REAL WORLD EXPERIENCE WITH EVENT DATA RECORDERS

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ABSTRACT

The National Highway Traffic Safety Administration (NHTSA) acquires detailed engineering information on new and rapidly changing technologies in real world crashes utilizing the National Automotive Sampling System Crashworthiness Data System (NASS CDS), Special Crash Investigations (SCI) and Crash Injury Research and Engineering Network (CIREN) programs. The data are used by NHTSA, the automotive industry and consumer groups to evaluate the performance of motor vehicles in crashes. Currently, the primary metric used to represent crash severity in NHTSA programs is the delta in velocity (DV). The principle source for the DV estimates in the NHTSA programs is a computer algorithm. The reconstruction computer program has a number of limitations. As a result, only about 38 percent of the NASS cases have reported DV.

Beginning with its 1994 model year vehicles, General Motors (GM) began producing a fleet of vehicles that recorded the DV. With the assistance of GM, SCI began collecting the DV from these vehicles' Event Data Recorders (EDR) on crashes of special interest to the Agency. In early 2000, a commercially available tool to read the output from General Motors vehicles' event data recorders became publicly available. NHTSA has implemented 50 of these units into their field data collection.

In 2000, NHTSA and Ford Motor Company (Ford) initiated a collaborative effort to perform case-by-case evaluation of the real world performance of Ford's advanced occupant protection technologies. Particularly noteworthy is the technical analysis of the EDR output. The EDR data has provided invaluable information relating to occupant status, severity assessment and deployment control in researching crashes with advanced occupant protection systems.

NHTSA is expanding its databases to allow event data to be stored. For the 2000 data collection year, variables were added to the NASS to identify if a vehicle is equipped with an on-board recorder and, if data was downloaded. Additionally, an open format field was provided for recording the data collected. Future enhancement will include the automation of all EDR output.

This paper will present information from NHTSA's NASS and SCI data collection programs concerning crash investigations of vehicles equipped with event data recorders. The focus of the paper will be to provide information on specific findings from the event data recorder compared to the physical evidence and computer reconstruction models.

INTRODUCTION

Event Data Recorders record information related to a vehicle crash. They range in design, scope and reach from simple to complex. EDRs can have a profound impact on highway safety by providing occupant and vehicle crash-specific data which helps formulate the basis for improved automotive safety. This data are also useful to crash reconstructionist in understanding the specific aspects of a crash. These devices collect basic crash related information that can provide benefits to overall crash research, thus enabling future improvements to the nation's transportation system.

This paper documents a brief history of how recorders have been used in many modes of transportation. The report details the current state of using EDRs at NHTSA. Descriptions of the EDRs currently being incorporated in original equipment manufacturers (OEM) automobiles are presented as well as commercially available tools for collecting these data.

A discussion of NHTSA's crash collection program, as it relates to EDRs, and the national crash databases which contain these data are defined and discussed. Several current applications where EDRs are enhancing the investigative process are chronicled.

BACKGROUND

Event Data Recorders have been used for many years to record crash-related metrics, including the crash deceleration characteristics of the vehicle, be it an airplane, train, ship, or highway vehicle. Aviation has long been the proving ground for on-board recording devices. Crash-protected flight data recorders have been around since the early 1950s, while cockpit voice recorders were introduced in the late 1960s. Significant improvements in safety have been realized in aviation as a direct result of flight data and cockpit voice recorders.

In the marine industry, the advantages of on-board recorders are just now being fully realized. Current voyage recorders remain very rudimentary and are of limited use in determining the causes of accidents.

EDRs were first implemented in the rail environment, during the late 1970s, for management purposes. Since then, EDRs have also contributed to crash investigations by providing more accurate accounts of the circumstances leading up to crashes, corroborating witness statements, and helping to eliminate much of the guesswork that had previously been involved in investigations.

NHTSA research in EDR applications for automobiles began in the early 1970s. This included an EDR which used analog signal processing and recording devices to analyze and store the crash data. This recorder was known as the Disc Recorder, and was installed in about 1,000 vehicles in several fleets.

