National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 10, 2009

In reply refer to: H-09-11 through -13, and
H-99-53 and -54
(Reiteration)

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In May 2005, the National Transportation Safety Board (NTSB) began its investigation of a school bus accident that occurred in Liberty, Missouri. During the course of the investigation, information was uncovered that suggested pedal misapplication as a factor in the accident—that is, depressing the accelerator instead of, or in addition to, the brake pedal.

The NTSB subsequently investigated four additional accidents involving heavy vehicles in which pedal misapplication was determined to be a factor.[1] These accidents occurred in Falls Township, Pennsylvania; Asbury Park, New Jersey; Nanuet, New York; and Newtown, Pennsylvania. Despite varying circumstances, these five accidents share common elements. In all five, the drivers either reported a loss of braking or were observed by vehicle occupants to be unsuccessfully attempting to stop the vehicles, though no evidence of braking system failure was found. This letter presents the supporting information for three new safety recommendations and for the reiteration and reclassification of two previously issued recommendations regarding on-board recording systems and data standards.

Despite the efforts of the NTSB, the National Highway Traffic Safety Administration (NHTSA), and others, unintended acceleration incidents attributed to pedal misapplication continue to occur. Such accidents warrant serious attention because they can be so injurious. To date, both the NTSB and NHTSA have focused on passenger cars. However, as the accidents discussed in the special investigation report demonstrate, pedal misapplication can occur in heavy vehicles as well as light vehicles. Any vehicle operated by a driver is susceptible to the loss of control caused by human error.

[1] For more information, see *Pedal Misapplication in Heavy Vehicles*, Highway Special Investigation Report NTSB/SIR-09/02 (Washington, DC: NTSB, 2009), which is available on the NTSB website at <http://www.ntsb.gov/publictn/2009/SIR0902.pdf>.

The NTSB has investigated both light and heavy vehicle sudden acceleration accidents. In 1997, the NTSB investigated a Normandy, Missouri, accident involving a transit bus.[2] The bus driver had just discharged passengers when the bus accelerated into pedestrians, resulting in four fatalities. In 2003, the NTSB investigated an accident in Santa Monica, California, in which a passenger car accelerated into a farmer's market, resulting in 10 fatalities.[3] The Board concluded that pedal misapplication was the probable cause in both of these accidents.

The National Transportation Safety Board determined that the probable cause of the Liberty, Missouri, accident on May 9, 2005, was a pedal misapplication by the school bus driver. In addition, the National Transportation Safety Board determined that the probable cause of the January 12, 2007, accident in Falls Township, Pennsylvania, was a pedal misapplication by the driver. Contributing to the occurrence of pedal misapplication was the driver's unfamiliarity with the school bus.

Brake Transmission Shift Interlocks

A brake transmission shift interlock (BTSI) device requires a driver to depress the brake pedal to shift an automatic transmission out of the "park" position.[4] Such interlock systems gained popularity following the widespread reporting of sudden automotive acceleration events in the 1980s. BTSI devices have a significant effect on sudden acceleration incidents; comparisons of accident or complaint data between vehicle models with and without BTSIs indicate that interlock systems result in a dramatically lower rate of sudden acceleration. For example, a NHTSA comparison of sudden acceleration incidents for three automobile models indicated much lower rates for the models equipped with interlocks: 1.7 vs. 16.6 per 100,000 cars for the Ford Aerostar, 4.1 vs. 15.0 per 100,000 cars for the Lincoln Town Car, and 2.9 vs. 17.3 per 100,000 cars for the Ford Thunderbird/Cougar.[5]

Three of the accidents discussed in the report—Falls Township, Asbury Park, and Newtown—involved vehicles that began the accident sequence in a parked position. In the Falls Township accident, for example, the school bus driver depressed what he thought was the brake and engaged the transmission; however, the engine revving and the response of the vehicle indicate that he was, in fact, depressing the accelerator. Because a BTSI device requires the driver to have a foot on the service brake prior to engaging the transmission, it would likely have prevented the pedal misapplication that initiated the unintended acceleration. Accordingly, the NTSB concludes that a BTSI device would have prevented the accidents in Falls Township, Asbury Park, and Newtown.

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[2] *Bus Collision With Pedestrians, Normandy, Missouri, June 11, 1997*, Highway Accident Summary Report NTSB/HAR-98/01/SUM (Washington, DC: National Transportation Safety Board, 1998).

