

AUTO ALLIANCE

DRIVING INNOVATION[®]

Statement of the
**Alliance of
Automobile
Manufacturers**

For the:

**Oversight Hearing on
Passenger Vehicle
Roof Strength**

Before the:

**Subcommittee on
Consumer Affairs,
Insurance, and
Automotive Safety**

of the

**Senate Commerce,
Science and
Transportation
Committee**

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INTRODUCTION

Thank you Mr. Chairman and members of the Subcommittee. My name is Robert Strassburger and I am Vice President of Vehicle Safety and Harmonization at the Alliance of Automobile Manufacturers. The Alliance of Automobile Manufacturers (Alliance) is a trade association of ten car and light truck manufacturers, including BMW Group, Chrysler LLC, Ford Motor Company, General Motors, Mazda, Mercedes-Benz, Mitsubishi Motors, Porsche, Toyota and Volkswagen. Within Alliance membership, safety is our highest priority. Ours is a high-tech industry that uses cutting-edge safety technology to put people first. In fact, automakers invest more in research and development than any other industry, including pharmaceuticals and computers, according to the National Science Foundation. In 2005 alone, automakers invested \$40 billion, roughly \$2,400 for every car and light truck sold in the U.S. that year. We support NHTSA's comprehensive plan to further reduce rollover-related injury risks, including strengthening vehicle roofs, and we are proud of our successes in voluntarily introducing critical safety advancements that help drivers avoid rollovers and enhance occupant protection in rollover crashes.

INDUSTRY, CONSUMERS and MOTOR VEHICLE SAFETY

Advancing motor vehicle safety remains a significant public health challenge – one that automakers are addressing daily, both individually and collectively. Most of the new, significant safety features currently available on motor vehicles in the U.S. – antilock brakes, stability control, side airbags for head and chest protection, side curtains, pre-crash occupant positioning, lane departure warnings, radar use for collision avoidance were implemented voluntarily by manufacturers, not as a result of any regulatory mandate. The industry is engaged in high-tech research and implementation of new safety technologies, such as autonomous braking systems and vehicle safety communications systems for crash avoidance. Claims that vehicle safety will not be advanced in the absence of regulatory requirements simply do not reflect the reality of the current market place. Before addressing specific measures to address rollover crashes and injuries, it is important to understand the industry's approach to motor vehicle safety. There are several principles to which the industry adheres.

First, we consider motor vehicle safety to be a public health challenge. Collisions result in a human toll – approximately 42,000 fatalities and 3 million injuries per year – and account for an estimated \$230 million in direct economic loss. This is why we work to improve safety. The causes of these fatalities, injuries, and crashes vary between driver behavior or attention errors, to roadway and vehicle hazards. Addressing the causes of motor vehicle crashes therefore requires a comprehensive and system-wide approach that encompasses driver, vehicle, and environmental factors.

Second, as with any public health challenge, it is essential to base policy and improvement initiatives on sound science and a robust understanding of crash and injury causation and effective countermeasures. It is also important to use good science in identifying and prioritizing specific opportunities for improvement. To do so, high-quality data about the occupant and injury morphology, the environment in which collision events occur (roadways), and the vehicle are necessary. Therefore, we support the collection and analysis of collision data and the prioritization of collision problems by measures of harm (numbers of fatalities, serious injuries, total economic cost, lost days of productivity, etc.). Such understanding and information should inform and prioritize public policy initiatives aimed at enhancing motor vehicle safety.

Third, safety resources should be expended so as to maximize the safety benefits, wherever possible, per dollar expended on safety.

ALLIANCE MEMBERS' VOLUNTARY ACTIONS TO MITIGATE ROLLOVER INJURIES AND FATALITIES

ROLLOVER CRASHES

According to crash data collected and compiled by the NHTSA, rollovers comprise approximately 3 percent of all light passenger vehicle crashes and account for almost one-third of all occupant fatalities in light vehicles. Rollover fatalities are strongly associated with the following factors:

Factor	Percentage
Single Vehicle Crash	83
Rural Crash Location	60
High-speed (55 mph or higher) Road	72
Nighttime	66
Off-road tripping/tipping Mechanism	60
Young (under 30 years old) Driver	46
Male Driver	73
Alcohol-related	40
Speed-related	40

NHTSA has estimated that approximately 64 percent of about 10,000 occupants fatally injured in rollovers each year are injured when they are either partially or completely ejected during the rollover. Approximately 53 percent of the fatally injured are completely ejected, and 72 percent are unbelted. Most of the fatally injured are ejected through side windows or side doors. Those who are not ejected, including belted occupants, are fatally injured as a result of impact with the vehicle interior.