In the early 1990s, NHTSA commenced a new project which combined EDRs with Automated Collision Notification (ACN) technology — technology which provides faster and smarter emergency medical services (EMS) response in an attempt to save lives and reduce disabilities from injuries. While ACN in itself is not an EDR, this ACN project combined notification equipment with recording technology. This in-vehicle system determined that a crash had occurred, initiated a request for assistance, determined the location of the vehicle, utilized a wireless communications system to send the crash notification, and stored the crash data in its memory for downloading during the post-crash investigation. Approximately 700 vehicles which were equipped with the prototype technology resulted in about 15 crashes detected during this study.

In 1997, the National Transportation Safety Board (NTSB) issued recommendations to the NHTSA, indicating that NHTSA should pursue crash information gathering using EDR technology. Further, in 1997, the National Aeronautics and Space Administration's Jet Propulsion Laboratory recommended that NHTSA "study the feasibility of installing and obtaining crash data for safety analyses from crash recorders on vehicles." During this time, NHTSA's Research and Development (R&D) office was evaluating the use of EDRs for vehicle crash research in support of NHTSA's Special Crash Investigation (SCI) program.

Early in 1998, NHTSA created a working group (WG) to study EDRs. The main objective of the WG was to facilitate the collection and utilization of collision avoidance and crashworthiness data from on-board Event Data Recorders. To facilitate achieving this objective, the WG developed a set of sub-objectives, which include: 1) status of EDR technology; 2) data elements; 3) data retrieval; 4) data collection and storage; 5) permanent record; 6) privacy and legal issues; 7) customers and uses of EDR data; and 8) demonstration of EDR technology. The WG has met routinely, about three times per year, through the end of 2000. The WG is currently documenting their findings in a technical report will be published in 2001. All materials provided to the WG, along with the final approved minutes from each meeting, were placed in the Department of Transportation's Document Management System (DMS), docket NHTSA-99-5218. These dockets are viewable and printable from the DMS, which can be located using an Internet browser at http://dms.dot.gov. (Search for docket 5218.)

NHTSA is currently also conducting further research on driver behavior, with the Georgia Institute of Technology, where data on operating speed and location will be continuously recorded from 1,100 vehicles, during each trip taken over a two year period. Crashes and other extreme accelerations will also be recorded using tri-axial accelerometers.

In addition, NHTSA currently collects crash data in three major vehicle crash programs:

NASS-CDS –	A national statistically sampled data base, currently collecting data on about 4,000 crashes each year at 24 locations around the U.S.;
SCI –	A collection of targeted crash investigations looking at emerging safety issues, and;

CIREN –   A system of crash investigations conducted at hospitals, collecting about 400 cases per year.

EVENT DATA RECORDERS AND DATA RETRIEVAL SYSTEMS

NHTSA crash investigation teams collect data from two OEMs — GM and Ford. Typically, EDR data is collected from crashes by all three of NHTSA's crash investigation programs involving 1994 and newer General Motors vehicles. The current cabling and software allows the downloading of 1996 and newer GM vehicles. In 2000, SCI initiated a new data collection program looking at advanced occupant restraint technologies. Ford teamed with the Agency to provide five copies of a proprietary device which allows NHTSA to download the EDR in model year 2000 Ford Taurus and Mercury Sable vehicles.
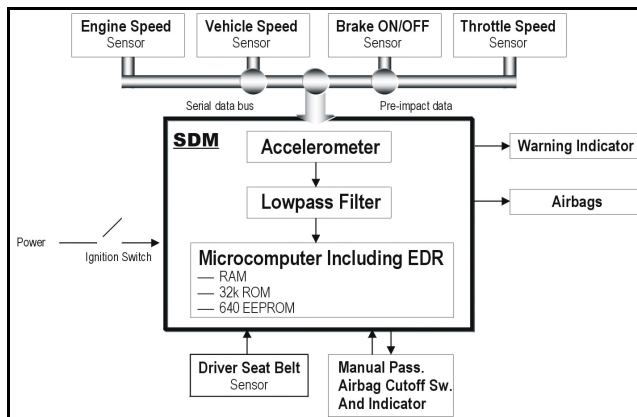
Figure 1 1999 GM System Diagnostic Module Block Diagram

General Motors Corporation System

The GM EDRs have undergone two major upgrades since their introduction around 1990. The first EDR unit was part of the Diagnostic and Energy Reserve Module (DERM). In 1994, GM redesigned its air bag control model, with the replacement named the Sensing and Diagnostic Module (SDM). This was the first OEM-installed EDR which measured crash severity, measuring cumulative DV of the vehicle during the crash. This unit is referred to as the 1994 SDM. In 1999, the model 1999 SDM was introduced (shown in figure 1), which included the recording of pre-crash information, collected each second for about 5 seconds prior to the crash. Included in these pre-crash data are vehicle speed, engine RPM,

engine throttle opening, and service brake application.

