



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 16, 1996

In reply refer to: H-96-29 through -33

To the domestic and international automobile manufacturers
(mailing list attached)

About 7:55 p.m. on September 20, 1995, a 1994 Toyota Camry driven by a 26-year-old female failed to stop for the red light at an intersection and collided with the left front of a 1985 Toyota Corolla. The weather was clear and dry and there were no visual obstructions. The air bags in the 1994 Toyota Camry deployed at impact. The driver sustained minor bruising on her inner arms and abdomen from contact with the air bag; the passenger-side air bag struck the back of the rear-facing child restraint system positioned in the right front passenger seat, breaking it in several places. The 5-month-old child in the restraint sustained fatal skull injuries. A 3-year-old child seated in a shield booster seat in the right rear vehicle seating position was not injured. All occupants of the 1985 Toyota Corolla were wearing their lap/shoulder belts. The driver and 10-year-old child who was seated in the right rear seating position sustained minor injuries. The adult occupying the right front seat was not injured.

The owner's manuals for the 1994 Toyota and for the rear-facing child restraint indicate that this type of child restraint system should never be used in the right front seat when the vehicle is equipped with an air bag for that position. These instructions were reinforced by two yellow and black labels, about 4 inches by 1½ inches, on each side of the child restraint with the words "WARNING: Place this restraint in a vehicle seat that does NOT have an air bag." The shoulder harness straps on the rear-facing child restraint system were not doubled back through the strap adjustment slide for proper securement, as directed by the restraint manufacturer's instructions. Further, the canopy on the child restraint—to shade the child's eyes from the sun—was being used in the vehicle despite the restraint manufacturer's instructions to the contrary.

The manufacturers' instructions for both the rear-facing child restraint and the booster seat in the 1994 Toyota recommend use of a locking clip when the vehicle seatbelts utilize a free-sliding latch plate, as this vehicle did. The locking clip provided by the manufacturer of the rear-facing child restraint was found by the Safety Board's investigator in the storage area on the back

of the child restraint. In summary, neither the rear-facing child restraint system nor the shield booster seat were being used according to the child restraint and/or vehicle manufacturers' instructions.

This accident (study case 136) demonstrates the complexity of using child restraint systems in today's passenger vehicles and, more importantly, the dangers of using child restraints improperly. Researchers, safety advocates, and parents have expressed concerns about the effect of improper use on the performance of child restraint systems, the incompatibility of child restraint systems and vehicle restraints (both vehicle seatbelts and air bags), and the performance of vehicle seatbelts (lap-only or lap/shoulder belts) for children who have outgrown child restraint systems.

According to the National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation, child restraints have been shown to be 69 percent effective in reducing the risk of death to infants and 47 percent effective for children between the ages of 1 and 4.¹ NHTSA also estimates that lap/shoulder belts reduce the risk of fatal injury by 45 percent and moderate to critical injury by 50 percent for passenger car occupants who are older than 5 years. Despite the effectiveness of child restraints and lap/shoulder belts to reduce the likelihood of severe and fatal injuries, accidents continue to occur in which restrained children are being injured and killed.

According to NHTSA's 1994 Fatal Accident Reporting System (FARS) data, 5,972 children younger than age 11 were passengers of motor vehicles in transport involved in accidents that resulted in at least one fatality. About 20 percent of the child passengers (1,203 of 5,972) were fatally injured. Restraint use was known for 1,114 of the 1,203 fatally injured children; about 54 percent of the fatally injured children (647 of 1,203) were unrestrained. Further, about 40 percent of all the children (2,402 of 5,972) involved in the fatal accidents were unrestrained; only 12 percent of these unrestrained children were not injured. These data show that the percentage of unrestrained children who were killed (26.9 percent) was almost double that of the percentage of restrained children who were killed (14.7 percent).

The National Transportation Safety Board, therefore, conducted a study to examine the performance and use of occupant protection systems for children—child restraint systems, vehicle seatbelts, and air bags.² The study also examined the adequacy of relevant Federal Motor Vehicle Safety Standards (FMVSS), the comprehensiveness of State child restraint and seatbelt use laws, and the adequacy of public information and education on child passenger protection. In order to fully discuss the performance of air bags and children, the Board examined the accident experience with passenger-side air bags in general.

¹ U.S. Department of Transportation, National Highway Traffic Safety Administration. 1996. Fatality and Injury Statistics on Children Ages 0-15, 1994. Conference Participant Manual, Conference on Moving Kids Safely. Washington, DC.

² National Transportation Safety Board. 1996. The performance and use of child restraint systems, seatbelts, and air bags for children in passenger vehicles. Safety Study NTSB/SS-96/01. Washington, DC. Volume 2 of the report, NTSB/SS-96/02, contains the case summaries of the 120 vehicle accidents.

The Safety Board selected for study accidents involving at least one vehicle in which there was a child passenger younger than age 11 and in which at least one occupant was transported to the hospital. The Safety Board used a sampling strategy designed to obtain a predetermined number of children in specified age ranges and in certain types of restraint systems to ensure equal representation of ages and restraint categories in the sample. The Safety Board investigated a total of 133 accidents. A total of 13 accidents were omitted from the study: 12 because data required for this study could not be obtained, and 1 because the restraint system used in the vehicle was not designed for automobiles. The study, therefore, analyzed data from 120 vehicle accidents.

In 13 accident vehicles in the study sample, a child was positioned in the right front seat of a vehicle in which the passenger-side air bag deployed. In 6 of the 13 accidents, the child was restrained by a child restraint system, and in 6 the child used the lap/shoulder belt or the lap portion of the lap/shoulder belt.³ In one accident, restraint use could not be conclusively determined. The head and neck injuries sustained by the children in 9 of the 13 accidents, including 5 fatalities, were directly related to the passenger-side air bag in each vehicle and to the spatial relationship between the inflating air bag and the child. Based on the low to moderate accident severity of most of these accidents and the lack of intrusion into the passenger compartments where the nine children were seated, the Safety Board believes that in each of the accidents, the child would have survived with minor or no injuries had the passenger-side air bag not deployed. The Safety Board believes that the air-bag induced injuries, including fatal injuries, sustained by the nine children in the study sample, should not have occurred regardless of restraint use.

