ASK THE CAR WHAT HAPPENED

Reconstructing traffic accidents through the use of a vehicle's "black box" technology.

Christie Swiss
Attorney at Law
Collins Collins Muir + Stewart LLP
Oakland ● South Pasadena ● Orange ● San Diego
ccmslaw.com
cswiss@ccmslaw.com ● (760) 274-2110

Marc Hammarström
Accident Reconstructionist
Incident Forensics
Pasadena
incidentforensics.com
marc@IncidentForensics.com ● (626) 646-9668

COLLINS COLLINS MUIR + STEWART LLP
ATTORNEYS AT LAW

ASK THE CAR WHAT HAPPENED
TODAY'S OBJECTIVES

- Gain a basic understanding of how accident reconstructionists obtain data from a vehicle and what information the vehicles yield;
- Understand how the information gained from a vehicle may be used in a lawsuit;
- Understand how public entities may gain access to critical vehicle information for use in litigation

ASK THE CAR WHAT HAPPENED
TODAY'S OBJECTIVES

- ❑ History of Event Data Recorders
- ❑ Accessing the information on EDRs
- ❑ Understanding the information accessed
- ❑ Case studies

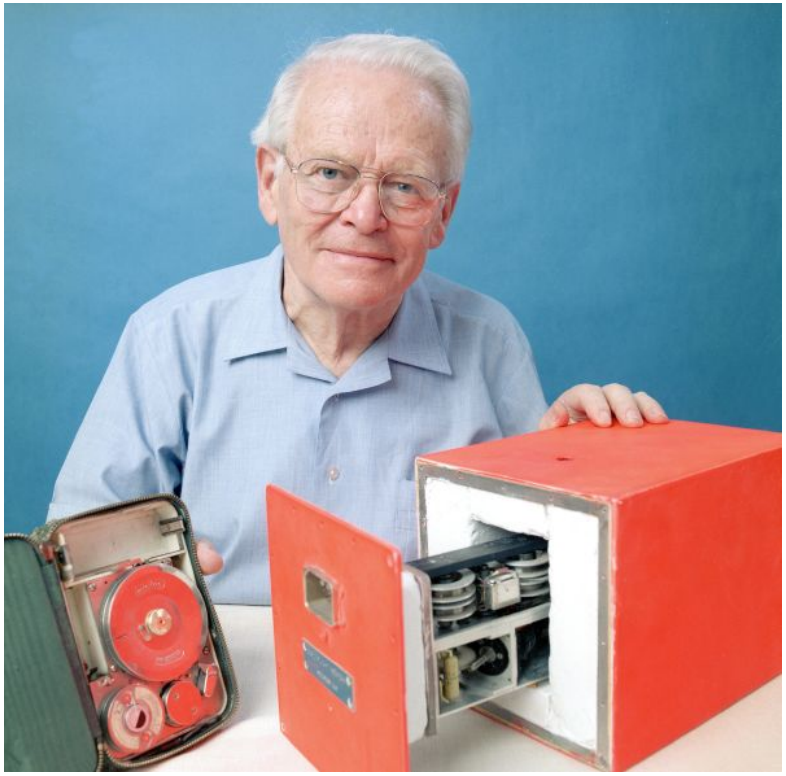
ASK THE CAR WHAT HAPPENED

How did you do that?

Event data recorders – not a new idea.

“Black Box”

- Invented in 1953 by Dr. David Warren of the Aeronautical Research Laboratories in Melbourne, Australia.
- Early versions could record up to four hours of voice and instrument data on a steel foil.
- It was initially rejected by the Australian aviation community for privacy issues, but was made mandatory in Australia in 1960.



Dr. Warren with a prototype of the black box

Event data recorder

- A vehicle “Black Box” or event data recorder (EDR) is a device that can record information from a vehicle immediately before, during and after an impact.

- NHTSA estimates that about:
  - 64% of 2005 vehicles had EDRs installed.
  - 96% of 2013 vehicles had EDRs installed.

- Most airbag control modules have the ability to record data, making them EDRs.
  - They do not record until after an impact
  - They do not record audio or video

Event data recorder

- Modern vehicle event data recorders have their history tied to the airbag.
- In 1990 vehicles were required to have either an automatic seat belt or a driver side airbag.
- Driver side airbags became mandatory for passenger vehicles from 1995.

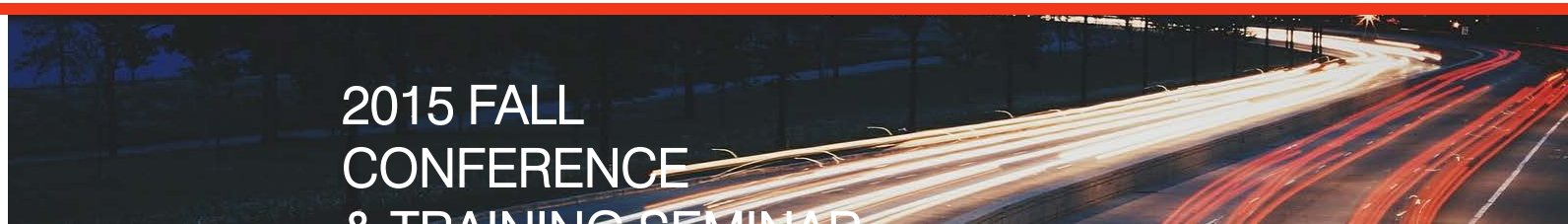
Who Owns the Data?

CA Vehicle Code § 9951

- ❑ Requires disclosure of EDR "sensing diagnostic modules"
- ❑ Prohibits download of data except:
  - With owner's consent
  - Court order
  - Vehicle safety research
  - Diagnosing, servicing, or repairing vehicle

Challenges

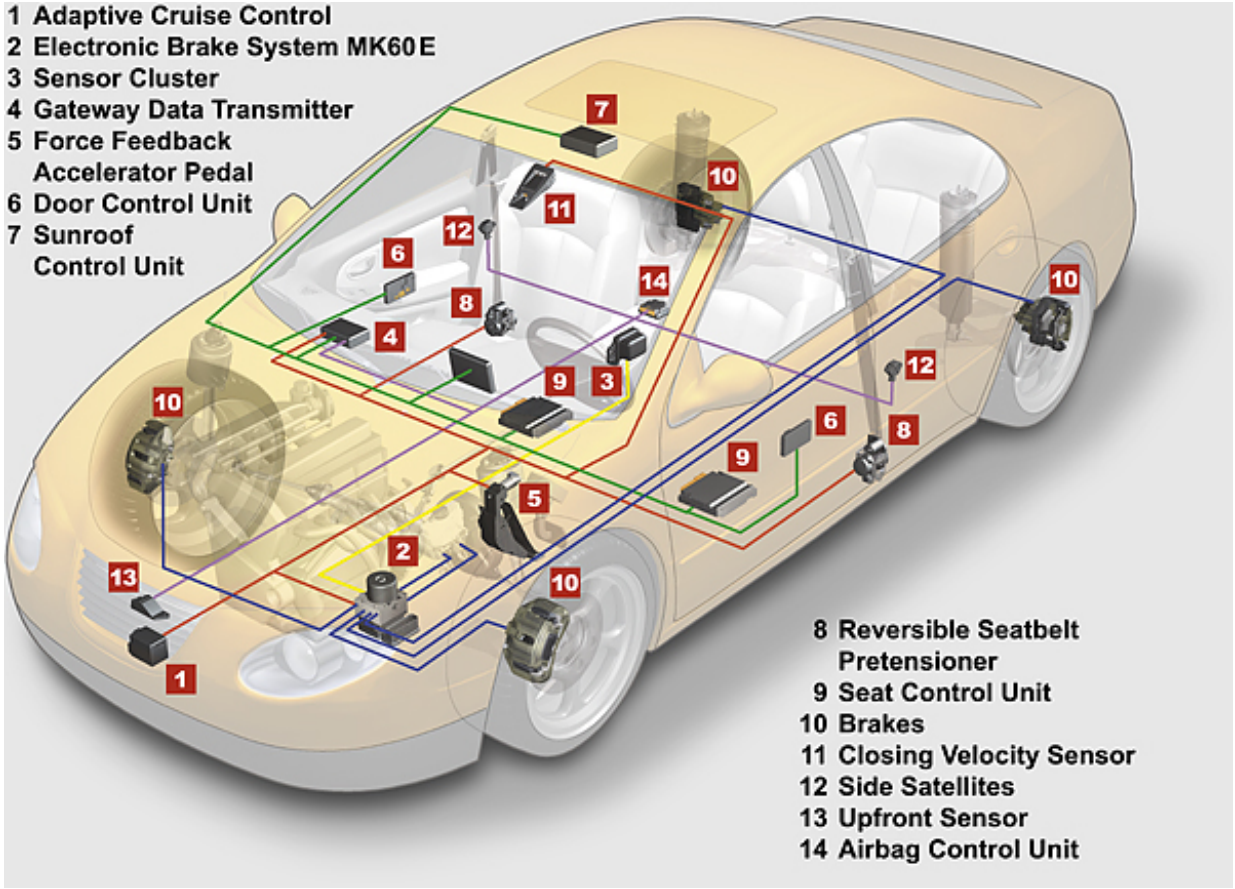
- ❑ Obtained legally?
  - Warrant, court order, consent
- ❑ Spoliation?
  - Evidence preserved properly



General list of vehicle brands having EDRs

Where do EDRs live

- Modern vehicles have a multitude of electronic control modules that are linked together via a vehicle's Controller Area Network or CAM.



