

Use of Event Data Recorders for the Defense Litigator

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Outline

- **What is an Event Data Recorder (EDR)?**
- **History of EDRs**
- **Consent Requirements for Download**
- **EDR Example Retrievals**
- **Evaluating Airbag Systems**
- **EDR Accuracy**
- **Crash Test Example**



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Event Data Recorders

- NHTSA definition:
 - ***A device installed in a motor vehicle to record technical vehicle and occupant information for a brief period of time (seconds, not minutes) before, during and after a crash.***
- Terms Used:
 - NHTSA – National Highway Traffic Safety Administration
 - EDR – Event Data Recorder
 - ACM – Airbag Control Module



Reference: www.nhtsa.gov/research-data/event-data-recorder

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Code of Federal Regulations Title 49, Part 563 – Event Data Recorders

- **Scope:** Specifies uniform, national requirements for vehicles equipped with EDRs. (**Effective Sept. 1, 2012, GVWR < 8,500 lb.**)
- **Event:** A physical occurrence that causes the trigger threshold to be met or exceeded, or an air bag to be deployed.
- **Trigger threshold:** A change in vehicle velocity that equals or exceeds 5 mph within a 150 millisecond interval.
- **563.6 – Requirements:** “Each vehicle equipped with an EDR must meet the requirements for data elements:
 - Longitudinal delta-V
 - Maximum delta-V



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Event Data Recorder (Airbag Control Module)



GM Sensing Diagnostic
Modules



Ford Restraint Control
Module



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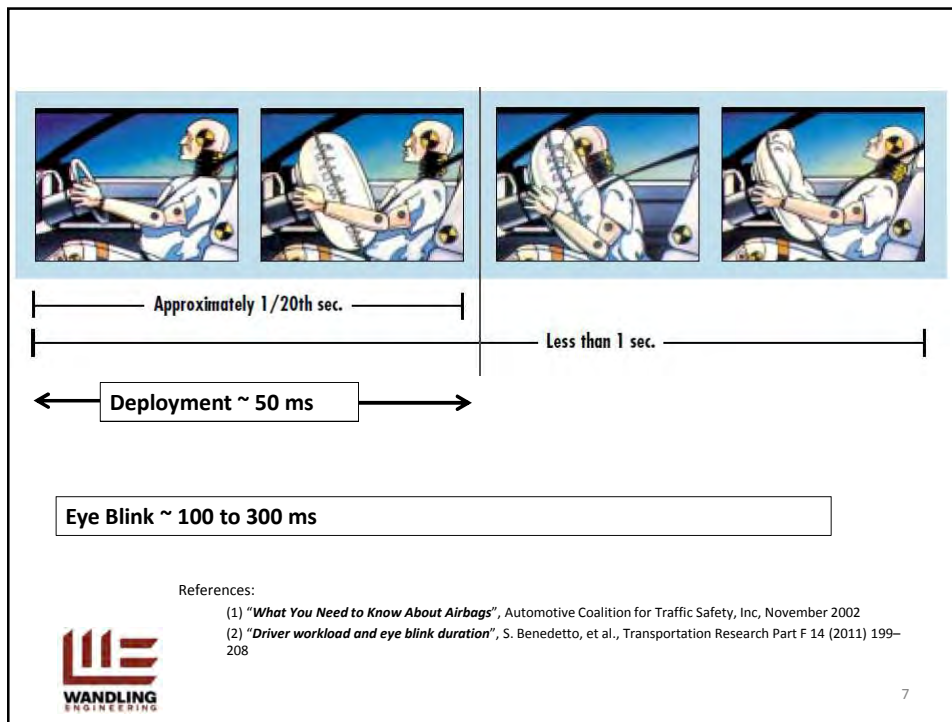
Air Bag Control Module

- Activates when the vehicle ignition is turned on
- Monitors the readiness of the air bag system
 - Air bag module – inflator unit and fabric bag
 - Crash sensors - accelerometers
- If needed, deploy the airbag in a crash
 - Most store electrical energy to deploy the air bag if the vehicle's battery is destroyed



Reference: "*What You Need to Know About Airbags*", Automotive Coalition for Traffic Safety, Inc, November 2002

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History of Event Data Recorders

- Crash recording devices:
 - 1973-1977: General Motors installed 10,000+ passive restraint systems for front seated occupants:
 - GM Air Cushion Restraint System
 - The analysis of these recording devices was limited to checking fuses and measuring electrical resistances
 - 1974: NHTSA installed 1,050 vehicles with EDRs that recorded a time history of accelerations.
 - 26 million miles travelled and 23 accidents recorded
 - EDRs had potential to provide accurate/objective data

References:

- (1) DOT-HS-4-00890, NHTSA, 1977, "A Manual for Evaluating the Performance of the Electrical Circuitry of the General Motors Air Cushion Restraint System"
 (2) "Automotive Recorder Research – A Summary of Accident Data and Test Results", S. Teel, et al., SAE Paper 740566.



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Event Data Recorders In Recent Years

- EDR's have been installed in an increasingly large number of light motor vehicles
- NHTSA estimated 65% to 90% of model year 2004 light duty vehicles had some recording capability
- In 2016 model year:
 - 99% have EDR
 - 88% of vehicles are accessible with a Bosch Crash Data Retrieval system
 - 11% have EDR accessible by another tool



References:

- (1) Traffic Crash Reconstruction, 2nd Edition, by Lynn Fricke
- (2) IATAI 2016 presentation, CDR Update, by Rick Ruth

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Event Data Recorders

- EDRs record information related to an event
- EDRs may record:
 1. Pre-crash data and system status
 2. Driver inputs (braking, accelerator pedal, etc.)
 3. Vehicle crash level (accelerations)
 4. Restraint usage/deployment status
 5. Post-crash data



Reference: www.nhtsa.gov

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Consent Requirements for Download

- CFR 49 § 563.11 requires that owner manuals contain information about EDR's.
- Driver Privacy Act of 2015:
 - Data in an EDR is the property of the owner or lessee of the vehicle.
 - Prohibits a person (other than owner/lessee) from accessing EDR unless:
 - Court, judicial or administrative authority authorizes retrieval.
 - Owner/lessee provides consent.
 - Pursuant to authorized DOT investigations, emergency medical response, or traffic safety research.



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Consent Requirements for Download

Consent to Download an Event Data Recorder (EDR)

What is an EDR?
Code of Federal Regulations (CFR) 49 § 563.11 information in owner's manual.
(a) The owner's manual in each vehicle covered under this regulation must provide the following statement in English:
This vehicle is equipped with an event data recorder (EDR). The main purpose of an EDR is to record, in certain crash or near-crash situations, such as an air bag deployment or hitting a road obstacle, data that may be useful in determining the cause of a crash or near-crash event.