The Safety Board recognizes that there may not yet be enough crash data available from the 2,000-plus accidents in which an air bag deployed that are listed in NHTSA's FARS and General Estimates System (GES) to statistically evaluate the performance of air bags for all passengers. There is sufficient empirical information, however, from the 13 accidents investigated for this study, in which 5 children were fatally injured; from accidents in Canton, Ohio; Orem, Utah; St. James, Missouri; and Nashville, Tennessee, which were also investigated by the Board; and from the 17 additional fatal accidents investigated by NHTSA since March 1994, for the Safety Board to conclude that passenger-side air bags, as they are currently designed, are not acceptable as a protective device for children.

NHTSA's notice of proposed rulemaking (NPRM) issued on August 6, 1996, did not provide any evidence that passenger-side air bags are effective in reducing death and injury, and the Board's study raises questions about the benefits of currently designed passenger-side air bags to reduce injuries and fatalities to children. Although NHTSA's databases and information provided by State Farm Insurance Companies to NHTSA in January 1996 suggest there may be some benefits from passenger-side air bags, the number of children killed and critically injured in accidents similar to those investigated for this study may continue to increase unless immediate

³ NHTSA also investigated several of these accidents and made determinations that differ from the Board's in terms of restraint use (cases 95, 137, and 140). Safety Board and NHTSA staff met to discuss the differences.

action is first taken to determine the benefits of passenger-side air bags as currently designed. Therefore, the Safety Board is recommending that NHTSA immediately evaluate passenger-side air bags based on all available sources, including NHTSA's recent crash testing. The Board also believes that NHTSA should publicize the findings and modify performance and testing requirements based on the findings of the evaluation.

Current Air Bag Testing Procedures

In the early 1980s, when the air bag testing procedures were being written, only about 15 percent of front seat occupants wore lap/shoulder belts. Accordingly, air bags were originally designed to protect occupants who were not restrained by their lap/shoulder belts. Since the early 1980s, however, there have been concerted efforts to increase the rates of lap/shoulder belt use through public education initiatives and the passage of seatbelt use laws by 49 States. Today, according to NHTSA, about 67 percent of front seat occupants wear their lap/shoulder belts. FMVSS 208, however, still requires that vehicle test procedures be based on unrestrained occupants. In essence, air bags are being designed, because of certification testing requirements, primarily to protect unbelted rather than belted occupants even though the air bags are promoted as supplemental restraint systems and the majority of motor vehicle occupants now use seatbelts.

The speed and force at which the air bag inflates need to be higher to protect unrestrained occupants than restrained occupants. FMVSS 208 requires that vehicles be tested at 30 mph with a 50th percentile male crash test dummy. In addition, manufacturers test with a variety of crash test dummy sizes and under various conditions with both restrained and unrestrained occupants.

On August 23, 1996, the American Automobile Manufacturers Association (AAMA) petitioned NHTSA to "(1) immediately revise the unrestrained dummy performance test, and (2) propose rulemaking to add new requirements for out-of-position occupant criteria." In discussing its concerns about the air bag-induced injuries sustained by children and small adult occupants, the AAMA stated that "these injuries are directly related to the energy level of the air bag during its deployment, with the force generated by an air bag currently being dictated by specific test protocol within FMVSS 208."

The Safety Board believes that there is an inconsistency in NHTSA's efforts to support increased lap/shoulder belt use, but to continue to require that air bags be tested and thus designed first and foremost to protect unrestrained occupants, which requires a more aggressive air bag. The Safety Board is concerned that air bag performance certification testing is not based primarily on belted occupants, that pre-impact braking is not considered in the testing procedures, and that testing is conducted with the seat track only in the middle position. By not using belted child occupants and out-of-position child occupants (belted and unbelted), by not considering the effects of pre-impact braking, and by not placing the seat track in the forward-most position, air bag performance testing is not representative of actual accident environments.

Testing procedures that reflect actual accident environments should result in performance requirements that reduce the speed and force of passenger-side air bag inflation. Consequently, the Safety Board agrees with the AAMA and believes that NHTSA should immediately revise FMVSS 208 to establish performance requirements for passenger-side air bags based on testing procedures that reflect actual accident environments, including pre-impact braking, out-of-position child occupants (belted and unbelted), properly positioned belted child occupants, and with the seat track in the forward-most position.

Reducing the speed and force of the passenger-side air bag alone, however, will not solve the problem of those air bags deploying in low-speed crashes in which the additional protection beyond that afforded by lap/shoulder belts is not needed. Therefore, the threshold of the passenger-side air bag deployment (the minimum level of crash severity at which the air bag will deploy) is also of concern to the Safety Board. According to NHTSA, air bags are designed to deploy in "moderate to severe" frontal collisions at speeds of about 10-15 mph into a fixed object or about 20-30 mph into a similar sized vehicle.⁴ In 9 of the 13 accidents investigated for this study in which there were collisions with other vehicles and passenger-side air bag deployment, the change in velocity was less than 20 mph, yet 5 of the 9 children in the right front passenger seats in these accidents sustained serious, critical, or fatal injuries from contact with the passenger-side air bag (2 of the 5 children were in rear-facing child restraint systems). In addition, both of the accidents for which a change in velocity could not be determined (cases 59 and 137) involved relatively low-speed accidents; the child in case 59 sustained critical injuries, and the child in case 137 died.

The Board believes that these cases support the need for an increase in the deployment thresholds. NHTSA's proposed rulemaking of August 6, 1996, states, "The Agency believes that an increase in the deployment threshold would yield a decrease in the number of air bag deployments and, therefore, a decrease in the number of air bag-induced injuries." Comments received by NHTSA did not uniformly support this belief; however, the Safety Board believes that an increase in the deployment thresholds of passenger-side air bags deserves serious consideration. Consequently, the Safety Board is recommending that NHTSA evaluate the effect of higher deployment thresholds for passenger-side air bags in combination with the recommended changes in air bag performance certification testing, and then modify the deployment thresholds based on the findings of the evaluation.

Current Proposals of NHTSA

Advanced Air Bag Technology.—The Safety Board agrees with the intent of NHTSA's NPRM issued August 6, 1996, to expedite installation of intelligent air bag systems. Technical solutions considered to date include intelligent air bag systems, increased deployment thresholds,

⁴National Highway Traffic Safety Administration. 1996. Effectiveness of Occupant Protection Systems and Their Use. Second Report to Congress. Washington, DC. February.

less aggressive air bags (reducing the speed and force at which the air bag inflates), and changes in the way the air bag is packaged. (The way an air bag is folded or the location and number of tethers can affect how it contacts the occupant.)