AA1Car.com

Event data recorder

- Airbag control models have different names

- General Motors:
  - Sensing Diagnostic Module, SDM.
  - General Motors started installing airbag control modules in passenger vehicles mid-1990s.

- Daimler-Chrysler:
  - Occupant Restraint Controller, ORC.
  - Airbag information available as of 2004.

General Motor SDM

Event data recorder

- Ford:
  - Restraint Control Module, RCM.
  - Ford started installing airbag control modules as early as 1997. Information is available in select vehicles starting model year 2001.
  - Some Ford vehicles have information stored on their Powertrain Control Module (PCM).

Ford PCM found in some Fords and Lincolns

Ford RCM

EDR data and events

- The term "**Algorithm Enabled"** or **AE**
  - AE is the time at which an airbag control module "wakes up" and starts running its programmed deployment decision making algorithm after detecting an acceleration greater than a preset threshold

- The execution of the algorithm will result in one of two events:
  - "Deployment Event"
    - Airbags and/or the seatbelt pretensioners or head restraints fired
    - The system will attempt to lock this event in the EDR.
    - If the vehicle is a Ford with a PCM, the airbag module with send a signal to the PCM to lock its data.
  - "Non-Deployment Event"
    - System did not deploy any supplemental restraints
    - Data is usually not locked; it can be over-written over time.

How to access EDR data

- To retrieve the crash data, aka “download” or “image” the data, the retrieval tool needs to read the data stored within the EDR.

- There are two ways to do this:
  - Connect directly to the airbag module, or powertrain control module.
  - Use the vehicle’s Diagnostic Link Connector (DLC) port, and talk to the EDR over the vehicle’s controller area network system.

- Bosch’s CDR tool can only read data, the software cannot alter or delete EDR data.
- Note: Data spoliation can occur if you incorrectly access PCM data or an airbag module where the data was not “locked”

Crash Data File

- The Bosch CDR software will save the data in a file with a CDRx file extension.
- The CDRx file is the file that contains the raw data and is important to save.
- When opened with the right software, the CDRx file will translate the data into a formatted report. This report is saved as a PDF file.
- The PDF is not the download!


1GCHK23698F****
SDMC2006
18991AC
Marc Hammarstrom
T-3***
09/27/2011

Tuesday, September 27 2011 at 10:46:58
Crash Data Retrieval Tool 4.1
Block number: 01
Interface version: 5E
Date: 07-06-11
Checksum: 5200

44BE4FF4

1GCHK23698F****_ACM.CDRx

What does an EDR record?

- NHTSA Crash test 4464: 2003 CHEVROLET AVALANCHE

What does an EDR record?

NHTSA 2003 Chevrolet Avalanche Crash Video

Crash Data Report – general layout

General file information

Event Specific Data

CDR CRASH DATA RETRIEVAL

CDR File Information

Vehicle Identification Number	3GNEK13T73G110398
Investigator	TRoston
Case Number	NCAP#M30100
Investigation Date	5/19/2003
Crash Date	
Filename	NHTSA4464-3GNEK13T73G110398.CDR
Saved on	5/19/2003 10:38:01 AM
Data check information	96CEB002
Collected with CDR version	Crash Data Retrieval Tool 2.00
Collecting program verification number	A31D1C76
Reported with CDR version	Crash Data Retrieval Tool 2.70
Reporting program verification number	70812808
Interface used to collected data	Block number: 00 Interface version: 35 Date: 01-02-03 Checksum: 6200
Event(s) recovered	Deployment

SDM Data Limitations

SDM Recorded Crash Events:
There are two types of SDM recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event is an event severe enough to "wake up" the sensing algorithm but not severe enough to deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle forward velocity change. This event will be cleared by the SDM after the ignition has been cycled 250 times.
The second type of SDM recorded crash event is the Deployment Event. It also contains Pre-Crash and Crash data. The SDM can store up to two different Deployment Events, if they occur within five seconds of one another. Deployment events cannot be overwritten or cleared from the SDM. Once the SDM has deployed the air bag, the SDM must be replaced.
The data in the non-deployment file will be locked after a deployment, if the non-deployment occurred within 5 seconds before the deployment or a deployment level event occurs within 5 seconds after the deployment.

SDM Data Limitations:
-SDM Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Forward 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. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change. For deployments and deployment level 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-deployments, the SDM will record the first 150 milliseconds of data after algorithm enable.
-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 if the vehicle has had the tire size or the final drive axle ratio changed from the factory build specifications.
-Brake Switch Circuit Status indicates the status of the brake switch circuit.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if the SDM does not receive a valid message.
-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit
-The Time Between Non-Deployment and Deployment Events is displayed in seconds. If the time between the two events is greater than 25.4 seconds, "N/A" is displayed in place of the time.
-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.

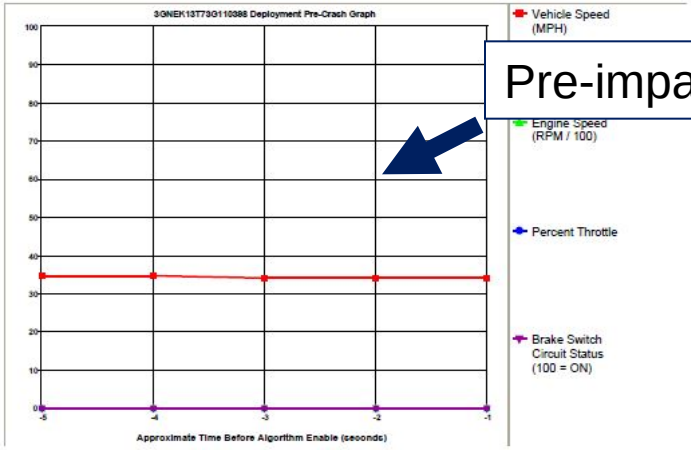
SDM Data Source:
All SDM recorded data is measured, calculated, and stored internally, except for the following:
-Vehicle Speed, Engine Speed, and Percent Throttle data are transmitted once a second by the Powertrain Control Module

Specific data about this airbag module

Vetronix

System Status At Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Ignition Cycles At Deployment	55
Ignition Cycles At Investigation	56
Maximum SDM Recorded Velocity Change (MPH)	-36.96
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	97.5
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	5
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	10
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	5
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	10
Time Between Non-Deployment And Deployment Events (sec)	N/A
Frontal Deployment Level Event Counter	1
Event Recording Complete	Yes
Multiple Events Associated With This Record	No
One Or More Associated Events Not Recorded	No

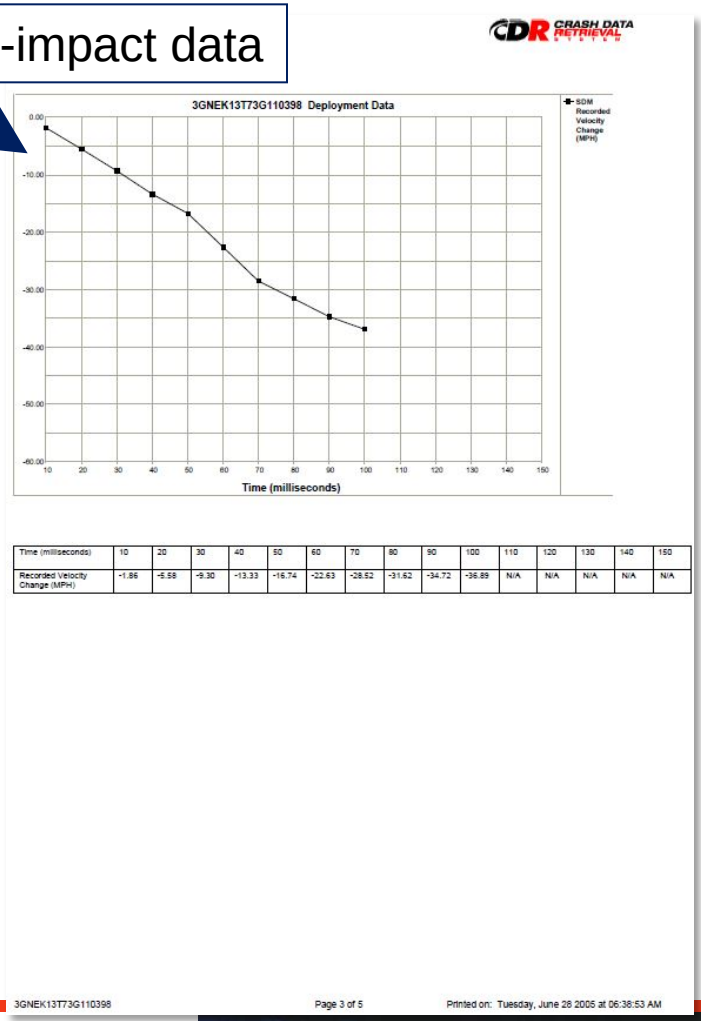


Pre-impact data

Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	35	0	0	OFF
-4	35	0	0	OFF
-3	34	0	0	OFF
-2	34	0	0	OFF
-1	34	0	0	OFF