Once each second, the SDM takes the most recent sensor data values and stores them in a recirculating buffer (RAM), one storage location for each parameter for a total of 5 seconds. When the air bag sensing system algorithm detects an impact that may require an air bag deployment the system quickly "enables", buffer refreshing is suspended. Note that algorithm enable is asynchronous with the transmission of vehicle speed and other data. Hence, the data on the bus can be skewed in time from the crash by as much as one second.

Ford Motor Company System

Ford began installing a single Restraint Control Module (RCM) beginning in 1997. The primary function of the RCM is to control the deployment of the occupant protection systems (air bags, seat belt pre-tensioner, etc.) In addition, the early RCM system stored a limited amount of air bag deployment data. Ford introduced a more advanced RCM in their latest fleet equipped with advanced occupant protection. This system records longitudinal and lateral acceleration, along with some data related to the driver and passenger air bag deployment including: deployment strategy of the dual-stage air bag system, seat belt use, pre-tensioner operation, and driver seat position.

Currently, there is no method to physically measure the performance of advanced occupant protection system vehicles. Therefore, the Agency has a high interest in reading the EDR output to determine the decisions made by on-board restraint control module during the crash sequence. This would include the air bag deployment determination including the stage of deployment, time of deployment etc.

In May 2000, a final rulemaking action was issued by NHTSA that requires automobile manufacturers to have crash protection for a wider range of occupant sizes and positions by automatic suppression or benign air bag deployments. This affords protection to out-of-position occupants, children and small-stature adults as well as protecting belted and unbelted large adult occupants. This rulemaking action will probably result in

manufacturers incorporating advanced sensors and/or

Figure 2. Hexadecimal Output

inflators. Ford began installing advanced occupant restraint systems into their 2000 model year Taurus and Sable vehicles. In an effort to determine how advanced occupant protection systems perform in real-world crashes the National Center for Statistics and Analysis (NCSA) initiated the Advanced Occupant Protection Special Study (AOPSS) in the SCI. The Agency has

Figure 3. Ford EDR Summary Page from a 2000 Ford Taurus/Sable.

teamed with Ford to study these crashes. The Agency is sharing their in-depth SCI data during the course of the field investigations with Ford. Ford is sharing the output from their on-board RCM which provides details the field

investigators would not be able to determine such as the
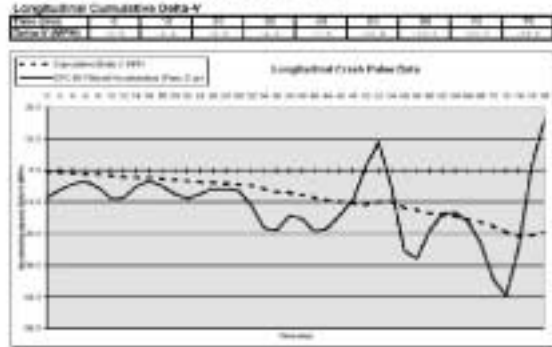
Figure 5 2000 Ford Taurus/Sable Longitudinal Crash Pulse.
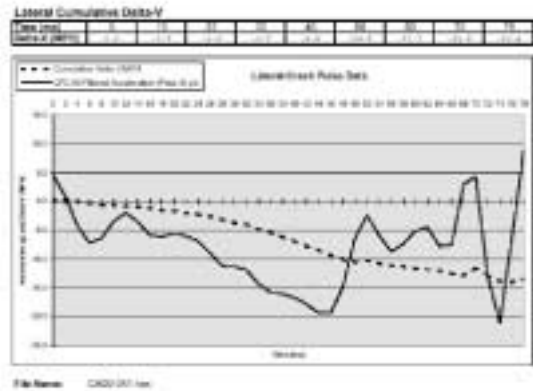
Figure 4 2000 Ford Taurus/Sable Lateral Crash Pulse.

air bag deployment stage. Ford provided the SCI five units and the software to download the data from the Taurus and Sable RCM. The data are downloaded in a hexadecimal file (see figure 2) which is sent to Ford. The hexadecimal file is converted by Ford into charts (see figures 3, 4 and 5). The EDR data has provided invaluable information relating to occupant status, severity assessment, and deployment control in researching crashes with advanced occupant protection systems.

