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S. HRG. 110–1161

OVERSIGHT ON PASSENGER VEHICLE ROOF STRENGTH

HEARING

BEFORE THE

SUBCOMMITTEE ON CONSUMER AFFAIRS, INSURANCE, AND AUTOMOTIVE SAFETY

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

JUNE 4, 2008

Printed for the use of the Committee on Commerce, Science, and Transportation

U.S. GOVERNMENT PRINTING OFFICE

75–609 PDF WASHINGTON : 2012

For sale by the Superintendent of Documents, U.S. Government Printing Office
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ONE HUNDRED TENTH CONGRESS

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OVERSIGHT ON PASSENGER VEHICLE ROOF STRENGTH

WEDNESDAY, JUNE 4, 2008

U.S. SENATE,
SUBCOMMITTEE ON CONSUMER AFFAIRS, INSURANCE, AND AUTOMOTIVE SAFETY,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 10 a.m. in room SR–253, Russell Senate Office Building, Hon. Mark Pryor, Chairman of the Subcommittee, presiding.

OPENING STATEMENT OF HON. MARK PRYOR, U.S. SENATOR FROM ARKANSAS

Senator PRYOR. Let's go ahead and call the meeting to order.

I'd like to welcome everyone here today, especially Senator Coburn. We're going to let him go first. But, let me just give, if I may, give a brief opening statement. I know that Senator Coburn has other commitments he has to get to.

Today we're going to talk about automobile safety, and we'll focus on the NHTSA rulemaking on vehicle roof strength standards to protect automobile passengers in the event of rollover accidents.

The hearing will look at the biomechanics and what actually occurs in a rollover, the relationship between the vehicle roof strength and the occupant injury risk, the history and efficacy of the National Highway Traffic Safety Administration's roof strength standard in improving vehicle safety, and a review of the January 30, 2008, Supplemental Notice of Proposed Rulemaking. The agency's deadline for issuing the final rule is July 1 of this year—which is just in—what, I guess 4 weeks from now or less—with a legally permissible extension, if necessary.

Just in terms of background, this agency has the responsibility of trying to make our vehicles safer, and thousands of Americans are killed and injured each year in motor vehicle accidents. The agency reported that—42,642 highway-related fatalities and 2,575,000 injuries in 2006. Of the 42,000 fatalities, about 10,000—a little more than 10,000 were killed by rollover crashes, and 2,007 people sustained injuries due to rollover crashes.

The majority of rollovers occur when a driver loses control of the vehicle, causing the vehicle to begin sliding sideways. Typically, something triggers the vehicle to begin rolling. The trigger could be a tripping object, such as a curb or a guardrail, or even soft and uneven ground at the side of the roadway, like the shoulder. Another trigger for rollover could be an attempt by the driver to make an overly aggressive turn of the vehicle, either at a high velocity or at a tight turning radius.

"Roof crush" describes the vehicle's roof as it is deformed during a rollover crash. When the vehicle's structural integrity is reduced, window glass can break and the doors can open, which can further weaken the roof structure. According to some analysts, a collapsing roof can compromise all the vehicle's safety features, including its seatbelts, window glazing, side-curtain airbags, and door retention. Partial or complete ejection of the occupants can result. And when a vehicle roof buckles inwards, occupants' heads are exposed to the risk of head and neck injuries.

On September 1, 1973, NHTSA issued its first roof crush standard that took effect for passenger cars. The standard currently applies to passenger cars and multipurpose passenger vehicles, trucks, and buses with a gross weight rating of 6,000 pounds or less. Federal Motor Vehicle Safety Standard 216 establishes a minimum roof strength standard for these vehicles. The purpose of the standard is to reduce deaths and injuries due to the crushing of the roof into the occupant compartment in a rollover crash.

One thing we'll talk about today is testing, and testing involves applying a metal plate at a constant speed to one side of the vehicle's roof. Compliance with the standard is contingent upon the roof withstanding a force of 1.5 times the vehicle's weight before 5 inches of crush have occurred. That's the current standard. SAFETEA–LU, which became law in August of 2005, directed the Secretary of Transportation to initiate a rulemaking to revisit this. The law clarified that the rulemaking proceeding would apply to vehicles with a weight of 10,000 pounds or less.

Congress encouraged NHTSA, in its rulemaking proceeding, to consider dynamic tests that realistically duplicate the actual forces transmitted during the rollover crash. I'm sure we'll hear some testimony about that. The law also directed the agency to issue a final rule by July 1, 2008. And actually, I met with NHTSA yesterday, and they hope—they think that they can finish this by 2008, but, you know, they're not 100-percent confident of that, but I know they're trying very hard. If the agency determines that it cannot meet the deadline, the agency has to notify the proper Congressional committees of jurisdiction and establish a new deadline.

And so, everybody's working hard. This is a very, very important hearing. We do have many, many fatalities in this country that are the result of roof crush during a crash, and it's something that I hear a lot about at home, and I know my colleagues do, as well. And so, we're going to have several witnesses today. I'm not going to go through the list right now.

But, I do want to open this by thanking my colleague from Oklahoma, Dr. Tom Coburn, who is also Senator Tom Coburn, for those of you who don't know, and he has approached me on the floor and in the hallways here several times about how important this is to him as a medical professional and based on some personal experience that he has had in his home State of Oklahoma.

So, Senator Coburn, welcome to the subcommittee, and we are honored to have you here, and we'd love to hear your opening statement.

STATEMENT OF HON. TOM COBURN, M.D., U.S. SENATOR FROM OKLAHOMA

Senator COBURN. Senator Pryor, thank you, and thank your staff, for making available this forum to address not only the process, but the safety.

And, like many other people who are going to appear before you today—I'm not an expert on automobile safety or manufacturing, but, like everyone here, I'm very much interested in seeing a reduction in rollover fatalities and injuries.

A few months ago, I met with one of my constituents from Oklahoma. His name's Kevin Moody. He's been a tireless advocate, calling for increased vehicle roof strength standard. In 2003, Kevin's son, Tyler, was killed when the SUV he was driving rolled over, causing the vehicle's roof to crush down on him. Unfortunately, Kevin couldn't be here today to testify, but I hope that my testimony in this hearing will honor his efforts and the life of his son, Tyler.

There are many different factors that lead to vehicle occupant fatalities and serious injuries in rollover accidents, but today we're here to discuss the vehicle roof strength safety standard known as FMVSS 216. And, as you outlined, Mr. Chairman, SAFETEA–LU included language requiring NHTSA to have a standard by July 1, 2008.

I would just take an aside. I don't think it's as important that they get this done by July 2008 as much as it is important as they get it right. So, I don't think the timing is as important as them getting it right.

An update of this standard will be the first substantial change since 1973. Since the early 1970s, advancing technologies create a great many vehicle safety improvements, which our manufacturers have incorporated, that have saved a lot of lives. These include anti-lock brakes, airbags, and Electronic Stability Control. Technology has also resulted in better materials and design engineering that can be used to produce stronger vehicle roofs.

While many automobile manufacturers have used these technologies to increase roof strength of their vehicles well above the Federal standard, there are still many vehicles that are produced that have roofs that will easily crush in the event of a rollover. Congress initiated the rulemaking process because NHTSA was still using the same test and performance criteria that they used when the roof standard was originally set up in 1973. It's hard to find anyone in private or public sector that's doing things the same today that they were in 1973. NHTSA's Notice of Proposed Rulemaking has acknowledged these new testing methods and the improved roof strength in today's technology embodied vehicles. It does not appear that they're ready to make, however, with a rulemaking, a leap to the 21st century from the 20th century.

I want to touch, for a minute, on the public health problem that's caused by vehicle rollovers. According to NHTSA's own numbers, 10,000 people are killed each year in rollover crashes, which is one-third of—at least—close to one-third of accident fatalities. They're the number one killer—automobile crashes are—of people between the age of 1 and 34. It is the number one cause of death. Including to—the loss of life, 24,000 people a year are seriously injured in rollovers, leading to millions of dollars of healthcare expenditures, but, more important, marked impairment of people's lives.

Spinal cord injuries are also very common, as the occupant's head makes contact with the roof or the ground. Of the 12,000 spinal cord injuries that occur each year, over 5,000 occur in automobile accidents. Although exact numbers are not kept, the number of spinal cord injuries that result from rollover accidents can be conservatively estimated to be around 2,600 per year.

As a physician, I see having vehicles with stronger roofs as an effective healthcare prevention measure to reduce the number of quadriplegic, paraplegic, and other serious injuries that result from roof crush.

I'm not here to offer a policy solution to address roof crush, but, after studying this issue, I believe that there are three things that will translate into safer cars and a more informed public:

The first is greater transparency into NHTSA's rulemaking process. Senator Obama and I created and passed the Transparency and Accountability Act, two years ago. The way we get accountability from government is transparency. And I have some great heartburn with the transparency in this rulemaking process. The rulemaking introduced by NHTSA examines the costs and benefits of increasing roof strength-to-weight ratio from 1.5 to 2.5. However, NHTSA did not provide any information as to why the 2.5 strength-to-weight ratio was chosen, as opposed to 3, 3.5, or 4.0.

In January, in a Supplemental Notice of Proposed Rulemaking, NHTSA does discuss these stronger strength-to-weight ratios, but they limit their analysis to the cost and weight each standard would add to vehicles, and largely ignore the safety benefits. NHTSA also mentions that if every single rollover crash—rollover death resulting from roof crush were prevented, the total lives saved would be 476. That doesn't fit with the other numbers that they publish. However, they provide no evidence for how they came up with that figure—there is no transparency in it—which most automobile safety experts say is difficult to quantify.

Another provision lacking proper rationale in the proposed rule is one that would give the new roof strength standard preemption from any common law or tort law. Twenty-six state Attorneys General wrote to NHTSA expressing that this would be a major setback to vehicle safety, yet NHTSA has not offered any explanation for why the rights of a vehicle purchaser to seek a common law remedy for harm done to them should be taken away.

When the final rule is released, NHTSA needs to provide the public with transparency into why they believe these regulations are to be adopted, not just offer the regulations. With a budget of over $830 million a year, there is no excuse for NHTSA not to provide clear and precise evidence for how vehicle safety standards were decided.

The second thing that I think is important is that—the increase in the efforts to inform consumers about the safety of vehicles in rollovers. In my almost 10 years of experience as a Member of Congress, I've found the best way to connect the government to the people is through an open and transparent government. That's how we hold our elected officials accountable. The 2005 highway bill contained a provision known as "Stars on Cars." And that requires all new cars to post NHTSA's five-star safety rating system result on car stickers. This was a great policy for Congress to adopt, because it takes critical safety information that might not be accessible to consumers, especially those without Internet access, and clearly displays it for the consumer to consider.

The three five-star rating categories are a 35-mile-per-hour frontal crash test, an offside—offset side-impact test, and a rollover resistance test. I believe that as part of NHTSA's comprehensive plan to address rollover safety, they should create a five-star rating system for roof strength that should appear on all car stickers. Automobile consumers need to know that there are significant differences in vehicle roof strengths among cars and trucks in the same class. For example, the Volvo XC90, that has the strongest roof in the midsized sport utility class, with a 4.6 strength-to-weight ratio—that is twice the roof strength of the Jeep Grand Cherokee, which has a vehicle roof strength-to-weight ratio of 2.3.

The final point I would make is, Congress should challenge NHTSA to produce results through reduced deaths and serious injuries. It's not just enough to offer a new standard. It is to have metrics on the standards, and that the standard make a difference in American lives.

A performance goal for the comprehensive rollover plan is never mentioned by NHTSA. As part of Congress's oversight of NHTSA, we should be setting performance measures that translate into real-world results, like a reduction in deaths caused by rollover accidents.

After the creation of NHTSA in the late 1960s, the number of automobile deaths began to decrease. From 1975 to 1992, the number of vehicle occupant deaths per 100,000 people declined by 23 percent. Since 1992, the number of occupant deaths per 100,000 people has only decreased by 1.5 percent. Congress should be asking NHTSA to get the decline of fatalities back at a similar rate that was achieved in the 1970s and 1980s.

With one-third of all vehicle deaths occurring in rollover accidents, if NHTSA's comprehensive plan to address the rollovers is at all successful, we should be able to see a substantial decrease in rollover deaths. The metric is important; the rule isn't. What the rule accomplishes should be our goal.

In 2008, as I said, we'll spend $830 million of taxpayer money at NHTSA. That's a substantial investment that should be tied to results in terms of reduction in accidents and accidental deaths. Specifically in regards to vehicle roof strength, if NHTSA cannot conduct a transparent and effective rulemaking process, I believe Congress should consider legislation that will set an adequate roof-strength standard without going through an ineffective rulemaking process.

Thank you very much for your time. I don't—doubt that you have any questions for me.