There appears to be agreement in the industry that any technological solutions for intelligent occupant sensing, which can also address concerns about occupants who are seated too close to the instrument panel, are at least 5 years or more away. The Board understands the complexity of the efforts to develop technological solutions and the need for thorough research prior to any proposals for change. However, NHTSA and the industry have been aware of the air bag problem for 25 years,⁵ and although they have been working to develop better air bag systems for many years, few vehicles incorporate the technology today. The Safety Board is concerned that every year about 13 million new cars with passenger-side air bags will be entering the market with the same dangers to children until new technology is available and in place. In meetings with several automobile manufacturers in preparation for this study, the Safety Board noted the length of time that it takes for the automobile manufacturers to prepare for the design, development, production, and installation of new parts. Although it varies depending on the complexity of the part to be added, it takes several years to design, test, and certify new safety components. Rulemaking takes additional time. For rulemaking completed in 1995, the average time from publication of the initial notice to publication of the final rule was 16 months. Based on these timeframes, if intelligent air bag technology were available today and FMVSS 208 needed to be modified to accommodate that new technology, it would be a minimum of 3½ years before the technology would be available for purchase by the public. More than 39 million new cars with passenger-side air bags with today's technology will have entered the market during that time period.

The Safety Board is concerned that the vast majority of parents are not receptive to placing infants in rear-facing child restraint systems in the back seats of vehicles because they cannot see the infant nor monitor the infant's actions from the front seat. NHTSA consumer testing in spring 1996 in conjunction with development of its "Air Bag Alert" brochure found that parents were resistant to having children ride in the back seat of the vehicle. Although the back seat is generally the safest place for children of all ages, some parents will ignore the warnings not to use the rear-facing child restraint system in the front seat of the vehicle with a passenger-side air bag and others will put the child restraint system in the back seat, but will turn the child restraint system to face forward. Because an infant's neck muscles are not well developed, an infant in a rear-facing child restraint system that is turned to face forward could sustain serious neck injuries as the head moves forward in a frontal accident.

The Safety Board is also concerned that, in spite of the educational efforts planned and already underway, children will continue to be positioned in the front seats of vehicles equipped with passenger-side air bags and that these children will continue to be in danger whether they are restrained or unrestrained. A November 1995 survey by the Insurance Institute for Highway Safety (IIHS) found that even when parents knew that they should not place their children in the

⁵ U.S. General Accounting Office. 1979. Report to Congress. CED-79-93. Washington, DC. July 27.

right front seat of a vehicle equipped with a passenger-side air bag, 8 percent still placed their child in front of the air bag compartment when they were traveling alone with the child.⁶ The Safety Board believes that permitting the installation of cutoff switches for vehicles manufactured in the future will not enhance the safety of children for several reasons: (1) drivers may choose not to have the switch installed; (2) as the cars are passed down and sold to the second and third owners, the importance of the switch may be overlooked because as new technology enters the marketplace, activities to make the public aware of the dangers that air bags pose to children will likely be reduced; and (3) drivers who choose to install the switches are likely to be more safety conscious and to place their children in the back seat. The Safety Board believes that a solution that requires action on the part of the driver is not likely to be effective and that a more technical requirement is needed.

Further, NHTSA's proposed rulemaking issued on August 6, 1996, would require vehicle manufacturers to install new, more prominent air bag warning labels if they do not provide intelligent air bag systems. The intent of the requirement is to encourage the manufacturers to provide such systems. However, NHTSA did not indicate how and the Safety Board is not confident that the additional labeling requirements, by themselves, provide sufficient encouragement for automakers to install intelligent air bag systems. The Board believes that establishing a date by which the automobile manufacturers must begin implementing intelligent air bag technology would be far more effective. Therefore, the Safety Board is recommending that NHTSA establish a timetable to implement intelligent air bag technology that will moderate or prevent the air bag from deployment if full deployment would pose an injury hazard to a belted or unbelted occupant in the right front seating position, such as a child who is seated too close to the instrument panel, a child who moves forward because of pre-impact braking, or a child who is restrained in a rear-facing child restraint system.

However, of immediate concern to the Safety Board is the large number of vehicles on the road that are equipped with passenger-side air bags. There are no provisions in the proposed rulemaking for the 22 million vehicles that will be on the road by the end of 1996 or the 13 million vehicles that will be sold each year with current technology pending the effective date of a new standard. Because of the large number of vehicles that are not included in the proposed rulemaking, the Board is concerned that the number of fatalities to children from deploying air bags will continue to increase. Technical solutions that are being considered for advanced air bag systems include increasing deployment thresholds, depowering the passenger-side air bag, and installing weight sensors. Consequently, the Safety Board is recommending that NHTSA determine the feasibility of applying technical solutions for vehicles not covered by NHTSA's proposed rulemaking to prevent air bag-induced injuries to children in the passenger side seating position. NHTSA should consider such solutions as increasing the deployment thresholds of passenger-side air bags, depowering the passenger-side air bag, installing weight sensors in the

⁶ Insurance Institute for Highway Safety. 1996. Survey of parents of infants. Presentation by Susan A. Ferguson, Ph.D., at the conference "Safety Belts, Airbags, and Passenger Safety: A Call to Action"; January 16-17, 1996; Washington, DC. The survey was conducted following increased media attention to the dangers that air bags can pose to children; consequently, the Safety Board believes that this may be a conservative estimate.

passenger-side vehicle seat, or deactivating the passenger-side air bag for families who choose to do so.

The Adequacy of Public Information.—The Safety Board is aware that NHTSA and the industry have attempted to inform the public about the problem of air bags relative to child restraint systems. However, the accidents described in this study raise concerns about the effectiveness of educational efforts alone to resolve this problem.