The Ford output provides a crash pulse for both the longitudinal and lateral axes. Figures 4 and 5 depicts the longitudinal and lateral crash pulse of a typical output chart from a Ford Taurus/Sable EDR. The actual acceleration pulse is recorded for 80 milliseconds in one millisecond intervals that may be integrated to determine DV.

4

DATA RETRIEVAL SYSTEMS

As mentioned earlier in this paper, NHTSA has two methods to download an EDR. The Ford system is currently proprietary, while the GM system is commercially available.
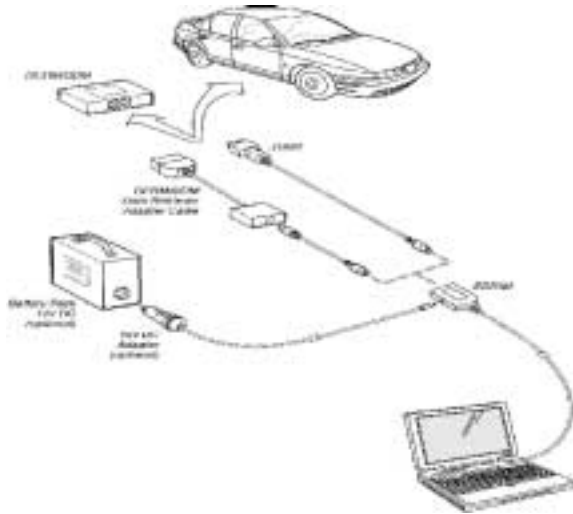
Figure 6 Vetronix CDR System

GM-Vetronix

In 1999, GM licensed manufacturing rights to the Vetronix Corporation to build a data retrieval tool for the Sensing and Diagnostic Module (SDM)-based EDR. Ford has recently initiated an agreement with Vetronix to develop a tool to download their Restraint Control Module.
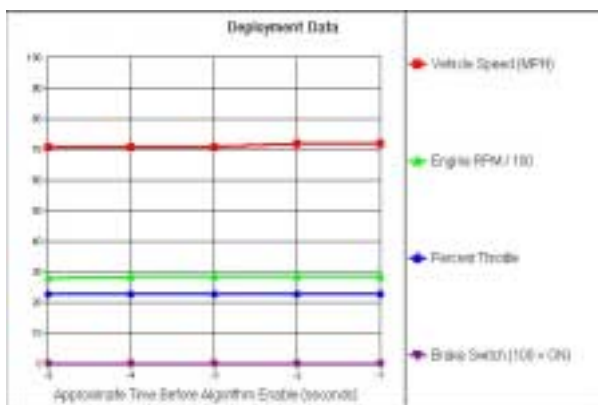
Figure 7 Vetronix CDR Pre-Crash Output

In early 2000, Vetronix Corporation began selling its Crash Data Retrieval (CDR) system. The system allows the user to connect directly between a notebook computer and many GM vehicles equipped with an SDM (see figure 6). The connection can be made between the vehicle's diagnostic connector, typically located below the steering wheel or directly to the SDM in cases where the vehicle's electrical system has been damaged during the crash. The cost of the CDR tool is about $2,500.

The CDR system reads the hexadecimal code stored in the SDM and converts it to engineering units and further displays the information in graphical format (figures 7 ,8 and 9) ready for use by the crash investigator.
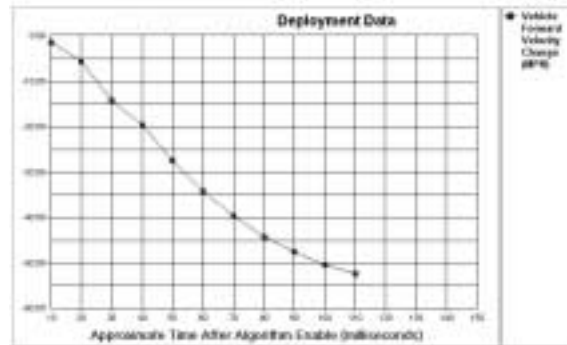
Figure 8. Vetronix CDR Delta V Output