This isn't—this is something we can fix, and we fix, at small cost. Small relative cost, we can make a major difference in individuals' lives, and we can give great information to the consumers about what they're buying.

Thank you, Mr. Chairman.

[The prepared statement of Senator Coburn follows:]

PREPARED STATEMENT OF HON. TOM COBURN, M.D.,
U.S. SENATOR FROM OKLAHOMA

I would like to thank Senator Pryor and your staff for holding this timely oversight hearing. Unlike the many other people on this panel I am not an expert on automobile manufacturing or safety, but like everyone here I am very interested in seeing a reduction in rollover accident fatalities. A few months ago I met with one of my constituents from Oklahoma, Kevin Moody, who has been a tireless advocate for calling for an increased vehicle roof strength standard. In 2003, Kevin's son Tyler was killed when the SUV he was driving rolled over causing the vehicle's roof to crush down on him. Unfortunately Kevin couldn't be here today to testify, but I hope that my testimony and this hearing will honor his efforts and the life of his son Tyler.

There are many different factors that lead to vehicle occupant fatalities and serious injuries in rollover accidents, but today we are here to discuss the vehicle roof strength safety standard known as FMVSS 216. In 2005, Congress passed the SAFETEA–LU surface transportation reauthorization bill which included language requiring the National Highway Traffic Safety Administration (NHTSA) to update FMVSS 216 by July 1, 2008. The update to FMVSS 216 will be the first substantial change to this vehicle safety standard since its inception in 1973. Since the early 1970s, advancing technology has created many vehicle safety improvements, such as anti-lock brakes, air bags, and electronic stability control. Technology has also resulted in better materials and design engineering that can be used to produce stronger vehicle roofs. While many automobile manufactures have used these technologies to increase the roof strength of their vehicles well above the Federal standard, there are many vehicles that have roofs that will easily crush in the event of a rollover. Congress initiated the rulemaking process through SAFETEA–LU because NHTSA was still using the same test and performance criteria that they used when the roof strength standard was originally introduced in 1973. It is hard to find anyone in the private or public sector that is doing things today the same way they did things in the early 1970s. Although the NHTSA's notice of proposed rulemaking has acknowledged new testing methods and the improved roof strength in today's technology embodied vechicles, it does not appear that NHTSA is ready to make the leap from 20th century to the 21st century.

I also want to touch on the public health problem that is caused by vehicle rollovers. Ten thousand people are killed each year in rollover crashes, which is one-third of all automobile accident fatalities.[1] Automobile accidents are the number one killer of people age one to thirty-four. In addition to the losses of life, twenty-four thousand people a year are seriously injured in rollovers leading to millions of dollars of healthcare expenses and reduced quality of life. Spinal chord injuries are very common in rollover crashes as the occupant's head makes contact with the roof or the ground. Of the twelve thousand spinal chord injuries that occur each year, over five thousand occur in automobile accidents.[2] Although exact numbers are not kept, the number of spinal chord injures that result from rollover accidents can be conservatively estimated to be twenty-six hundred a year. As a physician, I see having vehicles with stronger roofs as an effective healthcare prevention measure to reduce the number of quadriplegic, paraplegic, and other serious injuries resulting from roof crush.

I am not here today to offer a policy solution to address roof crush, but after studying this issue I believe that the following three things will translate into safer cars and a more informed public.

1. Greater transparency into the NHTSA rulemaking process. The notice of proposed rulemaking introduced by the NHTSA in August of 2005 examines the cost and benefits of increasing the roof strength-to-weight ratio requirement from 1.5 to 2.5. However, NHTSA did not provide information as to why the 2.5 strength-to-weight ratio was chosen as opposed to a 3.0, 3.5, or 4.0 strength-to-weight ratio. In January 2008, in a supplemental notice of proposed rulemaking, NHTSA does discuss these stronger strength-to-weight ratios, but they limit their analysis to the cost and weight each standard would add to vehicles and largely ignore the safety benefits. NHTSA also mentions that if every single rollover death resulting from roof crush were prevented the total lives saved would be 476. However they provide no evidence for how they came up with that figure, which most automobile safety experts say is very difficult to quantify.

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[1] NHTSA, *http://www.safercar.gov/portal/site/safercar/menuitem.13dd5c887c7e1358fefe0a2f35a67789/?vgnextoid=6539e66aeee35110VgnVCM1000002fd17898RCRD.*

[2] National Spinal Cord Injury Database, *http://www.spinalcord.uab.cdu/show.asp?durki=116979.*

Another provision lacking proper rationale in the proposed rule is one that would give the new roof strength standard preemption from any common law or tort law. Twenty-six state Attorneys General wrote to NHTSA expressing that this would be a major set back to vehicle safety, yet NHTSA has not offered any explanation for why the rights of a vehicle purchaser to seek a common law remedy for harm done to them should be taken away.

When the final rule is released, NHTSA needs to provide the public with transparency into why they believe these regulations are to be adopted. With a budget over $830 million there is no excuse for NHTSA to not provide clear and precise evidence for how vehicle safety standards were decided.

2. Increase efforts to inform consumers about the safety of vehicles in rollovers. In my almost 10 years of experience as a Member of Congress, I have found that the best way to connect the government to people is through an open and transparent government. In 2006 I co-authored the Federal Funding Accountability and Transparency Act with Senator Obama, which lead to the creation of *usaspending.gov,* a website that enables the public to find out information on all government expenditures, including contracts, grants, and loans. When taxpayers have better knowledge about how their tax dollars are being spent they are better able to hold their elected officials accountable. I believe the same holds true with the Federal Government's automobile safety testing and safety data.

The 2005 highway bill contained a provision known as "stars on cars" that requires all new cars to post NHTSA's five-star safety rating system results on car stickers. This was a great policy for Congress to adopt because it takes critical safety information that might not be accessible to consumers, especially those without Internet access, and clearly displays it for the consumer to consider. The three five star rating categories are a 35-mph frontal crash test, an offset side-impact test, and a rollover resistance test. I believe that as a part of NHTSA's compressive plan to address rollover safety, they should create a five star rating system for roof strength that would also appear on car stickers. Automobile consumers need to know that there are significant differences in vehicle roof strengths among cars and trucks in the same class. For example, the Volvo XC90 has the strongest roof in the mid-sized sport utility class with a 4.6 strength-to-weight ratio. That is twice the roof strength of the Jeep Grand Cherokee, which has a vehicle roof strength-to-weight ratio of 2.3.

3. Finally, Congress should challenge the NHTSA to produce results through reduced deaths and serious injuries caused by rollovers. In their notice of proposed rulemaking, NHTSA states that roof crush is only one factor in rollover fatalities and that their comprehensive plan to address rollovers looks at all the factors involved. However, a performance goal for the comprehensive rollover plan is never mentioned. As part of Congress' oversight of NHTSA we should be setting performance measures that translate into real world results, like a reduction in the deaths caused by rollover accidents. After the creation of NHTSA in the late 1960s, the number of automobile deaths began to decrease. From 1975 to 1992 the number of vehicle occupant deaths per 100,000 people declined by 23 percent. Since 1992 the number of vehicle occupant deaths per 100,000 people has only decreases by 1.5 percent.[3] Congress should be asking NHTSA's to get the decline of fatalities back at a similar rate that was achieved in the 1970s and 1980s. With one-third of all vehicle deaths occurring in rollovers accidents, if NTHSA's comprehensive plan to address the rollovers is at all successful, we should see a substantial decrease in rollover deaths. In 2008 we will spend $830 million of taxpayer money to fund operations, research, and grants within NHTSA. That substantial investment should be tied to results in terms of a reduction in accidents and accident deaths. Specifically, in regards to vehicle roof strength, if NHTSA can not conduct a transparent and effective rulemaking process, I believe Congress should consider legislation that will set an adequate roof strength standard without going through an ineffective rulemaking process.

Thank you very much for your time and I again thank the Chairman for holding this important oversight hearing.

Senator PRYOR. Thank you. I do have one follow-up, if I may, and that is, you mentioned, early in your testimony, that we have this deadline of July 1 of this year. You think it's more important that we get it done right than get it done fast. And that's my sense, as well. I'd love to get it done by the end of this month, but if we can't, it's more important to get it done right. What is your sense—

[3] Department of Transportation, *http://www-fars.nhtsa.dot.gov/Main/index.aspx.*

I mean, I can't really speak for the Senate, I know you can't either—what's your sense of Senators—I think most Senators would agree that it's more important to get it done right and not rush through this and come out with a bad result. Is that what you're hearing?

Senator COBURN. I would agree with that, but I'd—also say is, if we have a little increase in roof strength that doesn't result in a major decrease in fatalities and injuries, we've done nothing. And so, the roof strength-to-weight ratio is important. And you didn't see any explanation for that in why NHTSA chose the standards that they chose. And, again, the metrics, the measurement of the success of the rulemaking, will be the marked decrease in the number of fatalities and injuries.

And so, the question has to be, is, at what cost—I know there is a cost. The higher up we go, the more it costs. There has to be a point at which we see major benefit with a minimal amount of cost, and that ought to be part of the transparency of the NHTSA rulemaking process. And why we don't see a 4.5 or a 3.5 and the expected benefits from that is beyond me. With the kind of budget that they have, they have plenty of resources to get this right. And so, I think getting it right is much more important than getting it done by July 1, 2008.

Senator PRYOR. Right. Well, thank you for your interest in this, and thanks for your leadership on this. And when NHTSA comes up here to testify in a few minutes, we'll ask them some of——

Senator COBURN. Well, I—let me thank Mr. Moody. Being in the Senate and listening to constituents, I was unaware of this issue. And I'm not a big-government person, I don't want us involved, and most people—but, this is something we can fix, this is something we can make a difference on, and I look forward to your leadership on it, and I thank you.

Senator PRYOR.—thank you. Thank you for your help, and thanks for all that you're doing.

Well, we are now going to introduce all the witnesses, so I'd ask you all to come up, and—I'll call your name. While you all get situated, however she says to get situated. So, how does that sound?

[Laughter.]

Senator PRYOR. Oh, I'm sorry. I'm sorry, I misread my note here. We're going to have NHTSA first, in the first panel.

Mr. James Ports who is the Deputy Administrator, National Highway Traffic Safety Administration. Great, come on up and take your seat—and what I would ask everyone to do is, if we could please keep our opening statements to 5 minutes—I don't like to gavel people down, but we have a lengthy third panel, and we'll have good questions of both panels, and we think we're going to have other Senators come here. Several have said they would be here, but there are a lot of Committees and other things going on today. So, hopefully we'll have others here and we'll ask questions.

The last thing I'd say on that is, don't feel like, in your opening statement, you have to cover every single thing because we're going to leave the record open, and you can always submit your written statement, and it'll be part of the record.

So, Mr. Ports, go ahead.

STATEMENT OF JAMES F. PORTS, JR., DEPUTY ADMINISTRATOR, NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION, DOT; ACCOMPANIED BY STEPHEN R. KRATZKE, ASSOCIATE ADMINISTRATOR FOR RULEMAKING, NHTSA, DOT

Mr. PORTS. Thank you, Mr. Chairman. Let me first introduce, to my left, Mr. Steve Kratzke. He is the Associate Administrator for Rulemaking.

Mr. Chairman, members of the Committee, thank you for the opportunity to appear before you to discuss this important issue of rollover protection, and particularly roof-crush safety.

Every death and serious injury that occurs on our Nation's highways is a tragedy. As you know, rollover crashes account for about one-third of the nearly 30,000 light-vehicle occupant fatalities that occur each year. I share the same feelings of concern and empathy as you do for the individuals and families who have been tragically affected by these dreadful crashes, and I extend my deepest condolences to them.

The agency developed and is implementing a comprehensive plan to address rollover crashes. Our three-pronged strategy begins with preventing the rollover from ever happening. NHTSA has mandated that all passenger vehicles be equipped with electronic stability control by 2012, and has added a rollover rating to the agency's five-star vehicle safety ratings.

We also know that we cannot prevent each and every rollover, so we also do our best to keep occupants in the vehicle during the crash. Safety belts are the most effective crashworthiness countermeasure, reducing ejected rollover fatalities, reducing the probability of ejection by 91 percent in fatal crashes. NHTSA also has strength requirements for door latches and a forthcoming SAFETEA–LU proposal for ejection mitigation.

Finally, in addition to rollover crash prevention and ejection mitigation, we strive to better protect the occupants kept inside the vehicle during a rollover through enhanced roof-crush resistance.

As you mentioned, in 1973 the United States became the first country to adopt a roof-strength requirement. Since that time, Canada and Saudi Arabia have also adopted a similar requirement. No other government anywhere in the world has any requirement for roof strength.

Each of these initiatives must work together to address the various aspects of the rollover problem. We are in the final stages of completing our August 2005 Notice of Proposed Rulemaking to upgrade roof-crush requirements of light passenger vehicles. Among the major provisions, the NPRM proposed to extend application of the standard to heavier vehicles, increase the roof strength requirements so that the vehicle would sustain a load equal to 2.5 times the unloaded weight, and require a new headroom criterion.

