Use of Event Data Recorders for the Defense Litigator

Dr. Alan Lynch, P.E.

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
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


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 …….
**Event Data Recorder**  
*(Airbag Control Module)*

GM Sensing Diagnostic Modules  
Ford Restraint Control Module

---

**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

References:


Eye Blink ~ 100 to 300 ms

References:

(2) “Automotive Recorder Research – A Summary of Accident Data and Test Results”, S. Teel, et al., SAE Paper 740566.

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
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

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
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.

Reference: IPTM Bosch CDR Technician Consent Form, 2014
EDR Retrieval via DLC

Diagnostic Link Connector (DLC)

Tire & Loading Specifications and Vehicle Data Plate
Dr. Alan Lynch, P.E., Wandling Engineering

15

EDR Access
Direct to Module – On Lab Bench

16
Evaluating Airbag Systems
Deployment ~ 50 ms

2014 Toyota Camry SRS
(SRS – Supplemental Restraint System)
Driver Side SRS Airbags


Passenger Side SRS Airbags

Sensors and Sensor Module


2014 Toyota Camry, 0 mph

NHTSA Frontal Offset Test

Moving Barrier

56 mph

Reference: MOVING BARRIER TO VEHICLE CRASH TEST, #v8790
Crash Cameras

- Real Time
- Slow Motion

Moving barrier contacts front bumper

T = 0 ms
$T = 1 \text{ ms}$

$T = 3 \text{ ms}$
Airbag Command Signal Sent
Curtain Airbag deployment

T = 9 ms

T = 11 ms
Driver Airbag deployment (1st Stage) T = 13 ms

Driver Knee Airbag deployment

Seatbelt pretensioner movement T = 15 ms
Anthropomorphic Test Device (ATD) Moves Forward

T = 21 ms

Driver Airbag Command (2\textsuperscript{nd} Stage)

2\textsuperscript{nd} Stage Airbag: Advanced Occupant Protection Features

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

T = 37 ms
Driver Airbag deployment (2nd Stage) T = 42 ms

Driver Side/Torso Airbag deployment T = 52 ms
Driver Side/Torso Airbag deployment

Pre-Test

Post-Test

T = 70 ms

ATD contacts front airbag
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.

Comparison of Event Data Recorders and NHTSA Testing

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.
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

1. Is the EDR Recording Complete?

System Status at Time of Retrieval

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDR Part Number</td>
<td>93112-037700</td>
</tr>
<tr>
<td>EDR Generation</td>
<td>HS/EDR</td>
</tr>
<tr>
<td>Freeze Signal</td>
<td>On</td>
</tr>
<tr>
<td>Freeze Signal Operation</td>
<td>Front Airbag Deployment</td>
</tr>
<tr>
<td>Diagnostic Trouble Codes Exist</td>
<td>No</td>
</tr>
<tr>
<td>Ignition Cycle (Downloaded events)</td>
<td>72</td>
</tr>
<tr>
<td>Multibit, number of events (times)</td>
<td>5</td>
</tr>
<tr>
<td>Time from event 1 to 2 (ms)</td>
<td>2,002</td>
</tr>
<tr>
<td>Time from Previous Pre-Crash TRS Event</td>
<td>1586 or greater</td>
</tr>
<tr>
<td>Latest Pre-Crash Event</td>
<td>0</td>
</tr>
<tr>
<td>Contains Unlinked Pre-Crash Data</td>
<td>No</td>
</tr>
</tbody>
</table>
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)

System Status at Time of Retrieval

3. Compare Velocity Change to Physical Evidence

Why is velocity change important?

\[ F = m \times a \]

\[ F = m \times \frac{\Delta v}{\Delta t} \]

\[ F \times \Delta t = m \times \Delta v \]
4. Evaluate the Pre-Crash Data (if available)

<table>
<thead>
<tr>
<th>Time (sec)</th>
<th>-4.0</th>
<th>-4.4</th>
<th>-4.9</th>
<th>-2.4</th>
<th>-2.9</th>
<th>-2.4</th>
<th>-1.9</th>
<th>-1.4</th>
<th>-0.9</th>
<th>-0.4</th>
<th>0 (TRG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Speed (mph)</td>
<td>0/95</td>
<td>0/95</td>
<td>0/95</td>
<td>0/95</td>
<td>0/95</td>
<td>0/95</td>
<td>0/95</td>
<td>0/95</td>
<td>0/95</td>
<td>0/95</td>
<td>0/95</td>
</tr>
<tr>
<td>Acceleration (g's)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Deceleration (%)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Vehicle RPM (RPM)</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
</tr>
<tr>
<td>Service Brakes, ESC Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Brake Oil Pressure (psi)</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Longitudinal Acceleration, VSC</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
<td>0.072</td>
</tr>
<tr>
<td>Side-impact, VSC</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.49</td>
<td>-0.49</td>
</tr>
<tr>
<td>Roll Angle (deg)</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
<td>Invalid</td>
</tr>
<tr>
<td>Shift Position</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
Summary

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