Figure 9. Vetronix CDR Data Summary Output

Ford-Propriety Units

In March 2000, Ford provided the SCI and

NASS 5 propriety units, software and training to download the EDR data in 2000 and newer Taurus and Sables. The Ford system is quite a bit different than the Vetronix CDR tool. The system only allows the user to connect directly between a notebook computer and the vehicle's diagnostic connector (J1962 or Universal Serial Bus Connector.) Unlike the Vetronix unit, the Ford tool cannot simulate the on-board bus or sensors, therefore the tool cannot be connected directly to the RCMs. Thus, in cases where the vehicle's electrical system has been damaged during the crash, EDR boxes must be removed by the investigators and sent to Ford for downloading. However, the RCM were designed to be reusable. The Ford RCM does not store the crash event file in a permanent or incorruptible format. It will be over written by the next deployment event. Therefore, Ford has setup a depot of modules that the SCI investigators can exchange in the field. As previously discussed, this software only provides a hexadecimal file which must be interpreted by the manufacturer.

COMPARISONS OF CRASH TESTS WITH EDR OUTPUT

NHTSA routinely conducts tests of new vehicles as part of our New Car Assessment Program (NCAP) and compliance test programs (FMVSS 208). During the 1998 model year (MY) test program, several GM vehicles were tested. The air bag Sensing and Diagnostic Modules were removed from these vehicles and read to determine the DV shape and total DV for each vehicle tested. These data were then compared to the data collected by NHTSA's contractors during crash tests. The contractors' data collection generally consisted of accelerometers located near the seat tracks. Typically, there were four accelerometers for each test. The individual traces were inspected for general agreement, and any outliers were dropped from the analysis. The remaining data were averaged at each time step and integrated to determine the DV-verses-time characteristic.

Twenty-one EDRs were read from 1998 model year vehicles during this effort, consisting of 15 cars, 2 vans, 2 sport utility vehicles and 2 pickups. The test types consisted of 3 FMVSS 208 tests (30 mph full-frontal barrier), 13 Frontal NCAP tests (35 mph full-frontal barrier), and 5 Side NCAP tests (crabbed side impact with moving-deformable barrier).

Generally, the data corresponded well between the contractors' instrumentation and the DV trace from the SDM, as seen in Figure 10. However, the EDR data from the SDM was slightly lower that the integrated accelerometer data. Also, some of the SDM traces were incomplete.
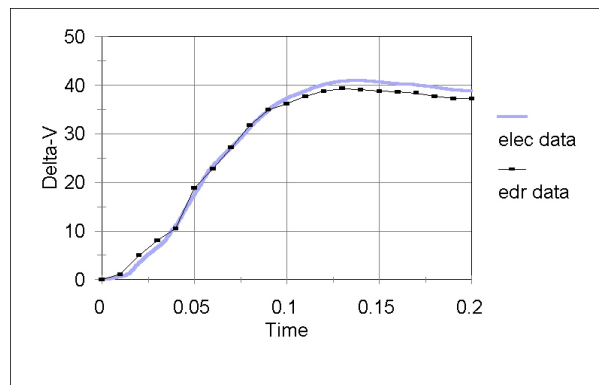

Figure 10 Trace of EDR to On-board Crash Test Accelerometers

FIELD DATA COLLECTION OF EDR DATA

NHTSA began collecting crash data from EDRs in the mid 1990s. The early efforts were cooperative between NHTSA and the automobile manufacturers. Data were typically collected by NHTSA's SCI program to support crash investigation activities. Most of these early cases were low speed air bag related fatalities that could not be accurately reconstructed by the WINSMASH algorithm. Prior to the Vetronix CDR tool, two methods were employed for obtaining the EDR data in the GM vehicles:

1. EDR boxes were removed by the SCI investigators, and sent to GM for downloading , or;

2. GM sent a representative, typically a contractor, to the crashed vehicle to directly read the data.

As previously mentioned, NHTSA has equipped their crash investigation teams (SCI, NASS CDS and CIREN) with Vetronix CDR tools. Ford has provided five proprietary readers to the SCI and NASS. The teams were trained on proper use of these tools and now collect EDR data on a routine basis. To date, the NHTSA crash investigation teams have investigated over 100 crashes where an EDR was read.