Further, agency data indicate that in 95 percent of single-vehicle rollover crashes, the vehicles were tripped, either by on-road mechanisms such as potholes and wheel rims digging into the pavement or by off-road mechanisms such as curbs, soft soil, and guardrails. Eighty-three (83) percent of single-vehicle rollover crashes occurred after the vehicle left the roadway. Five (5) percent of single vehicle rollovers were “untripped” rollovers. They occurred as a result of tire and/or road interface friction.

COMPREHENSIVE PLAN TO ABATE ROLLOVER INJURIES and FATALITIES

NHTSA’s proposal to upgrade its safety standard on roof crush resistance is just 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. The other parts of this plan are:

- Vehicle actions reducing the frequency of rollovers – for example, by improving vehicle stability and control;
- Vehicle actions reducing occupant ejections – for example by introducing side curtain air bags and increasing safety belt use; and
- Consumer education.

With the adoption of the provisions of SAFETEA-LU, Congress ratified this comprehensive plan. Section 10301 of this act directed NHTSA to complete rulemakings to “reduce vehicle rollover crashes and mitigate deaths and injuries associated with such crashes.” The objective of this plan is to, first, help vehicle operators avoid driving situations that may lead to a rollover – a loss of directional control followed by a tripping of the vehicle by a curb, or soft earth, etc., and second, reduce injury to vehicle occupants during rollover events when they occur. NHTSA has taken or is taking the following actions to implement this plan:

Comprehensive Rollover Fatality & Injury Mitigation Actions			
Action	Congressional Mandate	Federal Register Cite	Implementation Date
Dynamic Rollover NCAP	P.L. 106-414	68 Fed. Reg. 59250	MY 2004
Door Latches and Locks	P.L. 109-59	72 Fed. Reg. 5385	MY 2010
Electronic Stability Control	P.L. 109-59	72 Fed. Reg. 17236	MY 2012
Side Impact Protection	P.L. 109-59	72 Fed. Reg. 51908	MY 2013
Roof Strength	P.L. 109-59	Due 07/01/08	tbd
Occupant Containment	P.L. 109-59	Due 10/01/09	tbd

ALLIANCE MEMBERS HAVE VOLUNTARILY TAKEN A NUMBER OF ACTIONS IN FURTHERANCE OF NHTSA’S COMPREHENSIVE PLAN

The Alliance supports NHTSA’s comprehensive plan to further reduce the risks related to vehicle rollovers, including (1) reducing the occurrence of rollover crashes, (2) keeping occupants inside the vehicle when rollovers occur, and (3) enhancing protection of occupants inside the vehicle during a rollover. Alliance members are committed to making progress on the introduction of systems that will lead to reductions in rollover injuries. Members have voluntarily taken a number of proactive steps in furtherance of these goals. These actions are described briefly below.

Reducing the Occurrence of Rollover Crashes

Electronic Stability Control

By far, the most effective strategy for reducing rollover injuries is crash avoidance. Electronic Stability Control (ESC), a proven crash avoidance system, was voluntarily introduced by Alliance members and the volume of vehicles with ESC is rising rapidly. As of Model Year 2008, 81 percent of the new light vehicle models on sale are available with ESC (61% standard; 20% optional). The percentage of MY 2008 SUVs with ESC available is even higher. Ninety-five percent of MY 2008 SUVs are available with ESC (93% standard; 2% optional). This is well in advance of MY 2012 when such systems will be required.

