INSURANCE INSTITUTE
FOR HIGHWAY SAFETY

October 31, 2005

Jackie Glassman
Acting Administrator
National Highway Traffic Safety Administration
400 Seventh Street, S.W
Washington, D.C. 20590

Request for Comments
Federal Motor Vehicle Safety Standards; Child Restraint Systems
Docket No. NHTSA–2005–21245

Dear Ms. Glassman:

In response to Anton's Law enacted in December 2002, the National Highway Traffic Safety Administration (NHTSA) has proposed changing the booster seat requirements of Federal Motor Vehicle Safety Standard (FMVSS) 213, Child Restraint Systems. These modifications are important because the current standard is inadequate to determine whether the booster seats on the market provide a safe alternative to adult belts. The Insurance Institute for Highway Safety (IIHS) welcomes the opportunity to comment on this important issue.

Many states have enacted laws requiring children who have outgrown forward-facing restraints to be restrained in booster seats. Some states require children weighing up to 80 pounds or measuring up to 57 inches in height to be restrained in boosters. Currently FMVSS 213 can only regulate child restraints for children weighing up to about 60 pounds because it uses a 62-pound weighted 6-year-old dummy. Use of this dummy is an interim measure until the development of a Hybrid III dummy representing a 10 year-old. The weighted 6-year-old dummy is inadequate; it not only is too light but also too short to represent the tallest occupants for whom booster seats are recommended (IIHS, 2002).

The primary issue is whether booster seats provide an adequate fit of adult belts for children of the required ages and sizes. An earlier IIHS (2001) evaluation of booster seat fit identified some shortcomings. In particular, some boosters did not meet the requirement of routing a lap belt low across a child's hips to minimize abdominal loads in a crash. In fact, some boosters worsened the fit. Congress directed NHTSA to develop and evaluate a test dummy that simulates a 10-year-old child and to establish performance requirements for booster seats designed to accommodate children weighing more than 50 pounds. The agency also was instructed to evaluate whether to establish a test of seat belt fit.

In response to these directions, NHTSA is in the process of certifying a new Hybrid III test dummy that better represents a 10-year-old child. NHTSA also is proposing to extend the dynamic test requirements of FMVSS

1005 N. GLEBE RD., ARLINGTON, VA 22201 TEL. 703/247-1500 FAX 703/247-1678 www.iihs.org

213 to include booster seats recommended for children weighing up to 80 pounds (70 Fed. Reg. 51720 (Aug. 31, 2005)). However, the agency has decided not to move forward with an evaluation of belt fit, arguing that the dynamic test will be sufficient to establish whether fit is adequate. This approach is illogical, given the purpose of booster seats, which is to improve the fit of adult belts. Indeed, these devices often are referred to as "belt-positioning booster seats." Although IIHS concurs with NHTSA that it is sensible to replace the current weighted 6-year-old dummy with a more biofidelic representation of the larger children intended to be helped by booster seats, it does not follow that this new dummy will allow the dynamic test to distinguish among seats that do and do not reposition adult belts for optimal protection. The chief benefit of the new dynamic test procedures will be to help assure that boosters (e.g., high-backed boosters) that significantly change the fore/aft position of a child do not greatly increase the trajectory of the child's head, thus placing the head at greater risk of striking the backs of front-row vehicle seats.

As even the agency admits, the dynamic test will not distinguish whether booster seats address the key problem of lap belts that may be positioned over the abdomen or that may ride up over the pelvic girdle as a child submarines under them, such that crash loads are absorbed by the child's internal organs. It is unacceptable that NHTSA has abdicated its responsibility to assure parents that booster seats, which in some states are required to be purchased by parents for their children, do not mitigate this extremely serious problem. These issues are discussed in greater detail below, and it is hoped this discussion will lead the agency to adopt strict, effective specifications of booster seats that address lap belt fit along with the new dynamic tests that have been proposed.

Adoption of Hybrid III 10-Year-Old Dummy for Testing

Under the proposal, all child restraints for children weighing more than 50 pounds would have to meet dynamic test performance criteria for both the 6- and 10-year-old dummies, leading to the suspension of the 6-year-old weighted dummy. IIHS supports the move to the 10-year-old dummy because, as noted above, the current dummy is inadequate to assess whether booster seats designed for taller children are functioning as they should. Our concern is that the 10-year-old dummy is not designed to evaluate abdominal loads. There is evidence that booster seats have improved the effectiveness of adult belts in real-world crashes and reduced the incidence of abdominal injuries (Durbin et al., 2003), but experience to date is limited, especially among older children. We lack a full understanding of the child injury problem in crashes involving children in booster seats. Therefore, it is premature for NHTSA to conclude that "the injury criteria proposed in this document would ensure that the effectiveness seen across all types of child restraint systems

would be maintained for restraints recommended for children weighing up to 80 pounds."

