

the seat cushion that results in a "harder stop as the restraint bottom[s] out against the plywood platform." The commenter was concerned that, if the chest acceleration limit were reduced, child restraints that are already close to the current limit could fail the test with no change in how they actually perform in the field. "To counteract this possibility [of failing the test], a manufacturer could soften the system, allowing more head excursion (due again to the geometry change), to keep the chest acceleration in check. This would obviously be counterproductive to child safety." In addition, SafetyBeltSafe believed that the proposed chest deflection limit "does not relate to any evident injury among restrained child passengers" and thus would not advance child safety. JPMA, UMTRI and SafetyBeltSafe suggested that the agency collect data on chest deflection to establish a database that could be used to evaluate these measures more in the future.

Ford stated that in its sled tests of booster seats using the Hybrid III six-year-old dummy and the FMVSS No. 213 sled pulse, none of the tested boosters could be certified as meeting the proposed limits. "Boosters that showed good shoulder belt fit routinely measured chest acceleration at or near the 60 g limit and chest deflection very near the 40 mm limit. Dummy chest values were sometimes below the compliance limit, but were seldom far enough below the limit to provide a reasonable compliance margin." The commenter believed that boosters do improve child safety when used properly, and that "if dynamic testing of boosters is continued, the test procedure needs a major overhaul to effectively differentiate between acceptable and unacceptable designs."

Response: This final rule does not adopt the proposed chest injury criteria relating to acceleration and deflection. A safety need for adopting the proposal has not been established. NHTSA is persuaded by the commenters that there are not sufficient data that demonstrate that children have been seriously injured due to excessive chest acceleration or deflection in current restraint designs. Historically, the majority of child injuries are to the head as opposed to the chest. The agency is concerned about possible negative effects of adopting the proposed chest injury criteria on increased head excursion, as noted by SafetyBeltSafe. Further, not enough is known about the countermeasures that could be employed to meet the proposed criteria. If child restraint manufacturers were to redesign their restraints to meet such

requirements, the agency is concerned about the possibility of those revised designs compromising other aspects of the occupant's injury protection.

The data presented by JPMA, and to a lesser degree, the follow-on tests conducted at VRTC, show difficulty for current restraints to meet the scaled chest criteria, and also show problems for certain restraint types to meet the existing requirements with the revised test seat assembly and new dummies. Redesigning the restraints to meet the requirements, assuming such redesign is practicable, would involve a cost increase to manufacturers, which would be passed on to consumers. The agency does not believe that the cost increase is justified in this instance, and is concerned about the possible effect the cost increase could have on the purchase and use of child restraints. For the aforementioned reasons, we conclude that it is not in the interest of safety to adopt the chest injury criteria developed for FMVSS No. 208 into FMVSS No. 213.

iii. Neck. Virtually all parties commenting directly on this aspect of the proposal opposed the modified Nij neck criterion (modified from the criterion in FMVSS No. 208 in that the limits on axial force were excluded). The Alliance stated that it believes that serious neck injuries in child restraints are most likely caused by excessive upper neck tension, and not by exceeding the proposed Nij criterion. The commenter thus suggested the agency should specify neck tension and compression limits, as follows, when testing with the CRABI 12-month-, the HIII three-year- and the HIII six-year-old dummies, respectively: 780, 1430 and 1890 N for peak tension; and 960, 1380 and 1820 N for peak compression. The Alliance further stated, however, that applying these limits while maintaining the current sled pulse is likely to make compliance with the requirements impossible or possible only with substantial cost increases. The commenter suggested that NHTSA modify the crash pulse "to make it more representative of the current crash environment" instead of eliminating neck tension. Ms. Bidez stated that "Nij does not appear to predict cervical distraction injuries in children * * *." The commenter suggested that "the duration of the axial distraction load as influenced by the presence or absence of adequate torso restraint appears to be a more valid predictor of (spinal cord injury without radiographic abnormality) SCIWORA injuries among children in the absence of head contact."

JPMA, SafetyBeltSafe, UMTRI, TraumaLink and others did not support adopting the proposed Nij criterion at this time. SafetyBeltSafe believed that neither Nij as proposed nor Nij with a limit on tension should be used as a compliance criterion unless these are proven to be useful predictors of child neck injury. UMTRI believed that Nij should not be incorporated at this time because the relationship between the criterion and real-world injuries "under the type of loading simulated by FMVSS 213 are [sic] not well established." The Insurance Institute for Highway Safety (IIHS) was concerned that studies of real-world crashes indicate that neck injuries due to inertial forces appear to be rare, yet, the commenter stated, it is not clear how child restraints could be better designed to lower neck injury measures. Ford stated that, in its sled tests of booster seats, "Upper neck tensions and extension moments above the FMVSS 208 criteria were also routinely measured. Every test exceeded at least one of the Nij limits."

TraumaLink was concerned about the state of knowledge about pediatric neck injury and suggested that not enough was known to proceed at this time. The commenter stated that data on the biomechanical response of the pediatric neck to trauma are severely limited and as a result, the neck of current child dummies may not be representative of the real child. The commenter also believed that efforts to include pediatric neck tolerance levels in regulatory efforts are scientifically premature. TraumaLink further stated:

More research is needed to understand the movement of the child's neck in traumatic events and the likelihood for injury before enacting regulatory standards, but our results indicate that this work is of paramount importance. We believe that this research may reveal the importance of neck tension and suggest that exclusion of limits on peak tension in the test procedure is not appropriate. Therefore, we feel that the neck injury measures should be calculated but not used in the pass/fail criteria in the FMVSS 213 test to build the fund of knowledge needed to further refine the injury measure.

Similarly, commenters JPMA, SafetyBeltSafe, UMTRI and the IIHS suggested that more research is needed on neck injury among restrained children. Some of these suggested that NHTSA measure neck force and moment parameters during compliance tests to become familiar with the range of results.

Response: The agency has decided not to incorporate Nij into FMVSS No. 213 compliance tests at this time. Both NHTSA and JPMA testing has clearly demonstrated that existing child