ESC systems use automatic, computer-controlled braking of individual wheels to assist the driver in maintaining control (and the vehicle’s intended heading) in situations where the vehicle is beginning to lose directional stability (*e.g.*, where the driver misjudges the severity of a curve or over-corrects in an emergency situation). In such situations (which occur with considerable frequency), intervention by the ESC system can assist the driver in maintaining control of the vehicle and keeping it on the roadway, thereby preventing fatalities and injuries associated with run-off-the-road crashes that frequently

involve rollover or collision with various objects (e.g., trees, highway infrastructure, other vehicles). NHTSA estimates that ESC will prevent roughly half of all rollovers in passenger cars and light trucks.

Lane Departure Warning Systems

Some Alliance members have begun to install lane departure warning (LDW) systems. When a drowsy or otherwise impaired or distracted driver begins to drift out of the lane of travel, either into another lane or off the road, the LDW system alerts the driver by vibrating the steering wheel or seat, emitting an audible or visual warning, or by other means. Some systems can also brake selected wheels to nudge a vehicle back in lane. The potential benefit of LDW systems is to prevent head-on crashes, sideswipes, and run-off-the-road crashes which can lead to rollovers or impacts with off-road objects. LDW systems may be able to reduce such events by 25 to 30 percent.

Keeping Occupants Inside the Vehicle During a Rollover and Enhancing Protection of those Occupants

Enhanced Side Impact Protection

In December 2003, auto manufacturers committed to a plan developed by an international group of safety experts for enhancing the crash compatibility of passenger cars and light trucks. The plan established new performance criteria for further enhancing occupant protection in front and side crashes between cars and light trucks. It also defined research programs to investigate future test procedures and performance criteria. The Insurance Institute for Highway Safety (IIHS) facilitated the development of this plan with the sponsorship of the Alliance. By September 2009, 100 percent of each participating manufacturer’s applicable vehicles will be designed to these criteria. However, participating auto manufacturers began implementing the front-to-front and front-to-side performance criteria immediately upon industry’s agreement. Manufacturers’ recent progress in implementing this commitment is described below.

Approximate Percentage of Production Designed in Accordance w/Performance Criteria			
Crash Mode	Production Year	Production Year	Production Year
	2005	2006	2007
Front – to – Side	33%	53%	71%
Front – to – Front	62%	75%	81%

The front-to-side crash component of the commitment established performance criteria to further enhance head protection for people riding in passenger vehicles that are struck in the side. As of Model Year 2008, 76 percent of the new light vehicle models on sale are available with side curtain air bags (63% standard; 13% optional). The percentage of MY 2008 SUVs with side curtain air bags available is even higher. Ninety-seven percent of MY 2008 SUVs are available with side curtain air bags (91% standard; 6% optional). Side curtain air bags provide some ejection mitigation benefits in rollovers.

Occupant Containment Systems

Ejection is the most common source of serious injuries and fatalities in rollover crashes. With input from a separate rollover sensor, side curtain air bags can be designed to also deploy as rollover air

bags in the event of a rollover. Rollover air bags stay inflated longer to help keep occupants inside the vehicle during a rollover. The Alliance estimates that approximately one-quarter of the side curtain air bags available on MY 2008 models are fitted with rollover air bags.

Safety Belt Reminder Systems

Safety belt use is critical to reducing rollover-related fatalities and injuries. While safety belts are, overall, 45 percent effective in reducing fatalities in passenger cars and 60 percent effective in light trucks and SUVs, their greatest benefit occurs in rollovers. NHTSA data show that safety belts are 74 percent effective in reducing fatalities that occur in passenger car rollovers, and are 80 percent effective in reducing rollover fatalities in light trucks and SUVs. Thus, any comprehensive program to address fatalities in rollovers must begin with improving safety belt use, especially since the data show that approximately 72 percent of the people killed or injured in single-vehicle rollovers are unbelted.

Alliance members are voluntarily installing vehicle-based technologies to encourage safety belt usage. Research on one system deployed in the United States by an Alliance member found a statistically significant 5 percentage point increase in safety belt use for drivers of vehicles equipped with that system compared with drivers of unequipped vehicles. NHTSA estimates that a single percentage point increase in safety belt use nationwide would result in an estimated 280 lives saved per year. Beginning in model year 2004, all members of the Alliance began voluntarily deploying various vehicle-based technologies to increase safety belt use. Eighty-five percent of model year 2006 cars and light trucks were equipped with safety belt reminder systems.