Consent

I am the owner of the vehicle described below. I hereby consent to allow Dr. Alan Lynch, from Wandling Engineering, to examine my vehicle and download its EDR. I understand I do not have to allow him to download the EDR. I am giving my consent and written permission voluntarily and without threats, promises or reward of any kind.

Vehicle Make: XYZ
Vehicle Year: 2017
VIN: 12345678901234567

Download Date & Time: (To be Determined)

Date: _____
Signature: _____



Reference: IPTM Bosch CDR Technician Consent Form, 2014

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EDR Retrieval via DLC



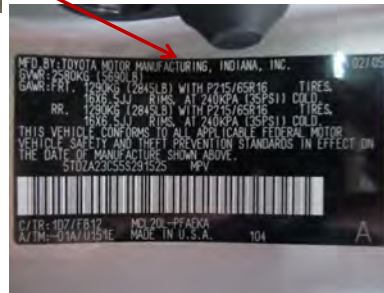
Diagnostic Link Connector (DLC)



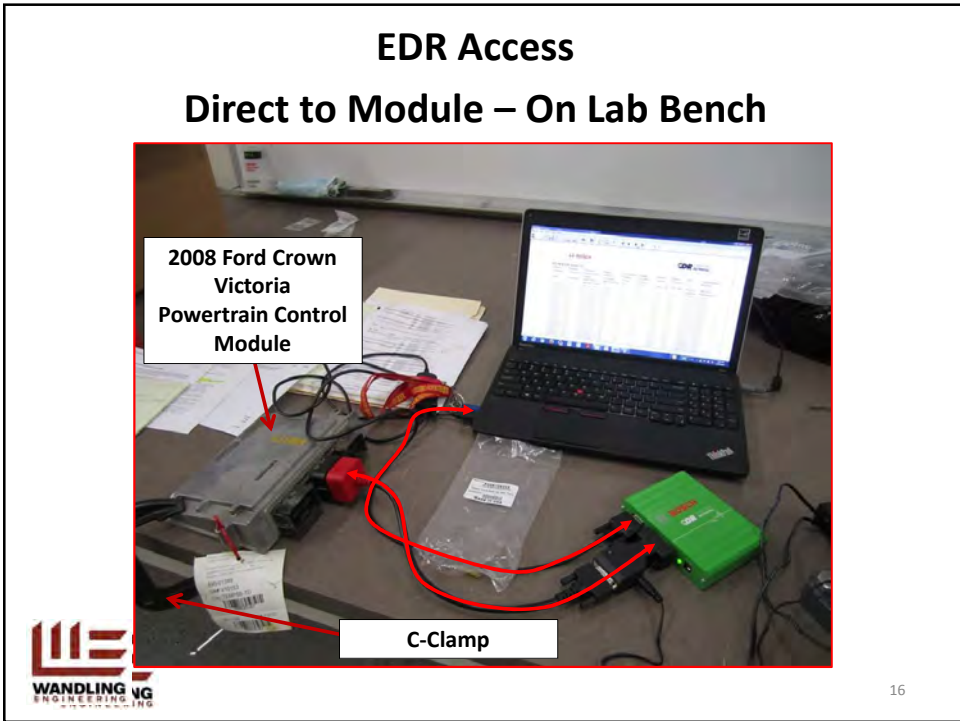
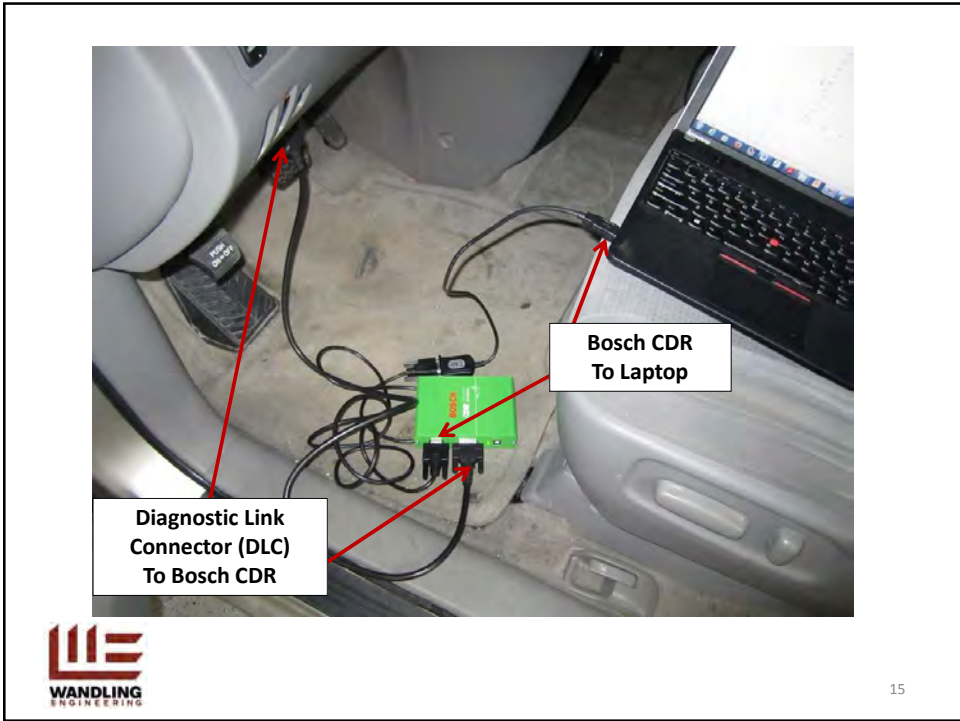
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Tire & Loading
Specifications and
Vehicle Data
Plate



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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	5TDZA23C55S291525
User	Alan Lynch
Case Number	EDR052014
EDR Data Imaging Date	05/13/2014
Crash Date	05/13/2014
Filename	251_5TDZA23C55S291525_ACM.CDRX
Saved on	Tuesday, May 13 2014 at 10:28:22
Collected with CDR version	Crash Data Retrieval Tool 12.3
Reported with CDR version	Crash Data Retrieval Tool 12.3
EDR Device Type	Airbag Control Module
Event(s) recovered	Front/Rear (1)

