have been moved out of the road, or the vehicle may have been started to tow the vehicle. This could also be useful in a hit and run investigation.

Once again all of the information reported on the CDR report must be analyzed, and by doing so the data can be a valuable tool to the crash investigation.



-All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

CASE EXAMPLE

At approximate 9:10 p.m., a 57 year old female driver was driving a 2000 BMW 323i northbound. The female driver was the only occupant of the vehicle, which approached an intersection. The BMW entered the left turn lane and then the crossover area of the intersection. A 2000 Chevrolet Impala, driven by a 27 year old male, was approaching the intersection southbound, travelling at a high rate of speed in snowy conditions. As the vehicles approached the intersection, the BMW began to cross the southbound lanes of the intersection, to make a left turn and was struck broadside by the Chevrolet. As the vehicles separated, the Chevrolet rolled and caught fire, coming to rest south of the intersection off the west side of the roadway. The driver exited his vehicle. The BMW came to rest near the traffic signal post, in the southwest area of the intersection (roadway). The driver of the BMW was killed as a result of the crash; the driver of the Chevrolet was transported to a local hospital and treated for minor injuries.

The crash investigator was able to remove the EDR Chevrolet from the burned Impala and image the data.

The post impact speed of the Impala was calculated at 56 MPH; the post impact distance measured 212 feet to final rest. Using conservation of linear momentum, an impact speed of 83 MPH to 88 MPH was Picture 9: Involved Chevrolet Impala. calculated for the Impala.



The speed imaged from the EDR shows a higher speed of 99-101 MPH. The physical evidence in this crash was limited because of the weather conditions (snow). The lack of tire marks, gouge marks etc. makes the determination of an area of impact, braking and departure angles a difficult task. This crash highlights the importance of the event data recorder in crash investigation and the crash data retrieval system. Without the EDR, the speed calculated for the Impala would be lower than the actual speed, but still well above the posted speed limit.

Time	Speed	Velocity	Throttle	Brake Switch
(in seconds)	(MPH)	(FPS)		Circuit State
-5	99 MPH	145.1 FPS	92%	OFF
-4	101 MPH	148.0 FPS	20%	OFF
-3	101 MPH	148.0 FPS	32%	OFF
-2	101 MPH	148.0 FPS	0%	OFF
-1	99 MPH	145.1 FPS	0%	ON

Many crashes occur where only one of the two vehicles contains an EDR from which data can be imaged. Still, valuable data contained by the EDR, such as the change in velocity [Delta V (Δ V)], can be used to calculate speed and/ Δ V for the other vehicle.

What you will not get:

- Who was driving?
- What time the crash occurred
- Where the crash occurred

BUT......many vehicles are now equipped with an automatic crash notification. These systems, such as OnStar, are activated when the airbag(s) are deployed. An advisor speaks with the occupants to determine if police and/or medical assistance are needed. The OnStar advisor can send help to crash site from the GPS location received.

OnStar will provide records, including audio, once a court order, search warrant or subpoena is received. For more information go to: www.onstar.com/publicsafety

The following is from a paper from a Frye/Daubert hearing prepared by Mr. Rick R. Ruth, P.E. (Ruth Consulting) <u>www.ruthconsulting.com</u> and re-printed with permission from Mr. Ruth.

EDR data is not New or Novel

The first event data recorders in vehicles started decades ago using pens on scrolling paper. In 1974 the National Highway Traffic Safety Administration equipped 1,000 vehicles in several fleets with data recorders.

a. Installation in Vehicles

- i. GM began installing EDR's measuring crash severity or Delta V in regular production 1994 models. The first publicly known production vehicle EDR's recording pre-crash vehicle speed were in 1999 and later General Motors products.
- ii. The Vetronix (now Bosch) Crash Data Retrieval systems first became available to download GM vehicles in 2000.
- iii. Ford began to phase in data recorders in 1997 model year, but to help protect owner privacy does not permit readout using public tools of 1997-2000 models, only 2001 and later model years are covered by the public tool.
- iv. Toyota began phasing in EDR's in the 2001 model year. By 2004, the National Highway Traffic Safety Administration estimated that 65 to 90% of all vehicles had some form of an EDR in them.
- v. Chrysler also began phasing EDR's with precrash data in for 2005 model year and now has EDR's in most
- vi. Many other manufacturers have EDR's but are only now releasing the ability to read them to publicly available tools (Honda, Nissan, Mazda, Suzuki). 91% of all new vehicles (2013 model year) are equipped with an EDR and will be able to be read by some form of publicly available equipment.

