

Log H-557



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

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In reply refer to: H-91-1 and -2

Honorable Jerry Ralph Curry
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Child safety seats have been shown to be 71 percent effective in reducing deaths and 67 percent effective in reducing serious injuries to children involved in motor vehicle accidents.¹ During the early 1980s, 50 States and the District of Columbia passed laws requiring the use of child safety seats for children riding in motor vehicles, typically for children up to 4 or 5 years old. The use of child safety seats has increased from 15.2 percent in 1980, when only one law had been passed, to 80.6 percent in 1989.²

Three types of child restraint systems exist: infant seats for children weighing less than 20 pounds, convertible or toddler seats for children weighing up to 40 pounds, and booster seats for children weighing 30-60 pounds. Researchers and safety advocates agree that a convertible or toddler safety seat provides the most protection for a child between 20 and 40 pounds (between about 1 and 4 years old), yet research indicates that usage rates decline as the child gets older.³ Parents often stop using the convertible or toddler safety seat before the child outgrows it. Reasons for discontinued use include giving the seat to a younger sibling, or using a booster seat or no seat at all when a child does not like the confinement of

¹ U.S. Department of Transportation, National Highway Traffic Safety Administration. 1986. An evaluation of child passenger safety: the effectiveness and benefits of safety seats--summary. NHTSA Technical Report DOT HS 806 889. Washington, DC. 28 p.

² (a) 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. 120 p. (b) U.S. Department of Transportation, National Highway Traffic Safety Administration. 1990. Restraint system use in 19 U.S. cities: 1989 annual report. DOT HS 807 595. Washington, DC. 73 p.

³ U.S. Department of Transportation, National Highway Traffic Safety Administration. 1988. Papers on child restraints--effectiveness and use. NHTSA Technical Report DOT HS 807 286. Washington, DC. 146 p.

a convertible or toddler seat. The Safety Board advocates the use of a convertible or toddler safety seat until the child outgrows it. The Board also recognizes that many parents use booster seats for their toddlers because the seats are less expensive, less confining to the child, and easier for the parent to use than convertible seats.⁴

Two types of booster seats are currently manufactured: mini-shield and belt positioning. The mini-shield, the only type of booster seat that currently meets existing Federal regulations on child safety seats, is secured to the vehicle by the vehicle lapbelt, or by the lap portion of a lap/shoulder belt, and has a small, C-shaped shield that spans from about the middle of the child's chest to the abdomen. On impact to the vehicle, the child's body bends over the small shield, which is intended to provide upper torso protection.

In discussions with Safety Board staff, researchers and safety advocates have expressed concerns about the use of mini-shield booster seats with the lapbelt: the small shields may not provide adequate upper torso restraint to control head and neck excursion, nor do they spread the crash forces over a wide enough portion of the child's body. Another concern is that a small child may be ejected out of the mini-shield booster seat because such seats have no harness system to retain the child in the seat.⁵ Research has also raised concerns about the use of mini-shield booster seats with vehicle lap/shoulder belts. Although the performance of the mini-shields in conjunction with the shoulder portion of the lap/shoulder belt has not been thoroughly tested, preliminary research indicates that these seats should not be used with the shoulder portion. Researchers cite two reasons: (1) the smaller child is more likely to slide under the small shield because the shoulder belt prevents the child's upper torso from bending over it,⁶ and (2) the small shield may push the shoulder belt up and away from a taller child, making the belt's angle worse in relation to the child's body.⁷

The belt positioning booster seat has a padded, contoured base that is several inches thick, and small handles or hooks on the sides of the seat

⁴ According to the Juvenile Products Manufacturers Association, about one-quarter of all child safety seats sold are booster seats.

⁵ The Safety Board notes that the National Highway Traffic Safety Administration (NHTSA), U.S. Department of Transportation, is currently conducting defects investigations into two accidents in which small children were ejected from mini-shield booster seats.

⁶ Weber, Kathleen (The University of Michigan, Ann Arbor). 1989. Letter dated January 17 to NHTSA regarding proposed rulemaking, Docket No. 87-08, Notice 2.

⁷ Weber, Kathleen. 1990. Automobile restraint systems for children. In: Coran, Arnold G.; Harris, Burton H., eds. Pediatric trauma: Proceedings of the 3d national conference; 1989 September 21-23; Ann Arbor, MI. Philadelphia, PA: J.B. Lippincott Co.: 175-193. Chapter 16.

that position and secure the vehicle lap/shoulder belt across the child's body. The child sits on the platform base, and the vehicle lap/shoulder belt is fastened under the small handles of the seat, anchoring the lapbelt portion of the vehicle restraint system across the child's hips and positioning the shoulder belt portion so that it does not cut across the child's neck or face.