Other Actions to Mitigate Rollover Injuries and Fatalities

Primary Enforcement Belt Use Laws

Alliance members' support (totaling \$33 million) of the Air Bag and Seat Belt Safety Campaign conducted from 1996 – 2007, helped to achieve a more than 20 percentage point increase in the national safety belt use rate, to a highest-ever level of 82.4 percent in 2007. The Campaign's work led to the national adoption of the Click It or Ticket program, supported by national and state advertising and significant commitments from the law enforcement community. In addition, the Campaign worked throughout its tenure for the adoption of primary enforcement seat belt laws in the states. States with primary enforcement laws have average safety belt usage rates approximately 11 percentage points higher than states having secondary enforcement laws. In 1996, when the Campaign started, only 11 states covering 38 percent of the nation's population had primary enforcement laws. Currently, 26 states and the District of Columbia have these laws, covering more than two-thirds of the population. Impressively, the latest data shows that 12 states, led by Hawaii at 97.6 percent, have belt use rates above 90 percent. Unfortunately, three states still have belt use rates below 70 percent.

Campaign to Eliminate Drunk Driving

Because approximately 40 percent of the fatalities occurring in rollovers annually are alcohol-related, abating drunk driving will also help to reduce rollover fatalities and injuries. In November 2006,

the Alliance joined with the U.S. Department of Transportation, the Insurance Institute for Highway Safety (IIHS), the Governors Highway Safety Association, The Century Council, the Distilled Spirits Council of the United States (DISCUS), and the International Association of Chiefs of Police, to support MADD’s Campaign to Eliminate Drunk Driving. The Campaign is pursuing the adoption of state laws mandating the installation of alcohol ignition interlocks (breathalyzers) on vehicles driven by convicted drunk drivers. In New Mexico – the first state to adopt such a mandate – alcohol-involved crashes are down 30 percent, injuries are down 32 percent, and fatalities are down 22 percent.

NHTSA’s ROOF STRENGTH RULEMAKING

Turning to the matter at hand, as part of a comprehensive plan for reducing the serious risk of rollover crashes and the risk of death and serious injury in those crashes, NHTSA has proposed to amend the agency’s safety standard on roof crush resistance – FMVSS 216 – in several ways. First, NHTSA has proposed to extend the application of the standard to vehicles with a Gross Vehicle Weight Rating (GVWR) of 10,000 pounds or less (the current rule limits applicability to vehicles with a GVWR of 6,000 pounds or less). Second, the agency has proposed to increase the applied force to 2.5 times each vehicle’s unloaded weight, and to eliminate the existing 5,000 pound limit on the force applied to passenger cars. Third, the agency has proposed to replace the current limit on the amount of allowable roof crush with a new requirement prohibiting roof contact with the head of a seated test dummy representative of a mid-size adult male occupant. A summary of the current and proposed roof strength requirements is given below.

FMVSS 216, “Roof Crush Resistance”			
	Existing Standard	NPRM	SNPRM
Applicability	GVWR ≤ 6,000 lbs.	GVWR ≤ 10,000 lbs.	GVWR ≤ 10,000 lbs.
Applied Force Limit	5,000 lbs.	None	None
Strength-to-Weight	1.5	2.5	2.5 ~ 3.0
Performance Criteria	5 in. Platen Travel	No head contact (50 th Male Dummy)	No head contact (Head Positioning Fixture)
Sides Tested	One side at a time (Driver & Passenger)	One side at a time (Driver & Passenger)	Two sides sequentially (Driver & Passenger)
Leadtime	na	3-years	3-years
Phase-in	na	None	None
Carry-forward Credits	na	None	None

The Alliance supports NHTSA’s efforts to implement multi-part comprehensive plan to mitigate rollover injuries and fatalities. The Alliance agrees with the agency that, by itself, the proposed changes to the roof crush resistance standard will have a limited effect (compared to other elements of the comprehensive plan) in reducing rollover related casualties. The Alliance has undertaken various studies and analyses to help inform this rulemaking. These demonstrate that the proposed rule should be

modified in several aspects as described below. We conclude with our recommendations for the final rule.

