rule furthers the goals of ISTEA, which were illuminated by the legislative history for the directive found in § 2503 of the Authorization Act. The directive evolved from a booster seat safety provision in S. 1012, a bill reported by the Senate Committee on Commerce, Science, and Transportation, and added verbatim to the Senate's surface transportation bill (S. 1204). (S. 1012, 102d Cong., 1st Sess. § 209 (1991).)[1] The Senate Commerce Committee report on S. 1012 expressed concern about suggestions that booster seats, ''depending on their design, can be easily misused or are otherwise harmful.'' The Committee also stated that the mandate in S. 1012 was a response to concerns expressed in a study performed for NHTSA entitled, ''Evaluation of the Performance of Child Restraint Systems.'' According to the Committee, the study showed that some booster seats ''may not restrain adequately a child in a crash, and some may put pressure on the child's abdomen during a crash.'' Senate Committee on Commerce, Science, and Transportation, S. Rep. No. 83, 102d Cong., 1st Sess. 6, 18 (1991).

c. Calspan Booster Seat Study

The booster seat study mentioned in the legislative history for H.R. 2950 was performed for NHTSA by Calspan Corporation. The study, ''Evaluation of the Performance of Child Restraint Systems,'' DOT HS 807 297, May 1988, evaluated the performance of ''shield-type'' booster seats in restraining children of the size and age for whom those seats were recommended. Shield-type boosters are designed to be secured to the vehicle seat by a lap belt that usually is placed around the shield. The shield restrains the upper torso of the child from moving forward in a frontal crash or sudden stop.

Concerns about shield-type boosters arose from the recommendations by manufacturers about the size of children which could appropriately use a particular booster. Particular designs or models of boosters were typically recommended for a broad range of children. Often, the seats were recommended for use by children whose masses are from about 9 to 32 kg (weighing from about 20 to 70 pounds). Such recommendations engendered concerns as to whether these boosters could provide adequate protection for children ranging from nine-month-old infants, whose average mass is 9 kg (20 pounds), to six-year-old and older children (an average six-year-old's mass is 22 kg (48 pounds).

The study discussed issues that are not addressed by current Standard 213. The ability of the restraint to protect children at or near the extremes of the recommended mass/weight range cannot currently be determined in Standard 213 compliance testing. As noted above, a booster's compliance with the standard is evaluated using only the three-year-old child dummy, whose mass is 15 kg (33 pounds). So tested, the restraints must meet Standard 213.

However, the Calspan program was not limited to the three-year-old dummy. Two other dummies were used, one representing a nine-month-old infant and the other, a six-year-old child. (These are the two sizes of the dummies adopted in today's rule.) The array of dummies represented children at the extremes of the weight ranges identified by the manufacturer as being suitable for the restraint.

The Calspan research program tested all 11 of the booster seats on the market during summer 1987. All 11 boosters were recommended for use by children with a minimum mass of 11 kg to a mass of 25 kg (weighing a minimum of 25 to 55 or more pounds). They were tested in a 48 kph (30 mph) sled test with the three-year-old and six-year-old dummies. Six booster seats were recommended for use by children whose masses are 11 kg or less (25 pounds or less). These seats were tested with the nine-month-old dummy, in addition to the two other dummies.

1. Calspan's Findings

Calspan found dummy head excursions exceeding the 810 millimeter (mm) (32 inch) limit specified in Standard 213. In tests with the six-year-old dummy, the head excursion limit was exceeded by 9 out of 11 booster seat models, with measurements in the range from 810 to 900 mm (32.0 to 35.4 inches). In the research tests with the three-year-old dummy, the head excursion limit was exceeded by five of the 11 models. Head excursions did not exceed the limit in tests with the nine-month-old dummy.

Calspan also tested four of the shield-type booster seats that were recommended for older children by restraining the six-year-old dummy in the seat with a three-point auto harness. Three of the models showed HIC numbers of approximately 900, the fourth had a HIC of 1238.

Calspan observed dummy ejections from the seats during the rebound phase of the dynamic test. Ejections occurred for three out of six models tested with the nine-month-old dummy, for two models tested with the three-year-old dummy, and for one model tested with the six-year-old dummy.

2. Follow Up Testing

NHTSA conducted additional research testing following the Calspan study to obtain more data about booster seat performance with different dummies.

Nine booster seats were tested with the three dummies used in the Calspan study. The seats performed well with the three-year-old dummy; the performance measures of Standard 213 were satisfied. However, the seats were generally unsuitable for the nine-month-old dummy. The dummy was ejected from seven of nine seats. Similarly, the seats generally did not provide adequate restraint for the six-year-old dummy. Seven of nine seats yielded head excursions that exceeded 810 mm (32 inches). Two of the seats also had structural failures with the six-year-old dummy. ''Evaluation of Booster Seat Suitability for Children of Different Ages and Comparison of Standard and Modified SA103C and SA106C Child Dummies,'' VRTC–89–0074, February 1990.

3. Implications of Research Findings

The implication of the Calspan and NHTSA test results was that test dummies representative of a wide range of child sizes were needed in Standard 213 to more effectively test the performance of booster seats and other child restraint systems. What seemed especially needed was an array of dummies representing children at or near the extremes of the weight ranges identified by a manufacturer as being suitable for any type of child restraint.

With the end in mind of incorporating new dummies into Standard 213 for compliance testing purposes, NHTSA completed specifications for the newborn, 9-month-old and 6-year-old child test dummies. The agency also completed rulemaking in 1991 and 1993 incorporating those specifications into Part 572, the agency's regulation on anthropomorphic test dummies. The biofidelity, reliability and repeatability of the test dummies were discussed in the documents incorporating the dummies into part 572. *See,* final rule

[1] As adopted by the Senate, the provision would have required rulemaking to be initiated within 30 days after the date of enactment of the Authorization Act and completed within 12 months after the date of the enactment. The conferees adopted the booster seat provision from the Senate bill, but amended it so that it no longer required that the booster seat rulemaking be both initiated and completed within a specified period of time. Instead, it simply required that rulemaking on that subject be initiated within a specified period of time. Conference Report to Accompany H.R. 2950, H.R. Conf. Rep. No. 404, 102d Cong., 1st Sess. (1991).