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**Roof Crush Resistance, Notice of Proposed Rulemaking,
70 FR 49223 *et seq.*, August 23, 2005**

Advocates for Highway and Auto Safety (Advocates) submits the following comments to assist the National Highway Traffic Safety Administration (NHTSA) in its adoption of amendments to Federal Motor Vehicle Safety Standard (FMVSS) No. 216, *Roof Crush Resistance*. The agency has proposed changes to the standard, including the terms of the compliance test and the range of passenger motor vehicles subject to compliance. Due to the complex and technical nature of this rulemaking, Advocates' submission exceeds the 15-page comment limit of 49 C.F.R. § 553.21.

Summary.

Advocates is disappointed in the NHTSA's notice of proposed rulemaking (NPRM or proposed rule) on roof crush resistance. 70 FR 49223 *et seq.* (Aug. 23, 2005). The proposed rule makes only marginal changes to the existing standard that can result in more intrusion than allowed under the current version of Federal Motor Vehicle Safety Standard (FMVSS) No. 216. Even the agency's own calculations show that the proposed rule will have almost no significant effect on improving the roof strength of most vehicle models. In addition, the proposed rule is a "do nothing" mandate for most makes and models of passenger vehicles given NHTSA's estimate that about 70 percent of current production models already meet the testing requirements proposed in the NPRM. Furthermore, according to the agency's benefits analysis, the proposed rule will result in few lives saved and injuries prevented. As a result, the proposed changes to the current standard will not address the pressing need to save thousands of lives from rollover crashes.

NHTSA asserts that the instant rulemaking proposal is "one part of a comprehensive agency plan for reducing the serious risk of rollover crashes and the risk of death and serious injury when rollover crashes do occur." *Id.* at 49226. But that intent is not evident from the NPRM. This proposed rule stands alone and is not complemented by other proposed regulations to substantially reduce rollover deaths and injuries. There are no pending rulemaking proposals offering stronger, better seat belt systems that will reduce occupant excursion during rollover crashes, including the use of pretensioners that restrain occupants throughout a rollover crash. Similarly, although the agency has repeatedly voiced its interest in the safety benefits of integrated seats, there is no current rulemaking action that would set performance standards to require their use. Furthermore, the agency has apparently abandoned action on establishing

requirements for advanced glazing to prevent ejection. No improved door retention components rulemaking is projected for publication. Effectively, contrary to the agency's claim, there is no comprehensive regulatory plan being pursued by NHTSA to dramatically reduce rollover deaths and injuries.

The Proposed Rule Will not Provide Adequate Occupant Protection.

The NPRM proposes a new version of the current quasi-static load test that is ineffectual in abating the enormous annual losses of deaths and injuries that are sustained by occupants in rollovers, with more than 10,000 fatalities each year and hundreds of thousands of severe injuries, many of them resulting in permanent disabilities, including quadriplegia. The inherent inadequacy of the new version of the regulation proposed by NHTSA is revealed in the startlingly low number of deaths that would be saved by adopting the proposed rule. The agency's benefit analysis shows only a handful of lives saved each year if all light vehicles complied with its test requirements. Increasing the crush resistance of vehicle roofs is a critical element in reducing rollover deaths and injuries. It is technically feasible and practicable to improve roof crush performance to save many more lives. The proposed rule, however, will continue to allow roofs to suffer massive failure leading to lethal head and neck injuries.

Moreover, the benefits of this rule explicitly exclude the thousands of deaths each year associated with partial and complete ejection from the vehicle. This unabated death toll is in large part a result of the weak compliance test protocol proposed by NHTSA that will allow vehicles that pass the loading test nevertheless to allow side window glazing to break, windshields to shatter or pop out, and door retention components, such as latches and hinges, to fail in real-world, on-roof, rollover crashes. In fact, the agency acknowledges that the proposed rule would not provide any benefits of preventing occupant ejection.

In addition, the agency's proposed rule also will not produce any benefits resulting from roof strength improvements when vehicles roll over in hostile roadside environments. Although the overwhelming majority of rollover crashes occur off-road in areas often thickly populated with fixed object hazards such as longitudinal barrier posts, rocks, fire hydrants, poles, and trees, the agency has offered an idealized view of roof crush resistance that treats rollover crashes as if they occur on only flat, even road surfaces. The agency itself has repeatedly shown that rollovers on flat, even road surfaces constitute a small minority of rollover crashes. The NPRM, however, fails to address the discrepancy between the proposed test procedure and the fact that approximately 95 percent of rollovers occur off-road.

The proposed rule also excludes rear seat occupants from coverage under the revised standard. Although NHTSA in the past has openly proclaimed a special obligation to protect vulnerable child occupants who are placed in rear seats based on NHTSA's advice, these children, as well as adults in rear seats, are also excluded from any protection afforded by the proposed roof crush resistance standard.

A central flaw in NHTSA's rulemaking approach to establishing a roof crush resistance is that it fails to accurately model the real-world forces that occur in rollover crashes and to protect occupants from the impact of these forces. The agency's choice of a simple head contact/no-contact criterion for determining roof crush resistance has virtually no connection with how occupants suffer head and neck injuries in rollovers. Occupants in rollover crashes with multiple quarter turns suffer injuries functionally tied to a sequence of different vehicle upper structural deformations and failure. A variety of head impacts result from both occupant excursion and

intruding roof components such as deformed pillars, headers, and side rails that result in severe injuries. Those injuries are primarily massive head trauma and axial neck compression or flexion, usually in concert with neck shear forces that produce cervical vertebrae dislocation or displacement (subluxation) with spinal cord disruption which sometimes concludes with complete cervical transection resulting in either quadriplegia or death.

In fact, it is a sign of the inherent weakness and inadequacy of this proposed rule that there is no modeling by the agency of how occupant injuries actually occur and exactly how those injuries would be prevented or reduced in severity if the proposed rule were adopted. Such modeling is impossible because the test plate load approach of this proposed rule is only a component test, not a vehicle test of roof responses to dynamic loads in real-world rollover crashes. A simple test plate loading to show that roof failure does not actually result in head contact with a front seat occupant ignores the primary injury mechanisms resulting from both restrained and unrestrained occupants suffering roof and upper interior vehicle contact in rollovers. Indeed, by relying solely on a head contact/no contact performance criterion without any limit on the amount of permitted roof crush, the proposed rule actually allows more intrusion into the occupant compartment than is now permitted under the current rule.¹

None of this is reviewed or taken in account by NHTSA in this NPRM, and the reason is plain: a roof crush test that pivots on the simplistic standard of head contact/no-contact cannot show anything about what actually occurs in loading the human head and neck during real-world rollover crashes. That loading results from protracted and ever-changing loads on occupants that are inflicted by roofs that collapse and distort in complex ways. In fact, a baseline defect in this proposed rule is the agency's inference that vehicles that comply with the proposed standard through no head contact are safer in rollover crashes than those that fail under the application of 2.5 times vehicle weight. In reality, when roofs fail in rollover crashes, there is usually dynamic flexing or elastic recoil of the roof and its supports that can often result in massive intrusion inflicting severe head and neck injuries, events that no quasi-static component test can measure or take into account. After the rollover is completed, many vehicles have positive headroom or "survival space" remaining over the occupants. A simple measurement showing residual headroom following a quasi-static component test leads to the false inference that severe injuries will not have occurred during an actual rollover crash.

Need for a Dynamic Test of Roof Strength/Crush.

The test plate loading of the front area of light vehicle roofs cannot substitute for a realistic dynamic test. Comments filed by Advocates with the preceding docket on this standard four years ago² stressed then that a strong dynamic standard for roof crush resistance was essential. Those comments emphasized that a dynamic test complemented by an integrated, systems

¹ This is an especially peculiar stance in that the agency's fundamental principle of vehicle crash performance has been to maintain the integrity of the occupant compartment. NHTSA's approach to enhancing occupant safety in all other crash modes - frontal, side, and rear impacts - has consistently been to limit through regulation occupant compartment intrusion and deformation as much as possible. Yet, this proposed rule will permit any amount of intrusion as long as it does not result in actual contact with a test dummy's head.

² Comments of Advocates for Highway and Auto Safety, dated Dec. 6, 2001, filed with Docket No. NHTSA-1999-5572, Notice 02, *Roof Crush Resistance: Notice with Request for Comments*, 66 FR 53376 (Oct. 22, 2001), incorporated by reference in these comments and copy filed with Docket No. NHTSA-2005-22143.

engineering regulatory approach to upper interior head impact protection, with ejection prevention by means of advanced glazing, advanced restraint systems, and fundamental improvements to door retention components, is the only reasonable course the agency could take to dramatically reduce deaths and injuries in rollover crashes in light of the agency's continued resistance to adopting a vehicle stability standard to reduce the rate and numbers of rollovers.