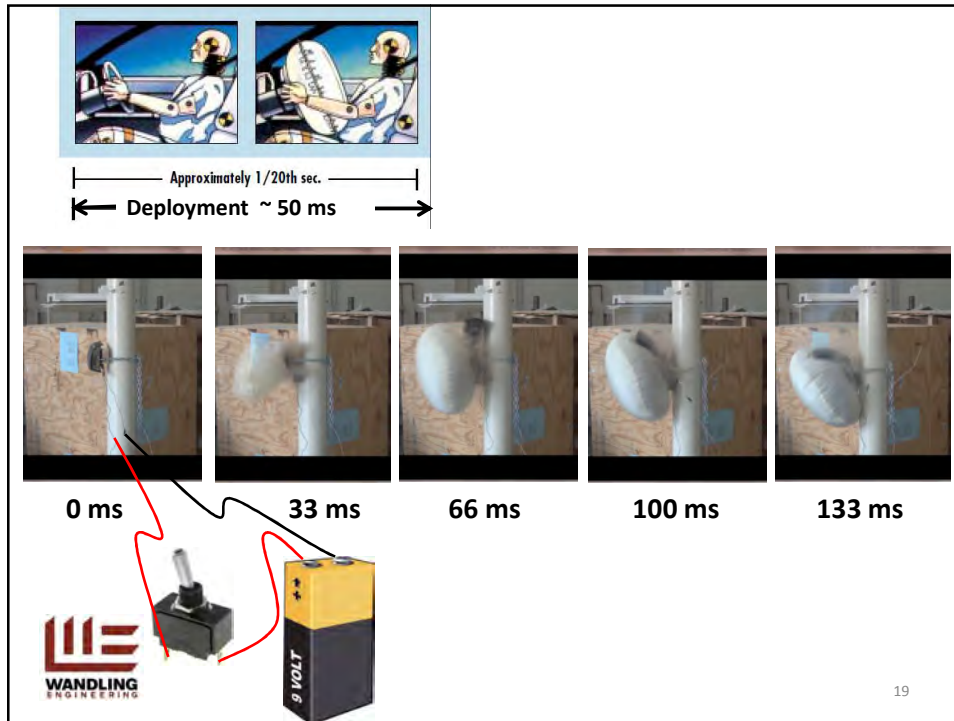
Comments

- a. Imaging Method: DLC
- b. Power: Vehicle Power
- c. Tire Information:
 - Recommended: P215/65R16 (Front/Rear)
 - Actual: P215/65R16 (Front/Rear)
- d. Vehicle Cable: 287 DLC to ACM
- e. Adaptor: N/A

2005 Toyota Sienna

Image Authority: Consent
Present At Inspection: AGL
Location: 923 N. 2nd Street, Ames, Iowa

Evaluating Airbag Systems



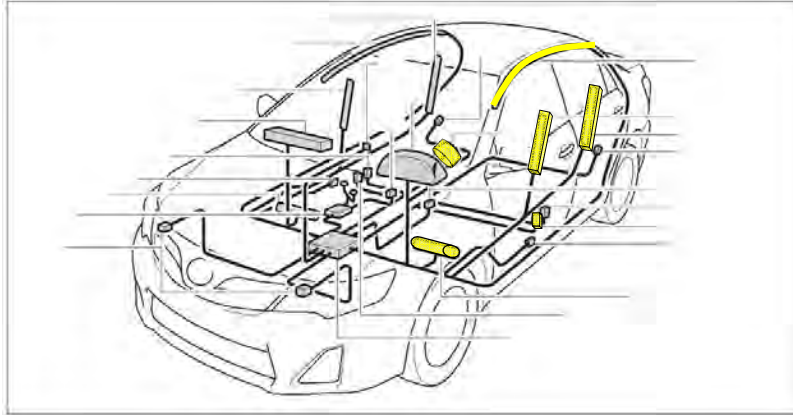
19

2014 Toyota Camry SRS (SRS – Supplemental Restraint System)



20

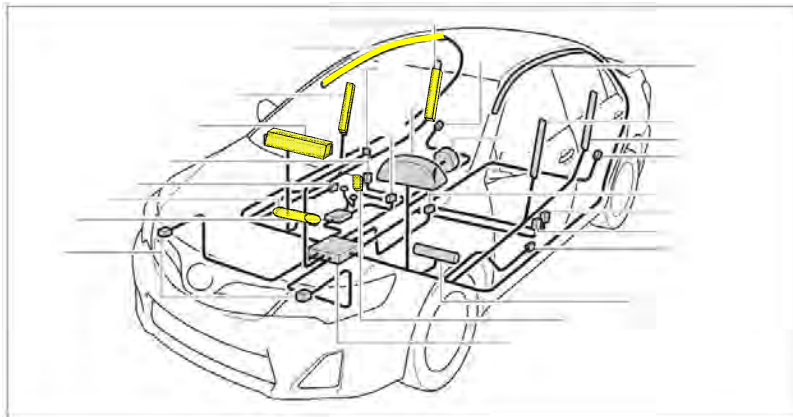
Driver Side SRS Airbags



Reference: 2014 Toyota Camry Owner's Manual

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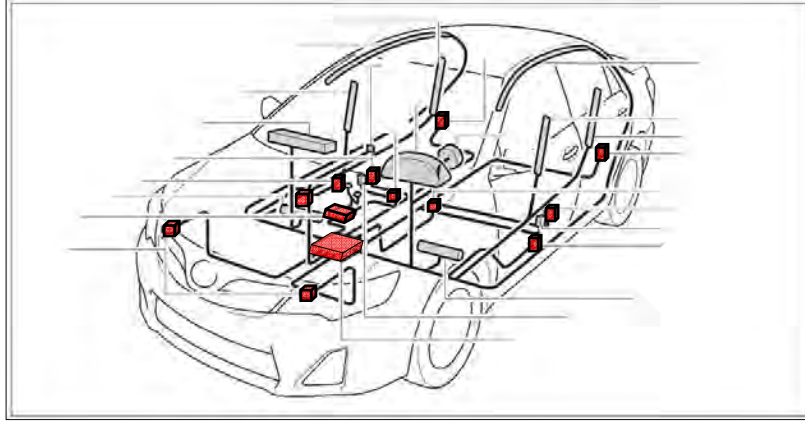
Passenger Side SRS Airbags