Injury Patterns of Occupants Involved in Rollovers

The Alliance sponsored research to examine the injury patterns of occupants involved in rollover crashes. Like NHTSA, the research sponsored by the Alliance analyzed real-world rollover injury data in order to determine the number of occupant injuries that could be attributed to roof intrusion. This research examined only front outboard occupants who were belted, not fully ejected from their vehicles, whose most severe injury was associated with roof contact, and whose seating position was located below a roof component that experienced vertical intrusion as a result of a rollover crash. Using the National Automotive Sampling System/Crashworthiness Data System (NASS/CDS), the first phase of this research developed a statistical estimate of the number of belted occupants seriously injured in rollovers through various injury sources. The second phase of this research involved an in-depth review of each of the cases identified during the first phase to explore injury patterns. A comprehensive review of 278 NASS/CDS rollover cases was performed. A few of the significant findings of this study are

- **Injury Causation.** Review of a wide range of rollover crashes, from those resulting in significant roof deformation and no injury to those resulting in significant injuries with minimal deformation, indicates that rollovers are complex events and that a single parameter (such as roof performance) cannot explain the injury potential for occupants.
- **Vehicle Headroom.** The NASS/CDS rollover data show no relationship between vehicle headroom and the risk of serious head/neck/face injury for belted occupants.
- **Roof Strength-to-Weight Ratio.** The NASS/CDS rollover data show no relationship between vehicle roof strength-to-weight ratio (as measured by FMVSS 216) and the risk of serious head/neck/face injury for belted occupants, even after controlling for rollover class, driver age, and belt use.
- **Two Occupants.** The detailed reviews include numerous examples of variability in injury outcome for occupants in the same vehicle, even when other factors (age, height, belt and ejection status, magnitude of vertical roof deformation at occupant positions, etc.) are essentially the same. In particular, these cases show no difference between far-side/near-side occupants and associated injury risk.

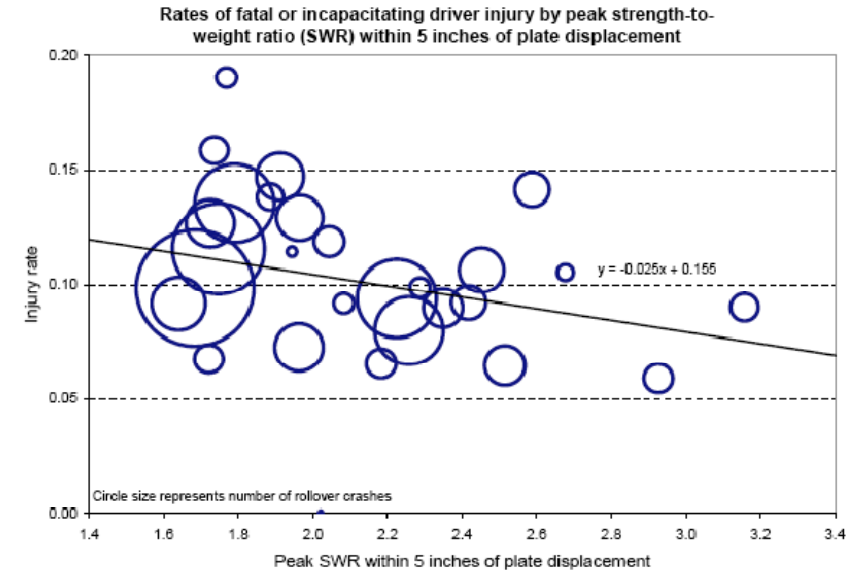
The auto industry has been conducting research into rollover related injury for many years and an understanding of injury causation is essential to understanding the relevance of roof strength. Decades of real-world crash data analysis and laboratory testing has established that roof deformation and injury in rollover crashes are related to the severity of the crash, but that does not mean roof deformation causes injury.

Roof Strength and Rollover Injury Risk

The Insurance Institute for Highway Safety (IIHS) recently published a study that examined the relationship between roof strength and rollover injury risk. IIHS conducted independent tests of roof strength among a group of midsize SUVs and analyzed the relationship between different measures of roof strength and injury risk in real-world rollover crashes. IIHS researchers concluded that there is a strong relationship between roof strength and injury risk in a rollover crash; the stronger the roof the lower the injury risk. See IIHS Figure 1 below. Based on this finding they are recommending that the

NHTSA consider increasing the minimum strength-to-weight (SWR) ratio beyond the currently proposed value of 2.5 within 5 inches of roof crush, to an SWR of 3.0-3.5.