Nineteen SCI cases contain EDR data with GM vehicles in which the manufacturer performed the download. In the 2000 data collection year, NHTSA teams began routinely collecting and entering EDR data

into their Electronic Data Collection System (EDCS) database. The EDCS is utilized by all three (SCI, NASS CDS and CIREN) data collection systems as their common database. The EDCS was modified to contain a field which indicates if the case has an associated EDR file. This data element is part of the searchable electronic file associated with the database. Since the data collected by various vehicle manufacturers in their EDRs is not uniform, NHTSA is not able to store the output in the electronic file. Currently, NHTSA scans the paper output from the EDR report into the data base. This allows the researcher to review the various data elements (for example: DV for GM vehicles vs. acceleration profiles for Ford vehicles). Future enhancements to the EDCS may include the automation of all the data elements available output from the EDR as variables and attributes.

The SCI and NASS CDS crash investigation teams have attempted 101 downloads; 94 of which, have been successful. The NASS CDS teams have attempted downloading 48 EDRs; 41 of which have been successful. The SCI has successfully downloaded 53 cases (25 GM, 28 Fords) involving an EDR. Table 1 presents these data as of January 1, 2001. The numbers in the brackets are counts of the EDRs downloaded by GM.

Table 1.
EDR Download Success by Manufacturer, Crash Program, and Downloading Agency

Program	GM (read by NHTSA/EISS)		FORD		Totals	
	Att.	Comp.	Att.	Comp.	Att	Comp.
SCI	7[18]	7[18]	28	28	53	53
NASS	41[1]	34[1]	6	5	48	41
Totals	48[19]	41[19]	34	33	101	94

The six GM cases the NASS was unable to read were either due to the lack of correct cables or to Vetronix software problems. Vetronix has sent out new cables and an upgraded software package that has corrected the download problems. The NASS and SCI have noted a printing problem with the latest Vetronix software version.

The NASS and SCI have successfully downloaded data from 33 Ford vehicles. In the only case not downloaded, the vehicle's electrical system was damaged during the crash, and the NASS researcher was unable to remove the RCM.

A number of shortcomings have been noted in each of the systems. While not all will be addressed, two of the more noteworthy problems are highlighted.

The data downloaded from an SDM-G used in 1999 and a few 2000 model year vehicles may incorrectly report the status of the driver's belt switch. This occurs when the vehicle's electrical system has been compromised during a crash. The state of the driver's belt switch circuit. may be reported as unbuckled, even though the driver's seat belt was buckled

An example of this is seen in case CA00-007. The driver of the case vehicle fell asleep and ran off the right side the road and impacted a utility pole. This is substantiated by the data noted in the pre-crash output seen in Figure 11. The sleeping driver slightly depresses the accelerator pedal, gradually increasing the speed. There appears to be a problem in the engine RPM output. Despite an increase in throttle and speed, there was no increase in engine RPM recorded. No avoidance action is taken with the brake application. The vehicle received significant frontal damage resulting in a complete failure in the electrical system (see figure 12.) The driver's belt switch indicated by the EDR data output screen (see figure 13) indicates the driver was "UNBUCKLED." However, as seen in the figure 14, there is significant physical evidence of seat belt usage.
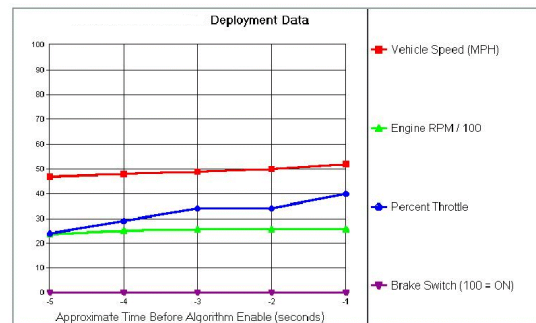

Figure 11 Pre-crash Data for case CA00-007

Figure 12 Damage to vehicle in case CA00-007

System Status At Deployment	
SRS Warning Lamp Status	OFF
Driver's Belt	UNBUCKLED
Passenger Front Air Bag	ON
Ignition Cycles At Deployment	1596

Figure 13 Data Output from case CA00-007

Figure 14 Physical Evidence on Seat Belt.

