Transport Association concerning which child restraint systems were approved for aircraft, and to respond to comments received from child restraint manufacturers, private testing organizations, the National Transportation Safety Board, foreign regulatory organizations, and consumer activists at the January 1993, session of the Society of Automotive Engineers (SAE) ad hoc committee on child restraints. Some of the most serious issues identified by CAMI concern child restraints commonly referred to as shield-type booster seats, vest- and harness-type child restraint systems, and belly belts.

FMVSS No. 213 defines a ''booster seat'' as ''either a backless child restraint system or a belt-positioning seat''. FMVSS No. 213 defines a ''backless child restraint system'' as ''a child restraint, other than a belt-positioning seat, that consists of a seating platform that does not extend up to provide a cushion for the child's back or head and has a structural element designed to restrain forward motion of the child's torso in a forward impact'' (hereinafter referred to as ''shield-type''). FMVSS No. 213 defines a ''belt-positioning seat'' as ''a child restraint system that positions a child on a vehicle seat to improve the fit of a vehicle Type 2 belt system on the child and that lacks any component, such as a belt system or a structural element, designed to restrain forward movement of the child's torso in a forward impact'' (49 CFR 571.213(S4)). NHTSA and the FAA are working together to develop additional standards to allow an improved assessment of the performance of child restraint systems in the aircraft environment.

Booster seats are generally designed for children who are 3 to 8 years old and weigh 30 to 60 pounds. As such, the children who weigh 40 pounds and over can be adequately protected in an aircraft seat restrained by the safety belt, and the children who weigh between 30 pounds (the threshold weight for a booster seat) and 40 pounds can be restrained in a forward facing child restraint system. The ''shield-type'' booster seat is secured to the vehicle with the passenger safety belt and the shield provides crash protection for the upper body of the child. The ''belt-positioning'' booster seat is secured to the vehicle, along with the child, with the passenger seat and shoulder belt system of the vehicle; the shoulder portion of the best provides crash protection for the upper body of the child.

Vest- and harness-type restraint devices are usually designed for children in the 25 to 50 pound range. The harness-type device usually consists of a torso harness with padded, adjustable straps over the shoulders and around the pelvis and, in some designs, it contains a crotch strap. The harness contains a means (e.g. a webbing attached to a metal back plate) for the passenger safety belt to attach the harness to the aircraft seat.

The belly belt included in the CAMI study has a short loop of webbing with standard buckle hardware installed on the ends. This belt is designed to be buckled around the child's abdomen and is secured to an adult's abdomen with the adult's safety belt by routing the safety belt through a small loop of webbing sewn on the belly belt. The belly belt, as well as other types of lap held child restraint devices, are not permitted to be used under the existing rules.

Under the existing rules, a child restraint system that bears one or more of the specified labels cannot be used unless the restraint system is properly secured to an approved forward-facing seat or berth (see §§ 91.107(a)(3)(iii)(C)(*1*), 121.311(b)(2)(iii)(A), 125.211(b)(2)(iii)(A), and 135.128(a)(2)(iii)(A)). Because lap held child restraint systems are not secured to a forward-facing seat or berth, but instead are secured to the adult, they cannot be used under existing rules. Nonetheless, the FAA has decided that it is important to emphasize this prohibition and, therefore, proposes to add clarifying language to the existing rules.

The CAMI study identified the following concerns with booster seats, vest- and harness-type child restraints, and belly belts:

Booster seats—In the test, the shield-type booster seat, in combination with other factors, contributed to an abdominal pressure measurement higher than in other means of protection.

Vest- and harness-type systems—When tested in an airplane seat, these systems allowed excessive forward body excursion, resulting in the anthropomorphic test dummy sliding off the front of the seat with a high likelihood of the child impacting the back of the row of seats in front of it. Rebound acceleration presents further risk for injury.

Belly belts—In the test, these systems allowed the anthropomorphic test dummy to make severe contact with the back of the seat in the row in front of the test dummy. The child also may be crushed by the forward bending motion of the adult to whom the child is attached.

CAMI research involved dynamic impact tests with a variety of certified child restraints installed in transport airplane passenger seats at the 16g peak loads required in 14 CFR § 25.562(b)(2). Some of the tests of child restraint systems were configured to represent a typical multi-row seat installation and included testing the effects of the occupant impact against the backs of seats. The tests investigated transport airplane passenger seat compatibility with child restraints and measured three performance factors: adaptability, structural response, and occupant protection.

Shield-Type Booster Seats

The FAA has determined that some child restraint systems that work well in automobiles may not be as safe for use in aircraft during takeoff, landing, and movement on the surface as other available means of protection. Unlike in an automobile, where seat backs are fixed and rigid and present a barrier to rear-generated forces, airline seats are generally not rigid and thus may breakover under their own inertia or when struck by a passenger. This represents a potential source of pressure and force to the occupant of a backless child restraint device.

The CAMI research found that in laboratory impact tests using representative airplane seats found in a transport airplane, shield-type booster seats may offer less protection from aft row occupant impact forces on the seat back than other available means of protection. Aft row occupant impact forces transmitted through the passenger seat back in which the child restraint is installed are an important consideration, particularly in seats with breakover seat backs. The movement of the aft row adult passenger may expose the child to an impact from behind and to being crushed between the airplane seat back and the booster seat shield. In addition, when this situation was studied by CAMI, increased abdominal loading of the child test dummy was discovered when the researchers reviewed the test data on an anthropomorphic dummy representing a 3-year old child weighing 33.3 pounds. The researchers then used a smaller ''CAMIX'' anthropomorphic dummy weighing 27.2 pounds, representing a 2-year old child, that was instrumented to measure abdominal loads. These measurements showed an increase in abdominal loads over those when the test dummy was protected by the aircraft seat's lap belt. The abdominal loading measured by this dummy in