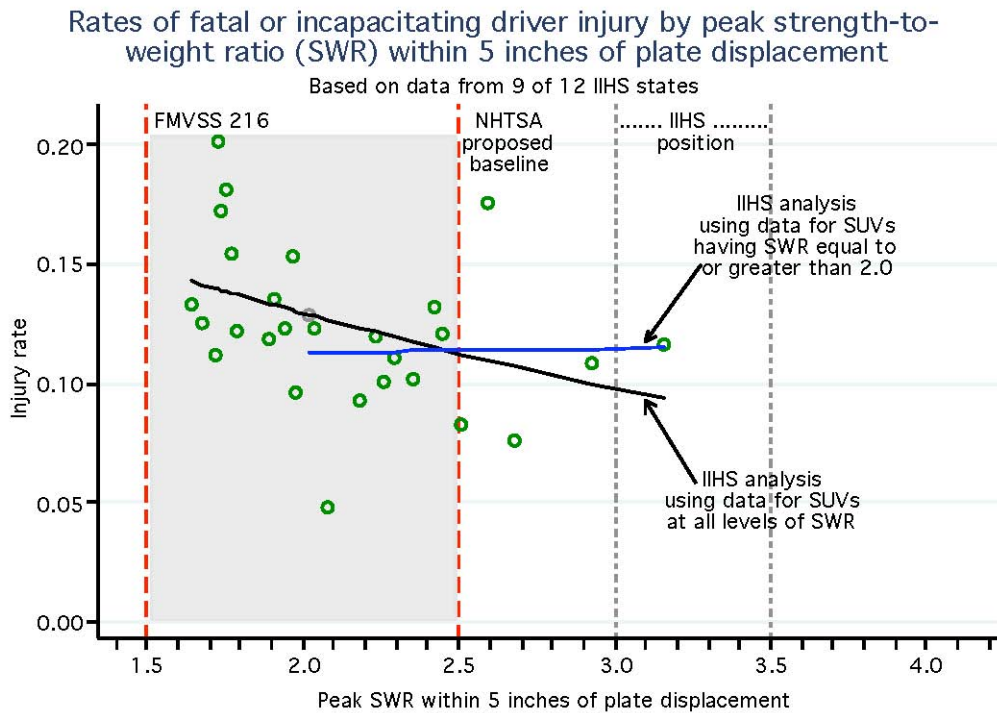
IIHS Figure 1



The Alliance welcomes the IIHS’s input in trying to shed light on this important but controversial issue, but the IIHS’s recommendations for even greater roof strength requirements than those currently being proposed by NHTSA are not warranted based on these data. The IIHS data do not demonstrate a relationship between roof strength and injury causation in rollovers.

In its analysis, the IIHS assumed that the ratio between roof strength and vehicle weight, or SWR, is monotonic (consistently decreasing) over the entire range of SWR for the samples it examined. Further analyses of these data casts doubt on the acceptability of these assumptions. Using the IIHS data on roof strength, and the same analytical approach, a statistical analysis commissioned by the Alliance closely replicated the IIHS analysis with police-reported crash data obtained from 9 of the 12 states used in the IIHS study (Some of the state data used by IIHS are not publicly available.). The analysis then tested whether there was good evidence that a straight line provided the best explanation of the relationship. Using a widely accepted statistical procedure, the data for SUVs from the central group of roof strength values was reanalyzed, followed by data from the lowest and the highest groupings. If a linear relationship is evident across the full range of values then the findings from the central group of the data should essentially predict those from the upper and lower groups. They did not – see Figure 2 below. Furthermore, limiting the analysis to higher roof strength vehicles ($SWR \geq 2.0$), arguably closer in value to the IIHS recommended SWR of 3.0-3.5), yielded no relationship between roof strength and injury risk.