Although all four of the accident vehicles involving rear-facing child restraint systems had (a) a warning on the passenger-side sunvisor advising against using a rear-facing child restraint system in the right front passenger seat, (b) cautionary information in the vehicle owner's manual, and (c) in two cases, warnings on the child restraint system and on the seatbelt, none of the parents reported seeing the warnings. In addition, the investigations revealed that public information and education efforts had reached the parents of only one of these children. In that specific case, a warning label on the vehicle seatbelt⁷ and the written information received from the birth hospital that addressed the dangers of using rear-facing child restraint systems in the front seat of vehicles with passenger-side air bags had less impact than a videotape viewed by the parents at the birth hospital that emphasized the need to place a child next to an adult for supervision and to never leave a child alone in the back seat. These accidents indicate that a more direct and wide-reaching approach is needed to ensure that the public is aware of the dangers that current passenger-side air bags can pose to children.

The Safety Board is concerned that many of the educational materials given to parents do not include warnings about the dangers that air bags pose to children. Several urgent recommendations issued by the Safety Board on November 2, 1995, in the accident investigation phase of the study, to health and safety organizations addressed this concern. To address this problem, NHTSA is planning a campaign to "recall" out-of-date educational films, videotapes, and brochures. The Safety Board supports NHTSA's efforts in this area.

One of the urgent recommendations issued by the Safety Board on November 2, 1995, asked NHTSA to

Immediately develop and implement, in cooperation with the National Association of Broadcasters and the Advertising Council Inc., a highly visible nationwide multi-media campaign to advise the public about the dangers of placing a rear-facing child restraint system or an unrestrained or improperly restrained small child in the front seat of a vehicle equipped with a passenger-side air bag. (H-95-17)

NHTSA responded on January 5, 1996, that it was working with the Advertising Council to produce both a public service announcement and a video news release that will specifically

⁷ The parents in this case (case 121) placed a locking clip next to the label on the vehicle seatbelt that warns against placing a rear-facing child restraint in front of an air bag.

address the dangers that air bags can pose to small children. Safety Board staff was subsequently informed that the video news release had been released on January 16, 1996, in conjunction with the NHTSA/National Safety Council conference. On April 30, 1996, the Safety Board added this recommendation to the Highway Vehicle Occupant Protection category of its "Most Wanted" list of safety recommendations stating that a nationwide multimedia campaign is essential to raise public awareness about the dangers that air bags can pose to children.⁸ The public service announcement was distributed to major media markets in July 1996. The Safety Board believes that NHTSA's video news release, the public service announcement, and its involvement in the National Automotive Occupant Protection Campaign are positive steps in meeting the intent of the recommendation.

The National Automotive Occupant Protection Campaign launched by a government/industry coalition for air bag safety in May 1996 should contribute substantially to efforts to raise public awareness. The Safety Board encourages the coalition, as part of its efforts to better inform motor vehicle users of air bag-related injury risks and the precautions to be taken to reduce those risks, to focus public information on (a) the proper use of rear-facing child restraint systems in the back seat of passenger vehicles, (b) the proper use of lap/shoulder belts for children who have outgrown child restraint systems and booster seats, and (c) the importance of placing all children in the back seat of a vehicle equipped with a passenger-side air bag.

In addition to recommending to NHTSA a highly visible, multimedia campaign, the Safety Board issued two urgent recommendations to the 20 domestic and international automobile manufacturers on November 2, 1995, asking them to take immediate action to

Conduct a mail campaign to all registered owners of vehicles equipped with passenger-side air bags that warns of the dangers of placing a rear-facing child restraint system and an unrestrained or improperly restrained small child in the front seat of the vehicle. (H-95-19)

Develop and attach to all new vehicles with passenger-side air bags a visible warning regarding the dangers of placing a rear-facing child restraint system and an unrestrained or improperly restrained small child in the front seat of the vehicle. This warning should be permanent and visible to front seat passengers at all times. (H-95-20)

On April 30, 1996, the Safety Board added these recommendations to its "Most Wanted" list of safety recommendations.

⁸ In October 1990, the Safety Board adopted a program to identify the "Most Wanted" safety improvements. The purpose of the Board's "Most Wanted" list, which is drawn up from safety recommendations previously issued, is to bring special emphasis to the safety issues the Board deems most critical. The Highway Vehicle Occupant Protection category also includes recommendations on the need for States to enact primary seatbelt enforcement laws.

In response to these safety recommendations, the AIAM, writing on behalf of 17 international manufacturers, noted in its letter of February 9, 1996, that NHTSA has "regulations that are very specific with respect to message content, location, and other features. As part of NHTSA's multi-faceted, broad-based public education campaign, we believe NHTSA will propose revisions to existing air bag information labeling requirements." The Safety Board classified Safety Recommendations H-95-19 and -20 "Open—Acceptable Response" on March 12, 1996, pending further action by the automobile industry. (Additional responses to Safety Recommendations H-95-19 and -20 have been received from the AAMA and General Motors dated July 22, 1996, and July 30, 1996, respectively.)

Mercedes-Benz, in a separate letter to the Safety Board dated April 24, 1996, responded that it supported regulatory action on labeling by NHTSA, but that "in the interim, however, beginning this week Mercedes-Benz of North America, Inc., will install on all new cars a new warning label on the inside of the right front passenger door." The label will also be made available, free of charge, to car owners. Mercedes-Benz's response to Safety Recommendation H-95-20 was classified "Closed—Acceptable Alternate Action" on June 13, 1996. NHTSA's proposal to require new and more prominent air bag warning labels inside the vehicle is in line with the intent of the Board's recommendation. Consequently, if the proposed rule is adopted, the manufacturers' compliance with the rule will also satisfy the goal of the Board's Safety Recommendation H-95-20. Pending NHTSA's publication of a final rule, Safety Recommendation H-95-20 has been classified "Open—Acceptable Response."

As noted earlier, the Safety Board is concerned that there are no provisions in NHTSA's proposed rulemaking for the vehicles currently on the road. The Board believes that the manufacturers should address these vehicles and should install warning labels on all passenger vehicles equipped with passenger-side air bags on the road or to be manufactured prior to the effective date of the requirements proposed by NHTSA on August 6, 1996. The labels should be similar to those to be required by NHTSA for installation in newly manufactured vehicles. Ways that the manufacturers could accomplish this labeling include notifying all vehicle owners through a mail campaign, by installing the labels when the vehicles are serviced at dealerships, by distributing labels at vehicle inspection or service stations, or by including labels in license or insurance renewals. The Safety Board believes that the manufacturers can determine the appropriate mechanism to accomplish this goal. In view of the foregoing, Safety Recommendation H-95-19 has been classified "Closed—Acceptable Action/Superseded" by this new recommendation.