b. Government Involvement

- i. The NTSB recommended NHTSA for EDR installation 1997
- ii. NHTSA formed a blue ribbon committee in 1999 that issued a report in 2001 that indicated EDR's could improve vehicle safety and that all should work towards making such data more available. The document specifically noted that many of the tools used to read the data were proprietary.
- iii. NHTSA issued an Advance Notice of Proposed Rulemaking approximately 2002, a Notice of Proposed Rulemaking in 2004, and a final rule in 2006 to standardize EDR content in vehicles equipped with EDR's.

c. Court Usage -

The use of EDR data is also not new to the courts. EDR data had been admitted in over 60 cases in the US and Canada, and has been reaffirmed in Florida, Illinois, Massachusetts, Ohio, Tennessee and Washington appellate courts. EDR CASE LAW LIST from www.harristechnical.com.

d. There is also a Westlaw briefing for attorneys on Event Data Recorders (This is copyrighted and cannot be reproduced, but the reference Westlaw number is 17 19 46).

General Acceptance of EDR Data within the relevant Scientific Community

- a. Tested or Testable (a Daubert criteria, but also a measure of general acceptance)
 - i. During the vehicle development prior to production, Ford conducts numerous crash tests and Ford's supplier reads the EDR data following each test and compares it to reference instrumentation for accuracy. These results are typically not published; they are for the company's internal use only.
 - ii. Ford EDR's have been tested on the 2005 Ford Crown Victoria, the 2007 Lincoln Town Car, the 2007 Ford 500, the 2008 Ford Focus, the 2008 Ford Edge, the 2009 Ford Crown Victoria and the 2010 Ford Flex.
 - iii. The 2010 Ford F250 EDR works using the same principles as other EDR's that have been tested extensively. IF the speedometer is right, the EDR is right. The 2010 Ford F250 could be tested, it has not been chosen for test only because the data is not yet available from a publicly available tool that makes access easier.

b. **Published and Peer Reviewed** (a Daubert criteria, but also a measure of general acceptance)

i. GM EDR vehicle speed accuracy was first assessed as +/-4% over the life of the vehicle by Chidester (of the National Highway Traffic Safety Administration (NHTSA), jointly with General Motors authors "Recording Automotive Crash Event Data" at the International Symposium on Transportation Recorders in 1999. This figure was a design tolerance and intended to include things like tire wear over the life of the vehicle.

ii. Lawrence published "The accuracy of pre-crash speed captured by event data recorders" SAE 2003-01-0889, which was peer reviewed.

iii. Niehoff et al published "Evaluation of Event Data Recorders in full system crash tests" at the 19th International Technical Conference on Enhanced Safety of Vehicles (2005) and reaffirmed EDR speed data accuracy under steady state conditions.

iv. The compendium book "Event Data Recorders: A decade of Innovation" by Gabler et al (published by SAE 2008) chronicles the top EDR developments over the last 10 years. (This is too voluminous to reproduce)

v. Additional Crash Test Data was published by Gabler in 2008 "Preliminary Evaluation of Advanced Airbag Field Performance Using Event Data Recorders" DOT HS 811 015

vi. Ford EDR accuracy has been specifically been tested and published in several SAE papers as follows

- "Accuracy of Powertrain Control Module (PCM) Event Data Recorders, SAE 2008-01-0162 by Ruth et al, tested the 2005 Crown Victoria, 2007 Ford 500, and 2007 Lincoln Town Car. While the subject EDR in this case is housed in the Restraint Control Module, the speed data comes from the Powertrain Control Module whose accuracy is evaluated in this paper.
- · "Accuracy of Selected 2008 Ford Restraint Control Module Event Data Recorders" SAE 2009-01-0884 by Ruth et al.
- "2009 Crown Victoria PCM EDR Accuracy in Steady State and ABS Braking Conditions: SAE 2010-01-1000 by Ruth et al.
- "Accuracy of Event Data Recorder in 2010 Ford Flex During Steady State and Braking Conditions", SAE 2011-01-0812, by Ruth et al

SAE publications go through a rigorous peer review process where a minimum of 3 peer scientists and the session organizer review the proposed paper and can mandate improvements or stop the work from being published.