Advocates continues to support a dynamic test based on the FMVSS No. 208 protocol using a cart or dolly to conduct rollover testing of vehicles to demonstrate their response to full, on-roof loading in these dynamic conditions.³ Rejection of a dynamic test approach to determining both roof strength and occupant protection needs is unwarranted,⁴ and NHTSA's apparent agreement that the FMVSS No. 208 cart test is not viable, is mistaken.

Moreover, NHTSA's continuing rejection of the No. 208 rollover test protocol has diverted the agency's attention from the need for a genuine rollover anthropomorphic test device. Instead, the agency has continued to use a Hybrid III dummy neck that has poor biofidelity especially for axial compression. This should not be unexpected given the development of the dummy primarily for frontal crash testing purposes.

Only a dynamic real-world test will show the agency how to model occupant injury mechanisms and their prevention to provide substantially enhanced roof crush resistance. The current rulemaking proposal is not only exceptionally weak taken on its own terms, but it can promise nothing about how to prevent occupants from being severely injured or killed in rollover crashes.

Essential Elements to Improve the Proposed Rule.

In the event that NHTSA determines not to adopt a dynamic test, and to rely only a quasi-static test method using plate loading against the front portion of light vehicle roofs, then the agency must dramatically strengthen the proposed rule and impose much greater demands on roof performance response to the proposed loading. This is crucial given the fact that the plate test load approach to the standard is an extremely poor surrogate for a dynamic test. As Advocates discusses below, the proposed rule must be amended to include a much higher applied load – at least 3.0X the gross vehicle weight rating of the vehicle plus the weights of the two dummies – along with a stringent limit on maximum crush intrusion of no more than three (3) inches.

³ Dynamic roof strength responses to rollovers, such as those conducted in the late 1980s with the No. 208 dolly by Autoliv, appear to be reliable and repeatable from the vantage point of occupant protection needs instead relying of on external observer judgments of roof deformation. In the Autoliv test, later data analyses by one group of investigators show that “[s]ignificant roof crush occurred PRIOR to peak injury metrics in each test for both driver and passenger dummies. These data establish a clear causal relationship between compressive upper neck forces (Fz) and lower neck moments (My and Mx) and maximum roof/pillar crush.” See, M. Bidez, J. Cochran, D. King, *Roof Crush as a Source of Injury in Rollover Crashes – An Independent Analysis of Autoliv SUV Rollover Tests B190043, B190042, B180220, B180219*, March 30, 2005, at 25, included in Docket No. NHTSA-1999-5572-120 (capitalized emphasis in the original).

⁴ Even though manufacturers oppose the use of such tests for compliance purposes, manufacturers and contractors have presented findings at many technical conferences in which these or similar tests have been used both to conduct rollover research and to validate roof strength and roof designs under the existing standard.

In addition, the agency must ensure that both sides of every passenger vehicle roof can withstand real-world rollover forces without the presence of side window and windshield glazing. Even a quasi-static component test can adopt procedures to simulate real-world worst-case scenarios in which side windows and the windshield are not in place to lend additional support to the roof. The goal must be to ensure that vehicle roofs possess both very high strength and very high rigidity in on-roof rollover crashes so that pillar collapse from compressive, bending, and shear forces is prevented, and roof elasticity or dynamic recoil that occur in actual rollover crashes is kept to a minimum. The goal must be dramatically increased roof and roof supports rigidity. Such a substantially strengthened test is more likely to result in stronger roofs that avoid brief episodes of intrusion during a rollover crash and the infliction of severe head and neck injuries. In turn, these changes to dramatically strengthen and stiffen roofs and their supports will substantially reduce glazing and door retention component failures that open ejection pathways for both restrained and unrestrained occupants.

I. Introduction.

a. Regulatory Background.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), P.L. 102-240 (Dec. 18, 1991) required NHTSA to provide “protection against unreasonable risk of rollovers of passenger cars . . .” ISTEA § 2503(1). The agency issued an advance notice of proposed rulemaking, 57 FR 242 (Jan. 3, 1992), to establish a vehicle stability standard for reducing rollover crashes, but terminated that rulemaking proceeding in mid-1994, 59 FR 33254 (June 28, 1994). At the time, the agency asserted that it did not believe that a single type of rulemaking or other agency action could solve all, or even a majority of, the problems associated with rollover crashes. *Id.* at 33255. Nevertheless, NHTSA stated that it would pursue a range of actions designed to prevent vehicle rollover as well as to make the vehicle compartment much safer for occupants when vehicles did roll over. The actions mentioned included, among others, the adoption of mandatory anti-lock braking systems, anti-ejection glazing, stronger roofs in rollovers, and improved seat belt performance to protect occupants when rollovers occur. On other occasions NHTSA has added integrated seats, improved door latches and hinges, and upper interior side impact protection, particularly the use of dynamic rather than static systems, as countermeasures the agency planned to pursue.

However, in the 11 years since the agency aborted rulemaking on establishing a vehicle stability standard, rollover crashes have continued to increase, and the percentage of light trucks rolling over has expanded in both numbers and percentage as a leading source of occupant fatalities and serious injuries. Anti-ejection glazing, after years of agency investigation, appears to have been rejected for further consideration in favor of upper interior dynamic head protection. Withdrawal of Advance Notice of Proposed Rulemaking, 67 FR 41365 (June 18, 2002). However, the rulemaking proposing requirements that would essentially mandate upper interior head impact dynamic protection systems, such as air bags, restricts compliance to only front-seat occupants, and the benefits extend only to adults. Children under the age of 12 are stated by the agency to be excluded from protection in both front and rear seats, including no benefit in ejection prevention. Furthermore, NHTSA is not requiring that these upper interior air bags or similar technologies remain inflated both to reduce occupant excursion and prevent ejection in rollover crashes.

In sum, when NHTSA closed the vehicle stability standard rulemaking more than 11 years ago, the agency promised that, although it would do nothing in regulation to abate rollover crashes, it nevertheless would make vehicles much safer when they do roll over. But given the continuing increase since 1994 in the numbers and percentage of light trucks in the passenger vehicle fleet, light vehicle occupants in the U.S. are at even greater risk of the lethal consequences of rollovers than they were 11 years ago. Yet, in the interim, NHTSA has failed to act – not a single regulation has been adopted to dramatically reduce the increasing annual losses from rollover crashes, and promising avenues of regulation have been unconscionably delayed, discarded, or undermined by weak proposals.

b. SAFETEA-LU Legislation.

In several important respects, this proposed rule has been overtaken by a statutory mandate to the agency contained in recently enacted legislation, the 2005 *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users* (SAFETEA-LU), P.L. 109-59 (Aug. 10, 2005), which directs NHTSA to undertake several rulemaking actions culminating in final rules by dates certain. SAFETEA-LU states that:

One of the rulemaking proceedings initiated under subsection (a) shall be to establish performance criteria to upgrade Federal Motor Vehicle Safety Standard No. 216 relating to roof strength for driver and passenger sides. The Secretary may consider industry and independent dynamic tests that realistically duplicate the actual forces transmitted during a rollover crash. The Secretary shall issue a proposed rule by December 31, 2005, and a final rule by July 1, 2008.

SAFETEA-LU §10301(a).

The proposed rule as issued by NHTSA argues for an extension of the new requirements of the amended regulation to encompass all motor vehicles up to 10,000 pounds gross vehicle weight rating (GVWR). 70 FR 49224. This argument has been mooted by the legislation which specifies that all the rulemaking actions required by the section, including roof strength, shall result in “rules or standards that will reduce vehicle rollover crashes and mitigated deaths and injuries associated with such crashes for motor vehicles with a gross vehicle weight rating of not more than 10,000 pounds.” SAFETEA-LU Section 10301(a).

Similarly, SAFETEA-LU clearly specifies that the agency’s upgrade of FMVSS No. 216 shall improve roof strength for both the driver and the passenger side of motor vehicles. SAFETEA-LU Section 10301(d). However, the proposed rule prepared for publication by NHTSA in advance of the enactment of SAFETEA-LU requires the proposed compliance test to be conducted on only one side of the roof. The agency asserts that it “does not have enough information to make a decision on the merits of testing both sides of the roof over the front seat area.” 70 FR 49239. In light of the SAFETEA-LU statutory mandate, NHTSA must amend its proposed rule to take into account testing each side of the driver and passenger seating areas for each vehicle.

Finally, the legislation also authorized the DOT Secretary to “consider industry and independent dynamic tests that realistically duplicate the actual forces transmitted during a rollover crash.” SAFETEA-LU §10301(d). However, despite Congressional interest in determining whether dynamic testing that duplicates real-world rollover crashes can be

developed, this proposed rule devotes only a small part of the preamble to the consideration of dynamic tests, and that discussion is both nominal and inadequate.