Figure 2: IIHS Figure 1 modified to show injury rates adjusted for IIHS confounding factors using logistic regression, and ranges of SWR relevant to this proceeding



The IIHS findings exceed the conclusions that can reasonably be drawn from their data and analysis, and the IIHS conclusions are at odds with an understanding of injury causation. They are assuming that a linear (straight line) relationship exists across the range of roof strength values for which they have test results. The evidence is that it does not. That being the case, it is not acceptable to use these limited data to predict benefits for roofs stronger than those currently seen in the fleet. Another limitation of the analyses that limit its extrapolation to the passenger vehicle fleet as a whole is that only a limited set of midsize SUVs were tested.

Alliance Cost/Weight Analysis

Alliance members studied strategies for increasing the strength-to-weight ratio (SWR) of exemplar large sport utility vehicles and large pickup trucks by simulating the modifications of existing designs with design changes that are capable of being produced in mass-production volumes with current technology. These studies confirmed NHTSA’s general concern that near-term design changes for existing vehicle models would add substantial weight to the vehicle, potentially adversely affecting two of NHTSA’s safety priority issues: reducing rollover events and improving vehicle-to-vehicle compatibility. A summary of these studies follows.

Summary of Alliance Cost/Weight Analysis				
Vehicle Type	Baseline	Effect of Modifications to Reach†:		
	Vehicle Weight	SWR 2.5 ₂₀	SWR 3.0 ₂₀	SWR 3.5 ₂₀
Large SUV	5,600 to 7,200 lbs.	+60 to 67 lbs.	+150 to 270 lbs.	+250 to 540 lbs.
Costs	na	Variable: \$38 - \$58 Fixed: \$40M-\$75M	Variable: \$60 - \$90 Fixed: \$80M-\$90M	Variable: \$110-\$130 Fixed: \$80M-\$180M
Large Pickup	5,800 to 8,900 lbs.	+38 to 68 lbs.	+85 to 260 lbs.	+120 to 520 lbs.
Costs	na	Variable: \$55 - \$185 Fixed: \$10.5M - \$77M	Variable: \$100 - \$200 Fixed: \$10.8 - \$218M	Variable: \$165 - \$525 Fixed: \$11M - \$660M

† The nomenclature SWR2.5₂₀ means NHTSA's proposal: a SWR of 2.5 times the vehicle's unloaded vehicle weight, plus a 20% compliance margin.

Strength-to-Weight Ratio at and above 2.5 and the Impacts on Safety

The Alliance's analysis demonstrates that increasing SWRs above 2.5 necessitates significant mass increases that negatively impact safety, if insufficient leadtime is provided. The average weight penalty, for a large SUV, for increasing the SWR from 1.5 to 2.5 (NPRM) would be 60 to 67 lbs, and for a large truck the corresponding average weight penalty would be 38 to 68 lbs. A NHTSA requirement for single-sided testing at a SWR of 3.0 or 3.5 or two-sided testing (SNPRM) will add substantial mass increases to vehicle roof structures, particularly for heavier vehicles. For instance, for a large SUV, increasing the SWR from 1.5 to 3.0 would add an average weight penalty of 150 to 270 lbs and increasing the SWR from 1.5 to 3.5 would add an average weight penalty of 250 to 540 lbs. Similarly, for a large truck, increasing the SWR from 1.5 to 3.0 would add an average weight penalty of 85 to 260 lbs and increasing the SWR from 1.5 to 3.5 would add an average weight penalty of 120 to 520 lbs. The added weight associated with increasing roof strength may also adversely affect vehicle crash compatibility.

Increase in Vehicle Mass and Effect on CAFE Performance

NHTSA has recently proposed substantial increases in the Corporate Average Fuel Economy (CAFE) standards for passenger cars and light trucks. The agency's fuel economy rulemaking is being issued pursuant to the Energy Independence and Security Act of 2007 (EISA), which Congress passed in December 2007. EISA mandates the setting of separate maximum feasible standards for passenger cars and for light trucks at levels sufficient to ensure that the average fuel economy of the combined fleet of all passenger cars and light trucks sold by all manufacturers in the U.S. in model year (MY) 2020 equals or exceeds 35 miles per gallon. That is a 40 percent increase above the average of approximately 25 miles per gallon for the current combined fleet.

