INSURANCE INSTITUTE
FOR HIGHWAY SAFETY

February 1, 2010

The Honorable David L. Strickland
Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue, SE
Washington, D.C. 20590

Federal Motor Vehicle Safety Standards, Ejection Mitigation; Phase-In Reporting Requirements; Notice of Proposed Rulemaking; Docket No. NHTSA-2009-0183

Dear Mr. Strickland,

The National Highway Traffic Safety Administration (NHTSA) has issued a Notice of Proposed Rulemaking (NPRM), asking for comments on a new Federal Motor Vehicle Safety Standard (FMVSS) 226. FMVSS 226 is intended to reduce the risk of occupant ejection from side windows in crashes, especially rollovers. The Insurance Institute for Highway Safety (IIHS) agrees with the need to reduce the risk of occupant ejection and believes NHTSA already has taken a significant step by upgrading its roof strength standard, FMVSS 216. IIHS also supports the present rulemaking because it is likely to result in all passenger vehicles being equipped with side curtain airbags that deploy in rollover crashes. However, IIHS is concerned that the proposed headform excursion limit is not correlated to real-world crash performance and may be overly restrictive. Additionally, based on observations of laminated side glazing performance in IIHS's roof strength and side impact crashworthiness evaluation programs, NHTSA should maintain the new standard's proposal to allow this type of glazing to complement airbag systems in reducing ejection risks.

Effect of roof strength on ejection risk

In May 2009, NHTSA upgraded FMVSS 216; Roof Crush Resistance (Office of the Federal Register). For vehicles with Gross Vehicle Weight Ratings up to 6,000 lb, the new rule increases the minimum ratio between a vehicle's roof strength and its curb weight (SWR) from 1.5 to 3.0. In 2 separate studies, IIHS has found that increases in SWR reduce ejection risk in rollovers. In a study of more than 30,000 rollover crashes of midsize SUVs, a 1.0-unit increase in SWR was found to reduce ejection risk by 41 percent (Brumbelow et al., 2009). The second study, involving more than 20,000 rollover crashes of small cars, found a 24 percent reduction in ejection risk for the same SWR increase (Brumbelow and Teoh, 2009).

NHTSA's analysis of 5,562 rollovers from the National Automotive Sampling System-Crashworthiness Data System found only an inconsistent relationship between roof intrusion and ejection risk (Strashny, 2009). However, the absence of any roof strength measure for the vehicles in these crashes prevents analysis of the link between FMVSS 216 test performance and ejection risk. By assuming that stronger roofs will have no influence on ejection, NHTSA has both underestimated the benefits of the upgraded FMVSS 216 and overestimated the target population for the proposed FMVSS 226. With its roof strength rulemaking, NHTSA already has begun to address the approximately 7,000 annual fatalities of ejected occupants (NHTSA, 2009).

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Need for evaluation of current ejection mitigation systems in real-world crashes

IIHS supports NHTSA's effort to reduce ejection risk beyond what will be accomplished by stronger roofs. Many vehicles already are equipped with side curtain airbags designed to inflate in rollovers, and IIHS agrees with NHTSA that the proposed rule likely will encourage manufacturers to install these systems in the rest of the fleet. However, it is unclear how the specific requirements proposed for these systems will affect their real-world performance. In particular, the headform impactor displacement limit of 100 mm may be unnecessarily small. Selecting this value based on its use in other safety standards with very different test conditions or in building codes for guardrails on balconies and stairs may be unreasonable.