Reference: 2014 Toyota Camry Owner's Manual

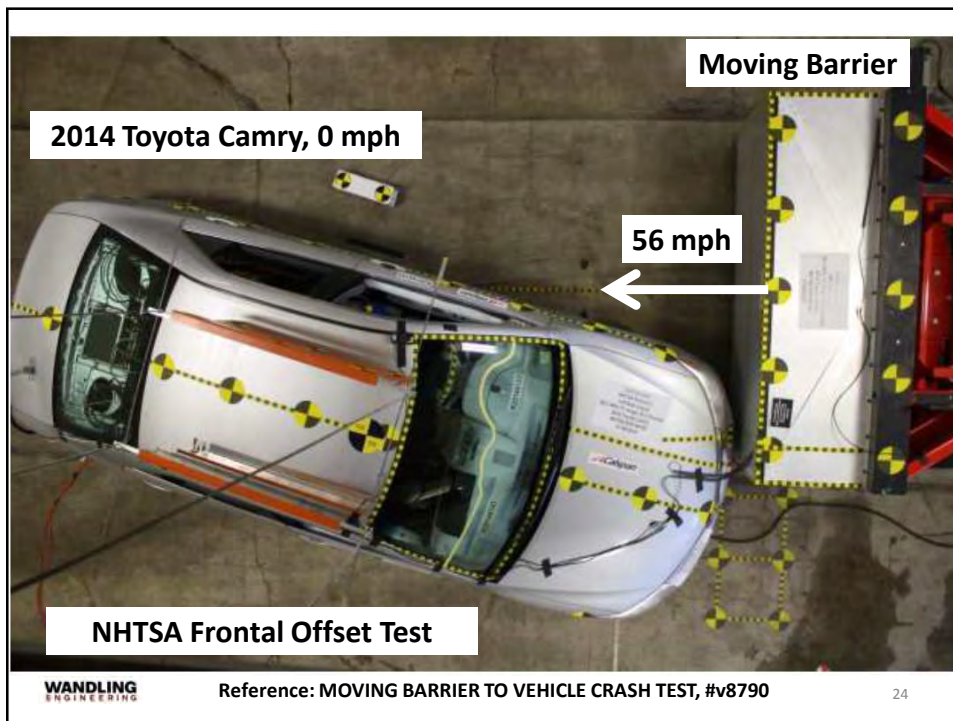
22

Sensors and Sensor Module

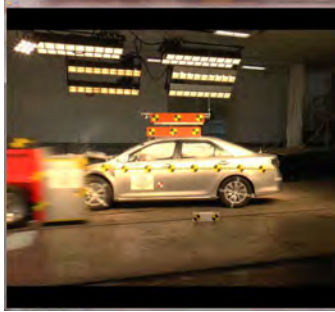


Reference: 2014 Toyota Camry Owner's Manual

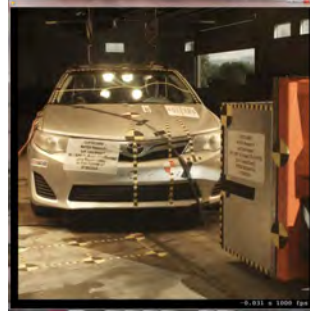
23



Crash Cameras



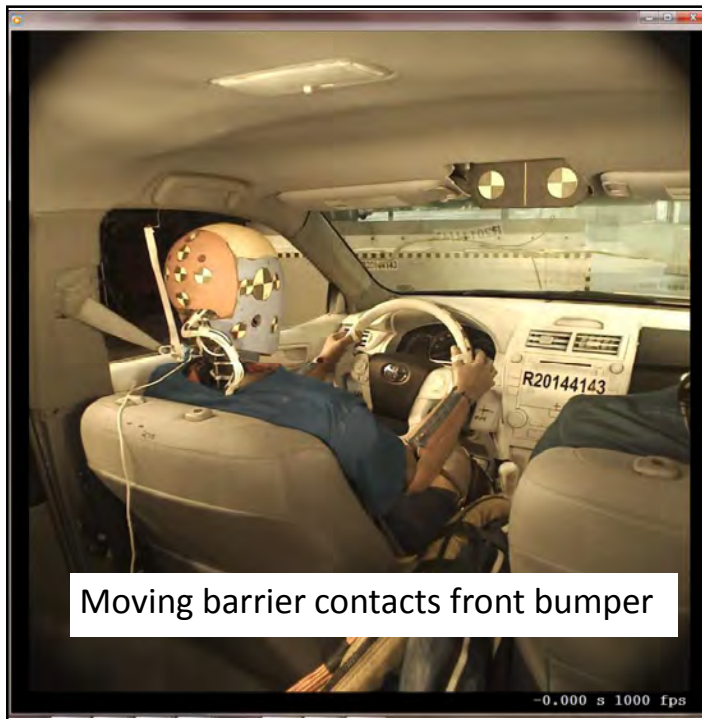
Real Time



Slow Motion



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Moving barrier contacts front bumper