[3] *Rear-End Collision and Subsequent Vehicle Intrusion Into Pedestrian Space at Certified Farmers' Market, Santa Monica, California, July 16, 2003*, Highway Accident Report NTSB/HAR-04/04 (Washington, DC: National Transportation Safety Board, 2004).

[4] Due to the necessity of clutch application before the transfer of engine power to the transmission, pedal misapplication associated with unintended acceleration is not an issue in manual transmission vehicles starting from a parked position. Therefore, a large segment of commercial vehicles are not susceptible to this event.

[5] U.S. Department of Transportation, National Highway Traffic Safety Administration, "Denial of Motor Vehicle Defect Petition, DP99-004," *Federal Register,* vol. 65, no. 83 (28 April 2000), pp. 25026–25037.

The installation of BTSIs in passenger vehicles sold in the United States is strictly voluntary. Each manufacturer determines whether an interlock system is offered as standard, optional, or not at all on a particular model and year of vehicle. By contrast, Canada has required such systems since 2003.[6,7] In July 2006, 19 automobile manufacturers[8] joined with NHTSA in a voluntary commitment to reduce the risk of inadvertent shift selector movement in automatic transmission-equipped light vehicles.[9] At that time, it was estimated that 80 percent of 2006 model year vehicles[10] were equipped with BTSIs and that 98 percent of 2009 model year vehicles would be so equipped.

Under the terms of the voluntary commitment,[11] the manufacturers agreed to the following:

- By September 1, 2010, vehicles with a gross vehicle weight rating (GVWR) up to 10,000 pounds, equipped with an automatic transmission with a "park" position, will have a system that requires the service brake to be depressed before the transmission can be shifted out of "park."

- The system will function in any key position in which the transmission can be shifted out of "park."

- Beginning on September 1, 2006, and on each September 1 thereafter through 2010, participating manufacturers will publicly disclose, at least annually, the models for the upcoming year that will be equipped with a BTSI system.

- Within the same dates, participating manufacturers will provide a statement to NHTSA affirming that the models so identified have been designed with BTSIs.

- Beginning on November 1, 2007, and on each November 1 thereafter through 2011, participating manufacturers will publicly disclose the percentages of their total production for the preceding 12-month period ending August 31 engineered in accordance with the BTSI performance criteria.

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[6] In fact, the Canadian Motor Vehicle Safety Standards go further, requiring interlock functionality on all light vehicles, including brake shift interlocks on vehicles equipped with automatic transmissions and clutch interlocks on those equipped with manual transmissions.

[7] See <http://canadagazette.gc.ca/partII/2003/20030618/html/sor189-e.html> (accessed February 26, 2008).

[8] The manufacturers are Aston Martin, BMW Group, DaimlerChrysler Corporation, Ferrari, Ford Motor Company, General Motors, Honda, Hyundai Motor America, Isuzu Motors, Kia Motors, Maserati, Mazda, Mitsubishi Motors, Nissan, Porsche, Subaru, Suzuki, Toyota, and Volkswagen Group.

[9] Although reducing risk was the stated goal of the voluntary commitment, BTSI devices also dramatically reduce the occurrence of sudden acceleration incidents.

[10] NHTSA defines these vehicles as passenger cars, light trucks, multipurpose vehicles, and buses with a GVWR up to 10,000 pounds, produced for the U.S. market.

[11] *Reducing the Risk of Inadvertent Automatic Transmission Shift Selector Movement and Unintended Vehicle Movement: A Commitment for Continued Action by Leading Automakers* (Washington, DC: U.S. Department of Transportation, National Highway Traffic Safety Administration, 2006).

Aspects of the voluntary agreement were given the force of law when the Cameron Gulbransen Kids Transportation Safety Act of 2007 was signed on February 28, 2008.[12,13] Among other things, the act requires vehicles to have "rolling away" prevention, which involves the use of BTSI systems. Each motor vehicle with an automatic transmission that includes a "park" position, manufactured for sale after September 1, 2010, must be equipped with an interlock device that requires the service brake to be depressed before the transmission can be shifted out of "park." Furthermore, the interlock device must function in any starting key position in which the transmission can be shifted out of "park." The legislation also incorporates other components of the voluntary agreement, such as the disclosure of BTSI-equipped models. The act is intended to increase safety by reducing inadvertent shift selector movement, but it also will increase safety by requiring a safety device that has been demonstrated to reduce unintended acceleration.