II. The Current Requirements of The Roof Crush Resistance Standard.

a. The Plate Load Application for Testing Roof Crush Resistance.

The current compliance requirements of FMVSS No. 216 specify that all passenger cars, multipurpose passenger vehicles, and trucks and buses with a GVWR of 6,000 pounds or less must be tested for roof crush resistance by applying a large steel test plate which is pushed down onto the roof over the front seating area at a pitch angle of 5 degrees and a roll angle of 25 degrees. There currently is no simulation of a driver and an occupant in the front seats, such as the use of anthropomorphic test devices (dummies). The vehicle roof structure must withstand a force equivalent to 1.5 times the unladen weight of the motor vehicle by the test plate being displaced downward no more than 5 inches. Under S5 of the standard, the application of force is, however, limited to no more than 5,000 pounds. 70 FR 49224.

The remainder of the current roof crush strength standard primarily specifies the size of the test plate and its angle of application. "In order to simulate vehicle-to-ground contact, the plate is tilted forward at a 5-degree angle, along its longitudinal axis, and rotated outward at a 25-degree angle, along its lateral axis, so that the plate's outboard side is lower than its inboard side. The edges of the test plate are positioned based on fixed points on the vehicle's roof." *Id.* at 49225. However, the placement of the plate differs if the vehicle's roof is raised or altered, or is severely sloped, unless the initial point of contact with the plate is rearward of the front seat area. "For vehicles with conventional roofs, the forward edge of the plate is positioned 254 mm (10 inches) forward of the forwardmost point on the roof, including the windshield trim." *Id.* For certain altered, raised, or aerodynamically sloped roofs, if the initial point of contact is not appropriately rearward of the front seat area, "the test plate was moved forward until its forwardmost edge was positioned 254 mm (10 inches) in front of the initial point of contact."⁵ *Id.* "Consequently, the plate did not apply the force in the location contemplated by the standard, *i.e.*, over the front occupants. In some instances, the test plate was positioned such that the edge of the plate was in contact with the roof, which resulted in excessive and unrealistic deformation during testing." *Id.*

b. Many Vehicles Are Exempt from Being Tested at the 1.5 Times Weight Requirement.

As a result of this maximum applied force limitation, vehicles that begin to approach 6,000 pounds GVWR after passing 3,333 pounds GVWR increasingly are subjected to an application of force that falls below 1.5 times unladen weight. As a result of the decreasing severity of the existing test as vehicles approach 6,000 pounds GVWR, "[t]hat mean[s] that heavier passenger vehicles * * * weighing more than 1,512 kg (3,333 pounds) [are] subjected to less stringent standards." *Id.* at 49236.

This is an especially serious shortcoming of the current standard even considered apart from its other major failings to ensure sufficient roof crush resistance in full rollover crashes. NHTSA points out in this rulemaking notice that the agency's tests of roof crush resistance of a range of

⁵ See, 64 FR 22567 *et seq.* (April 27, 1999).

vehicle weights, including passenger vehicles greater than 6,000 pounds GVWR, showed that heavier vehicles above this threshold experience a greater maximum vertical roof intrusion. *Id.* at 49228. The inherently weak requirements of the existing roof strength standard were actually made worse by the 1991 amendment that extended its requirements only in part to multi-purpose vehicles, trucks, and buses 6,000 pounds or less GVWR.⁶

c. The Current Standard Is a Weak Safety Regulation.

This amendment was an especially imprudent policy choice because it coincided closely with the rapid growth of the portion of the light motor vehicle fleet comprising light trucks, especially sport utility vehicles (SUVs). A very high percentage of these vehicles are greater than 3,333 pounds GVWR and, further, a high percentage were also thoroughly exempt from any compliance testing under FMVSS No. 216. The growing overrepresentation of SUVs in rollover crashes and consequent high rates of deaths and injuries, *id.* at 49227, were actually abetted by this mistaken regulatory decision, and it resulted in the manufacture and use of pickup trucks and SUVs whose roof strength in many instances was poorer than even passenger cars that complied with the full 1.5 times weight test.

In essence, the portion of the vehicle fleet at much greater risk of rollover and subsequent roof failure resulting in disproportionately high levels of deaths and injuries was exactly that portion that either was tested to a lower standard once the vehicle's GVWR passed 3,333 pounds, or was exempt from testing under the regulation. The tragic consequences were an increasing number of deaths and severe injuries sustained year after year in a fleet of vehicles—light trucks—whose market share grew by leaps and bounds in each succeeding year starting in the early 1990s.

d. NHTSA Has Taken No Effective Regulatory Actions to Reduce Rollover Crashes and Resulting Deaths and Injuries.

Yet, during this period of increasing losses from a mounting toll of rollover crashes by light trucks, NHTSA issued no regulations to stem these losses. Following the agency's amendment of the standard in 1991 to include limited application of the test requirements to trucks, buses, and multi-purpose vehicles with a GVWR of 6,000 pounds or less, the only action by the agency during this period was an amendment to FMVSS No. 214 in 1999 that changed the positioning requirements for the test plate applied to the roofs of passenger vehicles over the front seating area for "certain vehicles with aerodynamically sloped roofs." *Id.* at 49225. This action was the agency's response to petitions for rulemaking that argued that "the test plate was positioned such that the edge of the plate was in contact with the roof, which resulted in excessive and unrealistic deformation during testing. Similar problems occurred in testing vehicles with raised or altered roofs."⁷ *Id.*

⁶ *See*, 56 FR 15510 *et seq.* (April 17, 1991).

⁷ Even this change did not satisfy some parts of the manufacturing community. Petitions were filed with the agency in mid-1999 arguing that the secondary plate position still produced rear edge loading onto the roofs of some raised and altered roof vehicles. It was argued that rear edge loading caused excessive deformation "uncharacteristic of real-world rollovers" and even "roof penetration" because the rear edge of the test plate placed in the secondary test position purportedly resulted in unrealistic stress concentration. *Id.* at 49226. NHTSA responds to this request for reconsideration of the April 1999 secondary plate positioning amendment in this rulemaking proposal.

III. The Proposed Rule Has Major Weaknesses.

a. The Proposed Rule Does Not Model a Real-World Rollover Crash.

The proposed rule, if adopted, will continue to allow serious injuries and deaths because it does not adequately represent what actually occurs in rollover crashes. The choice by the agency of a quasi-static test using a plate to apply downward pressure on an upright light vehicle essentially eliminates all the interacting, dynamic forces of a real-world rollover crash that involve roof failures, breaking glass, poor safety belt performance (including spool-out and buckle failure), seat failures, and unlatched doors. Most importantly, these major features of actual rollover crashes are also accompanied by occupant excursion, even by belted passengers, a governing condition of rollover crashes with roof failures that is ignored by the proposed quasi-static test.

The agency's proposed rule, however, takes none of these dynamic outcomes of actual rollover crashes into consideration. Instead, NHTSA has chosen a simple, binary head contact/no-contact pass-fail performance standard that still does not ensure that occupants in actual, on-roof rollover crashes will not suffer serious head and neck injuries. Even conceding, for the sake of argument, the agency's assumption that manufacturers will rely on an additional compliance margin to exceed the final rule's chosen test plate load for compliance, this provides no assurance that occupants will not be subjected to dangerous roof contact in rollover crashes. Vehicles that comply with the proposed revised standard can still suffer roof failures and consequent intrusion that will inflict severe head and neck injuries in real-world rollover crashes.

This proposed rule simply extends and modifies the current regulatory approach of the existing FMVSS No. 216. The fundamental problem with a regulatory approach that dispenses with a dynamic performance test is that a vehicle may pass the proposed no-head-contact test plate procedure with only a small margin of residual space above a test dummy's head. However, that apparent benefit can be overwhelmed and nullified when the occupant is inverted and displaced in a rolling passenger vehicle with a roof that dynamically distorts during the rollover. When those real-world rollover forces are applied, even occupants that are restrained can still suffer impacts with an intruding roof and other interior vehicle components. Passing the proposed no-head-contact compliance test guarantees nothing about avoiding severe head and neck injuries.

b. The NPRM Does Not Propose Other Safety Countermeasures.

Additional and related occupant protection countermeasures that could substantially reduce the lethal character of these interior impacts and occupant ejections, however, have not been adopted by the agency and are not concurrently being proposed as new regulations. These would include pretensioners that remain engaged throughout a rollover crash, other active restraint systems, integrated seats that significantly reduce occupant excursion, upper interior dynamic head impact protection such as air bags with sensors that sustain inflation throughout the rollover, and revised door latching and glazing standards that could dramatically reduce occupant ejections by closing off ejection pathways through these portals. Although NHTSA states that this roof crush resistance rulemaking proposal is part of a comprehensive response or plan to abate rollover crash deaths and injuries, the agency in fact is presently offering none of these countermeasures or other actions that would actually reduce the frequency of rollover crashes,

such as the installation of Electronic Stability Control (ESC) Systems,⁸ as part of the proposed rule.

c. The NPRM Will Not Improve Roof Strength for the Great Majority of Light Vehicles.