T = 0 ms

26



T = 1 ms

27



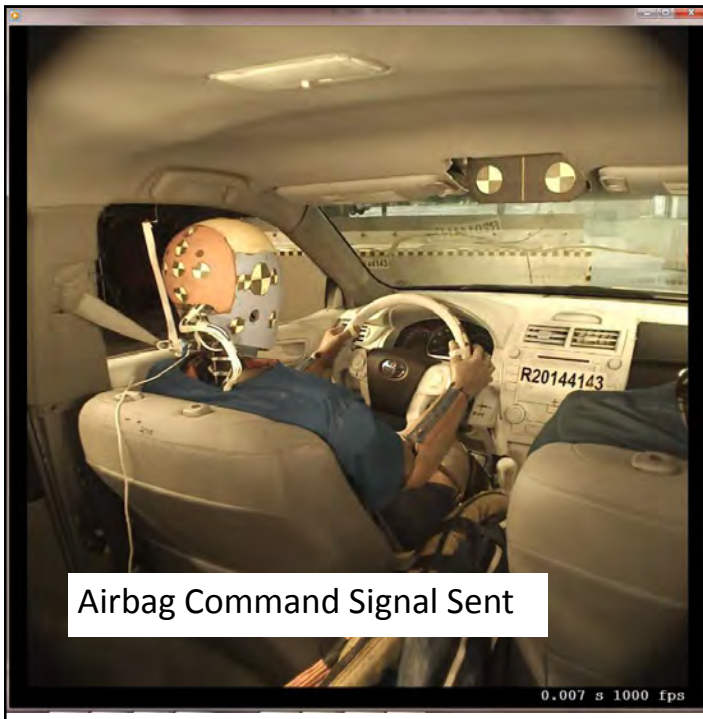
T = 3 ms

28



T = 5 ms

29



T = 7 ms

30



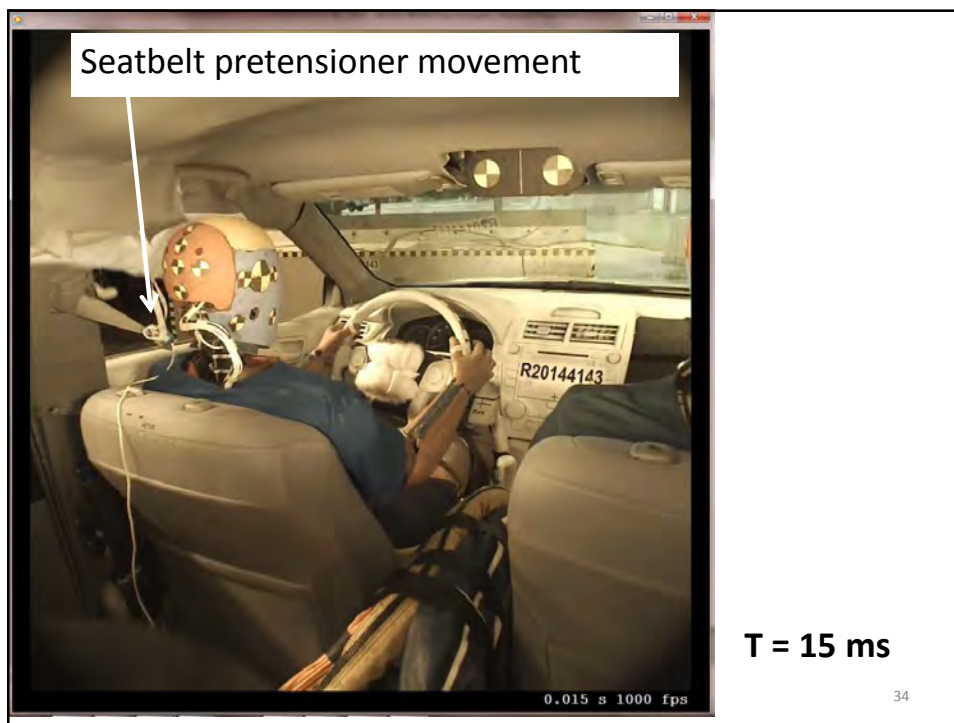
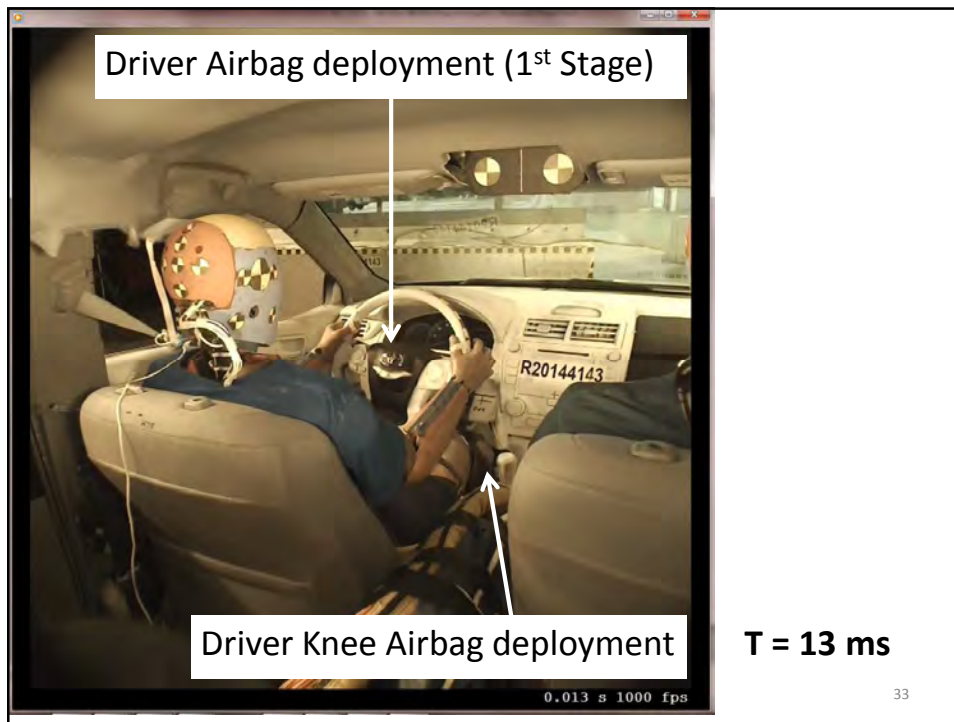
T = 9 ms