In response to extensive public interest to the NPRM, a Supplemental Notice of Proposed Rulemaking was published, this past January. The SNPRM modified our original proposal to include for consideration a two-sided test requirement, as well as solicited comments to allow the agency the potential to go beyond the 2.5 strength-to-weight ratio. We also requested comments on our extensive testing that the agency conducted of current production vehicles.

Because we're still in the rulemaking on this standard, we may not be able to discuss specific decisions related to the estimates of lives saved, the stringency of the requirements, or other issues related to the final rule.

Mr. Chairman, thank you for your consideration and this subcommittee's ongoing efforts to improve highway safety. I would be pleased to answer any questions.

[The prepared statement of Mr. Ports follows:]

PREPARED STATEMENT OF JAMES F. PORTS, JR., DEPUTY ADMINISTRATOR, NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION, DOT

Mr. Chairman, I am Jim Ports, Deputy Administrator of the National Highway Traffic Safety Administration (NHTSA). I appreciate the opportunity to appear before the subcommittee to discuss the important issue of rollover protection, and particularly roof crush safety.

Every death and serious injury that occurs on our Nation's highways is a tragedy. Rollover crashes account for about one-third of the nearly 30,000 light vehicle occupant fatalities that occur each year. I share the same feelings of concern and empathy as you for the individuals and families who have been tragically affected by these dreadful crashes, and extend my deepest condolences to them.

I am proud to say that NHTSA has taken significant steps to reduce the deaths and serious injuries that occur due to rollover crashes. Rollover crashes are complex and chaotic events. They can range from a single quarter turn to eight or more quarter turns, with the duration of the rollover crash lasting from one to several seconds. The wide range of rollover conditions occurs because these crashes largely occur off road where the vehicle motion is highly influenced by roadside conditions. Also, rollover crashes tend to occur at higher speeds than other crash types due to the energy required to initiate them.

The agency developed a comprehensive plan to address these crashes and has made great strides to implement these strategies. It is important to realize that each initiative in NHTSA's comprehensive program addresses a different aspect of the rollover problem. Our strategy is to first reduce the occurrence of rollover crashes; second, keep occupants inside the vehicle when rollovers do occur; and finally, to better protect the occupants kept inside the vehicle during the rollover. Each of these three initiatives must work together to address the various aspects of the rollover problem.

The most effective way to reduce deaths and injuries in rollover crashes is to prevent the rollover crash from occurring. Two agency efforts have been taken to reduce the occurrence of rollover crashes—mandating that all passenger vehicles be equipped with Electronic Stability Control and incorporating a rollover rating into the agency's 5-star vehicle safety ratings (known as the New Car Assessment Program).

In April 2007, NHTSA published a final rule establishing requirements for Electronic Stability Control, or ESC, in passenger cars, multipurpose passenger vehicles, trucks, and buses weighing less than 10,000 pounds. ESC systems use automatic computer-controlled braking of individual wheels to assist the driver in maintaining control in critical driving situations. ESC is the most significant safety advancement since the introduction of seat belts. The agency estimates that this technology will save up to 9,600 lives in all types of crashes annually once all light vehicles on the road are equipped with ESC. These safety benefits will occur in all types of crashes where the driver would lose control of the vehicle and the vehicle would crash off the road or into another vehicle. However, the lion's share of these benefits will be in rollover crashes, where it is estimated that ESC systems will reduce about one-half (4,200 to 5,500) of the approximately 10,000 deaths each year resulting from rollover crashes.

NHTSA incorporated a rollover static stability factor into its New Car Assessment Program (NCAP) in 2001. This consumer information program uses market forces to encourage manufacturers to make safety improvements not the least of which has been the voluntary adoption of ESC systems in many vehicles, including sport utility vehicles. In the 7 years since incorporation into NCAP, we estimate that the risk of rollover in a single vehicle crash for an average sport utility vehicle has been reduced by nearly 20 percent, and that an average pickup rollover risk has been reduced almost 10 percent.

When a rollover crash does occur, it is critical to keep the occupant inside the vehicle. The fatality rate for an ejected vehicle occupant is three times as great as that for an occupant who remains inside the vehicle. Our crash data show that about one-half of the people killed in vehicles that rolled over were completely ejected, and another 10 percent of those killed were partially ejected. So mitigating ejections offers potential for significant safety gains. Safety belts are the most effective crashworthiness countermeasure in reducing ejected rollover fatalities. In fact, seat belts reduce the probability of ejection by 91 percent in fatal crashes in passenger cars and light trucks. In addition to our successful efforts to increase seat belt use, NHTSA also has strength requirements for door latches and a forthcoming SAFETEA–LU proposal for ejection mitigation.

Finally, in addition to rollover crash prevention and ejection mitigation, we strive to better protect the occupants kept inside the vehicle during the rollover through enhanced roof crush resistance. In 1973, the United States became the first country to adopt a roof strength requirement. Since that time, Canada and Saudi Arabia have also adopted a similar requirement. No other government anywhere in the world has any requirement for roof strength.

Each initiative in NHTSA's comprehensive program to address the different aspects of the rollover problem is important because each initiative has a different target population for which that initiative will be effective. Each of these three initiatives must work together to address the various aspects of the rollover problem. However, it is important to understand which portion of the rollover problem can be addressed by each of these three initiatives so that there is a clear and correct understanding of the safety benefits potentially associated with each of the different types of actions to reduce rollover deaths and injuries.

In August 2005, NHTSA published a Notice of Proposed Rulemaking (NPRM) to upgrade the roof crush requirements of light passenger vehicles. Among the major provisions, the NPRM proposed to extend application of the standard to heavier vehicles, increase the roof strength requirements so that a vehicle would sustain a load equal to 2.5 times its unloaded weight, and require a new headroom criterion. The agency has received a large number of comments from industry, public interest groups, and other parties addressing significant issues related to this proposed rule.

In response to extensive public interest and safety advocate comments on the NPRM, a Supplemental Notice of Proposed Rulemaking (SNPRM) was published on January 30, 2008. The SNPRM modified our original proposal to include consideration of a two-sided test requirement, as well as soliciting comments to allow the agency the potential to go beyond a 2.5 Strength-to-Weight Ratio (SWR). Subsequent to issuance of the NPRM, the agency conducted extensive testing of current production vehicles to, among other things, determine the effects of two-sided testing and to assess the roof strengths of vehicles currently on the market. These test results were released in the SNPRM.

Since issuance of the NPRM in 2005, NHTSA has collected and analyzed additional crash data, tested the strength of vehicle roofs in the vehicle fleet, completed cost and lead-time studies, and completed other analyses important for the final rule development. The agency is in the final stages of its work to issue the final rule. Because we are still in rulemaking on this Standard, we are not able to discuss specific decisions related to estimates of lives saved, stringency of the requirements, or other issues related to the final rule.

Mr. Chairman, thank you for your consideration and this subcommittee's ongoing efforts to improve highway safety. I would be pleased to answer any questions.

Senator PRYOR. Great.

Let me open, if I may, with some questions. First, let me follow up on what Senator Coburn asked, a few moments ago. You know, basically, he said that there is not enough transparency in your process, and one of the things that is hard for John Q. Public and Members of the U.S. Senate to understand is all the criteria that you use. One of the things he asked about was, when you laid out some of what you're trying to accomplish here, you talked about a goal of trying to keep the costs down, et cetera, but I assume that your ultimate goal is safety. Is that fair to say?

Mr. PORTS. Yes, sir, and thank you for that question. NHTSA's mission is all about safety, it's about reducing fatalities and injuries on our Nation's highways. So, it is a top priority of this agency. Before we began the NPRM process in 2001, we solicited comments from the public because we wanted to gain their insight on some of the issues that were out there and the potential things that we should look at. From that public comment period, we began the NPRM process and issued that proposal in 2005. After receiving public comment again on that NPRM, we decided that we should do more testing and analyze more data. It was through that testing—there is—well, actually, it was through these public comments—the public comments that we received from all the stakeholders, the extra testing that we did, that we thought it was prudent to publish an SNPRM, the supplemental notice, in January of this year. We are now in the process of reviewing all the public comments from that process, from the supplemental budget—I mean, supplemental proposal, and analyzing that data, and we will include all of those comments in our final rule.

Senator PRYOR. I do agree with what Senator Coburn said a few moments ago—that if new rules don't make a major difference, in terms of safety and preventing fatalities and injuries—then we really haven't accomplished much. And I do agree with that. And I would hate for this agency to go through this exercise and then, in the end, not really change the outcome out there on the streets and highways of this country.

I have another concern. He mentioned the preemption issue, and he said that he did not think it would be prudent for NHTSA to somehow foreclose the car owner's rights with your rulemaking. Could you give us a status report on that?

Mr. PORTS. Yes, Senator, thank you for that question. I know that preemption is a very important topic.

NHTSA has a comprehensive approach to rollover, and saving lives and reducing injuries in a rollover crash. And through this process, a concern was raised that increasing the roof resistance too much could potentially increase a vehicle's rollover propensity if we added weight to the roof structure. Other things being equal, raising the roof's center of gravity could upset the balance between the efforts of increasing the roof strength and the rollover propensity, defeating the purpose of this rule.

It was in light of that concern that we simply asked the question. And the reason that we asked that question was because we wanted public input from all the stakeholders. I think it's important that we, as an agency, be transparent in this process and put the information out there so that the public does have an opportunity to comment. We've done that, we've received numerous comments from all the stakeholders, raising both factual and legal issues, and we're continuing to analyze those comments, and we are also doing extra testing based on that information.

All of those additional—and let me backtrack just a hair. We will carefully consider all of those comments before we make a final decision on this proposal, but all that information will be put in our final rule.

Senator PRYOR. I'm going to turn this over to my colleague, Senator McCaskill, here in just a moment, but let me go ahead and add my comments to your stack. I think it would be a mistake to do the preemption. I think that if NHTSA chooses that path, my guess is there would be a serious effort in the House and the Senate to try to change that. And I think you'd save everybody a lot of headaches and create less uncertainty by just not pursuing a preemption on this matter. I mean, you heard Senator Coburn, and I think you'd get that on both sides of the aisle.

Senator McCaskill?

STATEMENT OF HON. CLAIRE McCASKILL, U.S. SENATOR FROM MISSOURI

Senator McCASKILL. Thank you, Mr. Chairman.

I want to talk a little bit—you just mentioned "upset the balance," and I want to talk with you about preemption.

I'm having a hard time figuring out what preemption has to do with a standard rule for safety. The last time we had a rule was 30-some years ago, correct?

Mr. PORTS. Are you talking about the roof-crush rule?

Senator McCASKILL. The safety standard, wasn't it 30-some years ago?

Mr. PORTS. In 1973, yes, ma'am.

Senator McCASKILL. So, what you're basically saying, by proposing preemption, is, "You need to wait around for 30 years, and not have any redress in any court—any state court in America, until we get around to it again." I mean, don't you see the value at NHTSA of the innovation that has occurred as a result of people accessing the courts in this country? I mean, Ford has done a great job with some of the technology; they're building, now, SUVs in Kansas City with some patented technology that's going to make a difference, and that came about, in part, because they were spurred to action by the legitimate claims in the courts across this country about their safety standards. I mean, does that not worry you, that we're not nimble enough to update the rules, except every 30 years, and that we're going to tell every state in the Nation that their laws, as it relates to rights of people to go to court, are going to be crushed?

Mr. PORTS. Thank you, Senator, I appreciate the follow-up to that question on preemption.

The reason that we talked about upsetting the balance is because the concern was raised that if we increase the standard, that manufacturers may simply raise weight to the roof and raise the center of gravity, which would increase the vehicle's propensity to roll over. Part of our strategy, as I mentioned in my, opening statement, was that we have a comprehensive plan to first prevent the rollover, and we were not sure if this roof-crush rule would upset that balance or not, so what we did was, we asked the question of all the stakeholders, would this upset the balance? And what we're doing in this process is, we are receiving numerous comments from the stakeholders.

Senator McCASKILL. But, what does that have to do with—I mean, whether or not they're going to add more weight to the roof, what does that have to do with wiping out everyone in America's rights to use their state courts? What's that got to do—I don't understand the relationship there. What is the direct relationship between the balance, in terms of the weight of the roof, and the balance, in terms of every American's right to go to their courthouse in their state and have people from their community decide whether or not somebody has messed up or not?

Mr. PORTS. Thank you——

Senator MCCASKILL. That's what I don't understand. I mean—and when did NHTSA start including preemption language in all of their rules? When did this come about? This is a relatively new thing, isn't it?

Mr. PORTS.—thank you, Senator.