Belt positioning booster seats have been used in Australia and Sweden since 1978. A 1983 report by Volvo indicated that from investigations of 56 accidents involving the use of the Volvo belt positioning booster seat, only 20 percent of the children sustained injury; the maximum injury sustained was AIS 1 (minor).⁸ In the early 1980s, European researchers evaluated booster seats designed in Australia and Sweden to prepare for mandatory child restraint requirements in France and Great Britain. The researchers consistently recommended use of belt positioning booster seats if no convertible or toddler seat is available. This research showed that the performance of the lap/shoulder belt to restrain a child older than 3 years was improved when used in conjunction with a belt positioning booster seat.⁹ According to the European researchers, their studies on belt positioning booster seats and a similar study conducted in Australia considered the use of belt positioning booster seats for children up to 10 years old and concluded that the belt positioning booster seat was the preferred method of restraint for children who had outgrown a child safety seat and for children up to 6-8 years old (see footnote 9).

Belt positioning booster seats were available in the United States in the early 1980s. At that time, parents were being advised to place their children in the rear seat of their automobiles because accident data suggested that the rear seats were safer places for children than the front seats. Also at that time, the rear seats of most automobiles in the United States were equipped with lapbelt-only restraints. Proper use of a belt positioning booster seat in the rear seat required installation of a safety harness with a tether (anchor) strap, which was to be bolted to the rear shelf of the vehicle (or to the floor of a station wagon or hatchback).

⁸ Turbell, Thomas; Aldman, Bertil. 1983. A global approach to child restraint systems. In: Proceedings, 27th Stapp car crash conference; [Date of meeting unknown]; [Place of meeting unknown]. SAE 831605. Warrendale, PA: Society of Automotive Engineers: 61-68.

⁹ (a) Tarriere, C.; Thomas, C.; Brun-Cassan, F. and others. 1983. From three-years-old to adult size--how to ensure child protection in automobile accidents. In: Proceedings, SAE child injury and restraint conference; [Date of meeting unknown]; [Place of meeting unknown]. SAE 831664. Warrendale, PA: Society of Automotive Engineers: 179-198. (b) Bacon, D.G.C. 1985. Crash restraint of children by adult seat belts and booster cushions. Proceedings of the Institution of Mechanical Engineers. 199(D1): 49-63. (c) Waters, P.E. 1983. Development of a seat belt booster cushion standard. In: Proceedings, SAE child injury and restraint conference; [Date of meeting unknown]; [Place of meeting unknown]. SAE 831653. Warrendale, PA: Society of Automotive Engineers: 77-88.

Upper torso protection was provided by use of the safety harness, which had two straps that came over the child's shoulders and fastened to the vehicle lapbelt. Parents either did not understand the manufacturer's instructions on the proper use of these seats or they did not want to bolt the tether to their car. Consequently, belt positioning booster seats were often improperly used with the lapbelt, resulting in no provision for upper torso restraint.

This misuse problem was eliminated in 1980 when the Federal standard that governs the development of all child safety seats (Federal Motor Vehicle Safety Standard (FMVSS) 213, Child Seating Systems) was revised in a way that removed belt positioning booster seats from the U.S. market. The purpose of the 1980 revision was to establish dynamic testing requirements, such as limits for head and neck excursion, for all child safety seats. These requirements included tests designed to ensure that child safety seats requiring tether installation would provide a minimal level of protection without the use of the tether. Section 6.1.2.1.2 (Test Configuration II) of the standard requires that a child restraint system be installed as follows:

...at the center seating position of the standard seat assembly using only the standard vehicle lap belt to secure the system to the standard seat.

Because belt positioning booster seats were designed to be used with a tethered safety harness or with the vehicle lap/shoulder belt system, not with the lapbelt-only system, they cannot meet FMVSS 213 as the standard is currently written; thus, belt positioning booster seats are no longer marketed in the United States for children under 50 pounds.¹⁰

As a result of its safety study on lapbelts, published in July 1986, the Safety Board recommended that the National Highway Traffic Safety Administration (NHTSA) require installation of shoulder belts in the rear seats of passenger vehicles.¹¹ NHTSA subsequently issued rulemaking, and as of model year 1990, all vehicles manufactured for sale in the United States are required to have lap/shoulder belts at the outboard rear seat positions. Many older model cars also have lap/shoulder belts at the outboard rear seat positions: General Motors began installing them in its vehicles beginning with the 1987 model year, and European and Japanese manufacturers were already providing them in some of their vehicles.