Crash Data Report (2003 CHEVROLET AVALANCHE)

Post-impact data



3GNEK13T73G110398 Deployment Data

Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-1.86	-5.58	-9.30	-13.33	-16.74	-22.63	-28.52	-31.62	-34.72	-36.89	N/A	N/A	N/A	N/A	N/A

3GNEK13T73G110398 Page 3 of 5 Printed on: Tuesday, June 28 2005 at 06:38:53 AM

Vetronix

Hexadecimal Data

This page displays all the data retrieved from the air bag module.
It contains data that is not converted by this program.

```
$01  F0 21 F7 3C B0 F8
$02  F1 F1 3C 3C A8 00
$03  41 53 32 32 31 36
$04  4B 30 57 52 34 31
$05  00 00 00 00 00 00
$06  15 05 78 14 00 00
$07  00 00 00 00 00 00
$08  00 00 00 00 00 00
$09  00 00 00 00 00 00
$0A  00 00 00 00 00 00
$0B  00 00 00 00 00 00
$0C  00 00 00 00 00 00
$0D  00 00 00 00 00 00
$0E  00 00 00 00 00 00
$0F  00 00 00 00 00 00
$10  FF F8 FF 00 00 00
$11  80 7F 81 7C 7B 7D
$12  B0 9C 99 21 21 01
$13  FF 02 00 00 00 00
$14  03 03 00 00 6C 00
$15  FA FA FA FA FA FA
$16  FA FA FA FA FA FA
$17  FA FA 00 00 00 00
$18  00 3F 55 AC F1 00
$19  09 00 0A 00 00 64
$1A  00 00 00 00 00 00
$1B  00 00 00 00 00 00
$1C  00 0C 00 00 00 00
$1D  00 00 00 00 00 00
$1F  FE 00 00 00 00 00
$20  FF FF FF FF FF FF
$21  FF FF FF FF FF FF
$22  FF FF FF FF FF FF
$23  FF FF FF FF FF FF
$24  FF FF FF FF FF FF
$25  FF FF FF FF FF FF
$26  FF FF FF FF FF FF
$27  FF FF FF FF FF FF
$28  FF FF FF FF FF FF
$29  FF FF FF FF FF FF
$2A  FF FF FF FF FF FF
$2B  FF FF FF FF FF FF
$2C  FF FF FF FF FF FF
$2D  FF FF 00 00 00 00
$30  B2 FE 00 00 FF FF
$31  FF FF FF FF FF FF
$32  FF FF FF FF FF FF
$33  FF FF FF FF FF FF
$34  CA 00 33 04 02 03
$35  00 33 04 02 03 00
$36  55 08 04 03 00 55
$37  08 04 03 07 71 4F
$38  27 03 4F 27 00 00
$39  0F 00 00 01 00 00
$3A  06 12 1E 2B 36 49
$3B  5C 66 70 77 00 00
$3C  00 00 00 0A FF F9
$3D  80 A5 00 00 00 00
$40  37 37 37 38 38 00
$41  00 00 00 00 00 00
$42  00 00 00 00 00 00
$43  00 00 06 E0 00 00
```

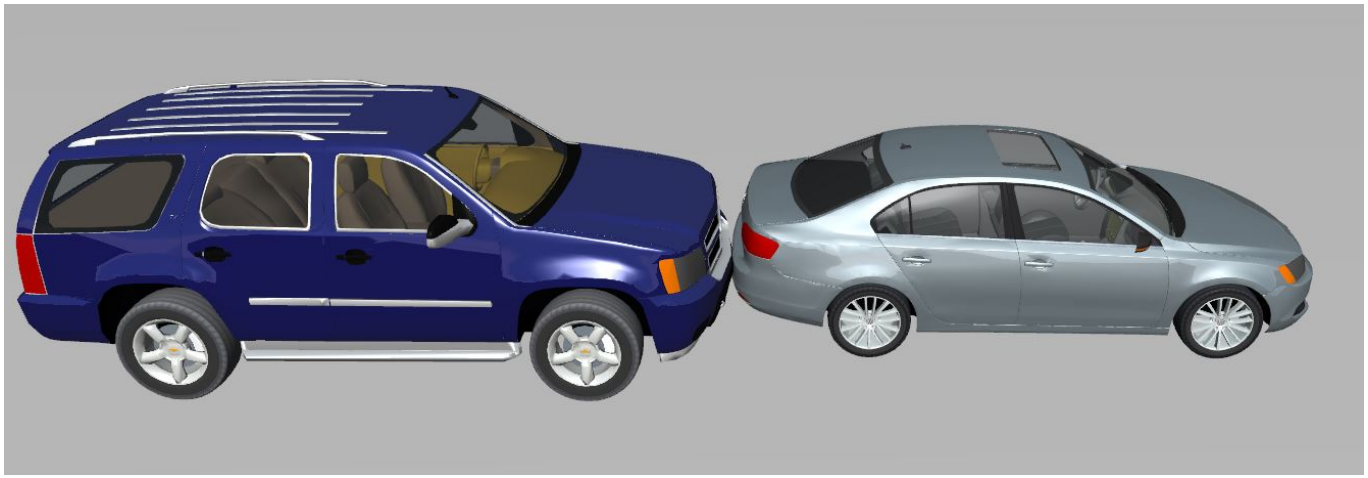
3GNEK13T73G110398 Page 4 of 5 Printed on: Tuesday, June 28 2005 at 06:38:53 AM

Last pages show the actual hexadecimal data read off the EDR

Case: rear end collision

- A Volkswagen CC was slowing down for a vehicle in front of it.
- The driver of a Chevrolet Tahoe realized too late that the Volkswagen was slowing down. The Tahoe driver attempted to stop, but hit the back of the car.
- No airbags deployed.
- No physical evidence was available from the accident scene.

- Questions:
  - How fast were the cars going?
  - How hard was the Volkswagen hit?



Case: rear end collision

Rear of the Volkswagen CC

Case: rear end collision

Front of Chevrolet Tahoe

Case: rear end collision

To solve this, I asked the Tahoe what happened.

System Status At Non-Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	UNBUCKLED
Passenger Seat Position Switch Circuit Status	Rearward
Ignition Cycles At Non- Deployment	17051
Ignition Cycles At Investigation	17176
Maximum SDM Recorded Velocity Change (MPH)	- 3.72
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	92.5
Crash Record Locked	No
Event Recording Complete	Yes
Multiple Events	No
Multiple Events Not Recorded	No

- By knowing the velocity change on the Tahoe, you can calculate the velocity change on the Volkswagen
- Volkswagen experienced a forward acceleration of 5 mph to 6 mph
- The Chevrolet would be traveling approximately 8-9 mph faster than the Volkswagen at the time of impact

Case: rear end collision

- Pre-impact data can help "see" what the driver was doing

9 mph speed change between 1 to 2 seconds before impact

2 sec before impact driver was using the gas pedal

Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle
-5	39	960	0
-4	39	960	0
-3	38	1024	5
-2	38	1088	11
-1	29	704	0

1 sec before impact using the brake pedal

Seconds Before AE	Brake Switch Circuit State
-8	ON
-7	ON
-6	ON
-5	ON
-4	OFF
-3	OFF
-2	OFF
-1	ON

Driver reacted between 1 and 2 seconds before impact

Do all EDRs record the same data?

- Vehicles made before September 1, 2012 can record anything the manufacturer thought was prudent for their needs!

- In August 2006 NHTSA issued an EDR rule that standardizes the information EDRs collect.

- As of September 1, 2012; 49CFR563 applies.
  - Code of Federal Regulation Title 49 –Transportation
  - Part 563 -Event Data Recorders

- 49CFR563 applies to vehicles:
  - That are equipped with an event data recorder. (i.e. only if the car has one)
  - That are manufactured on or after September 1, 2012.
  - That are passenger cars, multipurpose passenger vehicles, trucks, and buses with a GVWR 8,500 pounds or less. van-type trucks or vehicles designed to be sold exclusively to the U.S. Postal Service.
  - Exception: walk-in

Basic requirements of 49CRF563

- Requires devices defined as EDRs to record 15 data elements.
- EDRs may record additional information. The rules outline as many as 30 extra data elements that advanced EDRs may log.
- Vehicle manufacturers must ensure there are commercially available data retrieval tools.
- Vehicle manufacturers have to include a statement in the owner's manual telling consumers that their vehicle has an EDR.
- Recorders must be able capture the event, even if the power is lost during the crash.
- Must be capable of capturing multiple events.