My understanding of the preemption language is that we included it as part of the public discussion. At this time, we have not made any decisions on whether it will be included in our final rule or not. I would also state, however, that if it's a manufacturing defect, tort suits are not preempted, even with this language. So, your constituents may still have that right to sue in a case where a defect—a manufacturing defect is alleged.

So, we are going to, as I mentioned, analyze all those comments——

Senator MCCASKILL. Right.

Mr. PORTS.—and then, and only then, will we make a decision to move forward on preemption, or not. And that, again, will be in our final rule.

Senator MCCASKILL. Let me see if I can cut to the chase here. I reviewed your proposed rules on everything from child restraint to locking mechanisms; and unfortunately, the evil boilerplate preemption language appears in every single one of them. Where did this come from? Why, all of a sudden, does NHTSA feel compelled to crush the rights of states? I mean, the irony is, this administration is supposed to be all about a small Federal Government and the rights of states. When and how did NHTSA make the decision to start including boilerplate preemption language in every rule you're proposing?

Mr. PORTS. I appreciate that follow-up. That helps me.

The preemption language that you're talking about, the boilerplate language, is simply, if an issue of preemption should come up—or, if a balance is tipped, then preemption may be warranted. However, my understanding of the way these final rules are laid out, the preemption language is not included. So, it is literally up to a court to decide if that balance has been disrupted.

Senator MCCASKILL. If we're not going to include them, then you could relieve a lot of heartburn by not putting them in the proposed rules. But, we have to assume, if, all of a sudden, preemption language is popping up like spring flowers, that there is a plot somewhere in this administration to see if they can't wipe out the rights of Americans across this country to access their local courts. And there are people in this Congress that are pretty upset about it, and we're going to work hard to make sure this administration doesn't get away with it.

Thank you very much, Mr. Chairman.

Senator PRYOR. Thank you.

Let me follow up on that, if I may, and that is—you said that if your rule, or maybe if the language in the preamble is codified into a rule, that there could still be tort liability for manufacturing defects. Is that right?

Mr. PORTS. I'm sorry, I'm—I want to——

Senator PRYOR. You said that——

Mr. PORTS.—make sure I heard that question——

Senator PRYOR.—there could still be tort liability for manufacturing defects. Is that what you said?

Mr. PORTS. Yes, sir, Senator. My understanding, from what the NHTSA lawyers have told me, is that if there is a manufacturing defect alleged, that state tort lawsuits are not preempted——

Senator PRYOR. OK.

Mr. PORTS.—by this language.

Senator PRYOR. Well—but, what—I guess what you'd be preempting, then, is design defects. That's what you're going after here, is design defects. And those are two different things, because a manufacturing defect is where, during the manufacturing process, something wasn't put together correctly, or there was a faulty material, or something in there that caused it to fail. Design defect is different, that's when the actual design of the vehicle is flawed, or the design of the tire or the design of the seatbelt, whatever it may be, is flawed.

And, I'll tell you this, again—I just want to give NHTSA warning on this—I think that if you all pursue this preemption effort, I think you'll have bipartisan opposition in the Senate. You heard Dr. Coburn, who's not a big lawsuit guy, you know. You heard his reaction to this, and there will be others like that, as well. And I would strongly encourage NHTSA to back off of that because I think that's a big mistake.

First, I don't think the American public is there. I don't think it's in the public interest to do that. But, second, I think you all are overstepping your bounds, as the executive versus the legislative, and I think that's a problem. But, third, I think that what you'll see is a reaction from the Congress that you won't like, and I think it's easier—again, I said it earlier—just to avoid the headache and not get into that preemption issue. I think it's a big mistake here.

Let me ask you another couple of questions. I know my time is short here, and I don't know if Senator McCaskill has any other follow-ups, but let me just ask a couple of questions.

One of the concerns that I have, and I think others do as well, is that right now the test is on one part of the vehicle, and I understand that NHTSA is contemplating having a test that would actually cover two sides of the roof. Can you give us a status report on that? Can you comment on that?

Mr. PORTS. Thank you, Senator. I appreciate that.

As you mentioned, the test that we have right now is a quasi-static test which can test both sides of the vehicle, the driver side and/or the passenger side of the vehicle. So, it protects both sides, because the manufacturer does not know which side we would test. And then, through the—through all the comments in the NPRM that we received, we did additional testing, and in the supplemental notice, we asked for comment on two-sided tests, as you just mentioned.

Senator PRYOR. And so, you're just at the comment stage on that and you're not sure what NHTSA's going to do yet. NHTSA has not made a decision on a one-sided test or a two-sided test.

Mr. PORTS. Senator, that is correct, we have not made decisions.

Senator PRYOR. Now, I know that Congress mandated, and it at least encouraged NHTSA, to consider dynamic tests that realistically duplicate the actual forces transmitted during a rollover crash. Is that on the table for consideration?

Mr. PORTS. Senator, thank you very much. Appreciate that.

Yes, NHTSA has done considerable whole-vehicle dynamic testing for the past 20 years. Some of the testing that we've considered is the 208 dolly test, the SAE inverted drop test, and the JRS, or the Jordan Rollover System. NHTSA's assessment of those dynamic tests continues, and we will be including that in the final rule.

Senator PRYOR. OK. So, you're not saying the final rule will include a dynamic test but at least you're going to discuss it in the final rule?

Mr. PORTS. Yes, Senator. What Congress has asked us to do is to look at it and assess it, and we have done that. We've done a very comprehensive test. We sent some of our three—three of our top technical experts to meet with JRS, for example, and through that process we've learned a lot, and all of that information will be included in the final rule.

Senator PRYOR. OK. Do you anticipate that NHTSA will come out with separate rules for cars and trucks, or do you think you'll have one rule?

Mr. PORTS. Senator, we're striving for one rule and one standard.

Senator PRYOR. And on these tests that you're doing and this rulemaking you're going through right now has NHTSA decided to just use the 50th-percentile male dummy for all the tests? Is that what you're using for the tests?

Mr. PORTS. When we put out the supplemental notice, we asked—or we disclosed that we were talking about the 50-percentile dummy. There have been numerous comments to use the 95-percentile dummy. We are assessing those comments, and we will absolutely have those comments in our final rule.

Senator PRYOR. OK. My, just, general question would be, does it make sense, engineering sense and sense in the world of physics, et cetera, to use different sized dummies during your test, or should you just have one dummy size?

Mr. PORTS. Senator, let me refer that question to Steve Kratske, our expert, our technical expert, and he may be able to shed some light on that subject.

Mr. KRATSKE. Thank you, Mr. Chairman.

Typically, in our crashes for frontal crash or side crash we have used different-sized dummies because we want to be certain that it's not just targeting a particular level. In a quasi-static test, you're really trying to just get to vehicle performance. We don't have injury criteria now for the different sizes. So, in lieu of that, what we've proposed is just touching the head, so it's a measure of the distance available in the vehicle.

Senator PRYOR. Senator McCaskill, did you have any other questions?

Senator MCCASKILL. I just have one, on follow up.

I'm going to sound like a broken record here, but it's why I'm here today and it's what I really feel passionately about. And I do want to get on the record your acknowledgment that on April 6th, 2007, NHTSA issued a final rule on Electronic Stability Control which includes the boilerplate preemptive language in the preamble without any subject of notice or comment. And I want to make sure that you acknowledge that that is, in fact, true as it relates to the boilerplate language on preemption. The final rule was issued that included the boilerplate on preemption without any opportunity for anyone to comment about the preemption.

Mr. PORTS. Senator, I appreciate that. I am not positive right now, at this moment, whether that was included in the NPRM or not. What I'd be happy to do is go back and ask that question and share that information with you, your staff, and the rest of the Committee. I'd be more than happy to get that information for you.

Senator MCCASKILL. If you can figure out where this is coming from, what directive is this, who is saying that you've got to include this preemption in every rule, when did this come down, and where did it come from? Did it come from the White House? Who is responsible for this path that you have chosen at NHTSA on preemption?

I think we're anxious to figure out why all of a sudden this became an issue. It's not in the rule—it's in the preamble. What it's doing here is it is sending a shot across the bow to lawyers across this country that, "You're going to have to fight to be able to file a lawsuit on behalf of people who are hurting, people who have been dramatically injured," because you all are including this in there. It doesn't provide certainty, it provides a stew, rich for litigation. And that's not what we're looking for here. We're looking for certainty, so we don't have needless excessive litigation. Everybody ought to be in that camp.

So, I would be anxious, if you could share with us some kind of indication as to why this began and who's responsible for it beginning.

Mr. PORTS. Senator, I appreciate that. As I mentioned, I don't have that answer for you, at this moment, and we'd be glad to get that for you.

But, as it relates to this rule, we put it in the NPRM, in the supplemental notice, to make sure that everyone in the public had the opportunity to discuss this matter. So, we didn't simply wait until the final rule to surprise anyone.

Our goal is to be transparent, and our goal at NHTSA, to save lives and prevent injuries, is one that we take seriously. And so, when we look at a rule, we look at each and every rule as a standalone event, and that's how we make our decisions in this agency.

Senator MCCASKILL. Well, I know your lawyer is here, and I do know that comment does not generally come to the preamble, that the preamble is not part of the rule that's open to discussion and that NHTSA didn't say "Should we?" But instead it said "This is it," in the preamble, "we're going to have preemption." And so, I will let you know, and I'm not trying to be mean to you, but I am far from satisfied with the answers you've given. I think you obviously are not in a position to say. But, the way this thing is happening, it doesn't look like this is all about getting the input of the public. It looks like this is, frankly, being railroaded through in a way in which people can't comment—in a way that people can't have an impact, and proof of that is the fact that you issued a final rule with it in there, in the preamble.

So, if you would do whatever you can to address these questions in the coming days, I can assure you that I am one of many in the Senate who feels very strongly about this and we're anxious to get to the bottom of it.

Thank you, Mr. Chairman.

Senator PRYOR. With that, let me say that we are going to leave the record open for 2 weeks, and I'd ask you to get your answers back to Senator McCaskill—just get them back to the committee, and we'll share with the Senator as soon as you get them back.

And other Senators will have questions who are not here today, and I have a few to follow up on, as well, so we would ask you to try to get us timely responses and detailed responses within the next 2 weeks.

I don't have time to go into it, but one of the questions I am going to ask you about in the written question's is a status report on Section 10303 of SAFETEA–LU, specifically the tire research component—a question on tire aging. I know that's a little bit off the subject, but that's an important question I think the Senate Committee would like a status report on. So, we'll cover that then.

Thank you for being here, and now I'm going to call up the third panel. Thank you.

All right, as we're changing places here, I'll go ahead and call out the names of the panel. I'm not going to give a lengthy introduction, so—

First, we'd like to hear from Dr. David Garcia. He's an Independent Contractor and Public Speaker. Next, we'd like to have Mr. Stephen Oesch, Senior Vice President, Insurer and Government Relations, Insurance Institute for Highway Safety. Next, we'll have Mr. Rob Strassburger, Vice President, Vehicle Safety and Harmonization, Alliance of Automobile Manufacturers. Next, we'll have Ms. Joan Claybrook, President of Public Citizen. Next, we'll have Mr. Michael J. Stanton, President and CEO, Association of International Automobile Manufacturers. And next, we will have Ms. Jacqueline Gillan, Vice President, Advocates for Highway and Auto Safety.

So, what I'd like to ask everyone to do is, if possible, keep your opening statements to 5 minutes. Those first couple of panels took a little bit longer than we anticipated, and we would appreciate it if you all kept your comments to 5 minutes, and then I'm sure we'll have a lot of questions.

So, Dr. Garcia, are you ready? Why don't we go ahead.

STATEMENT OF DR. DAVID A. GARCIA, INDEPENDENT CONTRACTOR AND PUBLIC SPEAKER

Dr. GARCIA. Thank you, Chairman, and thank you, Senator.

I think a lot has been said here this morning, and thank you for your questions and being so direct on the right questions that need to be asked. So, I think it's going to shorten a lot of the things I need to say, because you have asked the tough questions. So, I'm going to focus more on what I have to say about the victims in this country.

Today, I graciously received from you 5 minutes to defeat a voracious—it's this one, right here? I'm used to this already, this happens a lot of times.

[Laughter.]

Dr. GARCIA. Hello? Can you hear me? OK.

Today, I graciously received from you 5 minutes to defeat a voracious and insatiable giant that, in biblical proportions, continues to devour our Nation's sons and daughters, fathers and mothers, husbands and wives, friends and foes alike, while many, in apathy, simply choose to watch. That giant is none other than "roof-crush" which is occurring on our Nation's highways and back roads, and more voraciously and insatiably than the biblical giant mercilessly continues to run his course. I aim, today, with a God-given minute, to defeat for the last time this ruthless giant.

