

safety" in a quasi-static test procedure when compared to the dynamic, crash-event performance of the same anchorage. "Static and dynamic strengths of materials are fundamentally different due to strain rate sensitivity. Strain rate sensitivity defines how the strength of materials changes with the velocity of loading." The Alliance stated that the design of an appropriate static or quasi-static test to evaluate the strength of a component subject to dynamic loads should consider strain rate sensitivity as an important parameter. The petitioner stated that it believes that LATCH anchorages can withstand peak dynamic loads that are significantly larger than static test loads. The Alliance stated that it conducted component level tests to directly compare the static and dynamic ultimate strengths of lower LATCH anchorages (Docket comment 6160-27). The tests involved a static test-to-failure of an anchor loop and mounting bracket subassembly, and a dynamic test using a drop tower that created the same failure condition as the static test. In the static test, which used an Instron testing machine to load the anchor loop in the same direction as a child restraint would load it in a frontal crash, the failure mode was consistently found to be shear-out of the mounting hole.

A drop tower test was then conducted to determine the acceleration that would produce the same failure mode as the static test. In the test, a 50 kg (110 lb) stack of laboratory weights was hung on an anchor loop. The drop tower height was increased until the post-test condition of the part was comparable to the parts subject to the static ultimate strength test. The acceleration measurements were filtered to SAE J211 60 CFC.

The static failure mode was duplicated in drop tower tests with peak accelerations of 45 g (440 m/s²). The Alliance believed that the peak dynamic load that corresponds to the 45 g acceleration is: (50 kg)(440 m/s²) = 22,000 N. Thus, the overall deformation and shear-out failure was similar for a statically loaded part that failed at 16,500 N and a dynamically loaded part that had peak dynamic load of 22,000 N. That is, a significantly larger load was required to fail the part under dynamic conditions. The petitioner stated:

The most severe vehicle impact conditions will result in a dynamic strength of approximately two times the static strength for the typical carbon steels used in automotive applications. The elevation of strength will depend on the selection of material. However, steel is one of the least strain rate sensitive engineering materials. If plastic or composite materials were used

instead, the elevation of strength would be even larger. The data shown here represents essentially the worst case for strength elevation. A static or quasi-static test load that would simulate high-speed impact should be approximately 50% of the expected dynamic load.

B. NHTSA Decides On 15,000 N

1. Proportioning Seat Belt Loads

NHTSA does not agree that it is appropriate to proportion Standard No. 210's load requirements. Loading of the seat belt anchorages by the vehicle's belt system when restraining an adult occupant is not analogous to the loading of the LATCH anchorages by a child in a child restraint. Differences in the geometry of the loading, the attachment of webbing and/or other components to the LATCH anchorages, and other factors that are not thoroughly known or evaluated argue for separate strength requirements for each seat set of anchorages. Further, the potential for misuse is greater with respect to the use of LATCH anchorages than with the use of vehicle belts to restrain adult occupants, as consumers in the past did not typically attach top tethers to the tether anchorage and often did not tightly attach child restraints to vehicle seats. Such misuse could increase or otherwise affect the loading of the LATCH anchorages in a manner that renders the loading of the anchorages dissimilar to the loading of seat belt anchorages.

2. Engineering Analysis

The agency agrees with the Alliance that Standard No. 225's strength requirement can be based on an analysis of the forces that are likely to be imposed on a LATCH system in a crash. NHTSA agrees that the maximum expected force acting on the center of gravity of a child in a child restraint is calculated as the total mass of the child and the child restraint system ("the child/CRS system") multiplied by the acceleration of the system. However, the agency does not agree with many of the Alliance's assumptions about the values that should be used for the mass and acceleration of the system.

NHTSA believes that petitioner's assumptions about the mass of the child/CRS system are too narrow. Child restraint manufacturers can and do produce full-harness child restraints for children over 18 kg, as nothing in the Federal motor vehicle safety standard for child restraint systems (Standard No. 213, 49 CFR 571.213) prohibits these child restraints to be recommended for children with masses above 18 kg (40 lb). As an example, Britax Child Safety, Inc., produces a number of 5-point

harness type restraints for children weighing more than 18 kg (40 lb). Currently, Britax produces the "Marathon," a convertible restraint certified for use by children weighing up to 65 lb, the "Husky," a forward-facing only restraint certified for use by children weighing up to 80 lb, and the "Traveler Plus," a restraint designed for special needs children and certified for use by children weighing up to 105 lb.⁷

The agency undertakes rulemaking to amend Standard No. 213 in response to changes in child restraint designs, uses and the safety needs of children. For example, NHTSA recently proposed to amend Standard No. 213, which currently applies to child restraints recommended for children up to 50 lb, to extend its applicability to restraints recommended for children weighing up to 65 lb (May 1, 2002, 84 FR 21806). The Transportation Recall Enhancement and Documentation (TREAD) Act directed NHTSA to consider whether to amend Standard No. 213 to cover restraints for children weighing up to 80 lb. To that end, the agency is working with the Society of Automotive Engineers (SAE) to develop a 10-year-old dummy for use in testing booster seats. Given the innovation in child restraints design and use and the move toward keeping children in child restraints longer, the mass of the child/CRS system on a LATCH system should be assumed to be greater than 18 kg. We will assume a child mass of 29.5 kg (65 lb), in line with the May 1, 2002 rulemaking proposal.

Further, the agency disagrees with the Alliance that the acceleration of the child/CRS system should be 27 g (265 m/s²). NHTSA has reviewed data from joint NHTSA/Transport Canada frontal, 30 mph rigid barrier crash tests of 1995 to 1999 model year vehicles. Transport Canada found that peak accelerations of many of these vehicles were higher than 27 g. Based on a comparison of the pulse shapes for the same vehicle and the same test used by the Alliance and Transport Canada, NHTSA believes that the two entities obtained different peak accelerations because of the filter used on the data. The Alliance used a 30 Hz cutoff filter, rather than the SAE specified CFC 60 with a 100 Hz cutoff frequency.

⁷ Britax provides the following consumer information for its LATCH-equipped child restraints certified for children weighing more than 40 lb: "Use vehicle seat belt (not LATCH connectors) for installations with children weighing more than 48 pounds (21 kg.). Refer to the vehicle's owner's manual for the maximum weight rating for their LATCH anchors. Unless specified otherwise by the vehicle manufacturer, assume a 48 pound child is the vehicle LATCH anchor limit."