49CFR563 -15 required data elements

- Pre-impact information
  - speed
  - % engine throttle or pedal depressed
  - brake on/off

- Post-impact information
  - Forward and maximum change in speed
  - Time of maximum change in speed occurred
  - Airbag deployment time for driver and front passenger
  - Number of crash events
  - Time between first two crash events, if applicable

- System status
  - Ignition cycle at crash and when the data was downloaded
  - Seat belt status of driver (buckled/not buckled)
  - Frontal airbag warning lamp (on/off)
  - Complete file recorded (yes/no)

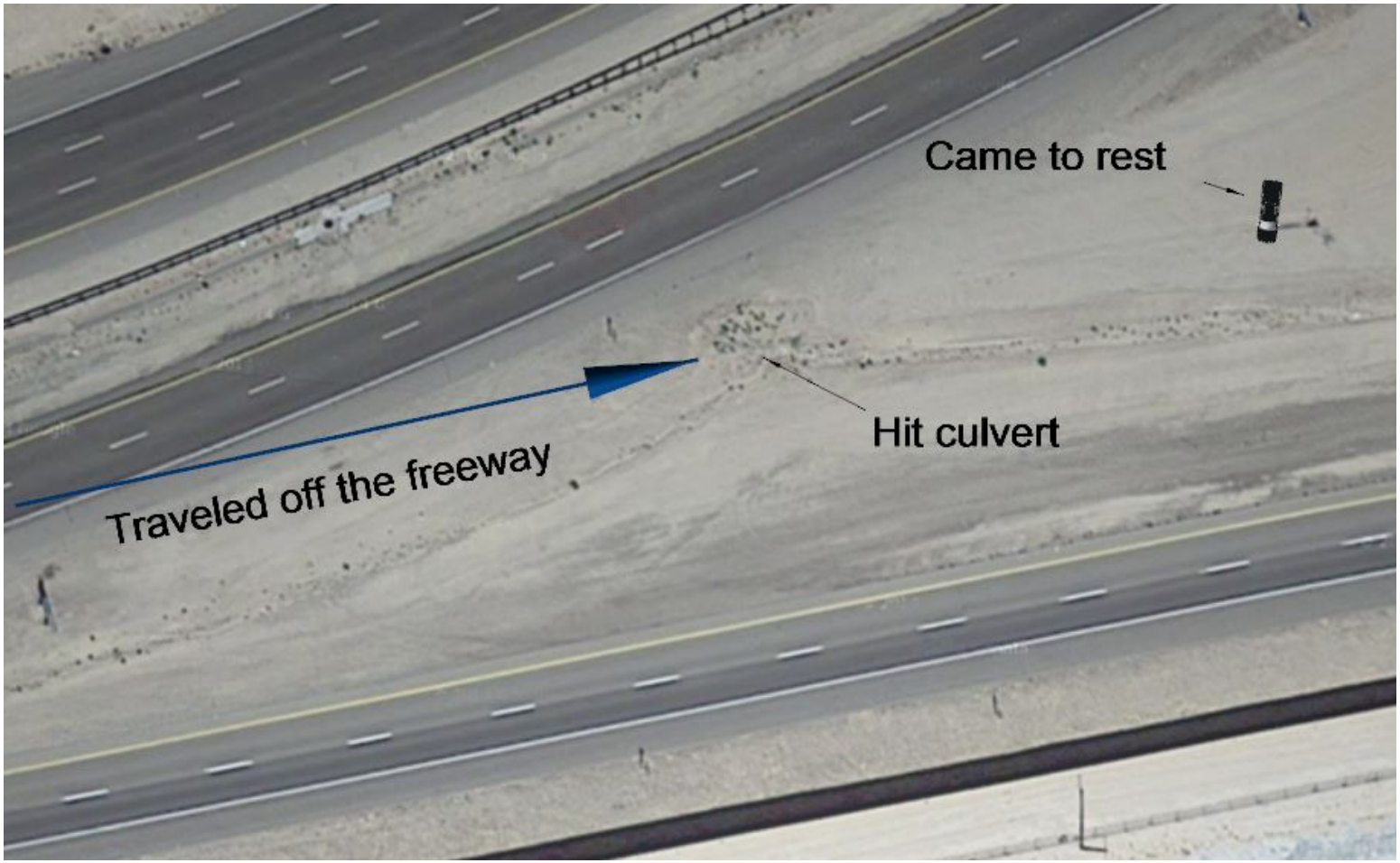
49CFR563 – optional data elements

- Pre-impact information
  - Lateral and maximum change in speed, Time for maximum lateral change in speed
  - Engine rpm, ABS activity (engaged, non-engaged)
  - Stability control (on, off, or engaged), Steering input
- Post-impact information
  - Vehicle roll angle, Safety belt status, right front passenger (buckled, not buckled)
  - Pretensioner deployment (time to fire), Side airbag, side-curtain deployment (time)
- System status
  - Frontal air bag suppression switch status, right front passenger (on, off, or auto)
  - Seat track position switch status for driver and right front passenger foremost. (Yes/No)
  - Occupant size classification for driver; 5th percentile female (Yes/No)*
  - Occupant size classification for right front passenger; child (Yes/No)**

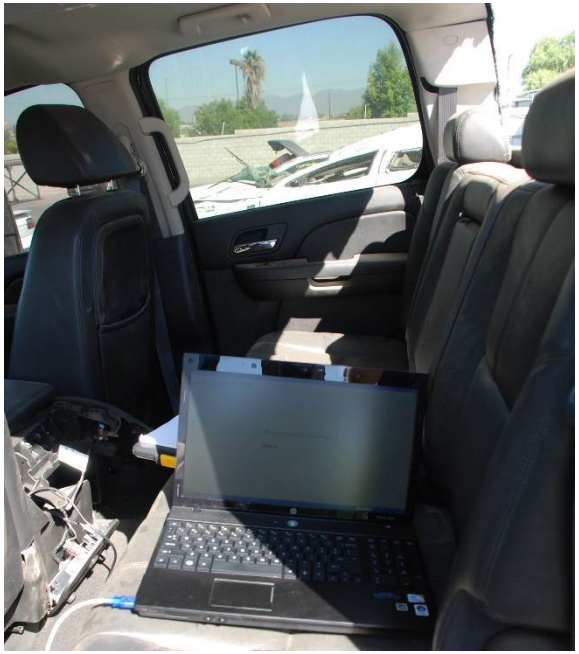
* 5th percentile female: Defined by 49CFR572, subpart O. Per NHTSA 59.1” and 108 lbs.
** Child: Defined by 49CFR572, subpart N. Six-year-old child. Per NHTSA 45” and 51.6 lbs.

Case: vehicle brakes don’t work

- Driver states he ran off the road after his brakes failed.



Case: vehicle brakes don't work

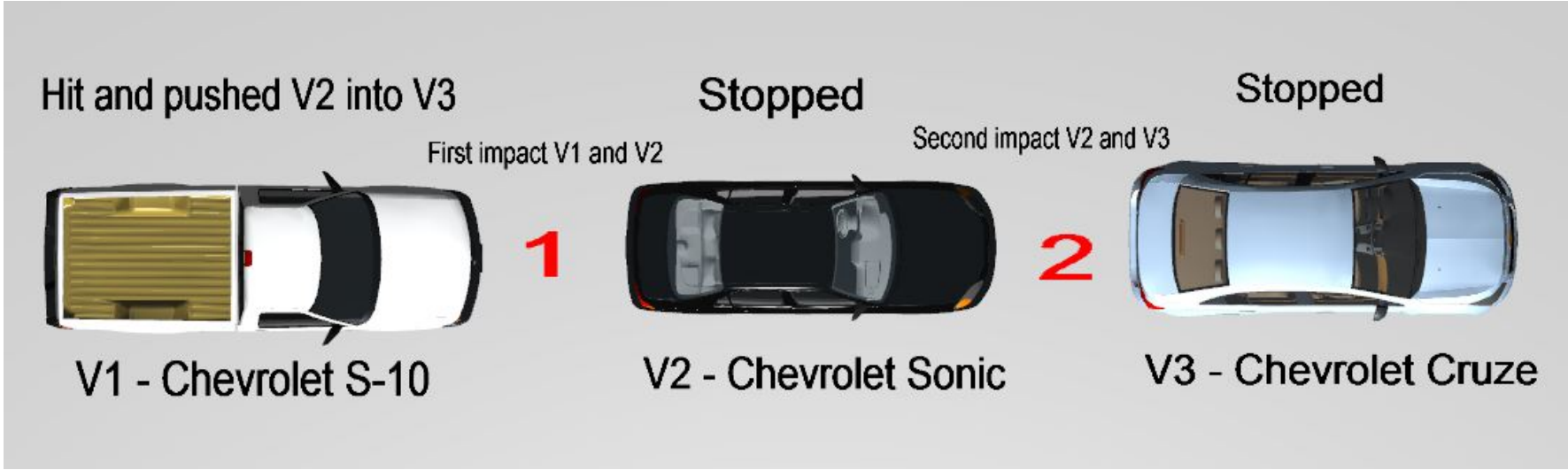


Pre-Crash Data

Parameter	-2.5 sec	-2.0 sec	-1.5 sec	-1.0 sec	-0.5 sec
Accelerator Pedal Position (percent)	100	100	100	100	100
Vehicle Speed (MPH)	71	72	73	72	71
Engine Speed (RPM)	2112	2304	2240	3392	3520
Percent Throttle	100	100	100	100	100
Brake Switch Circuit State	OFF	OFF	OFF	OFF	OFF

Case: three vehicle collision

- Explanation of the accident according to the driver of the black Chevrolet Sonic (V2)
  - I was stopped behind the blue car (V3) and all of a sudden I was hit in the back and pushed into it.