Tyler Moody, Kevin Moody's 18-year-old son, died in 2003 from positional asphyxia, when, not even knowing what hit him, the roof of the Ford Explorer he drove literally crushed the life out of him. The statistics would never tell you that Tyler once saved a life. Today, you can save more than 10,000 lives and 24 catastrophic injuries a year.

If Tyler's death is not enough, think about Arizona Border Patrol Agent David Webb, who, while responding to a routine narcotics call, died from roof crush when the right rear tire of his Chevrolet Tahoe blew out, causing his vehicle to overturn. Celia Webb is Agent Webb's widow, and her presence here today speaks for her husband.

If David's death is not enough, think about Christopher Cowan, whose Chevy Silverado rolled over on a flat, grassy terrain, and the roof completely collapsed to the belt line, also crushing the life out of him.

If Christopher's death is not enough, think about Kimberly Schute, who broke her neck when her Jeep Grand Cherokee's roof buckled at its "weak link" and came crushing down on her head. And think about what happened to Agent Luis Pena when the roof of his Ford F–250 patrol vehicle crushed and dislocated his vertebrae, injuring his spinal cord, thus rendering him a quadriplegic. Luis Pena has a wife, Jennifer, and two children. He and his family also speak out with their presence here today.

If Kimberly and Luis's inability to walk is not enough, think about Loa Griesbach, a teenage ventilator-dependent quadriplegic who will forever struggle for every breath that she needs, because of the complete collapse of her Suburban's roof.

If Loa's inability to breathe is not enough, and in light of the fact that the automobile industry takes the position that there is no correlation between roof crush and head and spinal cord injuries, think about the 14 Marines who were in their Ford E–350 Club Wagon that overturned when the vehicle's rear tire delaminated. All of the Marines who died or sustained serious injuries were sitting on the side where the roof crushed.

I am David Garcia, and I may not be a king or a war hero, but one of the many hundreds of thousands of individuals that roof crush has claimed. I was not driving an SUV, I was driving a Ford Escort. It is only by God's grace that I'm able to stand up today, even if metaphorically speaking, for Tyler, David Webb, Christopher, Kimberly, Luis, Loa, the marines, and all the victims who, for one reason or another, cannot afford the privilege to speak for themselves. The automobile industry should not go on doing business as usual, and we should demand that the facts surrounding roof crush should not continue to be a proprietary secret.

How many times must a father lose a child? And how many families must be broken apart for it to become obvious that roof crush kills and maims people for life?

Others will speak or submit the necessary supportive materials that are of concern to us here. However, it is necessary to underscore that the 26 state Attorneys General, maybe from your own states, who are extremely versed in the rule of law, rightfully oppose the preemption clause that will strip away the rights of injured victims while passing on the $34-billion-a-year bill to your constituents. What NHTSA is proposing regarding preemption is unjust, and if you consider the mandate, it is not legal. Yet, they plan to do this, 30 days from now.

As if behind our backs, NHTSA continues to promote and legislate what I believe is an FMVSS 216 mirage. Thus, understanding that it would take an act of Congress for NHTSA to do the right thing on behalf of the American people, we propose a bill that will mandate that NHTSA and the automobile industry will do the right thing, and we have a summary of that bill behind us.

The reason why we need a new standard is not a secret. NHTSA did not get it right, back in 1971. We are at another crossroad in automobile roof safety, and we are about to make the same mistake all over again. It is time that NHTSA and the automobile industry join the global momentum that was making vehicles that not only provide better gas mileage, but that truly are designed to protect occupants in a rollover, and they should be prevented from legalizing a roof standard that has not, does not, and will not work.

Every day, people die physically and spiritually in rollover accidents. I have a responsibility, before man and God. And even though I know nothing about healing broken bones and spinal cords, I do know a thing or two about healing broken spirits. Despite my condition, by the grace of God, I have been given much, and you, too, have been greatly blessed. Therefore, if you believe in what I believe in, then just as much is required of you as it is required of me. It is the sole purpose of why I made the long journey here today.

Thank you.

[The prepared statement of Dr. David Garcia follows:]

PREPARED STATEMENT OF DR. DAVID A. GARCIA, INDEPENDENT CONTRACTOR AND PUBLIC SPEAKER

Distinguished Members of the Committee:

Today, I graciously receive from you 5 minutes to defeat a voracious and insatiable giant that, in biblical proportions, continues to devour our Nation's sons and daughters; fathers and mothers; husbands and wives; friends and foes alike,[1] while many in apathy simply choose to watch. That giant is none other than *roof crush,* which is occurring on our Nation's highways and back roads, and more voraciously and insatiably than the biblical giant, mercilessly continues to run its course. I aim today with a God-given minute to defeat for the last time this "roofless" giant.

[1] *An American Auto Safety Tragedy—ROOF CRUSH* available at *http://www.peoplesafeinrollovers.org/An%20American%20Auto%20safety%20Tragedy.pdf.*

Tyler Moody, Kevin Moody's 18-year-old son, died in 2003 from positional asphyxia,[2] when, not even knowing what had hit him, the roof of the Ford Explorer he drove literally crushed the life out of him. The statistics would never tell you that Tyler once saved a life. Today you can save more than 10,000 lives and 24,000 catastrophic injuries a year.

If Tyler's death is not enough, think about Arizona Border Patrol Agent, *David Webb,* who, while responding to a routine narcotics call, died from roof crush when the right rear tire of his Chevrolet Tahoe blew out, causing his vehicle to overturn. Celia Webb is agent Webb's widow, and her presence here today speaks for her husband.

If David's death is not enough, think about Christopher Cowan whose Chevy Silverado rolled over on a flat, grassy terrain and the roof completely collapsed to the beltline, also crushing the life out of him.

If Christopher's death is not enough, think about *Kimberly Schute* who broke her neck when her Jeep Grand Cherokee's roof buckled at its "weak link" and came crushing down on her head. And think about what happened to Agent *Luis Pena,* when the roof of his Ford F–250 patrol vehicle crushed and dislocated his vertebrae, injuring his spinal cord, thus rendering him a quadriplegic. Luis Pena has a wife, Jennifer, and two children. He and his family also speak out with their presence here today.

If Kimberly and Luis's inability to walk is not enough, think about *Loa Griesbach,* a teenage ventilator dependent quadriplegic, who will forever struggle for every breath that she needs because of the complete collapse of her Suburban's roof.

If Loa's inability to breathe is not enough, and in light of the fact that the automobile industry takes the position that there is no correlation between roof crush and head and spinal cord injuries,[3] think about the *14 Marines,* who were in the Ford E–350 Club Wagon that overturned when the vehicle's rear tire delaminated. All of the Marines who died or sustained serious injuries were sitting on the side where the roof crushed.

I am *David Garcia,* and I may not be a king or a war hero, but one of the many hundreds of thousands of individuals that roof crush has claimed. I was not driving an SUV, I was driving a Ford Escort. It is only by God's grace that I am able to stand up today, even if metaphorically speaking, for Tyler, David Webb, Christopher, Kimberly, Luis, Loa, the Marines and all the victims, who, for one reason or another cannot afford the privilege to speak for themselves. The automobile industry should not go on doing business as usual, and we should demand that the facts surrounding roof crush should not continue to be a proprietary secret. How many times must a father lose a child, and how many families must be broken apart for it to become obvious that roof crush kills and maims people for life?

Others will speak or submit the necessary supportive materials that are of concern to us here. However, it is necessary to underscore that 26 State Attorney Generals, maybe from your own states who are extremely versed in the rule of law, rightfully oppose the preemption clause[4] that would strip away the rights of injured victims, while passing on the $34 billion a year bill to your constituents. What NHTSA is proposing regarding preemption is unjust, and if you consider their mandate, it is not legal. *Yet, this will happen in less than 30 days unless you promptly act.*

As if behind our backs, NHTSA continues to promote and legislate, what I believe is an FMVSS 216 mirage. Thus, understanding that it would take an act of Congress for NHTSA to do the right thing on behalf of the American people, we are proposing a *bill* that will mandate that NHTSA and the automobile industry:

1. Conduct two-sided sequential static roof crush tests as currently done, but increase the applied force to at least *3.5* times the maximum unloaded vehicle weight and prohibit any part of the roof or test device from contacting the dummy.

2. Develop repeatable dynamic tests on rollovers and disseminate test results to the public.

3. Establish a roof strength safety rating consumer information program and make the strength-to-weight ratio (SWR) of all vehicles available to consumers.

4. Initiate a study to determine the advantages and disadvantages of retrofitting vehicles with the 10 percent lowest SWR. If there is a benefit, require

[2] Kevin, Veronica and Michelle Moody's letter to Senators, engraved in marble, dated September 6, 2007.
[3] Paula Lawlor's letter to Senators dated June 4, 2008.
[4] Paula Lawlor's submission to NHTSA Docket 2005–22143 dated November 21, 2005.

manufacturers of these vehicles to develop retrofit kits and make these kits available to the public.

The reason why we need a new standard is not a secret: NHTSA did not get it right back in 1971.[5] We are at another crossroad in automobile roof safety, and we are about to make the same mistake all over again. It is time that NHTSA and the automobile industry joined the global momentum toward making vehicles that not only provide better gas mileage, but that truly are designed to protect occupants in a rollover, and they should be prevented from legalizing a roof strength standard that has not, does not, and will not work. The technology is not out of this world. The 2006 Volkswagen Jetta, 5.1; the 2007 Scion TC, 4.6; the 2006 Volvo XC90, 4.6; the 2006 Honda Civic, 4.5; and even the Ford 500, which has an SWR of 3.9 not only exceed the 1.5 FMVSS 216 standard, but also exceeds the proposed 2.5 SWR. To legally encourage a 2.5 SWR, is inconsistent with the momentum and innovation that we are seeing, and would only encourage automobile manufacturers to lax when it comes to vehicle safety. A request was formally made to the Office of Management and Budget[6] and to NHTSA, in 2005,[7] to evaluate the cost/benefit at 3.5 SWR, but to this date it has not been done. This cost/benefit analysis is of utmost importance in realizing the actual lives saved and the value placed on each life saved.

Every day people die physically and spiritually in rollover accidents. I have a responsibility before man and God, and even though I know nothing about healing broken bones and spinal cords, I do know a thing or two about healing broken spirits. Despite my condition, by the grace of God I have been given much, and you too have been greatly blessed. Therefore, if you believe in what I believe in, then just as much is required of you as is required of me. It is the sole purpose of why I made the long journey here today. Thank you.

DR. DAVID A. GARCIA,
Endicott, New York.

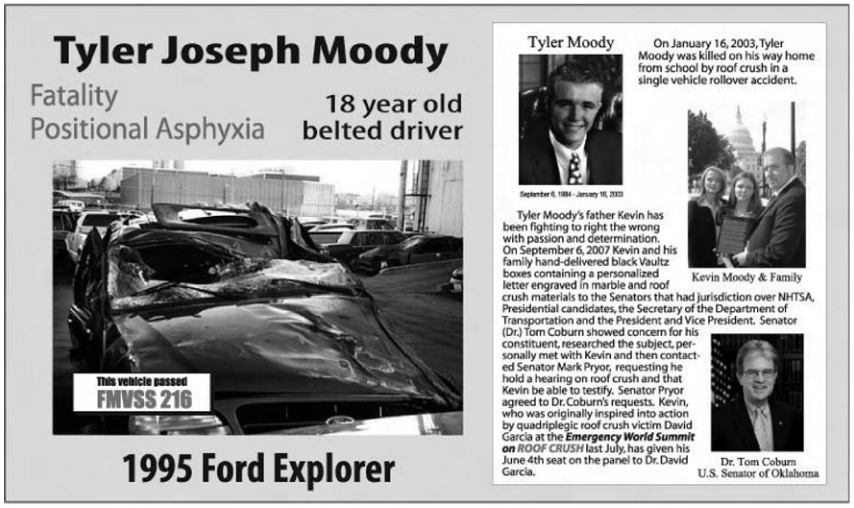
Attachments: Tyler Joseph Moody
David Webb
Christopher Cowan
Kimberly Schute
Luis Pena, Jr.
Loa Griesbach