The importance of placing children, whether they are in rear- or forward-facing child restraint systems or seatbelts, in the back seat of a vehicle equipped with a passenger-side air bag has been emphasized repeatedly by both NHTSA and the Safety Board. Although the Safety Board did not specifically address the printed information on NHTSA's proposed warning labels, the Board believes that NHTSA and the manufacturers should consider including on the warning labels specific information regarding the placement of children in the back seats of vehicles.

Child Restraint Systems and Seatbelts

The Safety Board's study found that more than two-thirds of the children in the sample were not in the appropriate restraint for their age, height, and weight; over half of the children who used child restraints were improperly restrained; and about one-quarter of the children who used seatbelts were improperly restrained.

Because of the large number of children who were not in the appropriate restraint and who were improperly restrained, the Safety Board is concerned that educational information about proper restraint use is either not reaching parents and caregivers or the consequences of not properly using child restraint systems, booster seats, and seatbelts apparently are still often misunderstood or ignored. As early as 1979, when child restraint use was mandatory in only one State (Tennessee), NHTSA publications were addressing the importance of using child restraints properly.⁹ The Safety Board has addressed the issue of improper use in several reports: in its 1983 study on child restraints, in a 1985 symposium on ways to decrease misuse, and in its 1988 study on the performance of lap and shoulder belts.¹⁰ In its 1983 study, the Board concluded that "misuse of child restraint systems appears to be a significant and widespread problem. While in some kinds of accidents, a misused child restraint system may still provide some protection, misuse can reduce or totally negate the protection provided by a child restraint system." Improper use of child restraints continues today at the same high levels: 75 percent in 1983, 64 percent in 1984,¹¹ 80 percent in 1995,¹² and 62 percent in the Board's current study. These continued high misuse rates suggest that it is difficult to educate parents and caregivers about child passenger protection (child restraints, seatbelts, and air bags), especially about these important points:

- air bags were not designed to protect children;
- seatbelts can injure children who should be in child restraint systems;
- children should be properly secured in the appropriate restraint system for their age, height, and weight;

⁹ National Highway Traffic Safety Administration. 1979. EarlyRider Educational Curriculum. DOT HS 805 060. Washington, DC. November.

¹⁰ (a) National Transportation Safety Board. 1983. Child Passenger Protection Against Death, Disability, and Disfigurement in Motor Vehicle Accidents. Safety Study NTSB/SS-83/01. Washington, DC. (b) National Transportation Safety Board. 1985. Child Passenger Safety Symposium: Ways To Increase Use and Decrease Misuse of Child Restraints. Safety Study NTSB/SS-85/03. Washington, DC. (c) National Transportation Safety Board. 1988. Performance of Lap/Shoulder Belts in 167 Motor Vehicle Crashes (Volume 1). Safety Study NTSB/SS-88/02. Washington, DC.

¹¹ (a) Shelness, Annemarie; Jewett, Jean. Observed Misuse of Child Safety Seats. 1983. Child Injury and Restraint Conference Proceedings Pap. 207-215. Warrendale, PA: Society of Automotive Engineers. (b) National Highway Traffic Safety Administration. 1984. The Incidence and Factors Associated With Misuse. Prepared by Goodell-Grivas, Inc. Washington, DC. December.

¹² Knoebel, K. Y.; Decina, L.E. 1995. Patterns of Misuse of Child Safety Seats: Final Statistical Analysis. Report to NHTSA. Malvern, PA: Bionetics Corporation, KETRON Division. October 2.

- child restraint systems must be properly secured in the vehicle; however, seatbelts may not be compatible with child restraints; and
- children should be positioned, whenever possible, in the back seat of vehicles.

The NHTSA brochure "Are You Using It Right?" and NHTSA's eight child passenger safety tips are clearly written and explain many of the problems that parents and caregivers encounter in choosing and using child restraint systems.¹³ The Safety Board believes that NHTSA has made comprehensive and continuous attempts to address the improper use problem through educational efforts.

However, many of the organizations working with NHTSA to promote proper use of child restraint systems do not focus exclusively on child passenger safety nor do they all have permanent funding to do so. Further, the number of organizations and the personnel involved change from year to year. For example, in 1984, there were 33 national organizations involved in promoting child passenger safety. However, only 11 national organizations that were involved in promoting child passenger safety in 1984 are still involved today, according to NHTSA's 6th Quarterly Safe & Sober Planner.

Over the past 20 years, four organizations dedicated exclusively to child passenger safety were founded: Physicians for Automotive Safety (1966–1989), Action for Child Transportation Safety (1971–1983), the National Child Passenger Safety Association (1983–1990), and SafetyBeltSafe USA (1990–present).¹⁴ All were primarily funded by membership dues and worked on limited budgets.¹⁵ Only SafetyBeltSafe USA exists today; it has a part-time staff of about 15 and an annual budget of about \$300,000. In addition, Federal funding of *Safe Ride News*, the national newsletter for child passenger safety advocates, is being phased out, and the newsletter is in jeopardy if it cannot sustain itself on membership subscriptions. Although many efforts have been initiated at the national, State, and local levels to educate parents and caregivers about why and how to use child restraints and seatbelts for children, these efforts are often short lived, vary in quality, and are limited by resources. The Safety Board is concerned that the lack of a stable, cohesive approach may adversely affect efforts to educate parents and caregivers about how to properly use child restraints; why to use the appropriate restraint for the child's age, height, and weight; and how to reduce the risk of injury severity by placing children in the back seat of a vehicle. The Safety Board is aware that millions of dollars are spent on advertising for the sale of automobiles and child restraint systems. The Safety Board believes that given the amount of money allocated to promote these products and the harm that can result from using the

¹³ The set of eight safety tips about using child restraint systems was part of NHTSA's 6th Quarterly Safe & Sober Planner (DOT HS 808 303) issued in 1995.

¹⁴ SafetyBeltSafe USA was originally founded in 1980 as a local advocacy group named the "Los Angeles Child Passenger Safety Association." The group changed its focus to national issues in 1990.

