
EDR Revisited: Extracting Crash Data from Airbag Control Modules *by Peter R. Thom*

In recent newsletter issues, we've taken a look at the origins of event data recorders (EDR), compared EDR to on-board diagnostic systems (OBD) and looked at the capabilities of the technology. With "EDR Revisited," we expand our view to the implications of the technology and crash data retrieval (CDR): Who wants the data? How do they want to use the information? And ultimately, who owns the data?

While few question the use of event data recorder technology in mass-transportation industries like airlines, rail and shipping, a much higher number do question its use in the automotive lives of average Americans. In airline crashes, company officials, NTSB investigators and surviving families count on cockpit recordings and the data from black boxes to help explain the final tragic minutes leading to an air disaster. Even though the airplane's EDRs and pilot conversations may deliver an ambiguous or incomplete picture, somehow the issue of personal rights diminishes in the crusade to heal the pain of loss and to learn how to prevent other crashes. At the micro level, though, there is something disturbing about a "tale-bearing" car that appears to erode personal liberty and responsibility. Buy a new car and, chances are, EDR is embedded in the airbag control module—NHTSA estimates 64% of model year 2005. Privacy laws generally grant consumers the right to opt out of data collection efforts, but that's been downplayed in the rush to expand the usage of EDR and CDR. For now, the DOT response to consumers is a full-disclosure rule issued on August 21, 2006, requiring automakers to note all safety monitoring equipment starting in 2011 cars.

The truth about automotive EDR and CDR is really not as dramatic as a conspiracy theory, nor is its application a determined assault on personal rights. Frankly, the technology was developed by auto manufacturers for gathering real-world crash data to improve automotive and roadway safety and not for accident reconstructions. That iconic crash test dummy, although a ready volunteer for all manner of crash experiments, only supplies a limited data set. EDR data can freeze the decisions, reactions and system responses that conspired to a real accident. Compiling that accident with thousands upon thousands of other accidents will improve automaker, Federal and state databases substantially. And in the long term, consumers benefit with safer cars and roads.

"Black Box" Retrospective

Access www.prtassoc.com for Black Box I and II or contact Peter R. Thom & Associates Inc. for reprints.

Black Box I traced EDR origins to the development of the automotive air bag. Along with the development of the air bag triggering mechanisms, automobile manufacturers amplified the data gathering resources connected to the air bags in order to gather real-world data for optimizing air bag system performance. OBD tracks emission-related components and systems for malfunctions that could trigger increased emissions. Both gather data, but OBD records specific component problems while EDR documents a finite data stream collected only in airbag deployment or near-deployment events.

Black Box II took a closer look at EDR technology and the types of data collected. Many new cars contain EDR modules, but not all car manufacturers have made their systems compatible with commercially available crash data retrieval products. EDR cycles through 5-8 second data streams, updating and deleting data at the end of a cycle. Upon airbag deployment (or near-deployment) the data stream can store about 5 seconds of pre-crash and crash data: vehicle speed, engine speed, brake status, throttle position, seat belt status, passenger airbag status, time from impact to airbag deployment, ignition cycles, the delta "V's" and time between deployment and non-deployment events.

The challenge with EDR and the CDR systems for downloading the data comes with the expanded use of the technology by law enforcement, insurance companies and lawyers. A module intended originally for gathering diagnostic data is now being used for investigating automobile accidents and interested parties like NHTSA are scrambling to guide the development of the technology in order to meet the information needs of a broader audience. Although NHTSA's primary goal is automotive and highway research; ultimately, those who want crash data from EDR for forensics purposes will benefit from NHTSA's efforts.

NHTSA Sets EDR Data Element Standards

When state and Federal agencies and independent researchers look at EDR they see an underdeveloped resource of real-world accident data that they could tap more easily if automakers complied with universal format standards. Car manufacturers see EDR very differently; EDR is one of any number of embedded modules that helps them diagnose problems. If an airbag fails to deploy, they need to know why and they need to fix the problem—that's the reality of their liability exposure. The fact that GM's diagnostic modules differ from Ford's or Toyota's doesn't matter to them. They are in a business of building safe cars and not sharing proprietary information with competitors, much less government agencies, insurance companies or litigants.

Despite that reality, automakers acknowledge that EDR has a broader implication for safety engineers and policy makers as well as for those who need a forensic understanding of individual automotive accidents. Both Ford and GM have made their systems compatible with a CDR system developed by Vetronix, although the compatibility doesn't extend to all models. Other manufacturers may supply EDR data by request for a fee, but at least until 2011, manufacturers aren't required to disclose whether their airbag safety systems even have EDR modules, nor will they be required to develop compatible systems any time soon.

The lack of data standards and the haphazardness in data collection and retrieval were two of a number of EDR issues that encouraged NHTSA to submit a Notice of Proposed Rulemaking on EDRs in June 2004 and then publish a final rule in August of 2006. Aside from the disclosure obligations, the new rule also requires automakers to collect the same type of crash data if they choose to install an EDR. The chart below details the required data elements; note that additional data elements are required for vehicles with advanced safety systems like side airbags and ABS.