Although the Kids Transportation Safety Act offers a significant improvement in safety for some vehicles, it would not prevent the accidents discussed in this report because it excludes "any motor vehicle that is rated at more than 10,000 pounds gross vehicular weight."[14] However, because the driver is both the source and the means of pedal misapplication—in either light or heavy vehicles—it is reasonable to expect that a safety device that works for one class (light) would work for the other (heavy).[15] Given the demonstrated benefits of BTSI systems in passenger cars and the fact that the mechanisms that cause pedal misapplications are dependent on the human driver and are, therefore, similar in both light and heavy vehicles, the NTSB concludes that requiring interlock devices in heavy vehicles susceptible to pedal misapplication would provide a safety benefit by reducing such instances and unintended acceleration. Accordingly, the NTSB recommends that NHTSA require the installation of BTSI systems or equivalent in newly manufactured heavy vehicles with automatic transmissions and other transmissions susceptible to unintended acceleration associated with pedal misapplication when starting from a parked position.

Although the widespread use of BTSI devices would reduce instances of pedal misapplication in initially stationary vehicles, these devices are ineffective in preventing accidents in vehicles that are already moving. In two of the five accidents discussed in the report (Liberty and Nanuet), the vehicles were in motion when the pedal misapplication occurred. In the most severe light vehicle pedal misapplication accident investigated by the NTSB (Santa Monica, California),[16] the automobile involved was also in motion. Research indicates that a significant number of pedal misapplications occur in vehicles that are in motion.[17]

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[12] Cameron Gulbransen Kids Transportation Safety Act of 2007, H.R. 1216, 110th Congress, 2nd Session (2008). The legislation passed the U.S. House of Representatives in December 2007.

[13] "President Bush Signs H.R. 1216 and H.R. 5270 Into Law," available from <http://www.whitehouse.gov/news/releases/2008/02/20080228-4.html> (accessed March 4, 2008).

[14] H.R. 1216.

[15] Both light and heavy vehicles found to be susceptible to pedal misapplication when starting from a parked position are typically equipped with automatic transmissions.

[16] NTSB/HAR-04/04.

[17] R. Schmidt, D. Young, T. Ayres, and J. Wong, "Pedal Misapplications: Their Frequency and Variety Revealed Through Police Accident Reports," *Proceedings of the Human Factors and Ergonomics Society 41st Annual Meeting* (1997), pp. 1023–1027.

Pedal Design Research

Due in large part to the widely publicized incidents involving sudden automotive acceleration in the 1980s, NHTSA undertook a significant effort to identify pedal characteristics that might be associated with driver performance problems and to develop recommended pedal configurations.[18] After experimentally comparing an "expected" configuration to two alternate configurations in a passenger car, the researchers found no statistically significant differences in the number of errors among them. They did, however, classify the errors for all designs as "high" and concluded that a standardized configuration would provide a benefit by reducing pedal errors. NHTSA identified the need for additional information on driver-preferred pedal location, the unknown effect of other in-vehicle cues, the sample population used in the study, and the exact benefits to be realized through standardization. As the BTSI device was incorporated into later automobile models and the instances of sudden acceleration decreased, NHTSA concluded that the incorporation of this technology would prevent pedal misapplication and abandoned its efforts toward standardizing pedals. However, countermeasures other than BTSI devices need to be explored because pedal misapplication can occur when a vehicle is already in motion.

Many researchers have attempted to quantify the relationship between pedal misapplication and pedal design—with some concluding that design plays a role in pedal misapplication[19] and others maintaining that design has no significant effect.[20] Some researchers[21] have sidestepped traditional configurations and suggested markedly redesigned pedals to reduce the incidence of pedal misapplication while also decreasing brake reaction time. These researchers independently evaluated a design that combines the accelerator and brake in a single pedal, which pivots fore–aft about a central fulcrum. The driver accelerates by pressing fore with the toes and brakes by pressing aft with the heel. Study participants learned the configuration rapidly, experienced few to no errors, and indicated that they preferred the novel design to current vehicle pedal designs. At least one manufacturer (Volvo) has demonstrated the

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[18] R. Brackett, V. Pezoldt, M. Sherrod, and L. Roush, *Human Factors Analysis of Automotive Foot Pedals*, DOT HS 807 512 (Washington, DC: U.S. Department of Transportation, National Highway Traffic Safety Administration, 1989).

[19] (a) J. Pollard and E. Sussman, *An Examination of Sudden Acceleration* (Washington, DC: U.S. Department of Transportation, National Highway Traffic Safety Administration, 1989). (b) R. Schmidt, "Unintended Acceleration: A Review of Human Factors Contributions," *Human Factors*, vol. 31, no. 3 (1989), pp. 345–364. (c) R. Schmidt, "Unintended Acceleration: Human Performance Considerations," eds. B. Peacock and W. Karwowski, *Automotive Ergonomics* (London: Taylor & Francis, 1993), pp. 431–451.