The proposed rule is not sufficiently stringent in the demands placed upon roof strength for compliance with the standard. Even assuming the minimum 20 percent additional compliance margin that NHTSA uses in its benefits analysis, the NPRM will grandfather the majority of existing vehicles.⁹ Basically, the new standard for most light vehicle makes and models is a “do nothing” requirement – manufacturers will have to only undertake marginal adjustments to existing designs to make sure that they comply with the proposed rule. Given the agency’s successive reduction of the cohort of occupants who would benefit from adoption of the rule as proposed, the new regulation will do very little to change the annual death tally of 10,000 fatalities each year in rollover crashes.

d. The NPRM Fails to Protect Children in Rear Seats.

The proposed rule would also exclude rear seat occupants from coverage under the revised standard. NHTSA has, in the past, acknowledged a special obligation to protect vulnerable child occupants who are in rear seats. In the context of the upper interior head impact protection regulation, for example, the initial proposed rule required protection only for front-seat occupants, and the benefits extended only to adults. Yet, the agency admirably revised the upper interior head impact protection rule from a front-seat-only set of requirements to extend occupant protection to all occupants in designated seating positions, front and rear.

e. The Proposed Rule Needs Significant Improvements.

It is clear that, as presented, the proposed rule will not afford adequate occupant protection and requires additional compliance criteria to ensure safety in actual rollover crashes. Vehicles can pass the proposed plate test loading of the front of light vehicle roofs by slim margins, that is, with little residual headroom after crush has occurred. In actual rollover crashes, however, the presence of this slim margin of residual headroom becomes just a compliance test artifact

⁸ The NPRM also makes no mention of any intent to establish a stability standard or adopt technologies that will actually reduce the rate and number of annual rollover crashes, especially by light trucks. Although the agency has enthusiastically embraced the value of Electronic Stability Control (ESC) systems to offset the high rollover propensity of especially light trucks such as pickup trucks and sport utility vehicles (SUVs), there is no rulemaking proposal setting a stability standard that must be met by light vehicles that could result in the universal use of ESC systems. NHTSA continues its resistance to adopting any standards that change light vehicle rollover propensity. The NPRM, for example, does not propose the adoption of ESC or of a vehicle stability requirement that essentially would result in the widespread manufacturer installation of ESC. NHTSA is required by SAFETEA-LU Sec. 10301(a) “to establish performance criteria to reduce the occurrence of rollovers consistent with stability enhancing technologies” and to issue a proposed rule by October 1, 2006. However, there is nothing preventing the agency from initiating rulemaking now to require vehicle stability enhancement as part of a comprehensive plan or systems engineering approach to substantially reducing rollover crashes. It should be noted for cautionary purposes that ESC is not a panacea, despite the predictions of dramatically reduced rollover crashes when it is installed in new vehicles. If a vehicle becomes destabilized and begins yaw or lateral acceleration with loss of tire adhesion, it will still be vulnerable to rollovers, especially when the vehicle encounters a tripping mechanism. Furthermore, destabilizing vehicles with ESC can still commonly occur in multi-vehicle collisions which often will still result in rollover crashes.

⁹ NHTSA estimates that only 32 percent of the current light vehicle fleet would need improvements to the proposed 2.5X load test for roof strength. 70 FR 49243.

that bears little relation to what will occur to the occupants in a complying vehicle. In fact, many occupants in vehicles that pass the agency's proposed compliance requirements can be severely injured or killed from roof failures. Consequently, as discussed below, Advocates recommends additional approaches to demonstrating compliance through the quasi-static test proposed in this notice that can substantially strengthen the regulation and provide some additional assurances that the standard will result in reduced roof crush and sufficient occupant survival space during a rollover crash. Nevertheless, even if these measures were adopted they will not prevent the overwhelming number of roof failures occurring in actual rollover crashes that inflict severe, even lethal injuries that could be abated if the agency adopted a stronger standard based on a realistic dynamic test.

IV. Analysis of the Proposed Rule.

a. Occupant Size.

i. There Is a Strong Correlation between Taller Occupants and the Least Amount of Headroom in Existing Vehicles.

NHTSA proposes to apply the plate test at 2.5X load with a 50th percentile male dummy which, when seated in either front outboard designated seating position, represents about 48 percent of standing height.¹⁰ 70 FR 49232. The agency claims that there is no perceptible trend between vehicle headroom and occupant size, and that "taller drivers seem no more likely to be in vehicles with less headroom than do shorter drivers."¹¹ However, the agency itself contradicts this claim, as pointed out in the following paragraph of these comments. NHTSA also deems it "likely" that passengers adjust seat positions and seat backs to prevent uncomfortable proximity to internal vehicle structures such as the roof.¹²

That passengers, or even drivers, adjust seat backs to gain headroom is a supposition without any support in the record. There is no indication that NHTSA has conducted a field survey to determine that this is true. However, Advocates notes that the agency includes a tabulated listing in the Preliminary Regulatory Impact Analysis (PRIA) accompanying the NPRM¹³ of available vehicle headroom by occupant height drawn from Consumers Union. That table shows that occupants that are 6 feet to 6 feet 2 inches tall have a far larger percentage of vehicle headroom that is less than 3 inches than any other cohort: 57 percent of the vehicles surveyed for this height cohort had less than 3 inches, the category used to show the smallest amount of headroom.¹⁴ Therefore, it is, in fact, untrue that there is no perceptible trend between occupant

¹⁰ This seated height percentage is a low percentage of standing height which is not generally accepted in anthropometry, where the general rule is that seated height is about 51-53 percent of standing height. *See, e.g.*, the guidelines used for aircraft boarding chairs in which the seated height of a 95th percentile male is 52.4 percent of standing height and for a 5th percentile female it is 52.2 percent of standing height. <http://www.access-board.gov/research&training>.

¹¹ *Preliminary Regulatory Impact Analysis – FMVSS 216, Upgrade Roof Crush Resistance* (PRIA), at IV-24, Office of Regulatory Analysis and Evaluation, National Center for Statistics and Analysis, National Highway Traffic Safety Administration, August 2005.

¹² *Id.*

¹³ *See supra*, note 11.

size and the amount of available headroom, and that “taller drivers seem no more likely to be in vehicles with less headroom than do shorter drivers.”¹⁵

ii. The Agency Should Consider Using the 95th Percentile Adult Male Dummy for Compliance Testing.

Taller drivers and passengers are at increased risk of head and neck injury in rollover crashes resulting in roof failure. Although the agency claims that a 95th percentile Hybrid III male dummy “is not yet available for compliance purposes[,]” there might be benefits to using the larger dummy for test compliance in the roof crush resistance standard. Although it is true that in many vehicles, headroom will increase with the slope of roofs rearward from the top edge of the windshield, this is also not true for many other vehicles in the light vehicle fleet, even though taller occupants may tend to move their seats to the rear on the fore-and-aft tracks.

Advocates is aware that, if NHTSA were to adopt the 95th percentile male dummy for roof strength compliance purposes, the seat track would be placed in the rearmost position as compared with a mid-track position for the 50th percentile male. Nevertheless, the issue is whether light vehicles such as light trucks that have different roll radii than passenger cars suffer roof failures that are more severe for taller occupants even when seats are placed in the rearmost position. The agency has not adequately accounted for the greater severity of roof failures among many pickup trucks and sport utility vehicles in this rulemaking proposal. The agency should continue to explore whether the 95th percentile adult male dummy could be used along with the 50th percentile dummy.

b. Test Plate Application.

NHTSA proposes the use of a rigid test plate applied at 2.5X vehicle weight with a 5 degree pitch angle and a 25 degree roll angle to determine that there is no-contact with a 50th percentile adult male dummy’s head. 70 FR 49237-49238. The agency also proposes to eliminate the secondary plate location that the agency adopted several years ago for certain raised, altered, and aerodynamically sloped roof vehicles because it “produced rear edge plate loading onto the roof of some raised and altered roof vehicles that cause excessive deformation uncharacteristic of real-world rollover crashes.” *Id.* at 439241. As a result of dispensing with the secondary plate position, “the testing of some raised and altered roof vehicles will result in loading the roof rearward of the front seat.” *Id.* Advocates has several concerns with these test parameters that we point out in the following subsections.

c. The Final Rule Should Retain a Limit on the Amount of Roof Crush.

Elimination of the 5 inches of maximum vertical crush, as is proposed, *id.* at 49236-49237, means that some vehicles could pass this test even though crush exceeds 5 inches.¹⁶ This is a very undesirable outcome that could have serious safety consequences in actual rollover crashes. NHTSA estimates that “32 percent of passenger cars and 49 percent of light trucks with a

¹⁴ *Id.*

¹⁵ In any case, the issue is not properly framed in the PRIA. The amount of available headroom is relevant for both driver and occupant in front seating positions, not just for drivers.