Case: three vehicle collision

- Explanation of what “really” happened according to the driver of the white Chevrolet pickup.
  - I was slowing down behind the black car that was also slowing down. Then it hit the blue car and I could not stop before I hit the black car.

Case: three vehicle collision

- Only have pictures of the Chevrolet Sonic.
- No airbags deployed in any of the vehicles.
- We have the Crash Data Retrieval (CDR) report from the Chevrolet Sonic.

Case: three vehicle collision

Software version to retrieve data is not the same as the software version to read the data file.

CDR File Information

User Entered VIN	1G1JC5SH2C4******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	2012-08-092-V2.CDRX
Saved on	
Collected with CDR version	Crash Data Retrieval Tool 5.0.2
Reported with CDR version	Crash Data Retrieval Tool 12.0
EDR Device Type	Airbag Control Module
Event(s) recovered	Non-Deployment, Non-Deployment

Two non-deployment events recorded!

Event Record 1

Event Data (Event Record 1)

Event Recording Complete	Yes
Event Record Type	Non-Deployment
Crash Record Locked	Yes
OnStar Deployment Status Data Sent	Yes
OnStar SDM Recorded Vehicle Velocity Change Data Sent	No
Deployment Event Counter	0
Algorithm Enable Counter	1
OnStar Notification Event Counter	0
Algorithm Active: Rear	Yes
Algorithm Active: Rollover	Yes
Algorithm Active: Side	Yes
Algorithm Active: Frontal	Yes
Ignition Cycles At Event	767
Time Between Events (sec)	Data Not Available
Concurrent Event Flag Set	No
Event Severity Status: Rollover	No
Event Severity Status: Rear	No
Event Severity Status: Right Side	No
Event Severity Status: Left Side	No
Event Severity Status: Frontal Stage 2	No
Event Severity Status: Frontal Stage 1	No
Event Severity Status: Frontal Pretensioner	No
Driver 1st Stage Deployment Loop Commanded	No
Passenger 1st Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop #1 Commanded	No
Passenger Pretensioner Deployment Loop #1 Commanded	No
Driver Pretensioner Deployment Loop #2 Commanded (If Equipped)	No
Passenger Pretensioner Deployment Loop #2 Commanded (If Equipped)	No
Driver Thorax Loop Commanded (If Equipped)	No
Passenger Thorax Loop Commanded (If Equipped)	No
Left Row 2 Thorax Loop Commanded (If Equipped)	No
Right Row 2 Thorax Loop Commanded (If Equipped)	No
Driver Row 1 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Passenger Row 1 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Left Row 2 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Right Row 2 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Left Row 3 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Right Row 3 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Driver Knee Deployment Loop Commanded (If Equipped)	No
Passenger Knee Deployment Loop Commanded (If Equipped)	No
Left Row 2 Pretensioner Deployment Loop Commanded (If Equipped)	No
Right Row 2 Pretensioner Deployment Loop Commanded (If Equipped)	No
Center Row 2 Pretensioner Deployment Loop Commanded (If Equipped)	No
Battery Cutoff Loop Commanded (If Equipped)	No
Driver Roll Bar Loop Commanded (If Equipped)	No
Passenger Roll Bar Loop Commanded (If Equipped)	No
Steering Column Energy Absorbing Loop Commanded (If Equipped)	No
Driver Head Rest Loop Commanded (If Equipped)	No
Passenger Head Rest Loop Commanded (If Equipped)	No
Left Row 2 Head Rest Loop Commanded (If Equipped)	No
Right Row 2 Head Rest Loop Commanded (If Equipped)	No
Center Row 2 Head Rest Loop Commanded (If Equipped)	No
High Voltage Battery Cutoff Loop Commanded (If Equipped)	No
Driver Belt Switch Circuit Status (If Equipped)	Buckled
Passenger Belt Switch Circuit Status (If Equipped)	Not Buckled
Driver Seat Position Status (If Equipped)	Data Not Available
Passenger Seat Position Status (If Equipped)	Data Not Available
Passenger Seat Occupancy Status (If Equipped)	Empty
Passenger Classification Status (If Equipped)	Not Applicable
Passenger SIR Suppression Switch Circuit Status (If Equipped)	Data Not Available

Ignition cycles at Event: 767
Time between events: not available

Max recorded velocity change: 5 mph

Passenger Air Bag ON Indicator Status (If Equipped)	Off
Passenger Air Bag OFF Indicator Status (If Equipped)	On
Low Tire Pressure Warning Lamp	Off
SIR Warning Lamp Status	Off
SIR Warning Lamp ON/OFF Time Continuously (seconds)	517590
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	0
Ignition Cycles Since DTCs Were Last Cleared at Event Enable	253
Time From Algorithm Enable to Maximum SDM Recorded Vehicle Velocity Change (msec)	90
Longitudinal SDM Recorded Vehicle Velocity Change at time of Maximum SDM Recorded Vehicle Velocity Change MPH [km/h]	5 [8]
Lateral SDM Recorded Vehicle Velocity Change at time of Maximum SDM Recorded Vehicle Velocity Change MPH [km/h]	0 [0]
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Driver Thorax/Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Passenger Thorax/Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Driver Pretensioner Time From Algorithm Enable to Deployment Loop #1 or Loop #2 Command Criteria Met (msec)	Data Not Available
Passenger Pretensioner Time From Algorithm Enable to Deployment Loop #1 or Loop #2 Command Criteria Met (msec)	Data Not Available

Pre-impact information

Pre-Crash Data -1 to -.5 sec (Event Record 1)

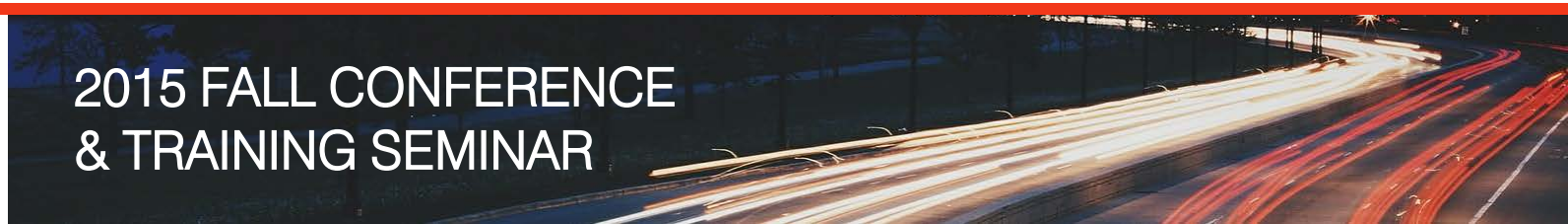
Times (sec)	Cruise Control Active	Cruise Control Resume Switch Active	Cruise Control Set Switch Active	Engine Torque (lb-ft [N-m])	Reduced Engine Power Mode Indicator
-1.0	No	No	No	4 [6]	Off
-0.5	No	No	No	-2 [-2]	Off

Pre-Crash Data -2.5 to -.5 sec (Event Record 1)