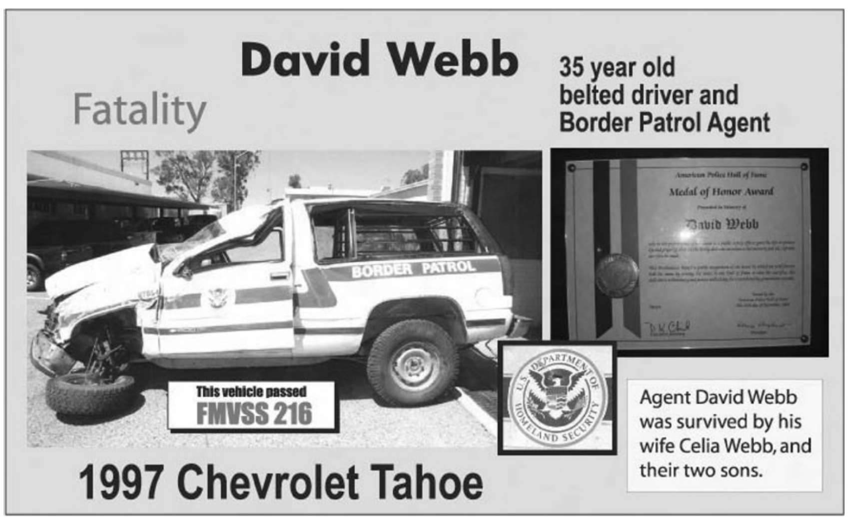
14 Marines—Those Injured or Dead:
- Major Trevor Kleineahlbrandt
- Captain David W. Lucas
- Staff Sergeant Frank E. Weathers
- Sergeant Armando Avila
- Sergeant Michael Vasquez

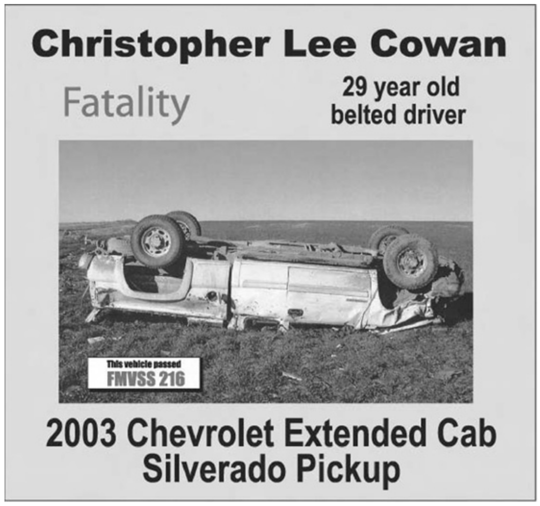
David Garcia
Improving the Safety of Vehicle Roofs

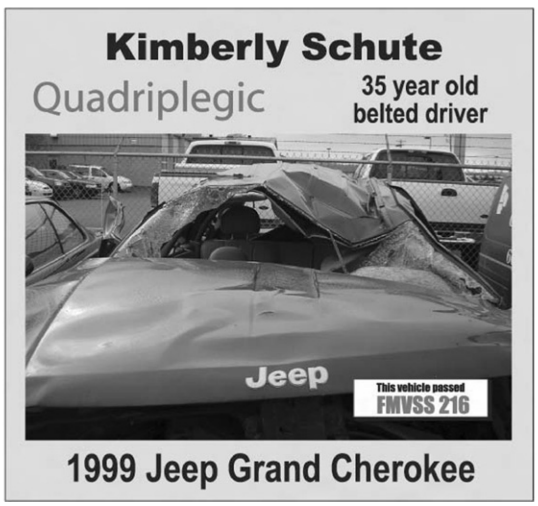
[5] *Deadly By Design* by Paula Lawlor and Todd Tracy.
[6] Record of April 28, 2005 meeting with Office of Management and Budget.
[7] Paula Lawlor's submission to NHTSA Docket 2005–22143 dated November 21, 2005.

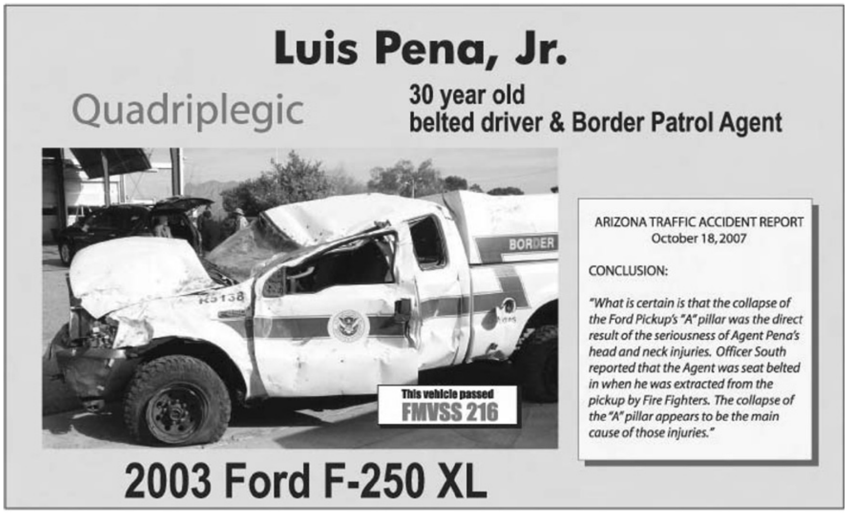
ATTACHMENTS

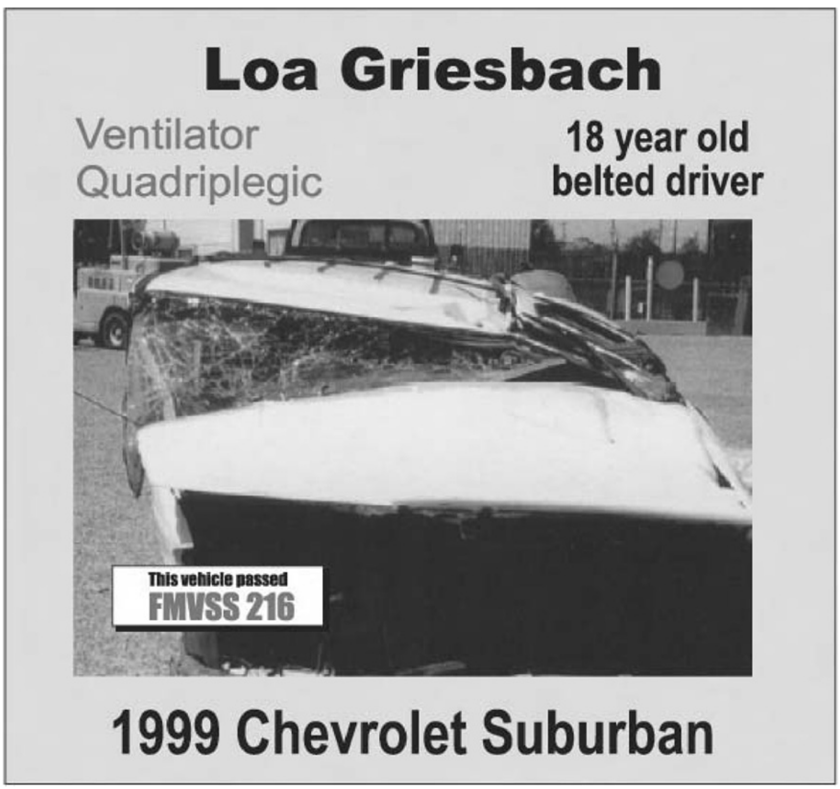


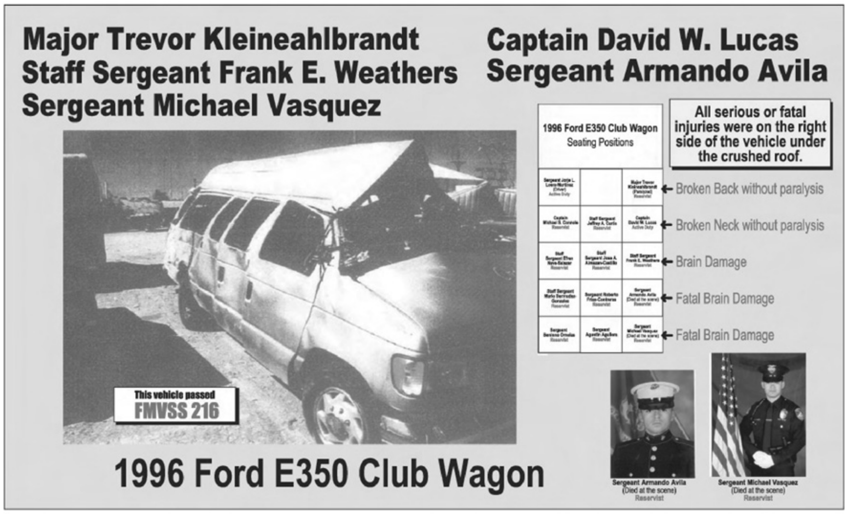


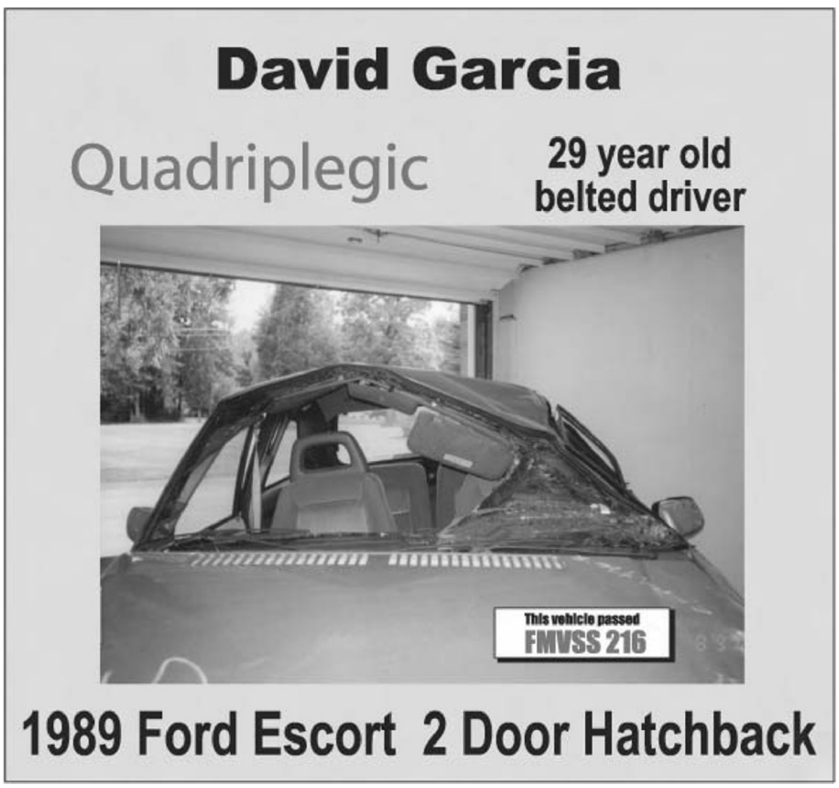

Christopher Lee Cowan
Fatality
29 year old
belted driver
This vehicle passed
FMVSS 216
2003 Chevrolet Extended Cab
Silverado Pickup


Kimberly Schute
Quadriplegic
35 year old
belted driver
Jeep
This vehicle passed
FMVSS 216
1999 Jeep Grand Cherokee


Luis Pena, Jr.
Quadriplegic
30 year old
belted driver & Border Patrol Agent
This vehicle passed
FMVSS 216
ARIZONA TRAFFIC ACCIDENT REPORT
October 18, 2007
CONCLUSION:
"What is certain is that the collapse of the Ford Pickup's "A" pillar was the direct result of the seriousness of Agent Pena's head and neck injuries. Officer South reported that the Agent was seat belted in when he was extracted from the pickup by Fire Fighters. The collapse of the "A" pillar appears to be the main cause of those injuries."
2003 Ford F-250 XL


Loa Griesbach
Ventilator
Quadriplegic
18 year old
belted driver
This vehicle passed
FMVSS 216
1999 Chevrolet Suburban


Major Trevor Kleineahlbrandt
Staff Sergeant Frank E. Weathers
Sergeant Michael Vasquez
Captain David W. Lucas
Sergeant Armando Avila
1996 Ford E350 Club Wagon
Seating Positions
All serious or fatal injuries were on the right side of the vehicle under the crushed roof.
Broken Back without paralysis
Broken Neck without paralysis
Brain Damage
Fatal Brain Damage
Fatal Brain Damage
This vehicle passed
FMVSS 216
1996 Ford E350 Club Wagon
Sergeant Armando Avila
(Died at the scene)
Reservist
Sergeant Michael Vasquez
(Died at the scene)
Reservist


David Garcia
Quadriplegic
29 year old
belted driver
This vehicle passed
FMVSS 216
1989 Ford Escort 2 Door Hatchback

IMPROVING THE SAFETY OF VEHICLE ROOFS

Whereas 10,000 people in the United States die in rollover crashes each year;

Whereas rollover crashes constitute 3 percent of passenger vehicle crashes, but about one-third of the fatalities;

Whereas 24,000 people are seriously injured in the United States in rollover crashes each year;

Whereas an internal NHTSA study *The Role of Vertical Roof Intrusion and Post-Crash Headroom in Predicting Roof Contact Injuries to the Head, Neck, or Face During FMVSS No. 216 Rollovers; An Updated Analysis* became publicly available on January 31, 2008 and concluded: *"A statistically significant relationship existed between both vertical roof intrusion and post-crash headroom on the one hand and maximum injury severity on the head, neck, or face injury from roof contact on the other hand.";* and

Whereas the Insurance Institute for Highway Safety (IIHS) sponsored study *Roof Strength and Injury Risk in Rollover Crashes,* dated March 2008 concluded: *"Increased vehicle roof strength reduces the risk of fatal or incapacitating driver injury in single-vehicle rollover crashes."*: Now, therefore, be it

(a) To amend title 49, United States Code § 30101(1) to require Federal Motor Vehicle Safety Standard No. 216; Roof Crush Resistance to incorporate the following——

(1) Increase applied force to 3.5 times the maximum unloaded vehicle weight;

(2) Prohibit any roof component or test device from contacting a seated 50th percentile male Hybrid III dummy under the specific applied force; and

(3) Conduct two-sided sequential tests on each vehicle retaining the current test procedure.