¹⁵ The National Child Passenger Safety Association was originally funded by a NHTSA grant of \$100,000 for 2 years. When the grant money ended, the organization could not sustain itself on membership dues.

inappropriate child restraint system and using it improperly, providing stable funding for child passenger protection education should not be the problem that it has been in the past. Accordingly, the Board is recommending that NHTSA review, through its Blue Ribbon Panel comprising child passenger safety advocates, automobile and child restraint manufacturers, and automobile insurance providers, the various efforts that promote child passenger safety, and then develop and implement a plan to ensure coordinated, comprehensive, continuing programs and stable funding for these programs.

General Motors (GM) and the National Safe Kids announced on June 13, 1996, a \$10 million, 5-year partnership to reduce misuse of child restraint systems. The campaign will include technical training for GM dealership personnel in the proper use of child restraint systems, promotional events at dealerships to provide parents and caregivers with information on proper use, health education efforts, and a national media campaign. The Safety Board commends GM and National Safe Kids on this effort and believes that the other automobile manufacturers should provide similar efforts at their dealerships.

Securing a child restraint system properly in the vehicle is also complicated by a number of incompatibilities related to the design of child restraint systems and vehicles and vehicle seatbelts. The child restraint manufacturers have, in the past, attempted to reduce installation problems associated with child restraint systems and vehicle seatbelts through modifications to child restraint systems. Tethers, which were utilized on child restraint systems in the 1970s and early 1980s and extensively misused, were eliminated, and child restraint system frames were redesigned to eliminate errors in routing the vehicle seatbelt.

Despite the modifications, compatibility between vehicle seatbelts and child restraint systems has posed problems since the mid-1980s. In 1984, a Children's Restraint Systems Task Force of the Society of Automotive Engineers (SAE) met to discuss these problems. The problems at the time, as summarized in the Rationale Statement for the SAE Recommended Practice J1819,¹⁶ were (a) seatbelts that did not hold a child restraint tightly, (b) automatic belts that require supplemental hardware, and (c) vehicle seats with rounded corners that did not provide firm support for a child restraint. The reasons for the seatbelts not holding a child restraint tightly included (a) lapbelts with emergency locking retractors that give adults freedom of movement but do not hold child restraint systems tightly, (b) seatbelts anchored forward of the seat cushion/seatback intersection that allow forward motion of the child restraint no matter how tight the seatbelt is pulled, and (c) the length and design of certain lapbelt buckles and belts that cause them to be in a position to loosen as they bend around the frame of the child restraint system to follow the belt path for the vehicle seatbelt. SAE J1819 covers specifications related to seatbelt adjustment hardware, webbing length, and contact points and is a voluntary practice for the automobile and child restraint manufacturers to use. SAE J1819 has resolved some of the problems of compatibility such as the location of the belt path for the vehicle seatbelt and the

¹⁶ Society of Automotive Engineers. 1990. J1819 Recommended Practice Securing Child Restraint Systems in Motor Vehicle Rear Seats. Warrendale, PA. November. The practice issued in 1990 related to rear seating positions. The practice was revised in 1994 to address front seating positions.

length and size of the vehicle seatbelt buckle. All manufacturers, however, do not adhere to this voluntary practice.

In July 1991, NHTSA issued a request for comments on possible upgrades to FMVSS 213, "Child Restraint Systems."¹⁷ Items under consideration included test dummy size and weights, vehicle test seat characteristics, proper labeling of allowable child weights and heights, crash test performance measures, lap/shoulder belt test procedures, and air bag/child restraint interaction.

In December 1991, NHTSA issued a supplemental notice and request for comments on whether lapbelts or the lap portion of lap/shoulder belts should be capable of tightly securing a child restraint system; this issue was referred to as "lockability."¹⁸ The Safety Board supported the need for such action. The Board's current study highlights the need for that action: there were 21 cases in which the vehicle seatbelts would not tightly secure the child restraint systems. NHTSA issued a final rule on October 13, 1993, requiring that seatbelts be capable of tightly securing a child restraint system without the need for any supplemental hardware. Vehicles manufactured after September 1, 1995, must meet this requirement.¹⁹

Although there has been repeated dialogue regarding the issue of incompatibility since 1984, the fact that many of the problems still exist 12 years later raises concern about the efforts of NHTSA, the child restraint manufacturers, and the automobile industry to resolve this issue in a timely manner. Although the concern that vehicle seatbelts could not tightly secure a child restraint system was formally raised in 1984, it took NHTSA 7 years to issue a supplemental notice of proposed rulemaking, another 2 years to issue a final rule, and then 2 additional years for the rule to become effective (September 1995). In the interim 11 years, parents continued to have problems properly securing child restraint systems in the vehicle. Because the lockability rule only became effective on September 1, 1995, problems securing child restraint systems in vehicles will continue until all of the pre-1995 vehicles are out of service. The Safety Board estimates that it will take roughly 20 years for this to occur.

The Board's study provides evidence that children in the back seat of the vehicle are less likely to sustain injury than children in the front seat. The Board's study found about an 8 percent difference in the frequency of injuries between the front and back seat in accidents: 23 percent of the children in the back seat sustained no injury compared to 15 percent of the children in the front seat. A review of 1993 data from NHTSA's GES showed that about 56 percent of child occupants involved in police-reported accidents were in the back seat. Additional analysis of the GES showed that children in the back seat are less likely to sustain injury. Other research

¹⁷ Federal Register, Vol. 56, No. 137, dated July 17, 1991.

¹⁸ Federal Register, Vol. 56, No. 235, dated December 6, 1991.

¹⁹ Federal Register, Vol. 58, No. 196, dated October 13, 1993.

supports this finding.²⁰ Further, the current design of air bags makes it essential for children to ride in the back seat of the vehicle. The Safety Board believes that several immediate design changes should be considered by NHTSA, the vehicle manufacturers, and child restraint system manufacturers that will encourage placing children in the rear seat of vehicles, thus improving child passenger protection.

Integrated Restraints.—Integrated (built-in) restraints eliminate the need for supplemental hardware, eliminate restraint system availability problems, encourage use of the back seat where the integrated restraint is installed, and provide restraint systems specifically designed for children. Chrysler and Volvo introduced integrated restraints in their vehicles in the early 1990s: Chrysler offered an integrated toddler and belt-positioning booster seat in its model year 1992 minivan, whereas Volvo offered an integrated belt-positioning booster seat for use with the lap/shoulder belt at the center rear seating position beginning in model year 1991.²¹ Currently, 7 automobile manufacturers offer integrated restraints in 31 vehicle models, thus encouraging parents and caretakers to transport children in the back seat. The Safety Board believes that the automobile manufacturers should offer integrated restraints in passenger vehicles for sale in the United States.