Another major shortcoming is noted when there is a complete electrical system failure in the 2000 Ford Taurus/Sable. Whenever this occurred, an incomplete file was written from the EDR. This resulted in lost data in most of the severe crashes involving these vehicles.

EDR DATA USAGE BY NHTSA

EDR data are a new technology and are not meant to take the place of a crash investigation. However, we at NHTSA have found EDR data to be a very useful quality control tool and a fundamental requirement when considering the performance of advanced occupant protection systems.

Enhancement of Field Data Collection and Quality Control:

The EDR data are being utilized to verify and supplement crash severity indicators. NHTSA's primary metric for representing crash severity is the vehicle's change in velocity (DV). Currently, NHTSA uses the WINSMASH computer algorithm to estimate DV for a crash. WINSMASH estimates the vehicle's or vehicles' DV(s) for a vehicle-to -vehicle or vehicle-to-large object crash. The WINSMASH algorithm relies primarily on stiffness parameters derived from a short duration 35 mph full-width rigid barrier impact tests (NCAP). Most real world crashes have a longer duration crash pulse than the 35 mph barrier tests. Even departing further are less

idealized crashes involving yielding fixed and narrow objects, under-rides, or multiple impacts, many of which are beyond the capabilities of WINSMASH. NHTSA can now use the output from EDRs to supplement the DV crash severity estimate currently derived from post-crash vehicle inspections.

The determination of seat belt use is routinely performed by SCI, NASS and CIREN crash investigators. The examination of the physical evidence to determine restraint usage is their primary source. In low severity crashes, such as near threshold collisions, there is insufficient occupant loading to leave definitive loading marks on the seat belt webbing or result in contact points. When explicit evidence of seat belt loading is not present, the investigator must rely on indications of routine use or interview data, neither of which is a definitive source. The belt use data output from EDRs has been utilized as the primary indication of restraint use in a number low speed crashes at or near the air bag deployment threshold speed.

The investigation of new, emerging technology is a primary function of the SCI program. The SCI attempts to monitor, as close to real time as possible, the effects that new-emerging technologies have on vehicle occupant safety. Beginning with model year 2000 vehicles, a number of automobile manufacturers have released advanced occupant protection systems, typically involve dual stage air bags, seat belt pre-tensioners, occupant sensing, etc. All of these components in the systems are controlled by on-board crash analyzers, which vary the air bag output and the threshold for air bag deployment. Since these occupant protection system characteristics are dynamically determined during the few milliseconds after the start of a crash, there is typically no physical evidence to exactly determine what crash protection was afforded to the occupant. For example, whether the air bag deployed at a first stage or second stage deployment level.

With the advent of these new occupant protection system technologies, manufacturers have upgraded the current designs, or in many cases, added new technology to capture the decisions the air bag controller made to optimize the protection to the occupant. These data are critical to NHTSA in the determination of how these new technologies perform in real world crashes.

UTILIZATION OF EDR DATA APPLICATIONS

Several categories of using EDR technology exist in today's crash investigation arena. The Federal Government can use EDR data to obtain more accurate

crash data, such as crash severity and crash pulse data. Law enforcement could also make use of these data to improve their crash investigation process. Other benefits relate to improving vehicle (manufacturer needs) and roadway design (highway designer applications). Still other less-direct, yet important benefits can also be achieved. The following provides a listing of possible applications, by major application areas and examples:

Improve Vehicle Design/Highway Infrastructure
    Vehicle systems
        • air bag sensing system deployment criteria
    Highway systems
        • roadside safety feature design standards
Provide a Basis for Regulatory & Consumer Information Initiatives
        • offset frontal impact severity
        • average/extreme vehicle deceleration pulses
Provide Objective Data for Crash Reconstruction
        • alleged defects & litigation
        • unintended vehicle acceleration
        • crash & air bag deployment sequence
Develop an Objective Driver Behavior Database
        • pre-crash driver braking/steering
        • belt use
        • vehicle speed

A practical application of how EDR data are being used to improve occupant protection systems and save lives is currently in place. Beginning with 2000 model year vehicles, a number of automobile manufacturers began introducing advanced occupant protection systems into their fleets. In an effort to determine how these advanced occupant protection systems affected occupants in real world crashes the NCSA initiated a special study to collect data on crashes involving 2000 model year vehicles equipped with these systems.