- b. **Known Error** Rate (A Daubert criteria but also part of general acceptance)
 - i. Chidester (1999) first stated the GM EDR speed data accuracy as being within 4%.
 - ii. In 2003 Lawrence found the GM EDR speed to be under reported by 1.5 kph (about 1 mph) at low speeds and over reported by 3.7 kph (about 2.3 mph) at high speed.
 - iii. In 2005 Niehoff reported 28 crash tests from 40 to 64 kph from multiple manufacturers and determined the average error rate in EDR pre-impact speed was 1.1% with a maximum of 3.7%.
 - iv. SAE 2008-01-0162 showed the 2005 Ford Crown Victoria PCM EDR was accurate to within 1.0%, the 2007 Lincoln Town car was within 0.6%, and the 2007 Ford 500 was within 0.8%.
 - v. SAE 2009-01-0162 showed the 2008 Focus was within 1.6% and the 2008 Edge was within 1.0%.
 - vi. SAE 2010-01-0812 showed the 2010 Ford Flex was within 2.7%

c. Other General Acceptance within the Relevant Industry

- i. Auto manufacturers install EDR's and rely upon the EDR data to investigate field concerns and to give feedback to product development on current product performance to influence future designs.
- ii. In 1997 the National Transportation Safety Board called for EDR's to be installed in all vehicles.
- iii. In 2004 the National Highway Traffic Safety Administration (NHTSA) published a Notice of Proposed Rulemaking on EDR's, and estimated that 65 to 90 percent of new vehicles had some type of recording capability.
- iv. In 2006 NHTSA issued a final rule setting standards for future vehicles equipped with EDR's, and granted some petitions for reconsideration in 2008.
- v. The Vetronix Corporation (subsequently bought by Robert Bosch LLC), a maker of automotive test equipment, began making a tool to read publicly available EDR data in 2000. They have sold over 2,000 such readout kits which are in use by police, private accident reconstructionists, and safety researchers at the National Highway Traffic Safety Administration for the US government and by Transport Canada for the Canadian Government.

- vi. There have been EDR symposiums in 2004, 2007, and 2011 by the Society of Automotive Engineers held at the NTSB training headquarters.
- vii. For over 6 years there has been an annual Crash Data Retrieval User's Conference with 200+ attendees.
- viii. There is a user group with approximately 1000 participants on Yahoo known as "CDR Tool" which has been in operation since 2000 and logged over 17,000 message posts.

Standards –The NHTSA part 563 regulation standardizing event data recorder content was enacted in 2006 and took effect in September 2012.

- x. The Society of Automotive Engineers published standard J1698 relating to standardizing EDR data format in the mid 2000's and is currently updating the standard.
- xi. Training on using the Crash Data Retrieval system and how to analyze the data from it is available from Northwestern University, the University of North Florida's Institute of Police Technology and Management, and other private institutions
- xii. The National Highway Traffic Safety Administration briefly set up a police standardized training committee, although it did not pursue the effort presumably because training classes already existed.
- xiii. The ASTM (formerly the American Society for Test Methods) Forensic Sciences Committee 30.05 work group 4150 created "Guide for the collection of non-volatile memory in evidentiary vehicle electronic control units", a protocol for retrieving EDR data.

Conclusions:

Event Data Recorders are not new or novel and hence there should be no need to demonstrate generalacceptance within the relevant scientific community.

In the alternative that the court finds the EDR to be new or novel, it is accepted within the relevant scientific communities of automobile crash safety researchers including the US and Canadian governments, auto companies performing safety field investigations, law enforcement and private crash reconstructionists.

References:

Bosch Crash Data Retrieval Software, "Bosch CDR Tool Help" files.

Ruth, Rick, et al., "Event Data Recorder Use in Traffic Crash Reconstruction", Institute of Police Technology & Management, University of North Florida

Rick Ruth Consulting, www.ruthconsulting.com

Fricke, L. B. (2010). *Traffic crash reconstruction 2nd Edition*, Northwestern University Center for Public Safety, Evanston, IL

Rusty Haight, Shwan Gyorke and Sean Haight, "Hyundai and Kia Crash Data, A Preliminary Overview", Collision Publishing Volume 8 Issue 1, 2013

NHTSA: 49 CFR Part 563-Event Data Recorders

Harris Technical, www.harristechnical.com

Augustus "Chip" Chidester, National Highway Traffic Safety Administration, John Hinch, National Highway Traffic Safety Administration, Thomas C. Mercer, General Motors Corporation, Keith S. Schultz, General Motors Corporation, Recording Automotive Crash Event Data; National Transportation Safety Board Symposium On Recorders

Collision Safety Institute, www.collisionsafety.net

Appendix

§ 46.2-1088.6. Motor vehicle recording devices.