31



T = 11 ms

32





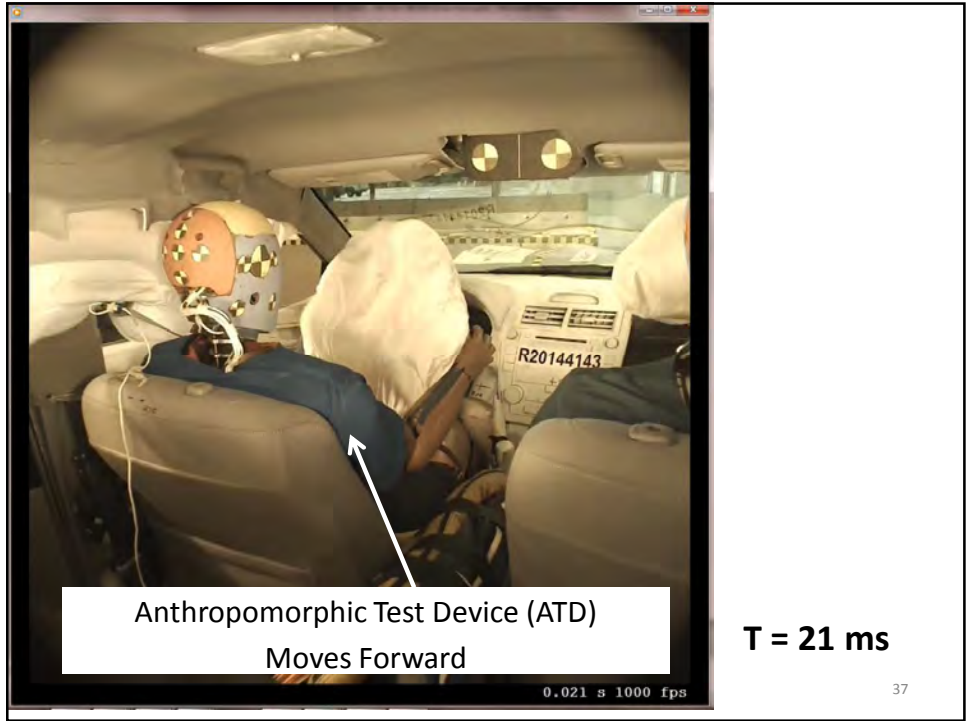
T = 17 ms

35



T = 19 ms

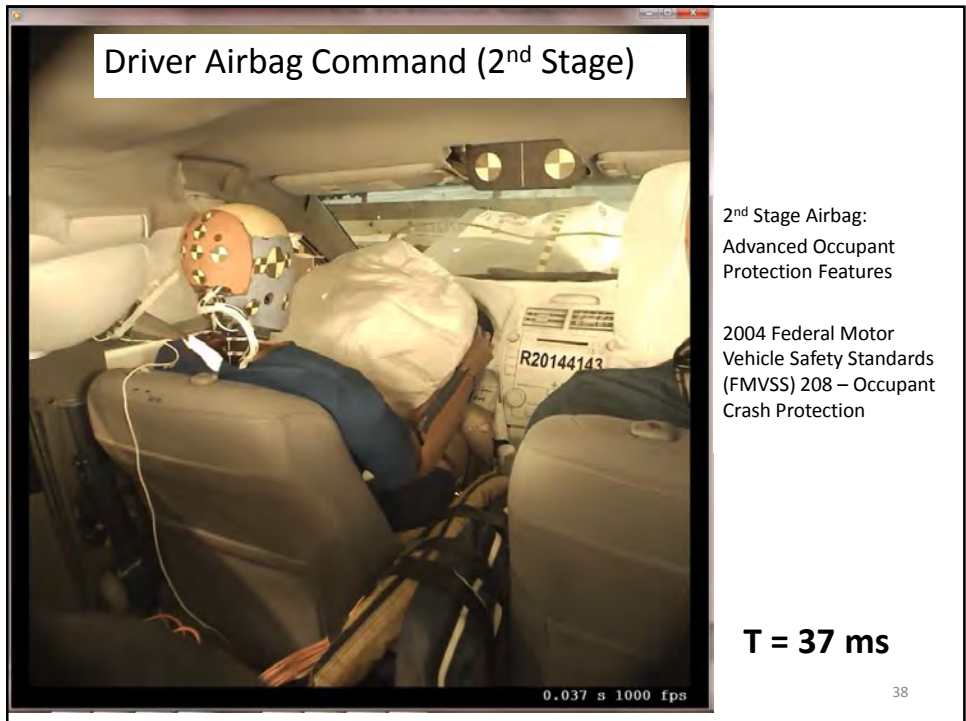
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Anthropomorphic Test Device (ATD)
Moves Forward

T = 21 ms

37



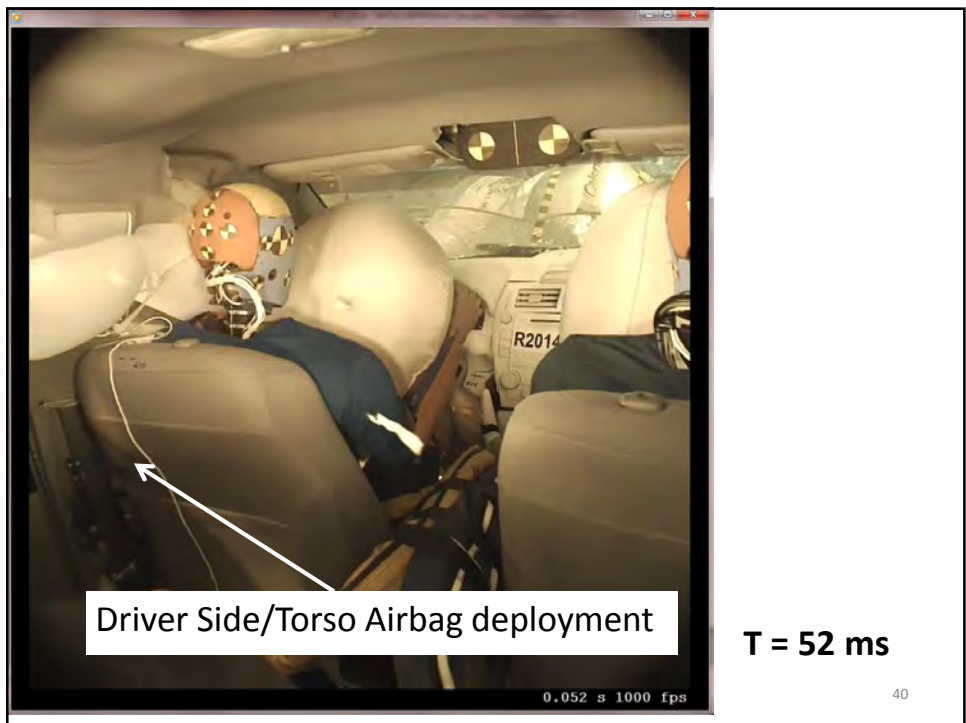
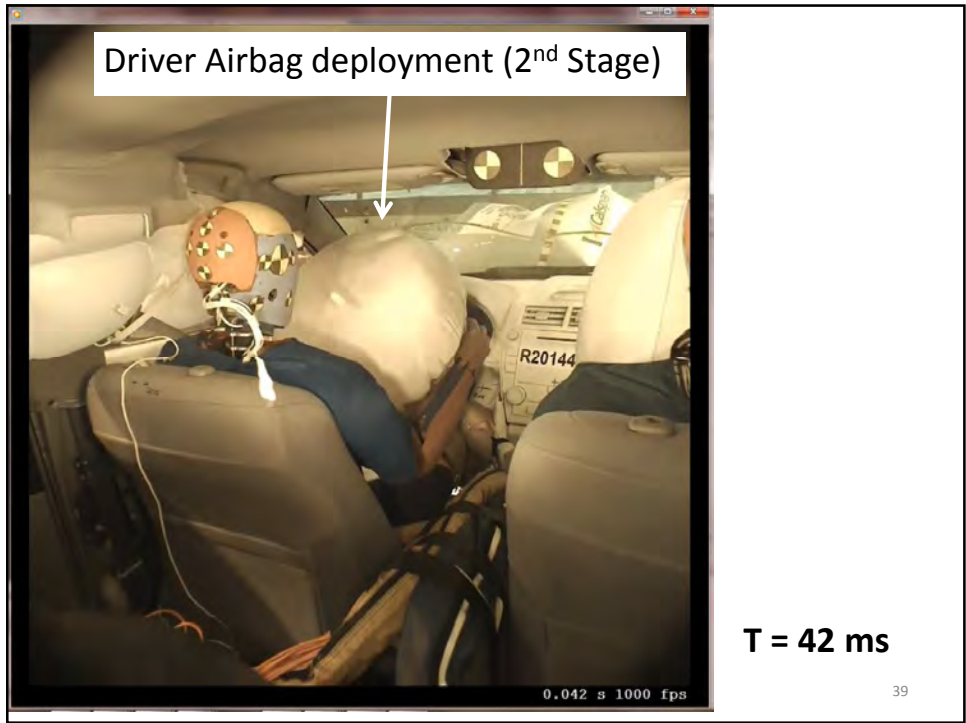
Driver Airbag Command (2nd Stage)