[20] (a) M. Vernoy and J. Tomerlin, "Pedal Error and Misperceived Centerline in Eight Different Automobiles," *Human Factors*, vol. 31, no. 4 (1989), pp. 369–375. (b) S. Rogers and W. Wierwille, "The Occurrence of Accelerator and Brake Pedal Actuation Errors During Simulated Driving," *Human Factors*, vol. 30, no. 1 (1988), pp. 71–81. (c) D. Trachtman, R. Schmidt, and D. Young, "The Role of Pedal Configuration in Unintended-Acceleration and Pedal-Error Accidents," *Proceedings of the Human Factors and Ergonomics Society 49th Annual Meeting* (2005), pp. 1984–1988.

[21] (a) S. Konz, N. Wadhera, S. Sathaye, and S. Chawla, "Human Factors Considerations for a Combined Brake-Accelerator Pedal, *Ergonomics*, vol. 14, no. 2 (1971), pp. 279–292. (b) G. Poock, A. West, T. Toben, and J. Sullivan, "A Combined Accelerator-Brake Pedal," *Ergonomics*, vol. 16, no. 6 (1973), pp. 845–848. (c) S. Glass and C. Suggs, "Optimization of Vehicle Accelerator-Brake Pedal Foot Travel Time," *Applied Ergonomics*, vol. 8, no. 4 (1977), pp. 215–218. (d) R. Nilsson, "Evaluation of a Combined Brake-Accelerator Pedal," *Accident Analysis and Prevention*, vol. 34, no. 2 (2002), pp. 175–183.

engineering feasibility of the design and has implemented it on several prototype vehicles in Sweden.[22]

However, research has failed to yield a consensus on the relationship between pedal design and pedal misapplication. Given the variability in results of experiments on pedal design, the NTSB concludes that there is no consensus on the role of pedal design in pedal misapplication and unintended acceleration.

Although moving from one vehicle to another with a different pedal design may play a role in some instances of pedal misapplication, the research on the effect of such transfer from a usual vehicle to a different vehicle—as was the circumstance in both the Falls Township and Nanuet accidents—is inconclusive. Exacerbating the issue is the fact that very little of this research has been performed in heavy vehicles. One effort, published by the Transportation Research Board in 1997, looked at ergonomics and operator preference for bus operator work stations, but it did not consider pedal error or reaction time.[23]

The NTSB recommends that NHTSA analyze pedal configurations in heavy vehicles, including innovative designs, to determine the effect of pedal design on the driving task, examining—among other things—pedal error, reaction time, driver acceptance, and driver adaptation. Once the analysis of pedal configurations is complete, the NTSB recommends that NHTSA publish pedal design guidelines for designers and manufacturers.

Highway Vehicle Event Data Recorders

As a result of this special investigation on pedal misapplication in heavy vehicles, the NTSB is reiterating and reclassifying two recommendations to NHTSA addressing (1) the requirement for on-board recording systems in school buses and motorcoaches, and (2) the development and implementation of standards for on-board recording of bus crash data. Supporting information is discussed below. The NTSB would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement these two recommendations.

In August 2006, NHTSA published a final rule that standardized the information event data recorders (EDR) collect to facilitate data retrieval and also addressed the survivability requirements for EDRs, basing those criteria on current *Federal Motor Vehicle Safety Standards* (FMVSS).[24] The rule, FMVSS 563, was amended on January 14, 2008, to allow more time for manufacturers to comply.

However, it is important to note that the current data and performance standards established by FMVSS 563 do not require vehicles to actually be equipped with an EDR, but rather establish data and performance standards for EDRs that may be voluntarily installed by the

[22] D. Graham-Rowe, "Combined Accelerator and Brake Pedal Could Save Lives," *New Scientist* (January 10, 2002). See <http://www.newscientist.com/article/dn1770-combined-accelerator-and-brake-pedal-could-save-lives.html> (accessed August 20, 2009).

[23] H. You, B. Osterling, J. Bucciaglia, B. Lowe, B. Gilmore, and A. Freivalds, *Bus Operator Workstation Evaluation and Design Guidelines: Summary*, TCRP Report 25 (Washington, DC: National Academy Press, 1997).