Universal Anchorage System.—On February 13, 1995, NHTSA established the Blue Ribbon Panel on child restraint and vehicle compatibility to address the “range of child restraint system-vehicle compatibility issues that make the secure installation of a child restraint system in some vehicle seating positions difficult and, in some circumstances, impossible. The need for supplemental attachment hardware (like auxiliary buckles, locking chips, seatbelt extenders) further complicates the task.”²² On May 30, 1995, the Blue Ribbon Panel issued 27 recommendations. The Panel determined that the best long-range resolution to the compatibility problem was probably a separate anchorage system for installing child restraint systems in vehicles not equipped with an integrated child restraint system. This anchorage system has been in development by the International Standards Organization Working Group on Child Restraint Systems for more than 5 years. The Blue Ribbon Panel recommended that NHTSA thoroughly evaluate a universal anchorage system, including appropriate crash modes and child comfort issues.

On June 28, 1996, six automobile manufacturers, five child restraint manufacturers, and one seatbelt supplier jointly petitioned NHTSA to promulgate rulemaking that would require vehicle manufacturers to provide a uniform child restraint anchorage.²³ The petition also

²⁰ Huelke, Donald F. 1995. Rear Seat Occupants in Frontal Crashes—Adults and Children: The Effects of Restraint Systems. In: Proceedings, 1995 IRCOBI [International Research Council on the Biomechanics of Impact] Conference; 1995 September 13-15; Brennen, Switzerland. Bron, France: IRCOBI: 421-427.

²¹ *Safe Ride News*. 1991. Product Notes. Elk Grove, Illinois. American Academy of Pediatrics; Summer 10(3).

²² American Coalition for Traffic Safety, Inc. 1995. Blue Ribbon Panel on Child Restraint & Vehicle Compatibility Recommendations. Arlington, VA. May 30.

²³ Letter to the Honorable Ricardo Martinez, M.D., Administrator of NHTSA, dated June 28, 1996, from the following companies: Chrysler, Ford, General Motors, Honda, Isuzu, Subaru, Century, Evenflo, Fisher Price, Gerry, Indiana Mills and Manufacturing, and Kolcraft.

requested NHTSA to promulgate rulemaking that would require the child restraint manufacturers to provide child restraint designs that are compatible with the universal anchorage system and existing vehicle seatbelts.

On July 1, 1996, Cosco, a major manufacturer of child restraint systems, petitioned NHTSA to promulgate regulations requiring that vehicle manufacturers install a universal child restraint anchorage system that consists of a Type 1 vehicle belt (a lap-only belt) anchored to the floor or frame of the vehicle or the vehicle seat at two attachment points. According to the petition, vehicle manufacturers would be required to install this anchorage system at the center and one of the outermost forward-facing second row designated seating positions in vehicles that have second row seats; in vehicles without second row seats or second row seats that cannot accommodate a rear-facing child restraint system, the anchorage system would be installed in at least one forward-facing front designated seating position.

Because integrated restraints do not accommodate the group of children who need to be rear-facing, uniformity in the installation of child restraint systems is also needed. In addition, each vehicle may not have an integrated restraint installed in every seat position where a child for whom an integrated restraint would be appropriate needs to be positioned, thus requiring use of a forward-facing child restraint system. More uniformity in the installation of child restraint systems than presently exists will eliminate many of the problems that parents and caregivers encounter when installing currently designed child restraint systems. Therefore, the Safety Board is recommending that NHTSA revise the necessary Federal Motor Vehicle Safety Standards to provide for the secure and uniform installation of child restraint systems.

Improvements to Seatbelt Fit for Children

The Safety Board's current study found that small children are not likely to use adult seatbelts (lap-only belts and lap/shoulder belts) properly. (In the Board's sample, 37 children who wore lap-only belts and 15 children who wore lap/shoulder belts should have been in a child restraint system or booster seat.) The Board found that 12 of 37 children who wore lap-only belts sustained injuries of moderate or worse severity. These children typically sustained head, abdominal, and spinal injuries. The abdominal and spinal injuries were lapbelt-induced; the head injuries were the result of not having upper torso protection. The Board's cases also provide evidence that shoulder belts do not properly fit children smaller than 54 inches (standing height) and that lap/shoulder belts can also produce abdominal injuries. These findings are consistent with the Safety Board's previous studies on the performance of lap-only belts and lap/shoulder belts and with highway safety research.²⁴ Consequently, in the current study, the Board examined several measures to improve seatbelt fit for children.

²⁴ Society of Automotive Engineers. 1993. Child Occupant Protection. SP-986. Warrendale, PA.

Adjustable Upper Anchorages.—Adjustable upper anchorages allow an occupant to adjust the height of the shoulder belt anchor upward or downward to better position the shoulder belt on the occupant's shoulder. If the shoulder belt fits comfortably, the occupant is more likely to wear it properly and obtain the full benefit of the upper torso protection. In its 1988 study on the performance of lap/shoulder belts, the Safety Board concluded that passenger vehicles should provide occupants with the opportunity to adjust the shoulder strap to an angle compatible with the occupant's body size. Accordingly, the Board asked NHTSA to

Evaluate the possibility of requiring an upper adjustable anchorage point for the shoulder portion of lap/shoulder belts in newly manufactured motor vehicles. (Safety Recommendation H-88-10)

NHTSA did not agree that adjustable upper anchorages should be regulated and took no action on the recommendation. In December 1990, the Safety Board asked the manufacturers of passenger vehicles to take voluntary action to

Provide in all newly manufactured passenger vehicles an adjustable upper anchorage for the shoulder portion of the seatbelt. (Safety Recommendation H-90-111)

Most automobile manufacturers voluntarily complied with this recommendation which was classified "Closed—Acceptable Action" on May 4, 1996. Safety Recommendation H-88-10 to NHTSA was classified "Closed—No Longer Applicable" on April 17, 1991.

