

cushion and would naturally be affected by the influences of the cushion, seat structure and other features of the vehicle that can affect loading patterns. The distribution of the force applied to the device (and in a real life situation to a child restraint) can vary from vehicle to vehicle and between one child restraint and another. The distribution of force in a crash can also vary within a given vehicle, depending on the design of the seat position and the child restraint. The percentage distribution of the crash forces among the anchorages can also depend on how the child restraint is installed. The tightening of webbing (of either a vehicle belt system or LATCH attachments on a child restraint) could have a significant effect on the distribution of the applied load. In the event that a vehicle belt is loose, or the LATCH or tether webbing is improperly installed with slack, it is likely that highly unequal load transfers to the various anchorages could occur. Thus, the fact that the SFAD unevenly distributes the test load to the anchorages is a positive factor since it better reflects real world use and performance. The fact that the anchorages might be subjected to loads above or below 5,300 N is not material, as long as the total test load applied to the system is appropriate for the system. The safety need for and practicability of the requirement will be discussed in the next sections.

Further, the agency does not agree that the Transport Canada test should have been disregarded. The data were meaningful in providing a basis for estimating the force imposed on the LATCH anchorages. The child restraint used was a reasonable representation of a child restraint with rigid LATCH anchorages, as were the tether anchorage and the tether strap. There was no basis at that time for setting a lower strength requirement.

In concluding that the 15,000 N requirement should be retained, NHTSA has closely considered the information submitted by the Alliance in the petitions for reconsideration regarding an 8,000 N requirement. As discussed in the remainder of this section, we have decided to retain the requirement while changing the displacement limit of 125 mm to a prohibition against the tether anchorage separating completely from the vehicle seat or seat anchorage or the structure of the vehicle.

The 15,000 N load requirement harmonizes with Canadian requirements for the strength of child restraint anchorage systems. On May 30, 2002, Transport Canada published its final regulation on universal anchorage systems for child restraints. Transport

Canada requires the anchorage system to withstand (*i.e.*, not separate completely from the vehicle seat or seat anchorage or the structure of the vehicle) when tested with an SFAD applying a 15,000 N force. Canada has analyzed NHTSA's evaluation of the petitioners' information and arguments and has concurred with our determination that the 15,000 N requirement meets the need for motor vehicle and child safety.

ii. What Should the Requirement Be?

A. Petitioners Believe It Should Be 8,000 N

The Alliance petitioned that an 8,000 N load application applied by an SFAD in the forward direction is sufficient for motor vehicle safety regardless of whether lower anchors or top tether anchors are being tested.

1. Comparison to Standard No. 210 Requirements

The Alliance stated that an 8,000 N load is consistent with FMVSS No. 210 ("Seat Belt Assemblies," 49 CFR § 571.210) with respect to scaling test forces and occupant sizes. The Alliance estimated that LATCH anchorages will be subjected to a 27 kilogram (kg) mass (about 60 pounds). This value represented the combination of an occupant and a restraint system. (The mass of the occupant, a child, was estimated to be 18 kg (equal to about 40 pounds), while the mass of the child restraint was 9 kg (about 20 lb).) The petitioner stated that the 27 kg mass was 36 percent of the 75.5 kg derived mass for the lap belt test and 33 percent of the 81 kg derived mass for the lap/shoulder belt test. Thus, the petitioner said that an 8,000 N static test force was suitable since it is approximately 36 percent of the 22,200 N test force applied in lap belt tests and 33 percent of the 24,000 N test force used on lap/shoulder belt combinations.

2. Engineering Analysis

The Alliance also believed that an 8,000 N load application in the forward direction is sufficient for motor vehicle safety based on an analysis of the forces that are likely to be imposed on a LATCH system in a crash. Petitioner submitted a February 16, 2000 document entitled, "Engineering Basis for Strength Tests of Child Restraint Anchors (FMVSS 225)" (Docket Document 6160-19), to support its belief that an 8,000 N load application is the maximum force level that should be attained in the anchorage strength test. The paper explained that the value that the standard should specify "should be * * * consistent with the appropriate management of the energy

of the child/CRS in a vehicle crash. It is this force which the anchorages must be able to resist in order to hold the CRS [child restraint system] in place during a crash." The petitioner believed, and the agency agrees, that in a frontal collision, 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 ("the child/CRS system") multiplied by the acceleration of this system. Based on certain assumptions about the mass of the system and the acceleration of the system in a certain type of vehicle, the Alliance concluded that the LATCH anchorages would be subject to a force of only 8,000 N.

As noted above, the petitioner made the following assumptions about the mass of this system: mass of child is 18 kilograms (kg) (equal to about 40 pounds); mass of the child restraint is 9 kg (about 20 lb); total mass of system is 27 kg (about 60 lb). The mass of the child restraint was estimated to be 9 kg (20 lb) based on current child restraints. The acceleration of the system was based on the typical peak sill acceleration of a 1999 Dodge Intrepid during a 30 mph rigid barrier collision, which was about 27 g, or 265 m/s². The petitioner selected this vehicle because the car exhibited the highest peak acceleration within the group of competitive vehicles for which data were available for the analysis. Based on these estimates, the Alliance believed that the expected peak force for the child/CRS system would be: $F = ma = (27 \text{ kg})(265 \text{ m/s}^2) = 7,200 \text{ N}$.

Moreover, the Alliance argued that the force should be applied for only 250 ms, because the significant accelerations that occur in a crash occur during the first 200 ms of the crash event.

With these considerations in mind, the Alliance suggested that the strength test procedure should specify the following:

Starting with a preload of 500 N, ramp-up the force (in an approximately linear fashion to avoid overshoot and undershoot) to 8,000 N and apply the force for 250 ms (providing a dwell to assure an accurate attainment of force magnitude and a conservative application time to assure accurate attainment of force magnitude and a conservative application time to assure accurate impulse.)

3. Static v. Dynamic Performance of Materials

The Alliance further argued that the agency should not have based a static pull requirement on the results of a dynamic test since the two are not equivalent. The Alliance stated that there is nearly a two-fold "factor of