2nd Stage Airbag:
Advanced Occupant
Protection Features

2004 Federal Motor
Vehicle Safety Standards
(FMVSS) 208 - Occupant
Crash Protection

T = 37 ms

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Driver Side/Torso Airbag deployment



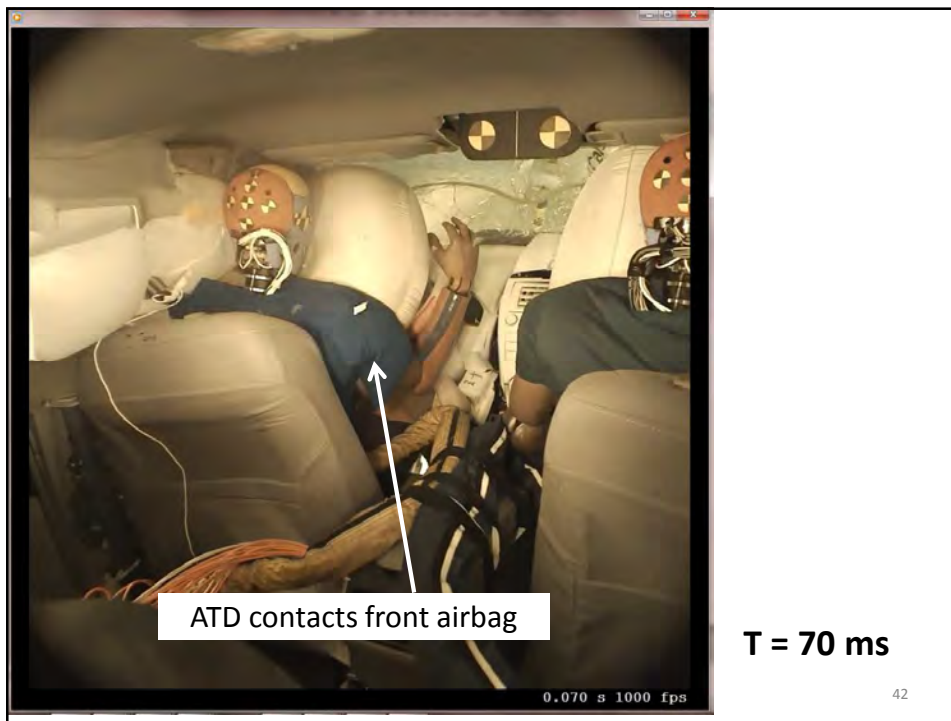
Pre-Test



Post-Test



41



T = 70 ms

42



A body at rest remains at rest unless acted on by an outside force

ATD moves independent of the vehicle.

The vehicle moves rearward and to right due to crash.

ATD wants to remain at rest until acted on by interior forces.

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Comparison of Event Data Recorders and NHTSA Testing



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CDR File Information

User Entered VIN	4T4BF1F00ER017208
User	
Case Number	
ECR Data Imprinting Date	07/06/2014
Crash Date	

Airbag ECU data should be used in conjunction with other physical evidence obtained from the vehicle and the surrounding.

All Physical Evidence in a crash needs to be evaluated.

Data Limitations

- Airbag ECU data should be used in conjunction with other physical evidence obtained from the vehicle and the surrounding circumstances.
- If any of the front passenger seat airbags, side airbags, or Curtain Shield Airbags have deployed, data will not be overwritten or deleted by the airbag ECU following that event. If none of the airbags have deployed, the data of that event may be overwritten by a following event even if other airbags (pretensioner, rear seat airbag, etc.) have deployed.
- If power supply to the airbag ECU is lost during an event, all or part of the data may not be recorded.
- "Diagnostic Trouble Codes" are information about faults when a recording trigger is established. Various diagnostic trouble codes could be set and recorded due to component or system damage during an accident.
- The airbag ECU records only diagnostic information related to the airbag system. It does not record diagnostic information related to other vehicle systems.
- The TaSCAN, Global TechStream, or Intelligent Tester II devices (or any other Toyota genuine diagnostic tool) can be used to obtain detailed information on the diagnostic trouble codes from the airbag system, as well as diagnostic information from other systems. However, in some cases, the diagnostic trouble codes of the airbag system recorded by the airbag ECU when the event occurred may not match the diagnostic trouble codes read out when the diagnostic tool is used.



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Evaluating EDR Information

- 4 Checks Before Further Evaluation

1. Is the EDR Recording Complete?
2. Confirm Ignition Cycles (if available)
3. Compare Velocity Change (Delta V) to Physical Evidence
4. Evaluate the Pre-Crash data (if available)

WARNINGS:

- EDR Data Should Always Be Confirmed with Physical Evidence from the Vehicle and Scene
- 4 Checks does not suggest an evaluation is complete



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1. Is the EDR Recording Complete?

System Status at Time of Retrieval

ECU Part Number	89170-06770
EDR Generation	13EDR
Complete File Recorded	Yes
Freeze Signal	ON
Freeze Signal Factor	Front Airbag Deployment
Diagnostic Trouble Codes Exist	No
Ignition Cycle Download (times)	72
Multi-event, number of events (times)	2 or greater
Time from event 1 to 2 (s)	0.003
Time from Previous Pre-Crash TRG (msec)	16381 or greater
Latest Pre-Crash Page	0
Contains Unlinked Pre-Crash Data	No



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2. Confirm Ignition Cycles

Ignition cycle counter increments +1 each time the ignition key is turned to RUN

Pre-Crash Data, 1 Sample (Most Recent Event, TRG 2)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	400
TRG Count when Pre-crash TRG was Established (times)	1
Safety Belt Status, Driver	ON
Safety Belt Status, Front Passenger	ON
Occupant Size Classification, Front Passenger	AME0 (Not Child)
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	SNA
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle, Crash (times)	71

@ Crash = 71

System Status at Time of Retrieval

ECU Part Number	89170-06770
EDR Generation	13EDR
Complete File Recorded	Yes
Freeze Signal	ON
Freeze Signal Factor	Front Airbag Deployment
Diagnostic Trouble Codes Exist	No
Ignition Cycle, Download (times)	72
Multi-event, number of events (times)	2 or greater
Time from event 1 to 2 (s)	0.003
Time from Previous Pre-Crash TRG (msec)	16381 or greater
Latest Pre-Crash Page	0
Contains Unlinked Pre-Crash Data	No

@ Download = 72



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3. Compare Velocity Change to Physical Evidence

Why is velocity change important?