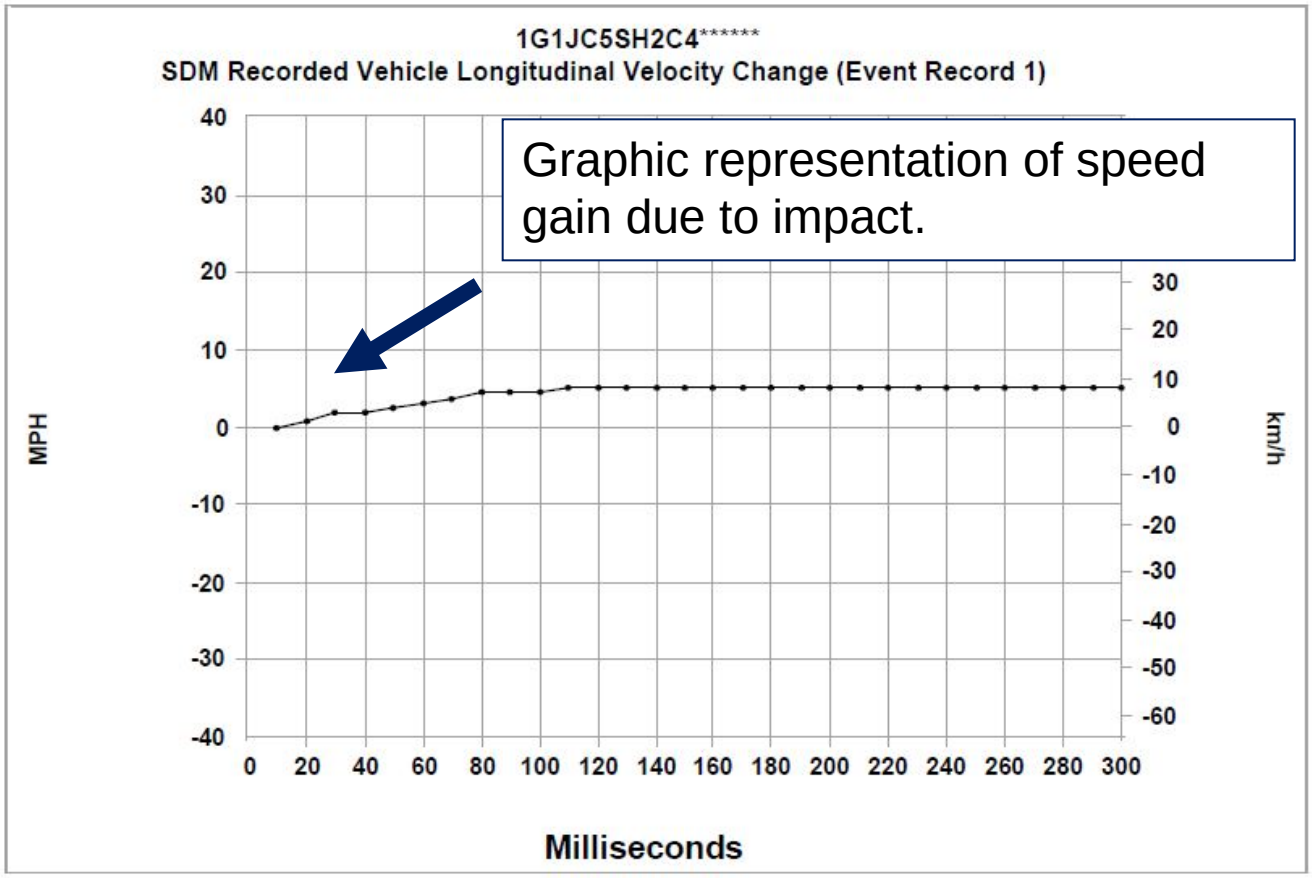
Times (sec)	Accelerator Pedal Position (percent)	Brake Switch Circuit State	Engine Speed	Throttle Position (%)	Vehicle Speed (MPH [km/h])
-2.5	0	On	1152	6	18 [29]
-2.0	0	On	1088	7	15 [24]
-1.5	0	On	960	4	11 [17]
-1.0	0	On	960	12	8 [13]
-0.5	0	On	1024	8	6 [10]

Vehicle braking

Vehicle slowing at time of impact



Event Record 1



- Hit in the rear and gained 5 mph

Event Record 2

Event Data (Event Record 2)

Event Recording Complete	Yes
Event Record Type	Non-Deployment
Crash Record Locked	Yes
OnStar Deployment Status Data Sent	Yes
OnStar SDM Recorded Vehicle Velocity Change Data Sent	No
Deployment Event Counter	0
Algorithm Enable Counter	2
OnStar Notification Event Counter	0
Algorithm Active: Rear	Yes
Algorithm Active: Rollover	Yes
Algorithm Active: Side	Yes
Algorithm Active: Frontal	Yes
Ignition Cycles At Event	767
Time Between Events (sec)	0.89
Concurrent Event Flag Set	No
Event Severity Status: Rollover	No
Event Severity Status: Rear	No
Event Severity Status: Right Side	No
Event Severity Status: Left Side	No
Event Severity Status: Frontal Stage 2	No
Event Severity Status: Frontal Stage 1	No
Event Severity Status: Frontal Pretensioner	No
Driver 1st Stage Deployment Loop Commanded	No
Passenger 1st Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop #1 Commanded	No
Passenger Pretensioner Deployment Loop #1 Commanded	No
Driver Pretensioner Deployment Loop #2 Commanded (If Equipped)	No
Passenger Pretensioner Deployment Loop #2 Commanded (If Equipped)	No
Driver Thorax Loop Commanded (If Equipped)	No
Passenger Thorax Loop Commanded (If Equipped)	No
Left Row 2 Thorax Loop Commanded (If Equipped)	No
Right Row 2 Thorax Loop Commanded (If Equipped)	No
Driver Row 1 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Passenger Row 1 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Left Row 2 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Right Row 2 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Left Row 3 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Right Row 3 Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Driver Knee Deployment Loop Commanded (If Equipped)	No
Passenger Knee Deployment Loop Commanded (If Equipped)	No
Left Row 2 Pretensioner Deployment Loop Commanded (If Equipped)	No
Right Row 2 Pretensioner Deployment Loop Commanded (If Equipped)	No
Center Row 2 Pretensioner Deployment Loop Commanded (If Equipped)	No
Battery Cutoff Loop Commanded (If Equipped)	No
Driver Roll Bar Loop Commanded (If Equipped)	No
Passenger Roll Bar Loop Commanded (If Equipped)	No
Steering Column Energy Absorbing Loop Commanded (If Equipped)	No
Driver Head Rest Loop Commanded (If Equipped)	No
Passenger Head Rest Loop Commanded (If Equipped)	No
Left Row 2 Head Rest Loop Commanded (If Equipped)	No
Right Row 2 Head Rest Loop Commanded (If Equipped)	No
Center Row 2 Head Rest Loop Commanded (If Equipped)	No
High Voltage Battery Cutoff Loop Commanded (If Equipped)	No
Driver Belt Switch Circuit Status (If Equipped)	Buckled
Passenger Belt Switch Circuit Status (If Equipped)	Not Buckled
Driver Seat Position Status (If Equipped)	Data Not Available
Passenger Seat Position Status (If Equipped)	Data Not Available
Passenger Seat Occupancy Status (If Equipped)	Empty
Passenger Classification Status (If Equipped)	Not Applicable
Passenger SIR Suppression Switch Circuit Status (If Equipped)	Data Not Available

Ignition cycles at Event: 767
Time between events: 0.89 sec

Max recorded velocity change: -6 mph

Passenger Air Bag ON Indicator Status (If Equipped)	Off
Passenger Air Bag OFF Indicator Status (If Equipped)	On
Low Tire Pressure Warning Lamp	Off
SIR Warning Lamp Status	Off
SIR Warning Lamp ON/OFF Time Continuously (seconds)	517590
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	0
Ignition Cycles Since DTCs Were Last Cleared at Event Enable	253
Time From Algorithm Enable to Maximum SDM Recorded Vehicle Velocity Change (msec)	50
Longitudinal SDM Recorded Vehicle Velocity Change at time of Maximum SDM Recorded Vehicle Velocity Change MPH [km/h]	-6 [-10]
Lateral SDM Recorded Vehicle Velocity Change at time of Maximum SDM Recorded Vehicle Velocity Change MPH [km/h]	-1 [-1]
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Driver Thorax/Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Passenger Thorax/Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Data Not Available
Driver Pretensioner Time From Algorithm Enable to Deployment Loop #1 or Loop #2 Command Criteria Met (msec)	Data Not Available
Passenger Pretensioner Time From Algorithm Enable to Deployment Loop #1 or Loop #2 Command Criteria Met (msec)	Data Not Available

Pre-impact information

Pre-Crash Data -1 to -.5 sec (Event Record 2)

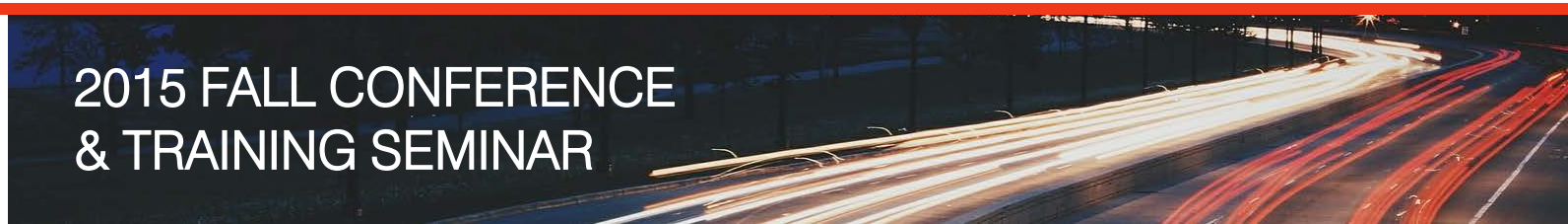
Times (sec)	Cruise Control Active	Cruise Control Resume Switch Active	Cruise Control Set Switch Active	Engine Torque (lb-ft [N-m])	Reduced Engine Power Mode Indicator
-1.0	No	No	No	-1 [-2]	Off
-0.5	No	No	No	26 [35]	Off