¹⁶ See, G. Rains and M. Van Voorhis, *Quasi Static and Dynamic Roof Testing*, DOT HS 808-873, National Highway Traffic Safety Administration, June 1998. The results of the quasi-static tests show that, for some vehicles, crush would substantially exceed 5 inches but might still pass a 2.5X load test without contacting the head of a 50th percentile HIII dummy.

GVWR under 2,722 kilograms (6,000 pounds) exceed 150 mm (5.9 inches) of vertical roof intrusion. Further, 55 percent of light trucks with a GVWR under 2,722 kilograms (6,000 pounds) and less than or equal to 4,536 kilograms (10,000 pounds) exceed 150 mm (5.9 inches) of vertical roof intrusion.” *Id.* at 49236. Based on those data, NHTSA concludes that the test force should be increased. *Id.* It is contradictory for the agency to base a proposed increase in plate application force on the basis of these tested amounts of vertical intrusion and yet dispense with a test compliance limit on the maximum amount of vertical intrusion.

d. A Stringent Maximum Limit on Roof Crush Is Necessary.

Advocates is not persuaded by part of the agency’s reasoning for eliminating the 5 inches maximum vertical crush distance, *viz.*, that this limit “may impose a needless burden on vehicles with a large amount of occupant headroom.” *Id.* at 49237. This remark strongly suggests that part of the agency’s motivation for eliminating the vertical crush limit is to facilitate manufacturer design choices which, the comment implies, are being restrained or inhibited by the current 5 inch limit. Liberalizing manufacturer design flexibility, especially for styling and marketing purposes, is not a proper agency consideration for removing a regulatory requirement that still serves a useful purpose by ensuring stronger roofs and more survival space in rollover crashes.

Given NHTSA’s resistance to the use of a dynamic test method that will actually show dynamic roof responses to real-world rollovers, Advocates strongly recommends the retention of a maximum crush distance. In fact, a more stringent crush distance, such as a maximum of only 3 inches, should be required in the final rule as a regulatory “floor” underlying the agency’s performance criterion of no head contact. This action would be in accord with the agency’s own expressed view in this rulemaking notice that “positive post-crash headroom (residual space over the occupant’s head after the rollover) reduced the likelihood of suffering a roof contact injury to the head, neck, or face. This real world data shows quantifiable benefits of limiting headroom reduction.” *Id.* at 49237. More importantly, this limit in connection with Advocates’ other recommendations for strengthening this proposal would ensure that roofs are much more rigid and resistant to flexing or elastic recoil in actual rollover crashes. The agency’s contact/no-contact performance criterion for the plate loading test does not necessarily limit headroom reduction in actual rollovers. Instead, headroom reduction can be considerable as long as there is no head contact after completion of the compliance test as proposed.

e. The Agency Properly Discards the False Claim That Rollover Deaths Occur Because Occupants “Dive” into Vehicle Roofs.

Advocates agrees with NHTSA about the need for stronger roofs because it is clear that occupants are injured and killed when a critical amount of vertical survival space is eliminated due to roof failures in rollover crashes. *Id.* at 49237. There is no credibility to the argument that even restrained occupants are severely injured or killed simply by “diving into the roof,” and NHTSA makes it clear in this rulemaking notice that it rejects this rationalization for the causative mechanisms underlying deaths and injuries involving roof crush in rollover crashes. The agency’s evaluation of crash data both from the New Car Assessment Program and from Consumers Union showed that “9 percent of occupants with post-crash headroom above the top[s] of their head[s] experienced roof contact injuries to the head, neck, or face, compared to 34 percent for occupants with post-crash headroom below the top[s] of their head[s].” *Id.* As a result of this evaluation, NHTSA concluded “that positive post-crash headroom (residual space over the occupant’s head after the rollover) reduced the likelihood of suffering a roof contact

injury to the head, neck or face. This real world data shows quantifiable benefits of limiting headroom reduction.” *Id.*

f. Plate Pitch and Roll Angles.

NHTSA claims that it has found no reason from its modified FMVSS No. 216 testing on a Dodge Caravan, Chevrolet S10, and Ford Explorer to disturb the current plate application roll and pitch angles cited earlier.¹⁷ The agency claims that “using 10-45 degree application angles had some additional lateral damage.” *Id.* at 49238. NHTSA found that the damage was localized near the roof side rail and did not extend laterally to the midline of the vehicle, that is, to the midline of the roof. Also, the agency found that the force distribution applied to the front and back of the load plate changed considerably between the two test configurations with the 10-45 degrees application angles applying almost all the force to the forward ram located near the front of the load plate whereas the 5-25 degrees test applied only two-thirds of the force to the front ram. *Id.*

As a result of these tests, Advocates supports the continuing use of the existing 5-25 degrees plate application angles for the initial test of the first side of the vehicle. However, in light of the agency’s single-side test using 10-45 angles, the agency should consider the use of 10-45 in conducting the plate application to the second side of the passenger vehicle. Advocates opposes deleting the secondary plate position for aerodynamically sloped and altered roofs.

Given the considerable differences in roll radius between passenger cars and many light trucks and vans, including vehicles with raised roofs, front-of-roof loading may occur in widely varying ways. Also, the test plate application, by necessity, idealizes compliance responses of vehicles evaluated for roof strength by essentially assuming that loading in a rollover occurs on a flat, level surface. Although the agency has already rejected an attempt to accommodate roof loading and consequent roof failures involving fixed object impacts, the fact remains that many roadsides and even roadways do not have uniformly flat surfaces when a vehicle’s roof is loaded in a rollover crash.

Because roof loading and the amount of roof crush differs among vehicles according to the test plate application angles, Advocates strongly recommends that NHTSA consider whether roofs can be safely loaded by applications of force other than the 5-25 degree angles in the current proposed rule. This could comprise a range of values, including loading up to 10-45 degrees.

g. NHTSA Should Raise the Test Plate Load.

The benefits analysis performed by the agency, with which Advocates disagrees on several grounds, could produce far more lives saved if the agency were to adopt at least a 3.0X test plate load application force. This load limit could produce additional benefits by reducing portal deformation in rollovers that result in door openings, and side window and front windshield glazing breakage and loss. Consequently, partial and complete ejection deaths and injuries could be substantially reduced in comparison with the lack of any benefits in ejection prevention for a 2.5X load application. Advocates will discuss in a later section (*see*, below, Section VI) how the agency’s benefits analysis improperly discards any justification for adopting a 3.0X plate load,

¹⁷ *See*, above, at 4.

and how appropriate changes in the benefits assessment by using a higher value of a life saved would easily justify a higher plate load than 2.5X.

h. The Secondary Plate Position for Certain Vehicles Should Not Be Deleted.

Advocates does not agree with the rearward plate positioning for raised and altered roofs that will result from eliminating the current secondary plate position for aerodynamically sloped, raised, and altered roofs so that the applied plate load is further to the rear of the front seat area. This plate position induces unrealistic loads in that the proportion of force applied to the roof is excessively concentrated over the B pillars. As a consequence, test conditions and roof response to plate loading can be substantially different than the loading that actually occurs in real-world rollover of these vehicles where the A pillars receive a proportionately greater force. This is crucial because some vehicles with severely sloped A pillars are *prima facie* candidates for A pillar collapse in rollover crashes. The percentage of new vehicles with severely raked A pillars and aerodynamically sloped roofs has increased each year since their use began in the early to mid-1990s.

Using the primary plate position for all vehicles, including those with severely sloped, raised, or altered roofs could result in these vehicles passing a head contact/no-contact performance standard, whereas in actual rollover crashes these vehicles would suffer catastrophic roof failure over front seated occupants resulting in deaths and severe injuries. Advocates opposes elimination of the secondary plate positioning requirement. It may also be the case that a different plate angle such as 10-45 on severely sloped, raised, and altered roofs, as indicated above in subsection (f), would avoid the problem of rear edge plate loading.

i. Roof Crush Limit.

NHTSA proposes that the vertical roof deformation or crush distance from application of the test plate not result in contact with the test dummy's head. *Id.* at 49237. Advocates supports this criterion but only in conjunction with a limit on maximum intrusion distance (3 inches), as argued above, and urges the agency to raise the compliance test load to at least 3.0X with a generous compliance margin for its benefits assessment that is greater than the 20 percent margin NHTSA uses for its assessment of equivalent lives saved in using a 2.5X load.¹⁸

j. Roof Crush Resistance Testing Should Be Conducted without the Vehicle's Windshield and Side Window Glazing.