NHTSA's Vehicle Research and Test Center has developed the abdominal injury ratio (AIR), which uses "impulse calculations from the iliac compressive and lumbar shear forces to identify dummy kinematics associated with submarining" (70 Fed. Reg. 51720 (Aug. 31, 2005)). The thought is that this measure might allow the agency to evaluate the potential for submarining, which occurs when a child's hips move under the belt and the belt shifts into the abdominal area. IIHS commends NHTSA for beginning research to measure abdominal injury potential but is concerned that this approach, pursued to the exclusion of measuring abdominal loads directly, will not be sufficient. Properly designed booster seats should position an adult belt low enough on a child's hips to avoid excessive abdominal loads. Yet nothing in the agency's proposal will guarantee that belt fit with booster seats is adequate to begin with. If a belt is positioned too high on the abdomen, abdominal injury can occur even in the absence of submarining. Furthermore, it is not clear whether the capability of the 10-year-old dummy to "slouch" will replicate whether booster seats will allow children to submarine in real-world crashes. IIHS urges NHTSA to pursue a method to measure abdominal loads directly. In the meantime, it is inappropriate to assume that a dynamic test with this dummy can address the risk of abdominal loads from poorly positioned lap belts.

Another concern is whether the 10-year-old dummy's head excursion limits are adequate to prevent children's heads from striking forward structures, especially to prevent children sitting in back seats from striking the front seats. Older children are taller, so their heads can move farther forward in a frontal crash. Some researchers have expressed concern that the head excursion measures obtained from dynamic testing with existing child dummies do not reflect laboratory findings with cadavers (Sherwood, Shaw, et al., 2003). Head injuries are the most common injury type for restrained children in crashes (Sherwood, Ferguson, et al., 2003), and more research should be conducted toward understanding both the mechanism of head injury in these crashes and whether current measurement of, and limits on, head excursion are adequate.

Limiting the Weight of Belt Positioning Boosters

NHTSA requests comments on the merits of using a chest deflection criterion to assess the effect of booster seat mass on chest load. The concern is that booster seats might become heavier to accommodate the older children specified in some state laws. Seats that are too heavy could impose additional loads on children's chests through adult belts. NHTSA researchers conducted a limited number of tests evaluating the relationship between booster seat mass and both chest deflection and

measured belt forces. No correlation was found between mass and belt force. In some instances heavier seats produced higher chest deflections, but in other instances they did not.

Because of the data limitations, NHTSA is requesting additional data but, in the meantime, is proposing a chest deflection limit of 44 mm that all tested seats currently meet. IIHS urges NHTSA to also consider requiring tethers for boosters that have a back. New vehicles have been required since September 1, 1999 to provide attachments for tethers. Tethers have been incorporated into the design of child restraints since September 1, 1999, and they also make sense for high-back booster seats.

Booster Seat Fit

Congress directed NHTSA to consider establishing performance requirements for booster seats and other belt guidance devices regarding belt fit. An IIHS (2001) study raised concerns that not all booster seats were doing an adequate job of improving fit and some worsened the fit. The agency completed two small-scale surveys (August and November 2003) of belt fit on dummies representing 6 and 10 year-olds with and without boosters in a variety of vehicle seats. Three booster seats were used to assess belt fit: one high-back seat with no belt guide, one high-back seat with belt guide, and a backless booster (in one of the studies only one of the booster seats was used with the 10-year-old dummy). Boosters generally improved belt fit for both dummies, but poor belt fit with booster seats was found for 17 percent of cases in the November 2003 study and 8-18 percent of cases in the August 2003 study. It is not known from the summary of the findings whether the poor assessments involved inadequate shoulder belt and/or lap belt fit.

Although these surveys identified reasons for concern, NHTSA argues that it is not currently known whether the variations in belt fit would affect safety in a crash; nor, the agency claims, is it known what belt fit (how far from optimal) should be considered acceptable. IIHS agrees that it is unclear how much deviation is acceptable in shoulder belt fit. However, all evidence points to the need to position lap belts across children's bony structures, not their soft tissue. The appropriate conclusion is that no deviation from this position is acceptable. Instead of recognizing this key issue, the agency asserts its belief that the FMVSS 213 dynamic test is sufficient to measure the performance of child booster seats.

NHTSA's conclusions are not supported by current research. As noted earlier, the proposed dynamic test is incapable of detecting injurious abdominal loads from lap belts. In addition, only three booster seats were examined in the two NHTSA studies, and not all of them were used with both dummies in each study. Drawing conclusions based on assessment of such a few booster seats is not acceptable. Indeed, the authors of

the NHTSA reports state that additional research is necessary to determine if there is a need for a static belt fit performance requirement. The November 2003 study goes further, stating that "belt fit needs to be evaluated with both a static fit and a dynamic test."