(4) MOTOR VEHICLES COVERED.—This subsection applies to motor vehicles, including passenger cars, multipurpose passenger vehicles, and trucks, with a gross vehicle weight rating of 10,000 pounds or less.

(5) EFFECTIVE DATE.—Subsection (a) shall take effect no later than 4 years after the date of enactment of this Bill.

(b) To amend title 49, United States Code § 30101(2) to require ROLLOVER TESTS FOR ROOF STRENGTH.——

(1) DEVELOPMENT.—No later than 2 years after the date of the enactment of this Bill, the Secretary of Transportation shall——

(A) develop a repeatable dynamic test on rollovers of motor vehicles for the purpose of a consumer information program of vehicle roof strength; and

(B) carry out a program of conducting such tests.

(2) TEST RESULTS.—As the Secretary develops a test under paragraph (1)(A), the Secretary shall conduct a rulemaking to determine how best to disseminate test results to the public.

(3) MOTOR VEHICLES COVERED.—This subsection applies to motor vehicles, including passenger cars, multipurpose passenger vehicles, and trucks, with a gross vehicle weight rating of 10,000 pounds or less.

(c) To amend title 49, United States Code § 30117(a)(1) to require a ROOF STRENGTH SAFETY RATING PROGRAM.—No later than 90 days after the date of enactment of this Bill, the Secretary of Transportation shall issue a notice of proposed rulemaking to establish a roof strength safety rating consumer information program and make publicly available the SWR (Strength-to-Weight Ratios) of all vehicles, to provide practicable, readily understandable, and timely information to consumers for use in making informed decisions in the purchase of vehicles. No later than 6 months after the date of enactment of this Bill, the Secretary shall issue a final rule establishing a roof strength safety rating program and provide consumer information which the Secretary determines would be useful to consumers who purchase vehicles.

(1) MOTOR VEHICLES COVERED.—This subsection applies to motor vehicles, including passenger cars, multipurpose passenger vehicles, and trucks, with a gross vehicle weight rating of 10,000 pounds or less.

(d) To amend title 49, United States Code § 30101(2) to require SAFETY RESEARCH AND DEVELOPMENT TO RETROFIT VEHICLES WITH LOW SWR.——

(1) SAFETY RESEARCH.—No later than 12 months after the date of enactment of this Bill, the Secretary of Transportation shall initiate and complete a study compiling information on the advantages and disadvantages of retrofitting vehicles with the 10 percent lowest SWR (Strength-to-Weight Ratios) to increase their SWR, determining the benefits, if any, of retrofitting, and submit a report on the results of that study to Congress.

(2) DEVELOPMENT.—If Congress believes there is a benefit to retrofitting vehicles with the 10 percent lowest SWR, then no later than 12 months after the date of enactment of this Bill, the Secretary of Transportation shall issue a notice of proposed rulemaking to require the manufacturers of vehicles with the 10 percent lowest SWR to develop retrofit kits to strengthen the roofs of those vehicles. No later than 18 months after the date of enactment of this Bill, the Secretary shall issue a final rule requiring the manufacturers of vehicles with the 10 percent lowest SWR to develop retrofit kits to strengthen the roofs of those vehicles and make the retrofit kits publicly available.

(3) MOTOR VEHICLES COVERED.—This subsection applies to the previous 10 model years prior to the date of the enactment of this Bill.

Senator PRYOR. Thank you.

I'm sorry, Mr. Oesch?

Mr. OESCH. Yes, sir.

Senator PRYOR. I mispronounced that earlier.

Mr. OESCH. That's quite all right.

Senator PRYOR. Go ahead. Thank you.

Mr. OESCH. No one ever gets it, sir.

[Laughter.]

STATEMENT OF STEPHEN L. OESCH, SENIOR VICE PRESIDENT, INSURER AND GOVERNMENT RELATIONS, INSURANCE INSTITUTE FOR HIGHWAY SAFETY

Mr. OESCH. I am Steve Oesch, with the Insurance Institute for Highway Safety.

The Institute is a nonprofit research and communications organization that is dedicated to identifying ways to reduce the deaths, injuries, and property damage on our Nation's highways. We are sponsored by automobile insurers. I'm here today to share with you the results of our recent research looking at the relationship between roof strength and injury risk in rollover crashes.

A key to providing protection to occupants in any type of crash, be it front, side, or rollover, is to ensure that the occupant compartment, the safety cage around the occupants, is well maintained so that the airbags and the lap/shoulder belts can provide protection in the event of a crash.

You'll see, in my written testimony, some examples of the 40-mile-an-hour frontal offset crashes that we've done. You'll see the test results for the Pontiac Transport, that the occupant compartment collapsed around the occupants, therefore increasing the risk of injury. In sharp contrast, you'll see the test results for the 2005 Chevrolet Uplander, and the occupant compartment is well maintained so that the airbags and lap/shoulder belt could provide protection in that crash.

Prior to our recent research on roof strength, several studies had reported no relationship between roof strength and injury risk in rollover crashes. These earlier studies defy logic, because, as I just explained, in every other crash configuration, the basic principle of occupant crash protection means that you preserve the safety cage so the airbags and lap/shoulder belts can provide protection in the event of a crash.

Thus, there is no logical reason to assume that in a rollover crash you would want to design a vehicle that would allow excessive intrusion. In fact, if you look at NASCAR vehicles, they're designed with roll cages. And I've included in my written testimony an example of a very violent crash in which the vehicle rolled over numerous times; the driver was well protected, because there was a roll cage in that vehicle.

Our study was a two-part analysis involving vehicle testing and examination of the outcome of real rollover crashes. We looked at 11 mid-sized four-door SUVs, and we subjected them to a test that's similar to the test that's conducted by automobile manufacturers to determine whether the vehicle complies with the Federal standard. I've included in my testimony two demonstration tests—one ivolved the Nissan Xterra, the vehicle with one of the strongest roofs in our study, and we subjected it to a force of 10,000 pounds. As you can see in the photograph, the Nissan Xterra withstood that force with only 2 inches of crush. In contrast, if you look at the 2000 model year Ford Explorer in that same test, we crushed it down to 10 inches, and it was not able to resist the 10,000 pounds of force. Such a striking difference in the amount of roof crush illustrates why you would expect to have higher injury risk in SUVs with weaker roofs.

Having established this difference in roof strength, we then looked at real-world crashes. We examined more than 23,000 crashes that occurred during the period 1997 to 2005 involving the vehicles that we tested. We then looked at the difference in the roof strength between those vehicles, and what we found was, no matter what measure of roof strength that we used, a constant relationship emerged; it showed that SUVs with stronger roofs had lower injury risks, just exactly what you would expect. We are going to continue to do additional research on other classes of vehicles. We expect to see that same relationship.

As to the proposed Federal standard, our study clearly shows the relationship between increased roof strength and reduced injury risk in rollover crashes. We support the use of the current roof-crush procedures set forth in existing Federal standard. Our study supports—shows that you—going to a strength-to-weight ratio of at least three times vehicle weight would be warranted by the data. But, as we point out, if we even went from 1.5 times the vehicle weight, which is the existing standard, to 2.5 times the vehicle weight, which is the proposal from the National Highway Traffic Safety Administration, there would be a reduction in rollover serious and fatal injuries by 28 percent. So, increasing the roof strengths, naturally, beyond that 2.5 times vehicle weight would reduce the risk even further.

Mr. Chairman, members of the Committee, I want to thank you very much for the opportunity. And I would like to acknowledge that two of the authors of the study, Mr. Matt Brumbelow and Mr. Eric Teoh, accompany me today, and I want to credit them with the very important research they did showing this relationship between increased roof strength and lower injury risk.

Thank you.

[The prepared statement of Mr. Oesch follows:]

PREPARED STATEMENT OF STEPHEN L. OESCH, SENIOR VICE PRESIDENT, INSURER AND GOVERNMENT RELATIONS, INSURANCE INSTITUTE FOR HIGHWAY SAFETY

The Insurance Institute for Highway Safety is a nonprofit research and communications organization that identifies ways to reduce the deaths, injuries, and property damage on our Nation's highways. We are sponsored by U.S. automobile insurers. Thank you for inviting IIHS to testify on the findings of our recent research on the relationship between roof strength and injury risk in rollover crashes.

Principles of Vehicle Crashworthiness

A key to protecting occupants in front, side, rear, or rollover crashes is ensuring that compartments, or "safety cages," surrounding the occupants remain intact so lap/shoulder belts and airbags can provide protection during the crashes. If an occupant compartment allows excessive intrusion of the door, instrument panel, footwell, roof, or other vehicle structure, it compromises the ability of vehicle restraint systems to protect the occupants.

This is demonstrated by comparing 2 vehicles IIHS evaluated in 40 mph frontal offset crash tests. The occupant compartment in the 1997 Pontiac Transport was compromised, thus increasing the potential for occupant injury. In sharp contrast is the occupant compartment in the 2005 Chevrolet Uplander, which withstood the forces of the frontal impact and remained intact, allowing the lap/shoulder belt and airbag to provide good occupant protection.

1997 Pontiac Transport

2005 Chevrolet Uplander

Prior to our recent research on roof strength, several studies had reported no relationship between roof strength and injury risk in rollover crashes. These earlier findings defy logic because, as I just explained, in every other crash configuration—whether front, side, or rear—the basic principles of occupant protection dictate that the compartment be designed to resist intrusion so lap/shoulder safety belts and airbags can provide protection to occupants. There is no logical reason to assume that in a rollover crash, you would design a vehicle to permit excessive intrusion. This is the reason NASCAR vehicles are equipped with roll bars to prevent roof crush in violent rollover crashes such as the one experienced by Michael McDowell at the Texas Motor Speedway in 2008. He walked away from this crash uninjured.

Michael McDowell's rollover crash

Findings of IIHS's Study of SUV Roof Strength

Our study, described in the attached documents,[1 2 3] is a 2-part analysis involving vehicle testing and examination of the outcomes of real-world rollover crashes. Eleven midsize 4-door SUV roof designs were subjected to a test similar to the one con-

[1] Brumbelow, M.L.; Teoh, E.R.; Zuby, D.S.; and McCartt, A.T., 2008. Roof strength and injury risk in rollover crashes. Arlington, VA: Insurance Institute for Highway Safety.

[2] Insurance Institute for Highway Safety, 2008. Comment to the National Highway Traffic Safety Administration in response to comments by Padmanaban and Moffatt on the Institute's study, "Roof Strength and Injury Risk in Rollover Crashes," May 13. Arlington, VA.

[3] Insurance Institute for Highway Safety, 2008. Strength of roofs on SUVs influences risk of occupant injury in rollover crashes, new Institute study finds. *Status Report* 43:1. Arlington, VA.

ducted by automakers to comply with Federal roof strength requirements. Researchers applied force to the roofs until crush reached 10 inches, measuring the peak force required for 2 inches of crush, 5 inches of crush, and 10 inches. There was a range of performance among the SUVs tested, and 2 demonstration tests illustrate the differences.

These photographs show what happened when the 2000 Nissan Xterra, the SUV with the strongest roof in IIHS tests, and the 2000 Ford Explorer, which has one of the weakest roofs, were subjected to a force of up to 10,000 pounds. The Xterra resisted a force of 10,000 pounds after only 2 inches of crush, while the Explorer crushed all the way to 10 inches without reaching this level of resistance. Such a striking difference in the amount of roof crush illustrates why higher injury risk would be expected in SUVs with weaker roofs.

2000 Nissan Xterra

2000 Ford Explorer

Having established the range of roof strength among the SUVs in the IIHS study, the researchers then focused on almost 23,000 rollover crashes of the same SUVs that occurred in the real world during 1997–2005. Logistic regression was used to assess the effect of roof strength on the likelihood of serious or fatal driver injury in the on-the-road rollover crashes of the SUVs. The regression controlled for state-to-state differences, vehicle stability, and driver age, and the results denote the injury risk, given the strength of an SUV's roof. No matter what measure of roof strength the researchers used, a consistent relationship emerged: SUVs with stronger roofs had lower injury risks.