Pre-Crash Data -2.5 to -.5 sec (Event Record 2)

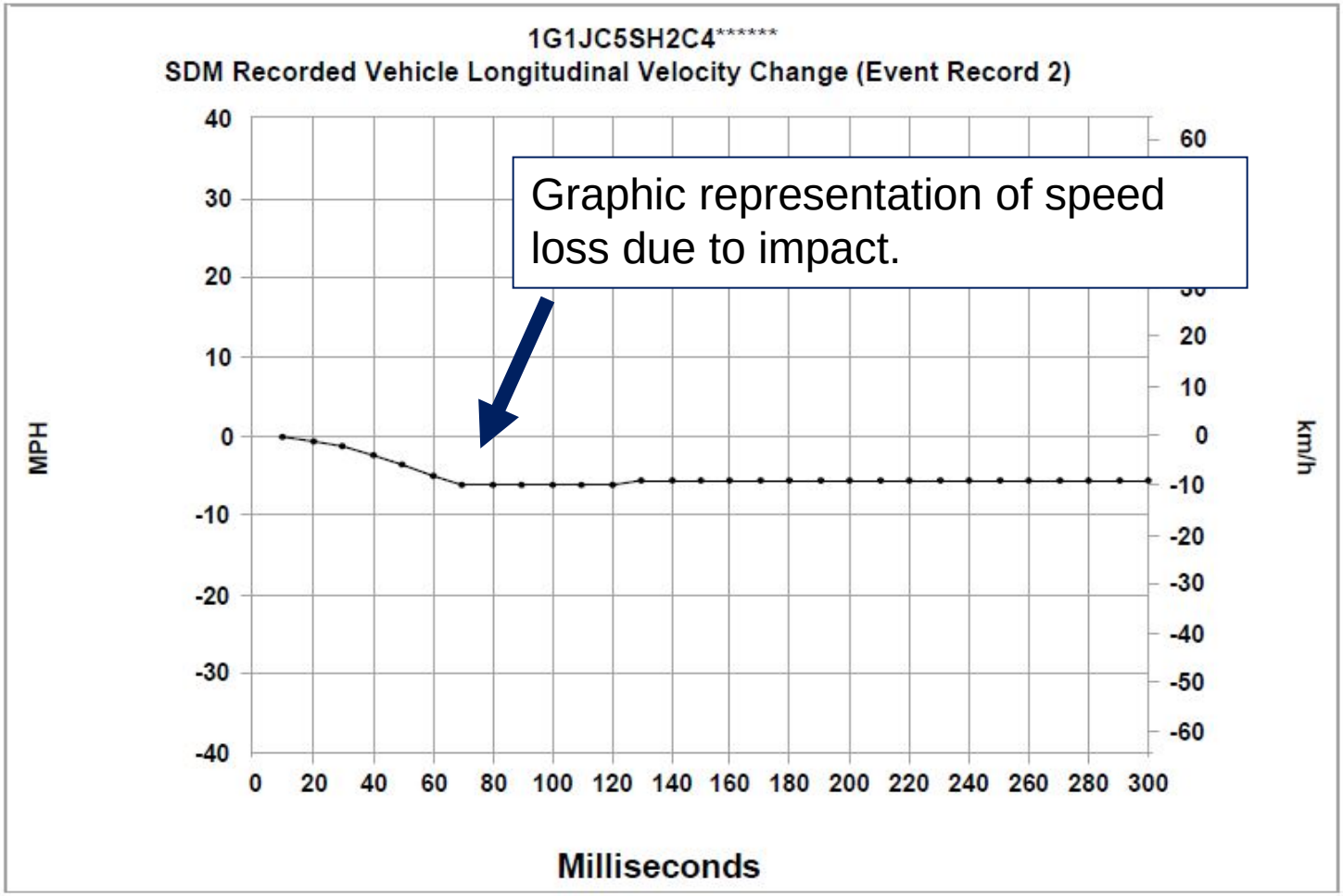
Times (sec)	Accelerator Pedal Position (percent)	Brake Switch Circuit State	Engine Speed	Throttle Position (%)	Vehicle Speed (MPH [km/h])
-2.5	0	On	960	4	11 [17]
-2.0	0	On	960	12	8 [13]
-1.5	0	On	1024	8	6 [10]
-1.0	21	Off	1024	6	11 [18]
-0.5	99	Off	1536	21	11 [17]

Notice: foot came off brake after first rear impact

Vehicle traveling at 11 mph



Event Record 2



- Struck car in front, lost 6 mph of speed

Case: three vehicle collision, summary

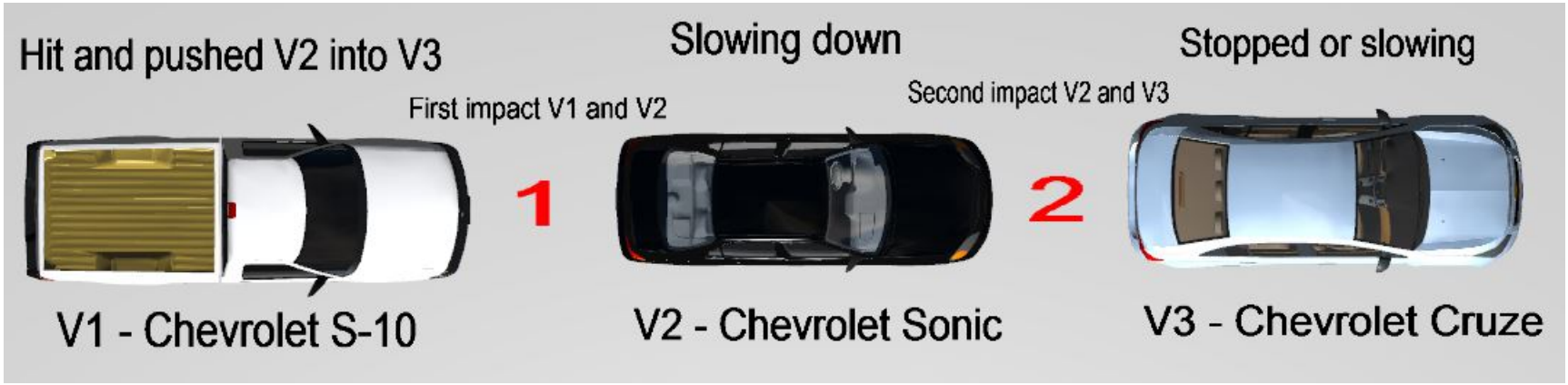
Traveling at 6 mph, hit and gained 5 mph, now traveling at 11 mph

Event 1	Time:	-2.5	-2	-1.5	-1	-0.5	Impact
	MPH:	18	15	11	8	6	5
	Brakes:	On	On	On	On	On	

Event 2	Time:		-2.5	-2	-1.5	-1	-0.5	Impact
	MPH:		11	8	6	11	11	-6
	Brakes:		On	On	On	Off	Off	

Note: Second impact was larger than first

Time gap between events was 0.89 sec or ~ 1 sec

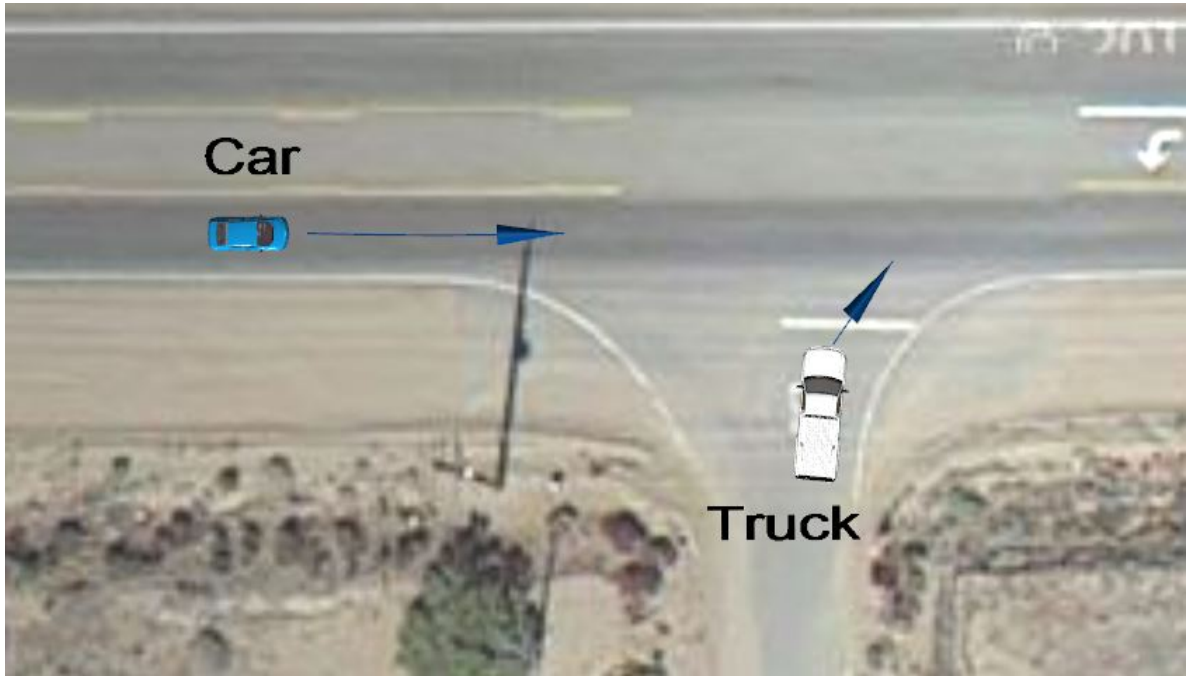


Case: Stop sign

- A Chevrolet truck makes a right turn onto a 55 mph country road and was struck in the rear by a car.