Unlike NHTSA, we believe that the prudent approach at this time is to ensure all booster seats currently on the market fulfill the basic requirement for which they are designed, namely that they provide good adult belt fit for children of different sizes in a wide range of vehicle seats. This begins with a requirement that all booster seats position the lap belt appropriately. Next, NHTSA needs to establish, using the full range of booster seats on the market, how well booster seats fulfill their function in re-positioning adult shoulder belts for children. Based on the limited research already conducted, it is highly likely that some booster seats will not provide good fit. It is not acceptable for the agency to recognize these deficiencies yet ignore them in the rule. NHTSA either must establish that booster seats provide optimal seat belt fit, or the agency must conduct research to ensure that a less-than-optimal fit will not increase the risk of injury. Anything less is an abdication of the agency's responsibility.

IIHS (2002) previously expressed its concern about the inability of the current dummies to measure abdominal injury risk from lap belts in dynamic tests. The proposed FMVSS 213 test still provides no means to measure the potential for abdominal injury from an improperly positioned lap belt. IIHS disagrees with NHTSA about the need to further investigate the impact of lap belt fit variations on child safety as well as the distance a lap belt can deviate from the optimal belt placement zone before it has the potential to cause abdominal injury. Guidelines (2005) on NHTSA's website indicate that a lap belt should be on the lap or upper thigh, not on the stomach. But belt fit was not ideal in every case on an immobile child dummy, and it is likely that the fit could be even worse for children of varying sizes who do not sit still in their restraints.

Aftermarket Belt Positioning Devices

Although NHTSA is not proposing to extend FMVSS 213 to regulate belt positioning devices, results of the studies cited in the notice of proposed rulemaking raise some issues that are cause for concern. For example, three seat belt positioning devices were examined in NHTSA's August 2003 study. Results indicated potential problems with the way the devices were positioning the belts on the dummies. Some of the devices introduced slack that could be worse for a moving child. In a crash, a loose belt could allow a child to slip out of a belt or move farther forward than if the belt fit snuggly without added slack.

The actual construction of the belt positioning devices raises another concern. One of the devices consisted of a hard metal clip that in some cases rested on the dummy's abdomen. It is likely that in a crash abdominal injury could result from the device itself. Of greater concern is that belt positioning devices can worsen the position of an adult belt. NHTSA found that in some cases the devices pulled a lap belt above the bony pelvis and into the soft abdominal region, thus positioning the belt to potentially cause harm.

IIHS believes any device that either pulls a lap belt into the abdomen or rests on the abdomen itself has the potential to cause serious abdominal injury and should be regulated. We urge the agency to develop a testing program to further investigate issues regarding seat belt positioning devices and to determine how they should be regulated.

Conclusions

The development of the dummy representing a 10 year-old provides a welcome opportunity to regulate the performance of booster seats that can accommodate children weighing up to 80 pounds and measuring up to 57 inches. Use of this dummy will allow NHTSA to retire the weighted 6-year-old dummy, which we believe is inadequate. However, NHTSA has not made a solid case that its proposed regulatory tests will ensure that booster seats perform as they should. The agency has dismissed the need for a belt fit static assessment, even though the express purpose of booster seats is to improve belt fit. The agency claims the dynamic test is a "true and thorough" test of real-world performance, even though it does not measure abdominal forces, a critical need. NHTSA needs to reconsider a static belt fit test for the lap belt while it conducts additional research on the issue of shoulder belt fit.

Consideration also should be given to requiring booster seats with backs to be equipped with top tethers, which could limit forces on the chest from forward movement of high-backed booster seats. Finally, NHTSA should move quickly to include belt positioning devices in the test requirements for FMVSS 213, given that the devices may increase the potential for injury.

Sincerely,

Susan A. Ferguson, Ph.D.
Senior Vice President, Research

cc: Docket Clerk, NHTSA–2005–21245

References

Durbin, D.R.; Elliot, M.R.; and Winston, F.K. 2003. Belt-positioning booster seats and reduction in risk of injury among children in vehicle crashes. *Journal of the American Medical Association* 289:2835-41.

Insurance Institute for Highway Safety. 2001. Comment to the National Highway Traffic Safety Administration concerning the use and effectiveness of booster seats. Docket Document No. NHTSA 2001-10359-10, September 27, 2001. Washington, DC: U.S. Department of Transportation.

Insurance Institute for Highway Safety. 2002. Comment to the National Highway Traffic Safety Administration concerning revisions to FMVSS 213, Child Restraint Systems. Docket Document No. NHTSA 2002-11707-31, July 1, 2002. Washington, DC: U.S. Department of Transportation.

National Highway Traffic Safety Administration. 2005. Comprehensive child passenger safety information. Washington, DC: U.S. Department of Transportation. Available: http://www.nhtsa.gov/.

Sherwood, C.P.; Ferguson, S.A.; and Crandall, J.R. 2003. Factors leading to crash fatalities to children placed in child restraints. *Proceedings of the 47th Annual Conference of the Association for the Advancement of Automotive Medicine*, pp. 343-59. Barrington, IL: Association for the Advancement of Automotive Medicine.

Sherwood, C.P.; Shaw, C.G.; Van Rooij, L.; Kent, W.; and Crandall, J.R. 2003. Prediction of cervical spine injury risk for the 6-year-old child in frontal crashes. *Traffic Injury Prevention* 4:206-13.