A. As used in this section:

"Accessed" means downloaded, extracted, scanned, read, or otherwise retrieved.

"Owner" means a person having all the incidents of ownership, including the legal title of a vehicle whether or not such person lends, rents, or creates a security interest in the vehicle; a person entitled to the possession of a vehicle as the purchaser under a security agreement; or a person entitled to possession of the vehicle as the lessee pursuant to a written lease agreement, provided such agreement at inception is for a period in excess of three months.

"Recorded data" means the data stored or preserved electronically in a recording device identifying performance or operation information about the motor vehicle including, but not limited to:

- 1. Speed of the motor vehicle or the direction in which the vehicle is traveling, or both;
- 2. Vehicle location data;
- 3. Vehicle steering performance;
- 4. Vehicle brake performance including, but not limited to, whether brakes were applied before a crash;
- 5. The driver's seatbelt status; and
- 6. Information concerning a crash in which the motor vehicle has been involved, including the ability to transmit such information to a central communications system.

"Recording device" means an electronic system, and the physical device or mechanism containing the electronic system, that primarily, or incidental to its primary function, preserves or records, in electronic form, data collected by sensors or provided by other systems within the vehicle. "Recording device" includes event data recorders (EDRs), sensing and diagnostic modules (SDMs), electronic control modules (ECMs), automatic crash notification (ACN) systems, geographic information systems (GIS), and any other device that records and preserves data that can be accessed related to that vehicle.

- B. Recorded data may only be accessed by the motor vehicle owner or with the consent of the motor vehicle owner or the owner's agent or legal representative; except under the following circumstances:
- 1. The owner of the motor vehicle or the owner's agent or legal representative has a contract with a third-party subscription service that requires access to a recording device or recorded data in order to perform the contract, so long as the recorded data is only accessed and used in accordance with the contract;
- 2. A licensed new motor vehicle dealer, or a technician or mechanic at a motor vehicle repair or servicing facility requires access to recorded data in order to carry out his normal and ordinary diagnosing, servicing, and repair duties and such recorded data is used only to perform such duties;

- 3. The recorded data is accessed by an emergency response provider and is used only for the purpose of determining the need for or facilitating an emergency response. Such persons are authorized to receive data transmitted or communicated by any electronic system of a motor vehicle that constitutes an automatic crash notification system and utilizes or reports data provided by or recorded by recording devices installed on or attached to a motor vehicle to assist them in performing their duties as emergency response providers;
- 4. Upon authority of a court of competent jurisdiction; or
- 5. The recorded data is accessed by law enforcement in the course of an investigation where constitutionally permissible and in accordance with any applicable law regarding searches and seizures upon probable cause to believe that the recording device contains evidence relating to a violation of the laws of the Commonwealth or the United States.
- C. The consent of the motor vehicle owner or the owner's agent or legal representative for use of recorded data for purposes of investigating a motor vehicle accident or insurance claim shall not be requested or obtained until after the event giving rise to the claim has occurred, and shall not be made a condition of the defense, payment or settlement of an obligation or claim. For underwriting and rating purposes, the motor vehicle owner may provide his consent either directly to the insurer or through and as certified by a named insured.
- D. If a person or entity accesses recorded data pursuant to subdivisions B 2 or B 3, such entity or person shall not transmit or otherwise convey the recorded data to a third party unless necessary to carry out their duties thereunder.
- E. When the recording device and recorded data are not removed or separated from the motor vehicle, the ownership of the recording device and recorded data survives the sale of the motor vehicle to any nonbeneficial owner such as an insurer, salvage yard, or other person who does not possess and use the motor vehicle for normal transportation purposes.
- F. The failure of an insurer to obtain access to the recorded data shall not create, nor shall it be construed to create, an independent or private cause of action in favor of any person.

(2006, cc. <u>851</u>, <u>889</u>.)