Data Elements for All Vehicles Equipped With an EDR

Data Element	Layman's Description	Recording Interval
Delta-V, longitudinal	Change in forward crash speed	0 to 250 ms
Maximum delta-V, longitudinal	Maximum change in forward crash speed	0-300 ms
Time, maximum delta-V	Time from beginning of crash at which the maximum change in forward crash speed occurs	0-300 ms
Speed, vehicle indicated	Speed the vehicle was traveling	-5.0 to 0 sec
Engine throttle, % full (or accelerator pedal, % full)	Was the accelerator pedal pressed?	-5.0 to 0 sec
Service brake, on/off	Was the brake applied?	-5.0 to 0 sec
Ignition cycle, crash	Number of times the engine had been started since being manufactured prior to the crash.	-1.0 sec
Ignition cycle, download	Number of times the engine had been started since being manufactured prior to downloading the EDR data.	At time of download
Safety belt status, driver	Was the driver safety belt buckled 1 second prior to the crash?	-1.0 sec
Frontal air bag warning lamp, on/off	Was the air bag system properly working 1 second prior to the crash?	-1.0 sec
Driver frontal air bag deployment for a single stage airbag, or time to first stage deployment for a multi stage airbag	Time from the beginning of the crash at which the driver air bag begins to deploy.	Event
Passenger frontal air bag deployment for a single stage airbag, or time to first stage deployment for a multi-stage air bag	Time from the beginning of the crash at which the right front passenger air bag begins to deploy.	Event
Multi-event, number of events (1,2)	Number of crash events — e.g., sideswipe followed by a head-on crash	Event
Time from event 1 to 2	Time between two crash events (if applicable)	As needed
Complete file recorded (yes, no)	Did the EDR complete the recording?	Following other data

Chart excerpted and adapted from NHTSA 06-06, published August 21, 2006

Vetronix Crash Data Retrieval *supplied by associate Art MacCarley, professor of electrical and computer engineering*

Vetronix, a wholly-owned subsidiary of Robert Bosch GmbH, offers the only commercially available CDR system for extracting EDR data. Only Ford and GM are compatible with Vetronix and yet not all their models are Vetronix accessible. Following airbag deployment, the Vetronix CDR interface can be used to download data directly from the Standard OBD-II Diagnostic Connector under the dashboard. If the vehicle's electrical system or diagnostic connector has been compromised, the data can be downloaded by using one of more than 15 different (all non-standard) Vetronix-supplied cables. At a minimum, the Vetronix-compatible modules retain some or all of the "crash" pulse, the rapid deceleration associated with the impact that deployed the airbag or other restraint system. Much more detailed information has been retained since 2003, especially with the installation of two-stage airbags in newer cars. The downloaded results are then displayed in graphs or lists via the proprietary Vetronix software. Vetronix generates software updates (and more umbilical cords) every six months to stay current with all Vetronix-compatible vehicles. Failure to be sensitive to the proper interpretation and limitations of the EDR data from any manufacturer can easily lead to incorrect but convincing conclusions—a situation documented in a number of court cases. This reality underscores the need for high-level understanding of the technology as well as ample common sense in annealing the revelations of EDR with the traditional results of collision dynamics analysis and the physical evidence from the vehicle or crash site.

Myth-Busting EDR & CDR

EDR: Not every car has an EDR module. No one can access EDR data without an appropriate CDR system and retrieval can only occur after a crash.

EDR: Stores only deployment or near-deployment data as part of an automobile safety system that controls airbag deployment and other restraint components—no conversations, curses or car-compartment confessions. Look to GPS-like systems instead for tracking daily driving.

EDR: Deployment data gets locked in permanently, but near-deployment data is stored for 250 engine cycles (typically several months) unless another near-deployment event supplants that data. A near-deployment is an event that wakes up the airbag system but doesn't deploy the airbag. Airbags/EDR must be replaced after deployment.

CDR: Vetronix is the only commercially available system for downloading EDR data and is only compatible with some Ford, GM and related vehicles. EDR data requests for all other cars must be directed to their automakers.

CDR: Even within Ford and GM models there is no commonality in data collected, sample rate, recording period, communications protocols and module connectors. Downloading and interpreting the data requires a certified Vetronix user who understands these eccentricities.

CDR: The lack of EDR standards has led to the development of a cottage industry of experts who own and know how to use Vetronix equipment. The Collision Safety Institute is exclusively authorized by Vetronix to teach and certify the use of their CDR equipment.

Data Ownership

The rain cloud hanging over EDR and CDR is the issue of data ownership. Virtually all parties circling EDR data understand that the owner of the car owns the data, but that precept blurs in application, especially with insurance claims and litigation. The common standard is the insured has a duty to provide all relevant information to insurance companies in the settlement of claims. States like California that vigorously defend individual privacy rights have enacted legislation that requires owner consent before retrieving data from EDR modules. Privacy rights watchdogs and public interest groups like the National Conference of State Legislatures (www.ncsl.org) update legislative efforts to protect individual rights. Agencies like NHTSA that seek the data for research purposes are mandated to obtain owner consent before collecting EDR data and typically they remove identifying markers from the data stream.

Peter R. Thom & Associates Inc. offers crash data retrieval services.

Visit www.ptassoc.com for information about the company, associate roster and areas of expertise.