[24] See Event Data Recorders, Final Rule, 49 CFR Part 563, NHTSA docket no. 25666, August 28, 2006.

manufacturer. Although this rule represents an important step in the process of developing EDRs for light vehicles, it currently excludes vehicles with a GVWR over 8,500 pounds and, therefore, does not apply to buses, motorcoaches, or other heavy vehicles.

There has also been some activity in developing EDR standards for heavy vehicles. In 1999, as a result of its special investigation of bus crashworthiness,[25] the NTSB made two EDR-related recommendations to NHTSA, Safety Recommendations H-99-53 and -54.

In October 2000, NHTSA organized the truck and bus EDR working group to focus on data elements, survivability, and event definitions related to trucks, school buses, and motorcoaches. Findings were published in May 2002.[26]

In 2004, the National Cooperative Highway Research Program examined current U.S. and international methods and practices for the collection, retrieval, archiving, and analysis of EDR data for roadside and vehicle safety.[27]

In 2004, both IEEE[28] and the Society of Automotive Engineers (SAE) published voluntary standards and recommended practices regarding highway vehicle EDRs.[29] IEEE completed project 1616 by publishing the first established standards for motor vehicle EDRs—standards that encompassed all highway vehicles on both light and heavy vehicle platforms. The SAE published a voluntary industry recommended practice (J1698) for displaying and presenting EDR data. This recommended practice was an effort to establish a standardized format for displaying and presenting crash-related data that had been recorded or stored by the electronic components currently installed in many light-duty vehicles. It applies specifically to the postevent format of downloaded data and does not direct how the data should be collected or which vehicle systems should be monitored. Further, SAE J1698 applies to data from frontal impacts only. SAE has not proceeded with plans to continue the standardization of EDR data by developing recommended practices for additional collision types, including multiple impacts, side impacts, and rollovers.

An additional SAE working group is reportedly near completion of a recommended practice for heavy vehicle EDRs. SAE J2728 addresses the following for medium- and heavy-duty vehicles: event triggers, data elements, event record duration, time stamping, recording rate, file format, performance requirements, electrical and environmental performance, survivability, power reserves, security, data volatility, access, interfaces, extraction procedures, and alternative extraction methods.

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[25] *Bus Crashworthiness Issues*, Highway Special Investigation Report NTSB/SIR-99/04 (Washington, DC: National Transportation Safety Board, 1999).

[26] *Event Data Recorders, Summary of Findings by the NHTSA EDR Working Group, Vol. II, Supplemental Findings for Trucks, Motorcoaches, and School Buses,* DOT HS 809 432 (Washington, DC: U.S. Department of Transportation, National Highway Traffic Safety Administration, 2002).

[27] H. Gabler, D. Gabauer, H. Newell, and M. O'Neill, *Use of Event Data Recorder Technology for Highway Crash Data Analysis,* NCHRP Project 17-24 (Washington, DC: Transportation Research Board, 2004).

[28] Formerly the Institute of Electrical and Electronics Engineers, Inc., the organization is now known exclusively by the acronym IEEE.

[29] (a) *IEEE Standard* for *Motor Vehicle Event Data Recorders*, IEEE Standard 1616-2004 (Los Alamitos, California: IEEE, February 2005). (b) Society of Automotive Engineers International, *Vehicle Event Data Recorder Interface—Output Data Format*, SAE Recommended Practice J1698-1 (December 2003).

Additional industry initiatives include the American Trucking Associations publication of a recommended practice (RP1214) to define the collection of event-related data on board commercial vehicles. This recommended practice, intended for mechanics, outlines data elements, storage methodology, and retrieval approach for event data.

The Commercial Vehicle Safety Technology Diagnostics and Performance Enhancement Program of the Federal Motor Carrier Safety Administration (FMCSA), also known as the CV Sensor Study, has worked to define advanced on-board diagnostic and improved safety-related products for trucks and tractor-trailers. The program has developed functional EDR requirements for the analysis of accident data from the FMCSA's Large Truck Crash Causation Study for both complete accident reconstruction and crash analyses. The CV Sensor Study has also developed requirements for EDR components, hardware, software, sensors, and databases, and has completed a cost-effectiveness analysis.[30] During the 2007 SAE symposium on highway EDRs,[31] industry representatives discussed the status of standards work; current system operating experience; and evidence that many operators currently use vehicle data recorders to improve operational control, to support insurance rates and claims, and to respond to litigation.