All of the 12 production vehicle designs tested by NHTSA would have failed to comply with the proposed standard's 100 mm limit, but the crash performance of these vehicles has not been assessed to demonstrate a need for improved ejection mitigation systems. The NPRM contained a review of real-world cases that found 2 ejected occupants among 7 rollover crashes of vehicles with side curtain airbags designed to inflate in rollovers. Both of these occupants were in the same vehicle, both were unrestrained and, according to the technical report for this case, both likely were ejected through openings not covered by the curtain airbags (Dynamic Science, 2006). Excessive stretching of the curtain airbag did not appear to contribute to ejection in this case, and additional similar cases should be evaluated to determine whether this is a real problem for those airbags already designed to prevent ejection. Also unknown is any potential negative effect of the greater airbag stiffness required to reduce impactor displacement. While NHTSA may believe that some limit on displacement is necessary to ensure sufficient coverage of the window opening as well as adequate tethering, the agency should consider the effects of raising the limit above 100 mm.

Laminated glazing

In the NPRM, NHTSA asks for comments regarding the potential for laminated side glazing to contribute to an ejection mitigation system. All of the agency's 36 headform tests with this type of glazing resulted in reduced impactor displacement compared with tests with the curtain airbag alone. IIHS has not performed any real-world analyses of the performance of laminated glazing in reducing ejection risk but has tested a number of vehicles equipped with this technology in its roof strength and side impact crashworthiness evaluation programs. Anecdotal observations from these tests suggest that laminated glazing could complement side curtain airbags in an ejection mitigation system.

In the IIHS roof strength test program, vehicles are subjected to a quasi-static test to 254 mm of plate displacement. Four sedans equipped with laminated glazing recently tested in this program were the 2009 Chevrolet Malibu, 2010 Buick LaCrosse, 2010 Ford Taurus, and 2010 Lincoln MKS. Even after 254 mm of roof crush, the front side windows in these vehicles remained intact within the window frame (Figure 1). In a rollover crash with similar or less severe roof crush, these windows could be expected to provide some protection against ejection. Similar results have been observed in the IIHS side impact test, in which a moving deformable barrier representing the front-end geometry of a midsize SUV strikes the side of the test vehicle at 50 km/h (IIHS, 2008). In contrast to side windows made of tempered glass, those made of laminated glass do not disintegrate. Some even remain within the frame and offer additional resistance to the outboard motion of the airbags and dummies in the test (Figure 2). Based on the IIHS roof crush and side impact tests indicating that laminated glazing may help retain occupants within the vehicle, IIHS encourages NHTSA to provide an incentive for manufacturers to equip vehicles with laminated glazing.

NHTSA has requested comments on its proposed method to pre-break side windows before conducting the headform test. It is difficult to comment on the proposed method because 35 of the 36 tests conducted by the agency on vehicles equipped with laminated glazing employed methods not proposed in the rule. Also, it is unclear why the remaining single test conducted with glass broken according to the proposed method has no associated baseline test without glazing in place (2007 Jeep Commander). Rather than pre-breaking the glass, a simpler approach, and one that would encourage the use of laminated glazing, is to test all vehicles without the glazing in place but allow a higher displacement for vehicles equipped with laminated glazing.

Overall, IIHS supports this rulemaking because it is likely to result in a high percentage of the passenger vehicle fleet being equipped with airbags designed to reduce ejection risk. Of course, the effectiveness of these airbags will be influenced by the ability of deployment algorithms to detect the wide variety of conditions which may exist in the early stages of a rollover crash. NHTSA understandably is reluctant to specify performance requirements for sensors that may not capture the scope of real-world rollover crash scenarios. However, it is crucial that the agency continue to monitor the performance of ejection mitigation systems in the field to determine the adequacy of a safety standard without deployment requirements.