The Intermodal Surface Transportation Efficiency Act of 1991 required NHTSA to address the matter of improved design for safety belts. In response, NHTSA issued a final rule,²⁵ amending FMVSS 208, to require that Type 2 safety belts installed for adjustable seats in vehicles with a gross vehicle weight rating of 10,000 pounds or less either be integrated with the vehicle seat or be equipped with a means of adjustability to improve the fit and increase the comfort of the belt for a variety of different size occupants. NHTSA's decision to make the requirement applicable only to adjustable seats and to exclude fixed seats has, in effect, excluded back seats. NHTSA's decision to exclude fixed seats is not, in the Safety Board's opinion, consistent with the desire to have children positioned in the back seats of vehicles. Because NHTSA has not required adjustable lap/shoulder belts in back seats, children may be encouraged to sit in the front seat where lap/shoulder belts can be adjusted to allow for a proper fit but where they are more likely to sustain injury in accidents. Consequently, the Safety Board believes that to further promote use of the back seat by children, NHTSA should revise FMVSS 208 to require adjustable upper anchorages at all outboard rear seating positions of a vehicle. The Board also believes that the automobile manufacturers should voluntarily install adjustable upper anchorages at all outboard rear seating positions in all newly manufactured passenger vehicles for sale in the United States.

²⁵ Federal Register, Vol. 59, No. 148, dated August 3, 1994.

Center Rear Lap/Shoulder Belts.—In NHTSA's safety tips for using child restraint systems, the agency indicates that the back seat is usually safer than the front seat and that the middle of the back seat is the safest location because it "is the farthest from danger." In the Safety Board's 1986 study on the performance of lapbelts in 26 frontal collisions,²⁶ the Board asked NHTSA to

Determine the feasibility of requiring that 3-point lap/shoulder belts be provided at every seating position in newly manufactured passenger vehicles manufactured for sale in the United States; if found technically feasible, undertake rulemaking to require such lap/shoulder belts. (Safety Recommendation H-86-47)

In a letter dated March 18, 1994, NHTSA stated that "on balance, we believe that the minimal safety benefits and the greater costs associated with the engineering development of lap/shoulder belt installations in the center positions do not warrant a new regulation." The reasons provided by NHTSA for this conclusion were that fewer than 1.5 percent of all fatalities occur to center rear occupants, and less than 2 percent of all fatalities occur in both front and rear center seats. NHTSA also concluded that engineering problems associated with belt routing and placement of anchor points make installation of lap/shoulder belts at center positions difficult. The Safety Board classified this recommendation "Closed—Reconsidered" on May 3, 1994, with the caveat that if the findings of the current study reveal a problem with injuries to children caused by center lap-only belts at center rear seating positions, the Board may revisit the issue of center rear lap/shoulder belts.

The Safety Board believes that this study continues to support the need for center rear lap/shoulder belts. Unrestrained children in the center rear seating position in the Board's sample sustained less severe injuries than children restrained by lap-only belts in the center rear seating position. Abdominal bruising of moderate or worse severity and head injuries were typical of the injuries sustained by the children using lap-only belts. Although NHTSA expressed concerns about the engineering problems associated with belt routing and placement of anchor points for lap/shoulder belts at center rear positions, the Safety Board is aware that 13 different automobile manufacturers are offering center rear lap/shoulder belts in 26 different model 1996 vehicles. The engineering concerns expressed earlier by NHTSA no longer appear to be a problem. According to NHTSA, 1.4 percent of injured occupants are seated in the center rear seating position, 3.8 percent in the left rear seating position, and 5 percent in the right rear seating position.²⁷ The Safety Board believes that occupants seated in the center rear seat should be afforded the same level of protection as other occupants of the rear seat, who have been afforded lap/shoulder belts since January 1, 1990. Further, belt-positioning booster seats, which are designed to be used with lap/shoulder belts, are an important, easy-to-use, and remarkably underutilized safety device for children. A center rear lap/shoulder belt provides an additional

²⁶ National Transportation Safety Board 1986. Performance of Lap Belts in 26 Frontal Collisions. Safety Study NTSB/SS-86/01. Washington, DC.

²⁷ National Highway Traffic Safety Administration. 1994. Traffic Safety Facts, 1993. DOT HS 808 169. In addition to the injured occupants in the rear seating positions, 65.8 percent of injured occupants are drivers, and 22.8 percent are right front seat passengers.

seating position for a belt-positioning booster seat. Therefore, the Safety Board is recommending that NHTSA require installation of center rear lap/shoulder belts in all newly manufactured passenger vehicles manufactured for sale in the United States. The Safety Board also believes that the automobile manufacturers should voluntarily install center rear lap/shoulder belts in all newly manufactured passenger vehicles for sale in the United States.

Therefore, as a result of this study, the National Transportation Safety Board recommends that the domestic and international automobile manufacturers:

Install enhanced warning labels on all passenger vehicles equipped with passenger-side air bags on the road or to be manufactured prior to the effective date of the requirements proposed by the National Highway Traffic Safety Administration (NHTSA) on August 6, 1996. The labels should be similar to those to be required by NHTSA for installation in newly manufactured vehicles. (Class II, Priority Action) (H-96-29) (Supersedes H-95-19)

Develop and implement a program to reduce the misuse of child restraint systems that would include elements such as technical training for dealership personnel in the proper use of child restraint systems and promotional events at dealerships to provide parents and caregivers with information on proper use. (Class II, Priority Action) (H-96-30)²⁸

Offer integrated restraints in passenger vehicles for sale in the United States. (Class II, Priority Action) (H-96-31)

Voluntarily install adjustable upper seatbelt anchorages at all outboard rear seating positions in all newly manufactured passenger vehicles for sale in the United States. (Class II, Priority Action) (H-96-32)

Voluntarily install center rear lap/shoulder belts in all newly manufactured passenger vehicles for sale in the United States. (Class II, Priority Action) (H-96-33)

Also as a result of the study, the Safety Board issued safety recommendations to the Governors and legislative leaders of the 50 States, the U.S. Territories, the Mayor of the District of Columbia, the National Highway Traffic Safety Administration, and the child restraint manufacturers.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public law 93-633).

²⁸ Because General Motors already had a program in place similar to that being recommended in Safety Recommendation H-96-30, the recommendation letter to General Motors did not include H-96-30.

The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations H-96-29 through -33 in your reply.

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

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