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National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: OCT 21 1996

In reply refer to: H-96-13 through -16

To the legislatures of the States and U.S. Territories
that have primary enforcement of mandatory seatbelt use laws
(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.

As a result of its study, the Safety Board made recommendations to NHTSA to improve the design of air bags, to expedite installation of advanced air bag technology, and to put labels on all vehicles with passenger-side air bags that warn of the dangers of placing children in front of them.

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 these differences.

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 the Board's safety 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 seatbelt⁴ 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 of the 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.

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.

⁴ 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.

Measures To Improve Child Protection

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. The Board made recommendations for improvements in the design and installation of child restraint systems.

The Board's study provides evidence that children (especially properly restrained 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 supports this finding.⁵ 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.

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.⁶ Consequently, in the current study, the Board examined several measures to improve seatbelt fit for children.

Belt-Positioning Booster Seats.—The use of booster seats is one method to improve seatbelt fit for children. The Safety Board study suggests, however, that booster seats, and in particular belt-positioning booster seats, are not recognized or understood by the public as the next step in child passenger protection after a child outgrows a child restraint system. Rather,

⁵ 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.

⁶ Society of Automotive Engineers. 1993. Child Occupant Protection. SP-986. Warrendale, PA.

once a child outgrows a child restraint system, they often use the vehicle seatbelts. This is clearly shown in the Board's study by the number of children who used the vehicle seatbelts, yet according to their height and weight should have been in booster seats. Further, the Board's study shows that the children who should have been in booster seats often misused the shoulder portion of the lap/shoulder belt because it did not fit comfortably.

American Academy of Pediatrics (AAP) and NHTSA guidelines for parents and caregivers, on the size child that can appropriately use booster seats, conflict with NHTSA's FMVSS 213 and child restraint system manufacturers' instructions. Most belt-positioning booster seats are labeled by the manufacturer for use by children up to 60–65 pounds (the average weight of an 8-year-old child is about 60 pounds). However, guidelines of the AAP and NHTSA recommend that children up to 70 pounds use booster seats, and some belt-positioning booster seats can fit children who weigh up to 80 pounds, according to NHTSA.⁷ Fit would be dependent on the child's height and weight. Current FMVSS 213 requirements, however, only apply to child restraints that can restrain children up to 50 pounds. The need for booster seats that fit children above 60 pounds was shown in the Board's study: there were 19 children in the Board's sample who exceeded the 60-pound manufacturer-recommended weight limit for booster seats but were too short for lap/shoulder belts. The Safety Board is concerned that booster seats that restrain children who weigh more than 50 pounds are not subject to any performance standards; however, booster seats are necessary for some children above that weight. Consequently, the Safety Board recommended that NHTSA revise FMVSS 213 to establish performance standards for booster seats that can restrain children up to 80 pounds.

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.

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,⁸ 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, to further promote use of the

⁷ National Highway Traffic Safety Administration. 1994. Study of Older Child Restraint/Booster Seat Fit and NASS Injury Analysis. DOT HS 808 248. Washington, DC.

⁸ Federal Register, Vol. 59, No. 148, dated August 3, 1994.

back seat by children, the Safety Board recommended that NHTSA revise FMVSS 208 to require adjustable upper anchorages at all outboard rear seating positions of a vehicle. The Board also recommended that the automobile manufacturers voluntarily install adjustable upper anchorages at all outboard rear seating positions in all newly manufactured passenger vehicles for sale in the United States.

Center Rear Lap/Shoulder Belts.—In NHTSA's published 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."

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 previously 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.⁹ 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 seating position for a belt-positioning booster seat. Therefore, the Safety Board recommended that NHTSA require installation of center rear lap/shoulder belts in all newly manufactured passenger vehicles for sale in the United States. The Safety Board also recommended that the automobile manufacturers voluntarily install center rear lap/shoulder belts in all newly manufactured passenger vehicles for sale in the United States.

⁹ 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.

Legislative Measures To Ensure That Children are Secured in the Appropriate Restraint

Although all 50 States require children under a specified age to be in a child restraint system and 49 States require occupants to use seatbelts,¹⁰ the ages of the occupants covered under these laws vary considerably among States. Only 12 States and 2 U.S. Territories (referred to as States for the remainder of this discussion) require all occupants in all seating positions to be restrained under the State's seatbelt use law.

Forty-three States and the District of Columbia allow substitution of a seatbelt for a child restraint system;¹¹ in three States, children who should be in a rear-facing restraint system can use a seatbelt rather than a child restraint system if they are in rear seating positions. In addition, 26 States have gaps in their laws that permit children to be unrestrained: 21 States permit children younger than 8 years—who should be in some type of child restraint system—to be unrestrained. Drivers of out-of-State vehicles are exempt from restraining 3- to 6-year-old children in six States, and four States exempt the driver from restraining the child if the driver is not the child's parent/guardian. More importantly, few State laws encourage or require the use of booster seats for children between 40 and 60 pounds.

In the Board's sample of 194 children, 138 children were covered by their State's child restraint use law and 43 were covered by their State's seatbelt use law. Thirteen children were not covered by either law. Many of the children in the sample were not in compliance with their State's laws ($n = 78$). Fourteen children were inappropriately restrained by a seatbelt instead of a child restraint system, but their State's law did not permit the substitution, and 21 additional children under age 5 substituted seatbelts in accordance with their State's law.