The agency argues that "the vehicle should be tested with all structural components in place." *Id.* at 49239. Advocates strongly opposes the agency's decision to adopt a compliance test with the windshield in place and side glazing raised or in place.¹⁹ *Id.* at 49238. Although subpart S6.1 of the current standard specifies that all windows are closed prior to testing, testing with the

¹⁸ However, the agency is relying upon a non-regulatory factor to strengthen its weak proposed rule. But this non-regulatory compliance margin is not enforceable and can be disregarded as long as a tested vehicle meets the minimum compliance threshold of 2.5X plate loading without head contact. NHTSA's invocation of a supposedly reasonable 20 percent compliance margin for roof crush strength is also confounded by the roof strength tests performed on the Dodge Neon, for example, that show the vehicle barely complying with the 1.5X load required by the current Standard No. 216. *Dodge Neon FEA Model Information*, FHWA/NHTSA National Crash Analysis Center, The George Washington University, October 11, 2005, Docket No. NHTSA-2005-22143-82, at 2.

¹⁹ Some side window glazing can be partially or completely retracted into the door or chassis, other designs open or close horizontally but cannot be retracted, and some side window glazing is fixed in some light vehicle makes and models.

windshield and side glazing in place artificially strengthens roofs undergoing the proposed compliance test. This requirement dramatically weakens the proposed standard even at a force limit of 2.5X.

The agency's argument that even broken windshields may provide some unknown quantum of additional roof strengthening over the front occupant seating area is an inappropriate stance. *Id.* The point is not whether cracked windshields still provide some unknown, additional resistance to roof failure; it is rather the fact that a substantial number and percentage of vehicles in full rollover crashes do, in fact, lose their windshields. Despite the agency's arguments elsewhere in this notice that its proposed quasi-static test purportedly reproduces the roof deformation achieved by dynamic loading, *id.* at 49238, that loading is not accompanied by real-world, translational velocity and other vagaries of actual ground contact by a light vehicle roof that often results in loss of the windshield and consequent roof failure. In real world rollover crashes windshields frequently break or pop out of their frames and side window glazing is shattered. The proposed test procedure, therefore, does not accurately model a significant portion of real-world, worst-case crash scenarios.

NHTSA has a responsibility to adopt a strengthened FMVSS No. 216 that reasonably protects as many people from death and serious injury as feasible, and permitting the use of installed windshields in the proposed plate loading test immediately undermines this responsibility and substantially weakens the lifesaving effects of any final regulation. For this reason, the application of a test plate load must be conducted without windshields in place and with side window glazing retracted or removed.

k. Revised Tie-Down Procedures.

NHTSA proposes to revise the vehicle tie-down method in order to improve test repeatability by specifying that securement is gained by four vertical supports welded or fixed to both the vehicle and the test fixture before the plate loading occurs. 70 FR 49240. This approach, along with attachment methods, appears to ensure less vehicle movement than with chains and jackstands. Advocates supports the proposed revisions.

V. Other Issues of the Proposed Rule.

a. Dynamic Testing.

i. Agency Consideration of Dynamic Testing.

NHTSA has decided in this rulemaking action not to adopt an actual dynamic test for measuring roof strength. Those tests comprise rollover testing launched from a dolly, a test similar to the one provided in current FMVSS No. 208; a "drop" test in which inverted vehicles are allowed to fall to a hard surface from pre-determined heights; a test in which a rotating vehicle is dropped from its suspended position off the rear of a moving semi-trailer; and a simulated rollover event using a rotating vehicle that is applied to a moving track beneath it. *Id.* at 49239-49240. In general, the agency avoids a specific, critical appraisal of the merits of each of these approaches and instead cites or quotes the comments that oppose or support each of these test methods without taking any position on their merits. Overall, NHTSA simply states that it needs additional data, especially on the Jordan Rollover System that mounts a vehicle on a spit and applies the vehicle to a moving track beneath it, and asserts that it is not adopting a dynamic test procedure "at this time." However, the agency does state the view that it "is

unaware of any dynamic test procedures that provide a sufficiently repeatable test environment.” Instead, “the agency believes that the current test procedure is repeatable and capable of simulating real-world deformation patterns.” *Id.* Advocates argued in the summary of our comments, *q.v.*, that the agency is mistaken in accepting claims that the FMVSS No. 208 cannot be rendered a repeatable, objective test for demonstrating actual roof and occupant responses to rollover forces.

ii. SAFETEA-LU Authorizes Specific Consideration of Dynamic Testing.

Section 10301(d) of SAFETEA-LU provides that “[t]he Secretary may consider industry and independent dynamic tests that realistically duplicate the actual forces transmitted during a rollover crash.” Although it is clear that the agency rejects the dynamic tests mentioned in this rulemaking notice, it is not clear that NHTSA has sufficiently met the terms of this part of the roof strength provision. There is not a detailed, specific evaluation in this proposed rule of each potential dynamic test and the precise reasons for rejecting each one. The agency arguably has an obligation not just to cite and quote the reasons of other parties on the untenable or uncertain character of each dynamic test, but to provide its own detailed assessment of why each dynamic test is not acceptable for the record of this rulemaking. Evidence already contained in the history of rulemaking on roof crush resistance shows that the No. 208 rollover cart test can be made objective and repeatable.²⁰

b. The Agency Should Consider Adopting an Energy Absorption Criterion.

NHTSA cites the arguments filed in response to the prior notice on roof crush resistance²¹ by Safety Analysis and Forensic Engineering and Syson-Hille and Associates that peak force attained by the test plate load application is not a sufficient indicator of roof crush resistance “because the peak forces often drop significantly due to breaking glass and other structural failures.” *Id.* at 49236. Accordingly, these organizations recommended that the agency also adopt an energy absorption requirement to prevent roof collapse after the initial peak forces are attained. This subsequent roof failure after structural failures is a realistic portrayal of what actually occurs in rollover crashes. Successful peak load testing resulting in no head contact does not necessarily indicate that severe roof failure would not occur in real-world roof loading during rollover crashes.

The arguments by these organizations for an energy absorption criterion were derived from inverted vehicle drop tests.²² Although NHTSA claims that its quasi-static plate loading is similar to the peak force-to-weight ratios obtained from drop tests, it is difficult to determine the energy absorption standard that should accompany the proposed plate loading compliance protocol. It is crucially important not to rely upon only peak load roof responses in compliance testing, but it is not clear what energy absorption criterion would best serve as a corrective to relying only upon peak loads attained with the plate. Advocates recommends that the agency continue to explore the potential for adding an energy absorption criterion to the proposed compliance procedure.

²⁰ See, M. Bidez, J. Cochran, and D. King, “Roof Crush as a Source of Injury in Rollover Crashes,” *op. cit.*

²¹ 66 FR 53376 (October 22, 2001), Docket No. NHTSA-1999-5572, Notice 02.

²² See, the comments of Safety Analysis and Forensic Engineering dated December 6, 2001, to Docket No. NHTSA-1999-5572-25, Notice 02, esp. at 4-5.

c. The NPRM Does Not Require the Use of Advanced Restraints.

NHTSA recognizes in this rulemaking proposal that occupants in actual rollover crashes experience significant excursion even when properly belted. The agency has used a “rollover restraints tester” (RRT) to evaluate the effectiveness of 3-point lap/shoulder belt systems, D-ring adjustments of the upper anchorages of 3-point belts, seat belt pretensioners, integrated seats, and an inflatable tubular torso restraint (ITTR) in preventing occupant excursion in rollovers. *Id.* The agency reports favorably on the excursion reducing benefits of all these systems, and Advocates strongly supports an occupant excursion performance criterion that could be met with any combination of these countermeasures. However, occupant protection could be considerably enhanced by requiring that upper interior head impact protection dynamic safety systems, such as inflatable tubular restraints and air bags, remain inflated throughout a rollover crash in order to lower head and neck impact severity.

d. The Agency Should Not Grant Exemptions.

NHTSA states its concern “that there may be some low roofline vehicles in which the 50th percentile Hybrid III dummy would have relatively little available headroom when positioned properly in the seat.” *Id.* at 49237 (footnote omitted). The agency goes on to explain that even minimal deformation of the roofs of these vehicles from the proposed test load would result in head contact. As a consequence, NHTSA wants comments on whether there would be any additional or substitute requirements that would make the standard “practicable.” *Id.* at 49237-49238.

Advocates strongly opposes any exemption or weaker standard to govern low roofline vehicles. The majority of these light vehicles are small sports cars. There is no justification for subjecting the occupants of these vehicles to weaker roofs that can kill them in rollover crashes. This is analogous to the agency’s decision several years ago to exempt vehicles with removable doors from having to comply with the lower interior side impact Standard No. 214. In contrast, the agency acted affirmatively in the case of upper interior head impact protection in its final regulatory decision on FMVSS No. 201 to extend protection from head injury with upper interior components to all occupants in designated seating positions. Advocates does not regard it as “practicable” for occupants of low roofline passenger vehicles to be subject to a greater risk of severe injury or death just because they happened to choose such a light vehicle. It is inconsistent for the agency to insist that vehicles with ties between the A- and B-pillars should now be subject to a roof crush resistance standard while demonstrating a willingness to weaken the standard for low roofline vehicles.