Force = Mass * Acceleration

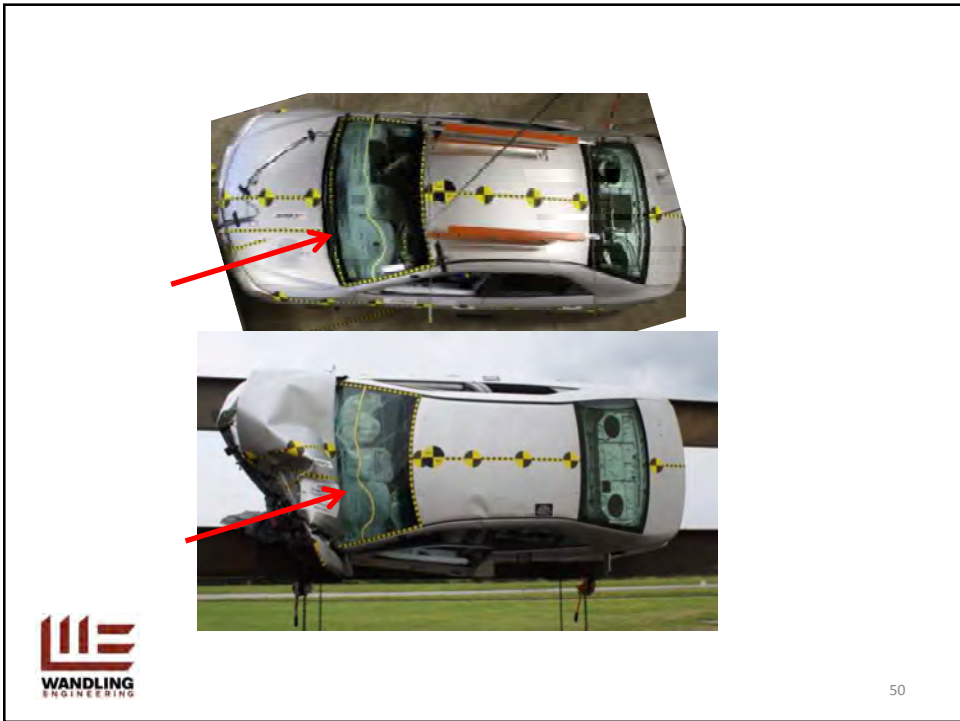
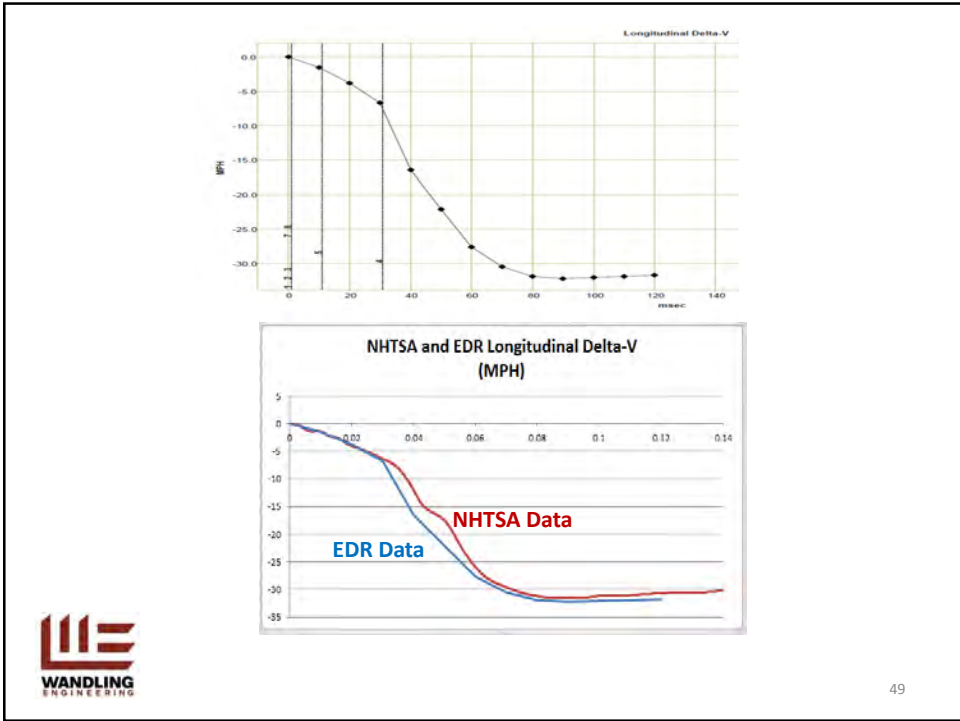
$$F = m * a$$

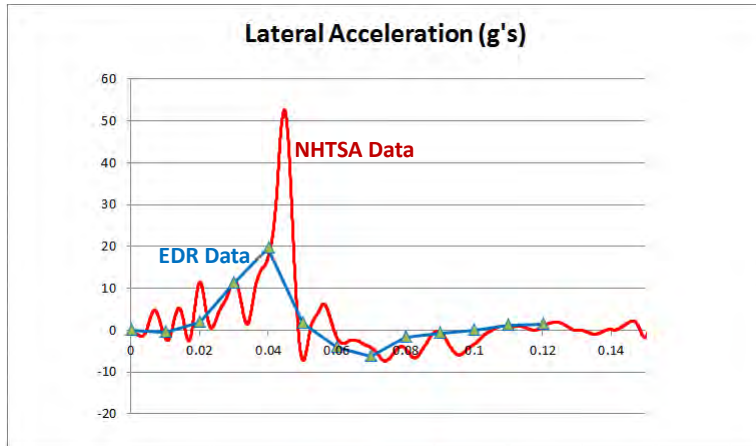
$$F = m * \frac{\Delta v}{\Delta t}$$

$$F * \Delta t = m * \Delta v$$



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4. Evaluate the Pre-Crash Data (if available)

Pre-Crash Data, -5 to 0 seconds (Most Recent Event, TRG 2)

Time (sec)	-4.9	-4.4	-3.9	-3.4	-2.9	-2.4	-1.9	-1.4	-0.9	-0.4	0 (TRG)
Vehicle Speed (MPH (km/h))	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Accelerator Pedal, % Full (%)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Percentage of Engine Throttle (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Engine RPM (RPM)	0	0	0	0	0	0	0	0	0	0	0
Motor RPM (RPM)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Service Brake, ON/OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Brake Oil Pressure (Mpa)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Longitudinal Acceleration, VSC	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.000
Yaw Rate (deg/sec)	-0.49	-0.49	-0.49	-0.49	-0.49	-0.49	-0.49	-0.49	-0.49	-0.49	-0.49
Steering Input (degrees)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Shift Position	N	N	N	N	N	N	N	N	N	N	N



Summary

- **Event Data Recorder (EDR)**
 - Definitions/History/Federal Regulations
- **Consent Requirements**
- **Retrieval and Evaluation**
- **EDR Accuracy**
- **Crash Test Example**

