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Statement on Deficiencies in NHTSA’s Roof Crush Test
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It is possible to prevent 200 casualties (deaths and serious injuries) a week, or nearly 7,000 each year, with properly designed rollover protection to strengthen the roof and reduce ejections. Yet NHTSA has said that its new rule on roof crush will not save many lives.

I will explain today why NHTSA’s current roof crush standard does not protect occupants in rollovers, and why the agency’s expected proposal will be inadequate to prevent most serious injuries from roof crush and rollover crashes.

The major causes of the most serious rollover injuries are roof intrusion – causing severe head and neck injuries – and ejection primarily through broken side windows. The new NHTSA standard addresses neither of these causes of injury to far side occupants, and would leave even belted near side occupants exposed to the risk of ejection.

Preventing full and partial ejection is a major benefit of a strong roof, but NHTSA’s benefit analysis on roof crush ignores any relationship between roof strength, window failures and ejection.

The current test uses a large platen – 6 feet by 2½ feet – to press on a section of one side of the vehicle’s roof at a pitch angle of 5°, and a roll angle of 25°. The roof must be strong enough that with a force of 1.5 times the vehicle’s weight pushing on it, it does not crush more than 5 inches. The 1.5 times figure is called the Strength to Weight ratio, or SWR.

Based on agency officials’ statements and reports we anticipate that NHTSA will propose a minimal change to FMVSS 216, increasing the SWR to about 2.5 and permitting the roof to crush until it contacts a normally seated dummy’s head (near the B pillar). The pitch angle and roll angle would not change. The test would also still be performed on only one side of the roof.

NHTSA officials have said that only a small number of lives would be saved by the new standard. This makes sense given that data show that the average for roof strength is already 2.3 SWR, and that many, if not most, vehicles now made can meet the anticipated NHTSA proposal. NHTSA test in 2003 of recent models found that 8 of 10 vehicles would pass the anticipated new standard.

Our testing shows that the NHTSA static test is in fact very flawed. Our research and testing is extensive and includes development of a dynamic, repeatable test device, the Jordan Rollover System, or JRS, human subject testing and more realistic quasi-static testing. In all, we have
tested the roof strength of dozens of vehicles and have investigated about 400 serious rollover crashes.

The NHTSA test is unrealistic because:

1) It tests only one side and does not address the more serious second side impact in a rollover, where most occupants are injured;
2) It allows vehicles to have a weak A pillar, while in rollovers occupants are injured when the A pillar collapses and windows break; and
3) Both omissions allow ejection risks, and the benefits of reducing ejection, to be ignored.

I will address each of these serious problems in turn.

The second, or trailing, impact in a rollover crash, which we call the far side impact, is different from the first impact in a number of ways. It has a different and more severe pitch angle and a roll angle much greater than the 25° in the NHTSA test. NHTSA agrees that most occupants seriously injured in rollovers were seated on the far side of the roll.

The strength provided by the windshield and windshield bonding is gone after the first impact when both break, meaning that the roof is substantially weakened when the second or far side impact occurs.

For this reason, a one-sided test fails to diagnose a major cause of injury to occupants in rollovers, and far side roof strength is far more important than near side. What the data show are that, on the far side, many vehicle roofs cannot actually support the weight of the vehicle. Our JRS testing confirms findings of other rollover tests that if the roof crushes less than 4 inches, the side window glazing is generally preserved, limiting ejection.

The second major flaw in NHTSA’s test is that the test permits a very weak A-pillar. There are three major aspects of the test that are wrong when compared to real-world rollover crashes:

1) The test uses the wrong pitch angle – 5° – when in an SUV or pickup truck the actual pitch angle in a rollover is 10°,
2) The dummy’s head position is unrealistic; and
3) The test does not measure intrusion speed – when a weak A-pillar buckles, it does so at a speed that injures occupants.

A weak A-pillar also allows side window glass to break, allowing ejection. NHTSA’s test uses an incorrect pitch angle. Damage patterns in the front fenders of the vehicle in dynamic tests and NHTSA’s own study of 271 NASS cases showed that the pitch angle for rollovers in SUVs and pickup trucks is at least 10°. The platen applies major force to the B-pillar early in the test,
distributing the load quite differently than in an actual rollover, where occupants are harmed when the A-pillar collapses and windows break.

The dummy’s head position is also unrealistic. In rollovers, witness marks show that a human head is closer to the roof rail and A-pillar when the roof crushes. In that location, it is more vulnerable to injury from roof crush. The test also does not measure roof intrusion speed which can exceed 20 mph when a weak A-pillar buckles – a speed that will inflict severe injury.

Because of all these factors, the NHTSA test is very poor at predicting the performance of vehicles in real world rollover crashes. Yet the statistics Ford submitted to the roof crush docket dispute a connection between roof strength and injury by showing there is no relationship between results on NHTSA’s test and rollover injury levels. The reason there is no connection is because the test is a very poor predictor of how vehicles will perform in rollover crashes.

NHTSA’s benefit analysis on roof crush ignores any relationship between roof strength, window failures and ejection. NHTSA excludes ejected occupants at the outset.

Yet NHTSA data show that 45 percent of ejected occupants contacted the inside of the vehicle before they were ejected.

A 1982 General Motors study agreed that ejection, window breakage and roof strength were related.

The study concluded that a better roof structure would stop windows from breaking and therefore prevent ejections.

Our JRS tests show that if the roof does not distort more than 3 or 4 inches, the rollover will not break the windows, and people cannot be ejected. A standard that limits crush to about 4 inches in a dynamic test, such as the dolly rollover now part of FMVSS 208, would reduce ejections at least 50 percent – saving at least 6,500 lives and serious injuries. Roof intrusion injury would also be greatly reduced, preventing another 75 deaths and serious injuries each week and bringing the total number closer to 10,000 each year.

NHTSA should make the now-voluntary FMVSS 208 dolly rollover test (perhaps with minor modifications) a mandatory test. At a minimum, a two-sided test with greater pitch and roll angles should be required by the agency, and verified with dynamic testing.