If the intent of the standard, and the amendments proposed in the NPRM, is to provide some baseline margin of occupant safety from roof contact, then the agency undercuts its safety rationale for the proposed rule by exempting vehicles in which attaining a no-contact condition is either difficult or inconvenient. NHTSA should not grant any exemptions to low roofline vehicles or accommodate them with a weaker standard in any final regulation. This is simply inequitable treatment of vehicle occupant safety that cannot be justified. Similarly, Advocates opposes the agency’s continuing acceptance of a substantially lower level of safety for convertibles in rollover crashes. There is no reason why the agency cannot establish rollover performance requirements that will prevent occupant ejection and head-neck injuries in rollovers of convertibles. This market segment has gained new popularity in recent years, and the agency

has a responsibility to forge innovative solutions that provide equivalent safety to the occupants of convertibles in rollover crashes.²³

NHTSA also proposes allowing final stage manufacturers to certify non-chassis-cab vehicles to the roof crush requirements of Standard No. 220. *Id.* at 49235. Advocates opposes the use of this weak standard whose effects on roof strength in actual rollover crashes is mostly unknown. Advocates also opposes any decision by the agency to exempt any vehicles, such as 15-passenger vans, from a final regulation increasing the stringency of the quasi-static roof crush resistance test if they exceed 8,500 pounds GVWR. *Id.*

VI. The NPRM Benefits Analysis Is Inadequate and Incomplete.

a. The Small Amount of Benefits Claimed by the Agency Are the Result of a Very Weak Proposed Rule.

The proposed rule will allow rollover crashes to occur at virtually the same level as they have in recent years – annually resulting in 10,000 deaths²⁴ -- while saving just a few lives by changing some features of the current roof crush resistance standard. Even before the benefits analysis is performed, the agency has radically reduced the potential benefits of the rule by severely circumscribing the types and number of crashes in which a stronger roof standard would provide protection.

i. The Agency Excludes Almost All Rollover Deaths from Being Prevented by a Stronger Roof Crush Resistance Regulation.

In the NPRM, NHTSA performs an elaborate exercise of showing what portion of the annual fatalities due to rollover crashes can be addressed by a stronger roof standard. This number is far smaller than the total of 10,000 deaths each year from rollovers. *Id.* at 49227. After taking into account unrestrained occupants who are ejected; rollover crashes involving deaths which nevertheless did not result from full, on-roof rollovers (2 or more quarter-turns); rollovers involving especially severe roof failure due to roof collisions with fixed objects; rollovers of only non-convertible light vehicles; front-seat occupants only²⁵; and occupants whose maximum injury resulting in death was not due to roof contact, NHTSA concludes that there are 807 seriously injured and 596 fatally injured belted occupants involved in rollovers resulting in roof intrusion and roof contact that can be mitigated by revising the roof crush resistance standard. *Id.* at 49229.

²³ After a period of low production numbers for convertibles, consumer acceptance of convertibles has rebounded with the manufacture of more makes and models, with corresponding increases in sales and market share. According to R.L. Polk and Co., more than 315,000 convertibles were registered in the U.S. in 2004, and the increase in the convertible market of 6.3 percent in 2004 was far above the increase of light vehicle market registrations of 1.4 percent. Convertibles are very close to being 2 percent of the overall light vehicle market. *See* <http://www.theautochannel.com/news/2005/03/24/020195.html>.

²⁴ It should be noted that the agency asserts that annual deaths in recent years have averaged 9,942 fatalities in “272,925 non-convertible light duty vehicle rollover crashes.” *Id.* at 49227 (footnote omitted, emphasis supplied). When soft-top and full convertible deaths are added to this figure, fatalities average approximately 10,000 or more deaths each year. *Fatality Analysis Reporting System 2001 – 2004*.

²⁵ The proposed amendments to the test requirements address only roof strength for front-seat occupants, as does the current FMVSS No. 216.

Therefore, the potential benefits of this rulemaking can affect deaths and injuries of only a portion of what is already only about six (6) percent of the number of annual deaths of occupants in rollover crashes that the agency believes are killed directly due to roof crush and roof contact. Of these 596 fatally injured occupants, NHTSA claims that only 13 fatalities will be prevented by its proposed amendments to FMVSS No. 216. *Id.* at 49242. This means that of the 9,942 (on average) non-convertible rollover deaths that occur each year, this rulemaking proposal will save 0.13 percent, that is, scarcely more than one-tenth of one percent of fatalities. It is hard to see how such an impoverished response to a safety problem of the magnitude of the annual rollover safety problem of thousands of deaths and tens of thousands of serious injuries could be argued to be a key component of a “comprehensive plan” to dramatically advance rollover safety. In fact, this benefits judgment on the value of the proposed roof strength amendments is an embarrassing commentary on the agency’s willingness to adopt lifesaving countermeasures to end the public health epidemic of rollover fatalities.

ii. The Benefits Analysis Relies upon an Agency Decision not to Reduce Occupant Ejections in Rollover Crashes.

Use of advanced glazing would also substantially help prevent occupant excursion outside the vehicle envelope to reduce partial ejection trauma. NHTSA’s statement of “[c]ontinued focus on ejection mitigation measures, such as side curtain airbags and rollover sensors[.]” provides little comfort for occupants who can continue to be ejected from passenger vehicles in rollover crashes even with the agency’s adoption of the proposed rule on roof crush resistance as published for public comment. Similarly, the agency has continued to fail to address the issue of the inherently inadequate forkbolt latch design for passenger vehicle doors, and the tendency of doors using this design approach, that has been applied universally by vehicle manufacturers since the middle 1960s, to fail when they are deformed by both the vertical and orthogonal forces commonly applied in rollover crashes with at least two quarter-turns.

Moreover, the proposed rule does not ensure that roof integrity will be preserved to the extent that available ejection portals, such as windshields, side windows, and doors will not suffer distortion and result in being opened so that there are unimpeded pathways for occupant ejection.²⁶ In large part, this is due to the agency’s test protocol that measures compliance only

²⁶ NHTSA itself recently provided a good summary of the losses suffered each year that this roof crush resistance proposed rule will scarcely alter if adopted as proposed:

Studies have shown that the fatality rate for an ejected vehicle occupant is three times as great as that for an occupant who remains inside of [*sic*] the vehicle. The best way to reduce ejection is for occupants to wear their safety belts. However, of the 5,400 ejected fatalities through front side windows, 2,200 are from partial ejections. Fatal injuries from partial ejection can occur even to belted occupants, when their head protrudes outside the window and strikes the ground in a rollover or even the striking vehicle prior to the rollover.

Door latch integrity is also a significant contributor to vehicle occupant ejection in rollover crashes. Every year, 1,660 fatalities and 1,970 seriously injured occupants are ejected through a door and 535 fatalities and 1,200 serious injuries occur in rollover crashes. About two-thirds of all door openings in these crashes involved structural damage to the latch and/or striker (the metal plate attached to the door pillar where the latch enters, securing the door).

Initiatives to Address the Mitigation of Vehicle Rollover, National Highway Traffic Safety Administration, June 2003, at 12. None of these losses are counteracted by the roof crush proposed rule of this docket, and there are no pending rulemaking actions proposing countermeasures to offset these vehicle design and performance failures and reduce occupant ejection deaths and injuries.

by the failure of the head of a 50th percentile male occupant to be contacted by roof intrusion when the test plate is applied for all vehicles up to 10,000 pounds GVWR with a force of 2.5X vehicle weight.

iii. The Benefits Analysis Shows That Compliance With the Proposed Rule Will Still Result in Thousands of Ejected Occupants.

In itself, this plate loading test does not guarantee anything about the adequate structural integrity of a roof in a full rollover crash, especially a rollover that involves more than a single on-roof application of force. In fact, some vehicles may pass the agency's crush test so that the test dummy's head is not contacted and yet experience severe deformation of the vehicle compartment so that ejection portals are opened in real-world rollover crashes. This is one of the main reasons why Advocates finds the agency's benefits assessment to be unacceptable in that the agency has excluded any ejection prevention value from its proposed roof crush resistance test.

Advocates strongly supports a roof strength test that specifically demonstrates that broken side windows, broken sun/moon roof panels, doors that open because of latch failures, and broken or missing windshields are not made available as occupant ejection pathways in rollover crashes. As discussed earlier, a dramatically improved strength test could result in fewer available ejection pathways if the agency tested roof crush resistance with windshields removed and side glazing retracted or removed prior to application of the plate load. However, because NHTSA's proposal does not provide specific ejection prevention benefits, it does not include them in the benefits assessment of its proposed roof strength regulation.

b. The Basis for the Benefits Assessment Is Inadequate and Underestimates the Value of a Life Saved.

i. The Number of Cases Relied Upon for Producing the Benefits Analysis Is Extremely Small.