The pedal misapplication incidents discussed in the special investigation report exemplify heavy vehicle accidents in which EDRs would have provided essential data. Although research and human factors principles provide a compelling explanation for unintended acceleration incidents in which no mechanical cause is found, some people remain skeptical that pedal misapplication is the cause of such accidents. If these vehicles were equipped with EDRs, the question of the drivers' actions during specific events could be documented, and investigators would have a physical record of specific actions and control inputs. Had any of the vehicles involved in these accidents been equipped with an EDR, a significantly higher level of science could have been applied to understanding the accident. The NTSB concludes that EDRs would provide essential and specific information regarding the causes and mechanisms of pedal misapplication and unintended acceleration in heavy as well as light vehicles.

Recognizing the work of NHTSA in formally requesting comments on bus EDRs and participating in working groups developing standards for EDRs, the NTSB classified both Safety Recommendations H-99-53 and -54 as "Open—Acceptable Response" on April 15, 2004. However, the NTSB reiterated these two recommendations on August 18, 2008, in a report on the motorcoach accident in Atlanta, Georgia, involving 33 members of the Bluffton University baseball team.[32] The NTSB's investigation of the crash dynamics and injury mechanisms was limited because of the lack of an EDR on the motorcoach. Despite the reiteration of Safety Recommendations H-99-53 and -54, NHTSA has not yet implemented a requirement for the use of EDRs on buses. Accordingly, the NTSB is reclassifying Safety Recommendations H-99-53 and -54 to "Open—Unacceptable Response" and reiterating them again:

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[30] See FHWA IVI Program 134, "Development of Requirements and Functional Specifications for Event Data Recorders," <http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/14146.htm>, April 3, 2008.

[31] Society of Automotive Engineers International, *Highway Vehicle Event Data Recorder Symposium, September 5-6, 2007, Ashburn, Virginia* (2007).

[32] *Motorcoach Override of Elevated Exit Ramp, Interstate 75, Atlanta, Georgia, March 2, 2007*, Highway Accident Report NTSB/HAR-08/01 (Washington, DC: National Transportation Safety Board, 2008).

> Require that all school buses and motorcoaches manufactured after January 1, 2003, be equipped with on-board recording systems that record vehicle parameters, including, at minimum, lateral acceleration, longitudinal acceleration, vertical acceleration, heading, vehicle speed, engine speed, driver's seat belt status, braking input, steering input, gear selection, turn signal status (left/right), brake light status (on/off), head/tail light status (on/off), passenger door status (open/closed), emergency door status (open/closed), hazard light status (on/off), brake system status (normal/warning), and flashing red light status (on/off) (school buses only). For those buses so equipped, the following should also be recorded: status of additional seat belts, airbag deployment criteria, airbag deployment time, and airbag deployment energy. The on-board recording system should record data at a sampling rate that is sufficient to define vehicle dynamics and should be capable of preserving data in the event of a vehicle crash or an electrical power loss. In addition, the on-board recording system should be mounted to the bus body, not the chassis, to ensure that the data necessary for defining bus body motion are recorded. (H-99-53)

> Develop and implement, in cooperation with other government agencies and industry, standards for on-board recording of bus crash data that address, at a minimum, parameters to be recorded, data sampling rates, duration of recording, interface configurations, data storage format, incorporation of fleet management tools, fluid submersion survivability, impact shock survivability, crush and penetration survivability, fire survivability, independent power supply, and ability to accommodate future requirements and technological advances. (H-99-54)

As a result of this special investigation of pedal misapplication in heavy vehicles, the NTSB also makes the following new recommendations to the National Highway Traffic Safety Administration:

> Require the installation of brake transmission shift interlock systems or equivalent in newly manufactured heavy vehicles with automatic transmissions and other transmissions susceptible to unintended acceleration associated with pedal misapplication when starting from a parked position. (H-09-11)

> Analyze pedal configurations in heavy vehicles, including innovative designs, to determine the effect of pedal design on the driving task, examining—among other things—pedal error, reaction time, driver acceptance, and driver adaptation. (H-09-12)

> Once the analysis of pedal configurations requested in Safety Recommendation H-09-12 is complete, publish pedal design guidelines for designers and manufacturers. (H-09-13)

The NTSB also issued a new safety recommendation to the National Association of State Directors of Pupil Transportation Services and to the National Association for Pupil Transportation, in addition to reclassifying one previously issued recommendation to the Community Transportation Association of America.

In response to the new recommendations in this letter, please refer to Safety Recommendations H-09-11 through -13. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our secure mailbox. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman HERSMAN, Vice Chairman HART, and Member SUMWALT concurred in these recommendations.

[Original Signed]

By: Deborah A.P. Hersman
Chairman