- The driver of the truck stated that he stopped at his stop sign, then after checking for cars accelerated onto the road.

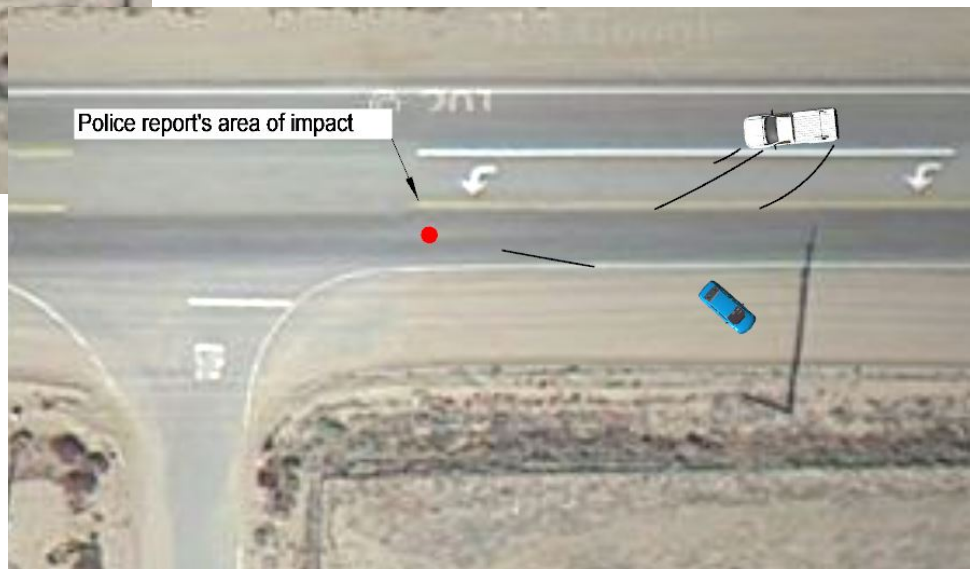
- The driver of the car said the truck came out of “nowhere”. He did not see the truck until right before impact.



- Question:
  - Did the truck stop at the stop sign?

Case: Stop sign

- Police report provided the area of impact and where the vehicles came to rest after the accident.



- A reconstruction of the accident showed that the truck was traveling approximately 18 mph when it was struck in the rear. The car was then traveling approximately 60 mph.

Case: Stop sign

- The car had no EDR data that could be imaged, but the truck had a Non-Deployment event.

Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle
-5	18	640	0
-4	14	640	0
-3	11	1280	34
-2	12	1728	50
-1	16	2048	51

Driver was accelerating for 3 seconds before impact

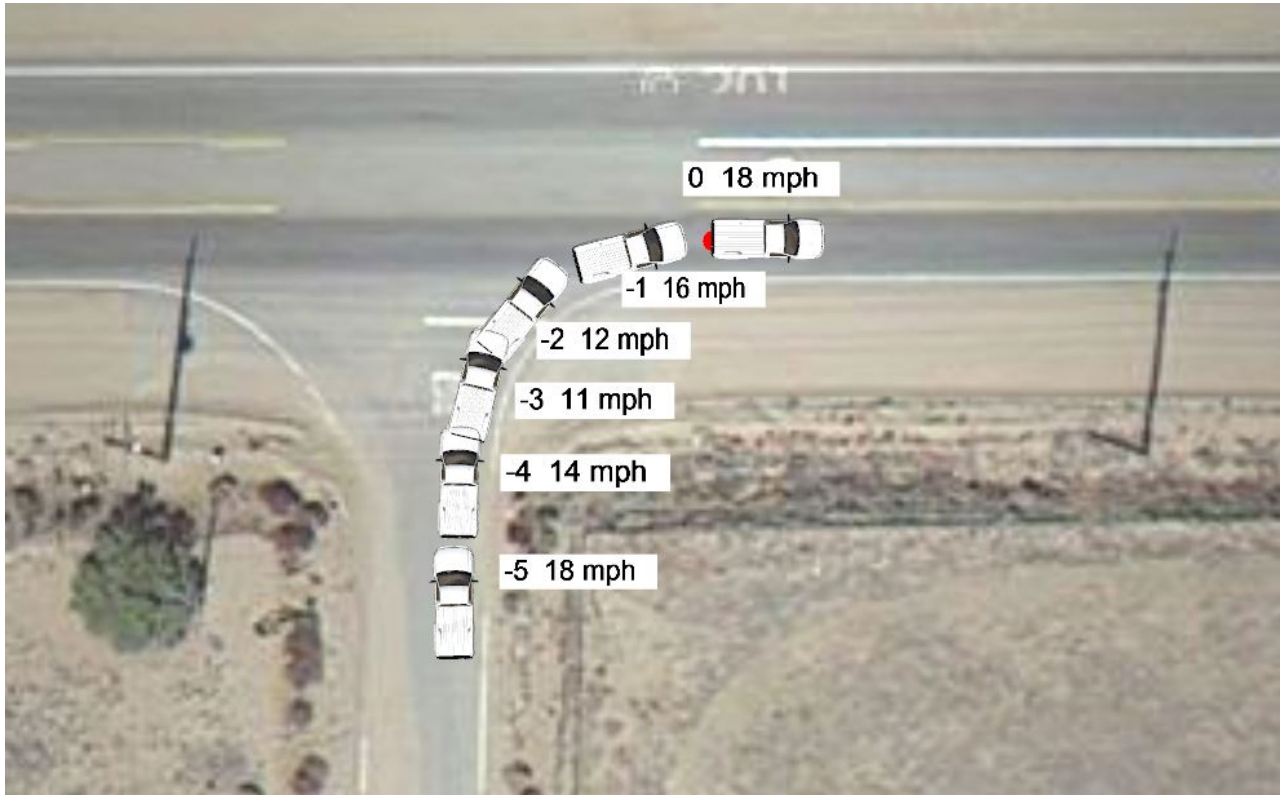
Truck slowing from 18 mph to 11 mph then accelerated to 16 mph

Seconds Before AE	Brake Switch Circuit State
-8	ON
-7	ON
-6	ON
-5	ON
-4	OFF
-3	OFF
-2	OFF
-1	OFF

Driver was braking up to 4 seconds before impact

Case: Stop sign

- Plotting the truck position based on the pre-crash data



- Pickup truck clearly did not stop at the stop sign

Summary

Accident Reconstruction

- EDR data can sometimes be the only physical evidence available to show circumstances surrounding a collision.
- EDRs are only useful in the context of the accident, a reconstruction is always needed.
- The latest Crash data retrieval vehicle coverage list can be found at:
  www.cdr-system.com/resources/coverage.html

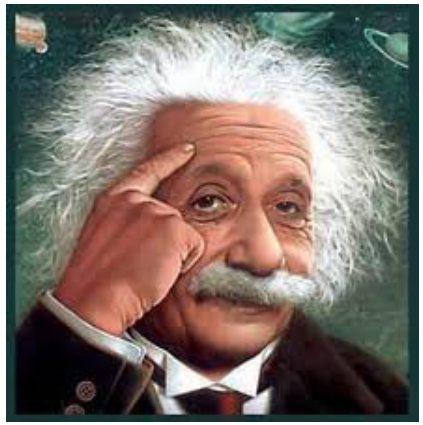
Litigation Strategy

- Discovery-ask for the right stuff!
  - Vehicle inspection
  - Event Data Recorder inspection
  - Data from EDR
  - CDRx file
  - Crash Data Report
- Trial-what is your theme?
  - Evidentiary issues
  - Cross-examination of witnesses and experts

Questions?

Marc Hammarström
Accident Reconstructionist
Incident Forensics
Pasadena
incidentforensics.com
marc@IncidentForensics.com ● (626) 646-9668

Christie Swiss
Attorney at Law
Collins Collins Muir + Stewart LLP
Oakland ● South Pasadena ● Orange ● San Diego
ccmslaw.com
cswiss@ccmslaw.com ● (760) 274-2110



You don't have to be an Einstein to have a good question…