The recent proliferation of lap/shoulder belts in the rear seat of

¹⁰ Mini-shield booster seats marketed by Century Products, Inc., and Gerry Baby Products convert to belt positioning booster seats. Also, two belt positioning booster seats are marketed for children above 50 pounds and are thus outside the jurisdiction of FMVSS 213: one by Downunder Design, Inc., and one by Volvo, sold in Europe but made available to Volvo's U.S. customers.

¹¹ National Transportation Safety Board. 1986. Performance of lap belts in 26 frontal crashes. Safety Study NTSB/SS-86/03. Washington, DC. 234 p.

passenger cars makes the use of belt positioning booster seats simple and logical. Because of their convenience and low cost, such booster seats would likely be used by a large number of parents when their children outgrow child safety seats or are no longer placed in them. The protection provided to children by the use of a belt positioning booster seat in conjunction with the vehicle lap/shoulder belt should be made available to the U.S. public.

On July 25, 1990, NHTSA was petitioned to "allow the manufacture and sale of lap/shoulder belt-positioning boosters, with appropriate limits on seating height, cushion compression, and weight (for those designed with backs)." The petition, submitted by the Child Passenger Protection Research Program at The University of Michigan Medical School, was granted on November 7, 1990. The Safety Board also urges NHTSA to revise FMVSS 213 to allow the use of belt positioning booster seats in conjunction with lap/shoulder belts.

Further, to ensure adequate performance of the belt positioning booster seats, any revision of FMVSS 213 also should establish performance standards for booster seats.¹² In addition to head and neck excursion limits, performance standards should include seat angles and firmness of the seat cushions for both the vehicle seat and the belt positioning booster seat. The performance standards should also allow for the possible development of belt positioning booster seats that are integrated into the vehicle seat. So that the protection provided by belt positioning booster seats may be available as soon as possible, the Safety Board urges NHTSA to expedite the rulemaking process.

The Safety Board is aware that the potential exists for parents to misuse the belt positioning booster seats in vehicles with lapbelt-only systems in the outboard rear seats or in center seating positions. However, because vehicles with lapbelt-only systems in outboard rear seats are rapidly disappearing from the market and because many vehicles no longer have center rear seating positions, the Board believes that the benefits offered by the belt positioning booster seats outweigh the concerns about possible misuse. Further, the Board believes that proper education programs, proper marketing, and proper labeling by the manufacturers can increase the likelihood of proper use.

The Board notes that NHTSA recently indicated its intentions to consider making additional revisions to FMVSS 213. The Board supports further improvements to the standard; we also believe that any revision of FMVSS 213 should include performance standards for the use of mini-shield booster seats, if NHTSA determines that their continued use is warranted. If such a determination is made, FMVSS 213 should address the level of protection that should be provided to a small child (2-year-old size) or to an older child (6-year-old size) who is likely to use a mini-shield booster seat. The standard should address the size, shape, and placement of the small shield in

¹² Performance standards for booster seats were not included in the 1990 revision because belt positioning booster seats were just being produced into the marketplace and mini-shield booster seats did not yet exist.

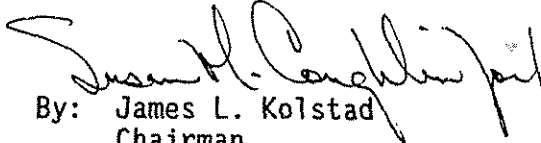
relation to the child's abdomen, should measure impact forces on the abdomen, and should establish head and neck excursion limits.

Therefore, the National Transportation Safety Board recommends that the National Highway Traffic Safety Administration:

Establish performance standards to Federal Motor Vehicle Safety Standard 213, Child Seating Systems, to allow for the manufacture, distribution, and use of child restraint systems that are designed for use in conjunction with the lap/shoulder belt systems in passenger vehicles, including child restraint systems that are integrated into the vehicle seat. (Class II, Priority Action) (H-91-1)

Revise Federal Motor Vehicle Safety Standard 213, Child Seating Systems, to include performance standards for mini-shield booster seats. (Class II, Priority Action)(H-91-2)

Chairman KOLSTAD, Vice Chairman COUGHLIN, and Members LAUBER, BURNETT, and HART concurred in these recommendations.


By: James L. Kolstad
Chairman