The objective of the Advanced Occupant Protection Special Study (AOPSS) is to provide data that will assess the real world performance of new occupant protection technologies. For this study, advanced occupant protection may include one or more of the following: rollover sensors, weight sensors, seat position sensors, multi-stage inflators, systems that may provide automatic air bag suppression, and event data recorders. However, the only method to observe and/or measure the performance of these systems is through the EDR data.

In an effort to obtain AOPSS data, NHTSA is currently sharing the in-depth SCI field data to the automobile manufacturers who, in turn, are sharing their EDR technology. The objective is to quickly provide feedback to NHTSA and the industry on the performance of these new occupant protection devices. This collaborative effort combines the talents of crash investigators, engineers and designers and thereby enables all interested parties to perform case-by-case evaluation of the real world performance of these advanced technologies. Particularly noteworthy is the technical analysis of the event data recorder output. The EDR data has provided invaluable information relating to occupant status, severity assessment, and deployment control in researching crashes with advanced occupant protection systems.

RECOMMENDATIONS FOR FUTURE EDRs

Based on our field data collection, NHTSA has found a number of positive experiences in the EDR systems currently being used by two automobile manufacturers. In an effort to assist future EDR hardware and software applications the Agency suggests the following be recorded:

Data Collection

• Lock the deployment record data in EEPROM such that the data cannot be erased, altered, or cleared by service or crash investigation personnel.

• Use SAEJ211 protocol for collecting data.

• Locate the EDR in a crash survivable location while still providing post crash inspection accessibility.

• Ensure sufficient auxiliary power is available to record the entire crash sequence even when the vehicle electrical system is damaged.

• Employ a single universal crash data retrieval tool for downloading data.

• The universal crash data retrieval tool should be able to be connected directly to the EDR for downloads.

• Record data for at least two events.

Pre-Crash Data Graph

- Record vehicle speed for 10 seconds before algorithm enable (MPH).

- Record engine speed for 10 seconds before algorithm enable (RPM).

- Record throttle position for 10 seconds before algorithm enable.

- Record the brake switch circuit status for 10 seconds before algorithm enable (on/off).

- Record the actuation of antilock brake system for 10 seconds before algorithm enable (on/off).

At Crash Data

- Record the status of the warning lamp (on/off).

- Record the driver and passenger belt switch status (buckled/unbuckled). The seat belt usage data should be recorded and stored in ram at algorithm enable.

- Record the driver and passenger air bag suppression switch status (on/off).

- Record the ignition cycle at deployment.

- Record the ignition cycle at investigation.

- Record the air bag deployment level. first stage or second stage deployment.

- Record the time from algorithm enable to air bag first stage or single stage deployment.

- Record the time from algorithm enable to air bag second stage deployment.

- Record the time from algorithm enable to driver and passenger pretensioner deployment.

- Record the time between the two event files if they are in the same ignition cycle.

- Record the driver and passenger seat position.

- Record the data from the passenger seat weight/position sensor.

Crash Pulse Graph:

- Record at least 300 milliseconds of crash pulse deceleration data recorded in Gs in 1 millisecond intervals for at least two events.

- Record both the longitudinal and lateral axes data.

CONCLUSIONS

The technology exists to provide detailed EDR data in all motor vehicles sold in the United States of America. The use of these EDR data can and has been used to improve occupant protection, thus saves lives.

EDR data are critical in providing information relating to occupant status, severity assessment and deployment control in researching crashes with advanced occupant protection systems, and future applications are expected to result in more lives saved.

CRASH INVESTIGATIONS WITH EDR DATA AVAILABILITY

NHTSA has a number of methods in which NASS CDS and SCI cases with event data recorder data are distributed. Beginning in June 2001, these crash investigation cases will be available from the National Automotive Sampling System's web page.

Http://www-nass.nhtsa.dot.gov/nass

Copies of completed hard copy NASS CDS and SCI reports publically available can be obtained at the address below. The reports contain images and accordingly there is a cost associated with reproduction of the crash report.

Marjorie Saccoccio, DTS-44
DOT/Volpe National Transportation Systems Center
Kendall Square
Cambridge, MA 02142
USA

Completed NASS and SCI reports can be reviewed at the hard copy storage facility. There is a nominal cost for case retrieval and handling.

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