Children of all ages need to be properly restrained and should be covered by State child restraint and seatbelt use laws. Analysis of the Board's sample indicates that child restraint and seatbelt use laws need to be strengthened and enforced in several ways. The Safety Board believes that the legislatures of the 50 States, the U.S. Territories, and the District of Columbia should review existing laws and enact legislation, if needed, that would (a) ensure that children up to 8 years old are required by the State's mandatory child restraint use law to use child restraint systems and booster seats; (b) eliminate exemptions for children to substitute seatbelts in place of child restraint systems; and (c) require children 8 years or older to use seatbelts in all vehicle seating positions.

¹⁰ New Hampshire, the only State without a mandatory seatbelt use law, has a child restraint law that requires children under the age of 12 to be restrained.

¹¹ Information on seatbelt substitution was not available for the Northern Mariana Islands.

Finally, the Safety Board believes that many of the problems related to child passenger safety, such as the dangers that air bags pose to children, can be resolved by ensuring that children are in the back seats of vehicles. The Board has made several recommendations to NHTSA that would promote use of the back seat for children through improvements in the design and installation of child restraint systems and seatbelt fit for children. Therefore, the Board believes the Governors should emphasize the importance of transporting children in the back seat of passenger vehicles through educational materials disseminated by the State. Further, the States should consider setting aside one-tenth of 1 percent from all motor vehicle insurance premiums for policies written to establish a highway safety fund to be used for this and other safety efforts.

In 1994, nearly \$114 billion in automobile insurance was written nationally. If only one-tenth of 1 percent were set aside from each policy, about \$110 million could be made available to States for highway safety education and enforcement. Nominal contributions from other entities using highways or contributing to highway accidents could also be considered. Possible sources include 25 cents for every registered vehicle, \$5 for each new car sold, one-tenth of a cent for each gallon of fuel, or 5 cents for each gallon of alcohol sold.

These contributed funds should be viewed as investments rather than as taxes or user fees. Research has shown that for every dollar spent on highway safety programs, impressive gains have been made. In British Columbia, insurance claims were reduced by \$8 for each \$1 spent.¹² In the United States, the benefit derived from traffic and highway safety programs exceeds their costs by a ratio of 31 to 1.¹³

Insurance industry contributions amounting to \$4.5 million over 5 years helped fund the North Carolina highway safety education, enforcement, and checkpoint program named "Booze It and Lose It" and "Click It or Ticket." Results have been impressive in that seatbelt use increased to 83 percent; 10,000 child restraint system violations were issued; alcohol-impaired driving was reduced by 50 percent at the checkpoints; and over 3,000 drug, fugitive, and other criminal arrests have been made.¹⁴ From 1993 through 1995, alcohol-related traffic fatalities in North Carolina declined from 33.9 percent to 27.2 percent. At the same time, insurance rates were reduced by 6 percent. In addition, for the first time in State insurance rate filings, auto insurers recognized a \$34 million savings over the first 2 years of this program, and researchers identified a \$165 million societal cost savings in the first year of the program.¹⁵

¹² (a) Insurance Corporation of British Columbia. 1986. Traffic Safety Education: Cost Effectiveness Measurement. Vancouver, BC. February 24. (p. 5). (b) McCarthy, Michael B. [Insurance Corporation of British Columbia]. 1987. Presentation in Anaheim, CA. May 7.

¹³ Bischoff, Donald C. 1994. Information: Benefit-Cost Ratios for NHTSA Programs. Washington, DC: National Highway Traffic Safety Administration. October 19.

¹⁴ Long, Jim. 1996. Address to Trauma Conference, Chapel Hill, NC. May 3.

¹⁵ Press release dated February 14, 1996, from the North Carolina Insurance Commission, Raleigh, NC.

Insurance premium support for safety is not a new idea in the United States. In Illinois, \$1 is set aside from private passenger vehicle comprehensive insurance policies to combat vehicle theft. The program has generated over \$31 million in grants since 1992 and has reduced auto theft substantially (24 percent in Chicago).¹⁶ Eight other States have similar programs.¹⁷ Most of these States have established governing boards that include gubernatorial appointments to ensure that the funds received are applied appropriately. In Massachusetts, fire insurance companies reimburse the State for a \$100,000 State budget line item under the Division of Fire Services for the Arson prevention program in Suffolk County (Boston). This fund operates the Massachusetts Fire Incident Reporting System and the State Burn Registry.¹⁸

Therefore, as a result of this study, the National Transportation Safety Board recommends that the legislatures of the 50 States, the U.S. Territories, and the District of Columbia:

Emphasize the importance of transporting children in the back seat of passenger vehicles through educational materials disseminated by the State. Consider setting aside one-tenth of 1 percent from all motor vehicle insurance premiums for policies written to establish a highway safety fund to be used for this and other safety efforts. (Class I, Urgent Action) (H-96-13)

Review existing laws and enact legislation, if needed, that would:

- (a) Ensure that children up to 8 years old are required by the State's mandatory child restraint use law to use child restraint systems and booster seats. (Class II, Priority Action) (H-96-14)
- (b) Eliminate exemptions for children to substitute seatbelts in place of child restraint systems. (Class II, Priority Action) (H-96-15)
- (c) Require children 8 years or older to use seatbelts in all vehicle seating positions. (Class II, Priority Action) (H-96-16)

Also as a result of the study, the Safety Board issued safety recommendations to the National Highway Traffic Safety Administration, the domestic and international automobile manufacturers, and the child restraint manufacturers.

¹⁶ State of Illinois. 1996. Illinois Motor Vehicle Theft Prevention Council Annual Report, 1995. Chicago.

¹⁷ Theft prevention programs that are at least partially funded from insurance policies have been established in Arizona, Florida, Maryland, Michigan, Minnesota, Pennsylvania, Texas, and Utah.

¹⁸ Safety Board staff communication with Jennifer Meith, Commonwealth of Massachusetts, Division of Fire Services, September 1996.