Part of the basic problem with the agency's benefits analysis in the PRIA is that NHTSA's basis for calculating benefits is extremely slender: "[B]ecause we narrowed the case sample to reflect specific crash characteristics, the agency has a very limited sample of relevant cases at its disposal."²⁷ *Id.* at 49242. This means that slight differences in the selected cases and changes in the variables of interest that govern them would produce fairly dramatic changes in the benefits assessment, given the exceedingly small sample of cases relied upon to construct the benefits analysis.

As a result of its benefits analysis using these criteria, NHTSA judges that the application of a 2.5X load in the proposed compliance test would save 39 to 55 "equivalent fatalities," while a 3.0 load factor would prevent from 122 to 171 equivalent fatalities.²⁸

²⁷ Serious questions have been raised about whether many of the cases relied upon by the agency are even legitimately relevant to Standard No. 216 roof failures. Because a high percentage of these cases may not be relevant to roof crush resistance, the agency may have no legitimate basis for the entire benefits analysis it uses to justify this rulemaking proposal.

²⁸ PRIA at VII-3. An equivalent fatality is the product of NHTSA's judgment that several non-fatal injuries at various levels of severity when combined are equal to a death, as calculated by using the hierarchy of injury severity in the Maximum Abbreviated Injury Scale (MAIS). *See*, PRIA at VII-1—2.

This finding is not only extremely sensitive to the nature of the few cases relied upon by the agency for judging the value of the proposed roof strength test, it also relies on accounting principles of the present discount value of equivalent fatalities and the value chosen of a statistical life saved. NHTSA has performed the benefits calculations for both a 2.5X load and a 3.0X load in the proposed regulation, and uses a value of \$3.5 million per statistical life saved in valuing reductions in premature fatalities. The agency acknowledges, however, that “[m]ore recent studies indicate that higher values may be justified.”²⁹

ii. The Benefits Analysis Underestimates the Statistical Value of a Life Saved.

Not only more recent studies, but other, prior studies have often valued a life saved at far higher figures than relied upon by NHTSA. With respect to recent studies, Costa and Kahn (2003) provided an overview of specific studies showing changes in the value of a life, and her summary review shows numerous studies examining years during even the 1960s, 1970s, and 1980s that found value of life estimates ranging up to 3 to 10 times greater than used by NHTSA for benefits assessments.³⁰ Similarly, Dockins *et al.* (2004) of the Environmental Protection Agency also show that mean predicted values of a life are often far higher than used by NHTSA in this rulemaking, often nearly 3 times greater.³¹ Other estimates, such as the well-known values reached by Moore and Vicusi (1990) and Olson (1981), range between \$15 and \$25 million.³² The survey by Ted Miller (1999) of variations between countries in assigning values of a statistical life also shows far higher values in many countries.³³

iii. The Benefits Analysis Ignores Realistic Assessments of the Value of a Life.

The benefits analysis performed by the agency to justify this rulemaking proposal ignores other measures of the value of life that takes the cost of losses of functional capacity and quality

²⁹ PRIA at VII-4—5. The PRIA, in footnote 29, cites the reliance upon the value of a life quantification for its benefits assessment taken from a document entitled, *Revised Departmental Guidance, Treatment of Value of Life and Injuries in Preparing Regulatory Evaluations*, Memorandum from Kirk K. Van Tine, General Counsel and Linda Lawson, Acting Deputy Assistant Secretary for Transportation Policy to Assistant Secretaries and Modal Administrators, January 29, 2002. However, although Advocates inquired about this policy by contacting personnel listed at the start of the rulemaking preamble for this proposed rule both by telephone and by e-mail, it has not been made available for public evaluation.

³⁰ D. Costa and M. Kahn, *Changes in Value of Life, 1940-1980*, National Institutes of Health, October 23, 2003. Also see, S. Madheswaran, *Valuations of Statistical Life: A Brief Bibliographical Survey*, Institute for Social and Economic Change, Bangalore, India, September 2004.

³¹ C. Dockins, *et al.*, *Value of Statistical Life Analysis and Environmental Policy: A White Paper*, U.S. Environmental Protection Agency (EPA), April 21, 2004. The EPA itself has relied since 1999 on a value of statistical life estimate of \$6.2 million in 2002 dollars for most of its economic analysis, and recently has used an estimate of \$5.5 million in 2003 dollars in air quality regulation. See, *id.*, at 18.

³² See, M. Moore and W. Vicusi, “Discounting Environmental Health Risk: New Evidence and Policy Implications,” *Journal of Environmental Economics and Management*, 1990, 18:52-62; C. Olson, “An Analysis of Wage Differentials Received by Workers on Dangerous Jobs,” *Journal of Human Resources*, 1981, 16(2):167-185. Also see, J. Mrozek and L. Taylor, *What Determines the Value of A Life? A Meta-Analysis*, Georgia State University, Atlanta, Georgia, August 29, 2001.

³³ T. Miller, “Variations between Countries in Values of Statistical Life,” *Journal of Transport Economics and Policy*, November 1999, 34(Pt.2):169-188.

of life into account. For example, the HARM scale for measuring the cost of different types of injuries and their severity would result in a far higher assessment of the value of a life saved in rollover crashes.³⁴ In the HARM system of costs and benefits estimation, each level of the Abbreviated Injury Scale (AIS) has a prescribed social cost.

This rulemaking does not provide an opportunity for Advocates to fully address NHTSA's value of an equivalent life saved figure of \$3.5 million, but it will have to suffice that this figure relied upon by the agency varies strongly towards the lower end of such estimates as compared with even other departments and agencies in the federal government and also ignores other methods of valuing life. As a consequence, even if other assumptions were not varied, the agency's benefits assessment using this low value of a life figure when compared with the costs to manufacturers conducted in the ensuing section the PRIA result in a negative benefits outcome for the use of a 3.0X load in conducting roof strength compliance. If a somewhat but not excessively higher value of a life figure were used, the 3.0X load factor would pass muster for positive benefits even using the basis assumed by NHTSA for calculating benefits which, as Advocates indicated above, is extraordinarily weak and inadequate.

Conclusion.

Although Advocates strongly supports a dynamic test that reveals actual vehicle and occupant responses to rollover crash forces, NHTSA's proposed quasi-static test can be strengthened in several ways to ensure far better protection in rollover crashes. The agency needs to add major features to the proposed rule that include a stringent, maximum crush distance and an increase of the plate load for the test to at least 3.0X GVWR plus occupant (dummy) weights. While we fully support the agency's inclusion of vehicles to meet an upgraded standard that have ties between A- and B-pillars, we believe that the standard should be extended to convertibles, and we oppose exemptions for low roofline vehicles. Advocates also opposes the adoption of a weaker standard for non-chassis-cab vehicles and for vehicles above 8,500 pounds GVWR.

Most importantly, this rulemaking action by itself cannot accomplish a dramatic decrease in annual deaths and injuries from rollover crashes until NHTSA sets a vehicle stability standard that will impel the universal manufacturer installation of appropriate ESC systems. In addition, since rollover crashes will still occur, even with increased vehicle stabilizing technologies, the agency also must accompany this rulemaking action with complementary regulations that ensure sustained inflation of required upper interior air bags or other dynamic passive restraints, and substantially improved seat belt designs and seats that reduce occupant excursion and displacement.

Finally, the agency has to set a roof crush resistance standard that limits the potential for windshield, side glazing, and door failures that create available pathways for occupant ejection in rollover crashes. Once again, a complementary regulation is needed to adopt advanced glazing

³⁴ See, A. Malliaris, R. Hitchcock, and M. Hansen, "HARM Causation and Rankin in Car Crashes," SAE 850090 1985; K. Digges, A. Malliaris, and H. DeBlois, "Opportunities for Casualty Reduction in Rollover Crashes," Proceedings of the International Technical Conference on the Enhanced Safety of Vehicles (ESV)," Paper No. 94-S5-0-11, 1994. For the latest application of the HARM metric to far-side rollover occupant injury, see, H. Gabler *et al.*, "Side Impact Injury Risk for Belted Far Side Passenger Vehicle Occupants," SAE Paper No. 2005-01-0287, April 2005.

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that will stop occupant ejections through side windows and sun/moon roofs even when the window glazing is closed or raised. Additional regulation is needed to prevent door retention component failures when rollover distortion is applied to side doors and rear hatches.

This rulemaking proposal as offered for public comment is an insufficient response to the chronic safety problem roof failures in rollover crashes, and needs, at a minimum, to be revised as suggested in the foregoing comments.

Respectfully submitted,

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