Sincerely,

David Zuby
Senior Vice President, Vehicle Research

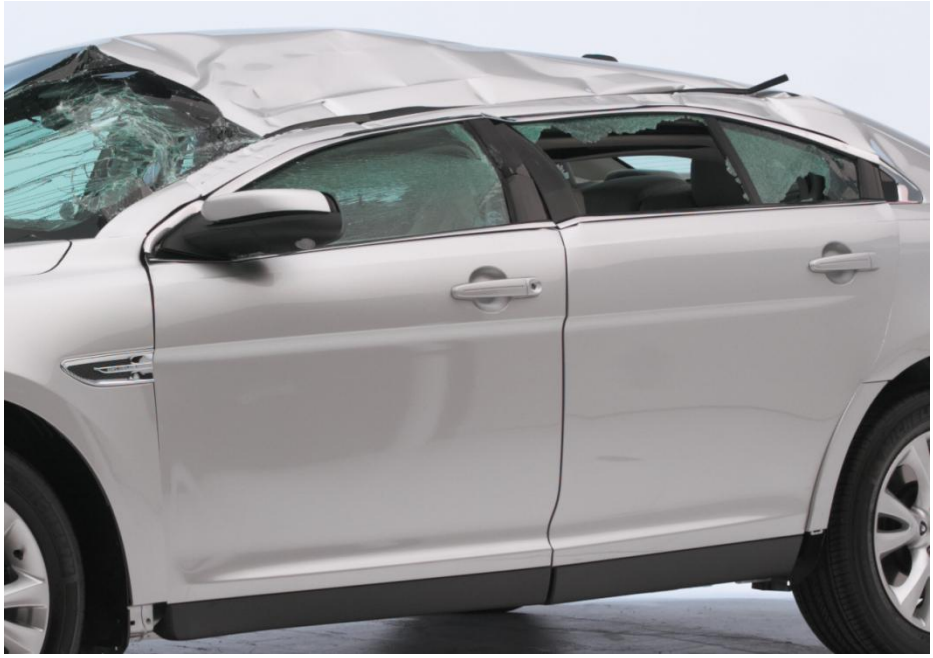

Figure 1. 2010 Ford Taurus after IIHS roof crush test to 254 mm, showing performance of laminated glazing (front window) and tempered glazing (rear window)

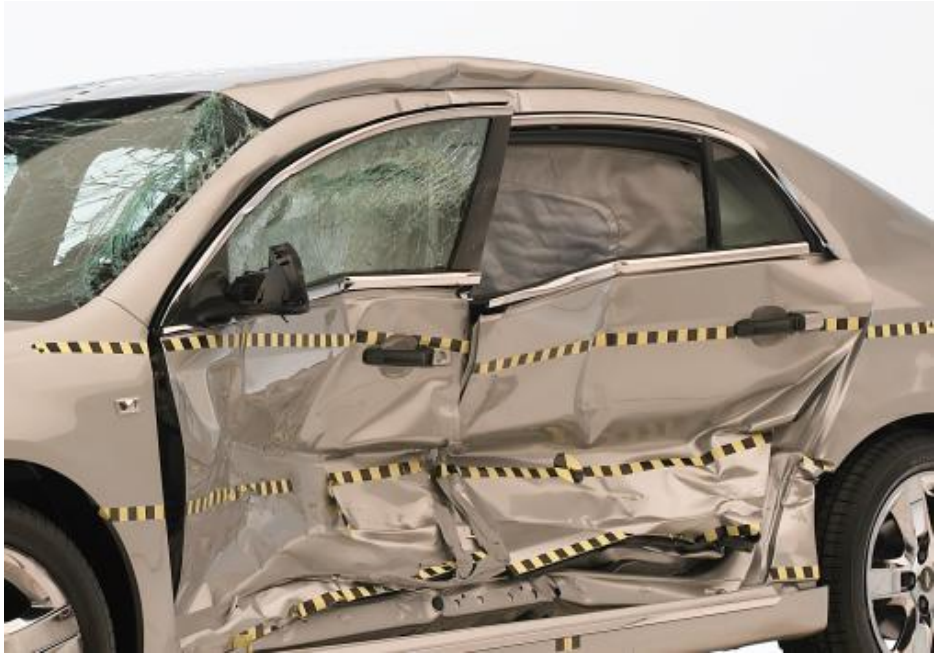

Figure 2. 2008 Chevrolet Malibu after IIHS side impact test, showing performance of laminated glazing (front window) and tempered glazing (rear window)

References

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