Increasing SWR above 2.5 necessitates significant mass increases that negatively impact fuel economy. As indicated above, the average weight penalty, for a large SUV, for increasing the SWR from 1.5 to 2.5 (NPRM) would be 60 to 67 lbs, and for a large truck the corresponding average weight penalty

would be 38 to 68 lbs. A NHTSA requirement for single-sided testing at a SWR of 3.0 or 3.5 or two-sided testing (SNPRM) will add substantial mass increases to vehicle roof structures, particularly for heavier vehicles. For instance, for a large SUV, increasing the SWR from 1.5 to 3.0 would add an average weight penalty of 150 to 270 lbs and increasing the SWR from 1.5 to 3.5 would add an average weight penalty of 250 to 540 lbs. Similarly, for a large truck, increasing the SWR from 1.5 to 3.0 would add an average weight penalty of 85 to 260 lbs and increasing the SWR from 1.5 to 3.5 would add an average weight penalty of 120 to 520 lbs. The added weight will also reduce fuel economy and increase vehicle lifetime fuel consumption. Because every 100 lbs added to a vehicle reduces its fuel economy by 1-2%, a 3.5 SWR could reduce a large pickup truck or SUV's fuel economy by up to 10 percent.

Two-sided vs. One-sided Testing

NHTSA has indicated that it is considering two-sided testing to evaluate the strength of the second side of the roof of vehicles whose first side had already been tested. In this testing, after the force was applied to one side of the roof over the front seat area of a vehicle, the partially-crushed vehicle was repositioned and force was then applied on the opposite side of the roof over the front seat area. The variability and challenges in repeatability of roof strength testing in a one-sided test would be amplified in a two-sided test and manufacturers would have to select compliance margins to compensate for this resultant increased variability. The setup of vehicles relative to the platen can vary substantially from testing facility-to-testing facility and within a single testing facility. The configuration of the load application device and the load measurement system can be quite different between testing facilities. Depending upon the structural architecture of the vehicle, these variations and differences can manifest themselves as variations in measured roof strength.

Performance Criteria – Headroom vs. Platen Travel

The Alliance recommends that NHTSA maintain the use of 5 inches of platen travel as the deformation criterion in the final rule. The Alliance does not support a "no head contact" criterion, whether it is determined by the use of a test dummy representative of an average adult male (as in the NPRM) or via the use of a headform-positioning device with an associated contact force measured by a load cell attached to the headform. A "no head contact" criterion only serves to further increase both test-to-test variability and testing complexity without providing any additional engineering data beyond that which can be obtained using a 5-inch platen travel limit.

Besides the fact that a "no head contact" criterion offers no engineering value with respect to assessing a vehicle's roof strength performance, such a criterion does not recognize the well-established, scientific body-of-knowledge concerning occupant kinematics in a rollovers. In rollover events, rotational and gravitational forces combine to result in restrained and unrestrained occupants moving inside vehicles in an uncontrolled and unpredictable manner and thus are subject to injury risk from incidental impact with the vehicle interior, other occupants, and the ground, independent of roof-to-ground contact or roof deformation. Use of any variant of a head contact criteria for

determination of roof strength or the ratio of roof strength to vehicle mass (SWR) does not correlate or relate to occupant injury.

Recommendations

The table below summarizes the Alliance recommendations for the final rule for FMVSS 216. Where the Alliance recommendation differs from NHTSA’s proposal bolded text has been used.

FMVSS 216, “Roof Crush Resistance”			
	Existing Standard	NPRM SNPRM	Alliance Recommendation
Applicability	GVWR ≤ 6,000 lbs.	GVWR ≤ 10,000 lbs.	GVWR ≤ 10,000 lbs.
Applied Force Limit	5,000 lbs.	None	None
Strength-to-Weight	1.5	2.5 ~ 3.0	2.5
Performance Criteria	5 in. Platen Travel	No head contact (50 th Male Dummy or Head Positioning Fixture)	5 in. Platen Travel
Sides Tested	One side at a time (Driver & Passenger)	One side at a time Two sides sequentially	One side at a time (Driver & Passenger)
Leadtime	na	3-years	3-years
Phase-in	na	None	Yes
Carry-forward Credits	na	None	Allow