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BLACK BOX (Part 1 of 2)

The Evolution of the BLACK BOX:

From Airplanes, to Race Cars, To Under Your Seat

Event Data Recorders (EDR), now being installed as standard equipment by many automakers, are designed to record pre-crash and post-crash data elements such as engine speed, vehicle speed, % throttle, braking, etc. In the event of a collision, the last five seconds of data prior to the crash are recorded on a computer chip for retrieval. The increased use of EDRs correlates strongly to the increased availability of EDR information, increased awareness of the technology by the media and the public, and greater clarification of the history of this device.

EDRs should not be confused with the On Board Diagnostic (OBD) systems found in nearly all vehicles manufactured after the mid-1980s. In fact, OBDs (and OBD-IIs, updated versions required on all 1996 and newer vehicles) are different in both function and purpose, as described below.

On Board Diagnostic (OBD) versus Event Data Recorder (EDR)

On Board Diagnostic

OBD monitors nearly all emission-related components and systems for malfunctions that can cause emissions to increase and is capable of generating two types of diagnostic trouble codes (DTC):

1. GENERIC CODES – Are the same for all makes and models and are divided into two general types:
   - Major Monitors - Consist of the misfire, catalyst, oxygen sensor, exhaust gas recirculation (EGR), secondary air, evaporative leak check, and fuel systems.
   - Comprehensive Components - Include any component that, when malfunctioning, can cause an emission increase during any reasonable driving condition, whether it be idle, cold start, acceleration, cruising, or any other condition.

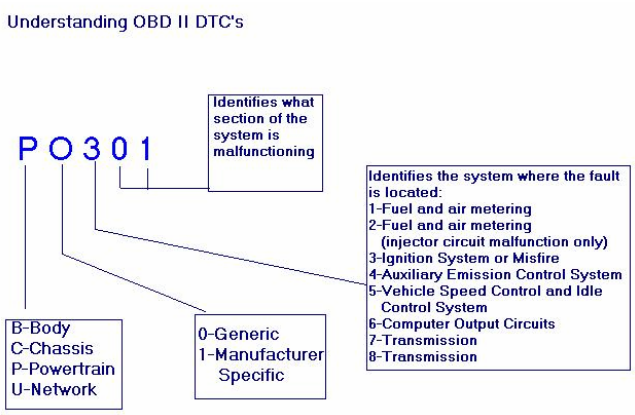

Figure 1 – *Deciphering OBD Codes*

2. ENHANCED CODES – Are unique to specific vehicles and cover non-emission related failures that occur outside the engine control system. These include ABS codes, HVAC codes, airbag codes and other body and electrical codes. While there are many more parameters than can be read by the OBD, they are not required by law and thus vary according to each manufacturer and model.

It is important to note that the codes reported by the OBD are the record of failed or out of range components and only describe that a problem existed, not to what extent or for how long the code was present.

Event Data Recorder

EDR primarily records vehicle operating conditions starting five seconds prior to impact and saves this data to a computer chip for retrieval. Recorded data depends on vehicle year, make and model; the following data is typical of what is found on newer GM and Ford vehicles:

- Vehicle Speed (5 seconds before impact)
- Engine Speed (5 seconds before impact)
- Brake Status (5 seconds before impact)
- Throttle Position (5 seconds before impact)
- State of Driver's Seat Belt Switch (ON/OFF)
- Passenger's Air Bag Status (ON/OFF)
- SIR Warning Lamp Status (ON/OFF)
- Time from vehicle impact to air bag deployment
- Ignition cycle count at event time
- Ignition cycle count at investigation
- Maximum ΔV for non-deployment event
- ΔV vs. time for frontal air bag deployment event
- Time from vehicle impact to time of maximum ΔV
- Time between non-deploy and deploy event

Figure 2 - *GM's Event Data Recorder*

Event Data Recorder History

1953 - David Warren of the Aeronautical Research Laboratories in Melbourne, Australia invented the "Black Box" flight data recorder. Soon after, Flight Data Recorders were installed in commercial aircraft to record control and other flight parameters in the event of an "unanticipated energetic disassembly" of the airplane.

1974 - The NHTSA Disc Recorder Project equipped 1,000 vehicles in several fleets that totaled 26 million miles. Twenty-six-crashes were analyzed, measuring changes in velocity up to 20 mph.

1975 - GM introduced the first regular-production driver/passenger airbag systems as an option in full-sized Oldsmobiles and Buicks. The data-recording feature utilized fuses to indicate when a deployment command was given and stored the approximate time the vehicle had been operated with the warning lamp illuminated.

1990 - A more complex Diagnostic and Energy Reserve Module (DERM) was introduced with the added capability to record closure times for both the arming and discriminating sensors as well as any fault codes present at the time of deployment.

1992 - GM installed sophisticated crash-data recorders on 70 Indy racecars. While impractical for high volume production, these recorders provided new information on the tolerance of the human body to severe impacts. Analyses of this data helped improve both race car driver and passenger safety.

1994 - The multiple electromechanical switches previously used for crash sensing were replaced by the combination of an accelerometer and a computer algorithm integrated in a Sensing & Diagnostic Module (SDM). The SDM computed and stored the change in longitudinal vehicle velocity during the impact to provide an estimate of crash severity. The SDM also added the capability to record the status of the driver's belt switch (buckled or unbuckled) for deployment and near-deployment events.

1999 - Certain GM vehicles were given the added capability to record vehicle systems status data for a few seconds prior to an impact. Vehicle speed, engine RPM, throttle position, and brake switch on/off status could be recorded for the five seconds preceding a deployment or near-deployment event.

2000 - In March, the Vetronix Corporation began selling its Crash Data Retrieval (CDR) system. With the introduction of this system, data could be extracted from selected General Motors models manufactured since 1996 and virtually all GM models manufactured since 1998.

2004 - Data is made accessible through the use of Vetronix's CDR system for select GM models manufactured in 1994 and 1995 and some Ford models manufactured since 2001.

Present - NHTSA's Special Crash Investigations program has analyzed data from over 2,000 crashes and estimates that nearly 65 to 90 percent of all vehicles on the road in the U.S. have some degree of EDR. Included in this estimate are Chrysler Group's 2005 Chrysler 300 and Dodge Magnum. In addition, Toyota reports that all its '05 models except Scion xA and xB, Lexus IS300, Tacoma, Tundra, and GX470 have EDRs.

Future - Additional models that will have EDRs and will support crash data retrieval in the near future include other GM and Ford models, as well as Chrysler and Toyota vehicles. With the introduction of these and future models, the number of vehicles supporting extractable EDR data is estimated to increase by four percentage points per year.

Conclusions

As more automotive manufacturers incorporate Event Data Recorders in their vehicles, information regarding the events leading up to and during an accident will become more readily available.

The severity of the collision, driver actions such as braking prior to impact, vehicle speed prior to braking, and seat belt usage can be recorder and retrieved.

This information can be of help in analyzing an accident and determining fault.

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