There are important strengths of our study. We looked only at midsize SUVs because they are similar vehicles with similar drivers and a high risk of rolling over. This allowed researchers to limit the number of variables in the analysis and concentrate on the ones that would ensure that results were not biased by factors such as differences in driver age, types of use, etc. Another strength is that we used several different measures of roof strength, all of which confirmed that injury risk is lower among vehicles with stronger roofs. This makes logical sense, and the data confirm it.

Based on our research, we expect that the study's finding of reduced injury risk with increased roof strength will hold for other types of vehicles, although the magnitude of the injury risk reductions may differ among vehicle groups. To further establish this, we plan to conduct another series of roof crush tests involving a different class of vehicles—small passenger cars—that also has a high rollover rate.

Dynamic Rollover Test

A dynamic rollover test using instrumented test dummies would be a gold standard for assessing occupant protection in rollover crashes. However, we are not certain that the procedures for a dynamic test are reasonably repeatable, and we are not sure how to conduct such a test to obtain the most relevant information. Real-world rollover crashes vary widely. They often are preceded by violent events as vehicles leave the road and begin to roll over. The positions of occupants at the time a rollover begins are uncertain, so it is difficult to position test dummies to represent where occupants would be in real-world rollover crashes. Current dummies designed for front, side, and rear testing have not been shown to behave in a human-like manner in rollover crashes.

Proposed Federal Roof Crush Standard

IIHS's study clearly shows the relationship between increased roof strength and reduced injury risk in rollover crashes. We support the continued use of the current roof crush procedures set forth in the existing Federal standard on roof crush resistance. However, our study supports requiring vehicles to have a strength-to-weight ratio of at least 3.0. We estimate that a 1-unit increase in peak strength-to-weight ratio—for example, from 1.5 times vehicle weight, as specified in the existing Federal standard, to 2.5 times, as proposed by the National Highway Traffic Safety Administration—would reduce the risk of serious or fatal injury in a rollover crash by 28 percent. Increasing roof strength requirements beyond 2.5 times vehicle weight would reduce injury risk even further.

ROOF STRENGTH AND INJURY RISK IN ROLLOVER CRASHES—March 2008

by Matthew L. Brumbelow, Eric R. Teoh, David S. Zuby, and Anne T. McCartt

Abstract

Vehicle rollover is a major cause of fatality in passenger vehicle crashes. Rollovers are more complicated than planar crashes, and potential injury mechanisms still are being studied and debated. A central factor in these debates is the importance of having a strong vehicle roof. Minimum roof strength is regulated under Federal Motor Vehicle Safety Standard (FMVSS) 216, but no study to date has established a relationship between performance in this or any other test condition and occupant protection in real-world rollover crashes. The present study evaluated the relationship between roof strengths of 11 mid-size SUV roof designs and the rate of fatal or incapacitating driver injury in single-vehicle rollover crashes in 12 states. Quasi-static tests were conducted under the conditions specified in FMVSS 216, and the maximum force required to crush the roof to 2, 5, and 10 inches of plate displacement was recorded. Various measures of roof strength were calculated from the test results for evaluation in logistic regression models. In all cases, increased measures of roof strength resulted in significantly reduced rates of fatal or incapacitating driver injury after accounting for vehicle stability, driver age, and state differences. A one-unit increase in peak strength-to-weight ratio (SWR) within 5 inches of plate displacement, the metric currently regulated under the FMVSS 216 standard, was estimated to reduce the risk of fatal or incapacitating injury by 28 percent.

Introduction

During the past two decades automobile manufacturers have made important advances in designing vehicle structures that provide greater occupant protection in planar crashes (Lund and Nolan 2003). However, there has been little consensus regarding the importance of roof strength in rollover crashes, as well as the best method for assessing that strength. In 2006 one-quarter of fatally injured passenger vehicle occupants were involved in crashes where vehicle rollover was considered the most harmful event (Insurance Institute for Highway Safety, 2007). Many fatally injured occupants in rollovers are unbelted, and some are completely or partially ejected from the vehicle (Deutermann 2002). There is disagreement concerning how structural changes could affect ejection risk or the risk of injury for occupants who remain in the vehicle, regardless of belt use.

Some researchers have concluded there is no relationship between roof crush and injury risk as measured by anthropometric test devices (ATDs) (Bahling *et al.,* 1990; James *et al.,* 2007; Moffatt *et al.,* 2003; Orlowski *et al.,* 1985; Piziali *et al.,* 1998), whereas others have reached the opposite conclusion using data from the same crash tests (Friedman and Nash, 2001; Rechnitzer *et al.,* 1998; Syson 1995). These disparate conclusions have led to distinct hypotheses about the primary source of rollover injury: either a diving mechanism in which injury occurs independently of roof crush, or a roof intrusion mechanism in which injury is caused by structural collapse. These hypotheses often are seen as being mutually exclusive, but both assume that keeping occupants in the vehicle and preventing head-to-roof contact reduces injury risk. According to Bahling *et al.,* (1990), "the absence of deformation may benefit belted occupants if it results in the belted occupant not contacting the roof."

Federal Regulation of Roof Strength

Although many researchers have studied potential rollover injury mechanisms, evaluation of the Federal regulation governing roof strength has been lacking. Federal Motor Vehicle Safety Standard (FMVSS) 216 was introduced in 1971 to establish a minimum level of roof strength and is the only regulation governing rollover crashworthiness for passenger vehicles (Office of the Federal Register 1971). FMVSS 216 specifies a quasi-static test procedure that measures the force required to push a metal plate into the roof at a constant rate. It requires a reaction force equal to 1.5 times the weight of the vehicle be reached within 5 inches of plate displacement. In 1991 the standard was extended to apply to light trucks and vans with gross vehicle weight ratings less than 6,000 pounds (Office of the Federal Register 1991).

In 2005 NHTSA issued a notice of proposed rulemaking (NPRM) announcing its intent to upgrade the roof strength standard (Office of the Federal Register 2005). According to the proposal the test procedure would remain largely unchanged but the level of required force would be increased to a strength-to-weight ratio (SWR) of 2.5. The maximum 5-inch plate displacement limit would be replaced by a requirement that the minimum strength be achieved prior to head-to-roof contact for an ATD positioned in the front outboard seat on the side of the vehicle being tested. Using two different analysis methods, NHTSA estimated 13 or 44 lives per year would be saved by the proposed standard, equivalent to less than 1 percent of rollover fatalities. These estimates were based on an evaluation of 32 crashes in the National Automotive Sampling System/Crashworthiness Data System (NASS/CDS), after assuming that the following occupants, among others, would not benefit from the proposed upgraded standard: occupants in arrested rolls, ejected occupants, unbelted occupants, occupants in rear seats, and occupants without coded intrusion above their seating positions.

In 2008 NHTSA issued a supplemental notice of proposed rulemaking announcing the results of additional research tests (Office of the Federal Register 2008). The proposal indicated the agency may consider adopting a sequential two-sided test. Final decisions about the minimum SWR for either a one- or two-sided test are pending results of an updated benefits analysis.

Previous Research Relating Roof Strength to Crash Injury Outcomes

NHTSA's benefits analysis in the 2005 NPRM assumed that roofs designed to meet a higher strength requirement in the quasi-static test are better able to maintain occupant headroom during rollover crashes in the field. This link has never been shown, nor has any measure of roof strength been found to predict injury risk. The agency's own assessment found most vehicles "easily exceeded" the requirements of FMVSS 216, even vehicles produced before introduction of the standard (Kahane 1989). Demonstrating that a test promotes crashworthy designs is difficult without either a sample of vehicles not meeting the test requirements or a range of performance among vehicles that pass. Kahane found that some hardtop roof designs without B-pillars sustained more crush before meeting the minimum strength requirement, and that fleet-wide fatality risk in non-ejection rollover crashes declined during the 1970s, a time period corresponding to a shift toward roof designs with B-pillars. These findings did not establish a relationship between roof strength and injury because test results for specific vehicles were not compared with injury rates for those vehicles.

Only two studies directly investigated the relationship between peak roof strength and injury outcome for occupants in real-world rollover crashes (Moffatt and Padmanaban 1995; Padmanaban *et al.,* 2005). Vehicles were evaluated using the quasi-static procedure outlined in FMVSS 216, but every vehicle was tested to a full 5 inches of plate displacement to measure roof strength in excess of the minimum SWR. An earlier study by Plastiras *et al.,* (1985) did not incorporate measures of peak roof strength and used a severely limited sample of crashes.

Moffatt and Padmanaban (1995) constructed a logistic regression model to investigate the effects of age, gender, belt use, alcohol use, crash environment (rural/urban), number of vehicle doors, vehicle aspect ratio (roof height divided by track width), vehicle weight, roof damage, and roof strength on the likelihood of fatal or incapacitating driver injury in single-vehicle rollover crashes. Crash data consisted of single-vehicle rollovers in databases of police-reported crashes in four states. Multiple vehicle types were included. The study reported no relationship between roof strength and the likelihood of fatal or incapacitating injury. Although more severe roof damage was associated with higher likelihood of injury, the study found roof strength did not predict the likelihood of severe roof damage.

Padmanaban *et al.,* (2005) conducted a follow-up study that expanded the vehicle sample and differed in a few other respects, but the findings were similar. Driver factors such as belt use, age, and alcohol use were reported as important predictors of injury risk, whereas roof strength was not related to the risk of fatal or incapacitating injury, or to the risk of fatal injury alone. Both studies also found that vehicles with higher aspect ratios had lower rates of fatal or incapacitating injury.

These findings call into question the effectiveness of the FMVSS 216 regulation. The standard was established to "reduce deaths and injuries due to the crushing of the roof," but according to this research, roof strength assessed under the regulated test conditions has no relationship to injury likelihood. Furthermore, the Moffatt and Padmanaban (1995) study found no relationship between roof strength and roof damage in rollover crashes. This finding suggests two possibilities: either the Federal standard is not evaluating roof strength in a mode relevant to real-world rollovers, or the methods used in these studies have allowed other factors to obscure this relevance. Differences among vehicle types and state reporting practices are two examples of factors that may have confounded the results for roof strength.

The purpose of the present study was to investigate whether there is any relationship between performance in the quasi-static test specified by FMVSS 216 and injury risk in rollover crashes. By restricting the analysis to midsize four-door SUVs the study sought to minimize other factors that may confound an analysis of roof strength, such as the differences in crash severity, vehicle kinematics, occupant kinematics, and driver demographics associated with vehicles of different types. Vehicle stability, occupant age effects, and differences between states were controlled statistically in the analyses. The study estimated the effects of raising the minimum SWR requirement and also compared alternative strength metrics calculated from the roof test data.

Methods

Logistic regression was used to evaluate the effect of roof strength on driver injury risk in single-vehicle rollover crashes involving midsize four-door SUVs. Roof strength data for 11 SUV models were obtained from quasi-static tests in which roofs were crushed with up to 10 inches of plate displacement. Using data from police-reported crashes in 12 states, driver injury rates by make/model were calculated as the proportion of drivers in single-vehicle rollover crashes who were coded as having fatal or incapacitating injury.

Vehicle Selection and Roof Strength Testing

Certain vehicle safety features might affect the rate of injuries in rollover crashes and thereby confound the analyses of roof strength. Side curtain airbags and electronic stability control (ESC) are two such features. In a single-vehicle rollover crash the presence of side curtain airbags may reduce the risk of full or partial occupant ejection or reduce the risk of injury for occupants remaining in the vehicle. ESC does not influence injury risk once a rollover has begun, but it most likely affects the type of rollover crashes in which ESC-equipped vehicles are involved. All models with side curtain airbags or ESC as standard features were excluded. None of the remaining vehicles had optional ESC installation rates exceeding 3 percent, and only one had an optional curtain airbag installation rate higher than 5 percent (Ward's Communications, 2006). Potential confounding from the inclusion of 2002–04 Ford Explorers, 15 percent of which had curtain airbags, was addressed in a manner described below. Although it would have been desirable to evaluate roof strength effects for vehicles with these safety features, which soon will be standard across the fleet, there were insufficient data to do so.

Roof strength data from vehicle manufacturers typically do not enter the public domain and therefore are not readily available to independent researchers. Additionally, compliance testing rarely is extended beyond the crush distance required to demonstrate the minimum SWR of 1.5. To study the range of roof strengths in the vehicle fleet, testing must continue beyond this level to measure peak force. The required test data were available for three midsize SUVs from NHTSA research related to the proposed standard upgrade. These data were included in the study.

Roof strength data for additional vehicles were obtained from tests conducted by General Testing Laboratories, under contract with the Insurance Institute for Highway Safety. The eight midsize SUVs with the most rollover crashes in the state databases used for the study were tested. Six of these models were not current designs, so it was necessary to test used vehicles. Tested vehicles had no previous crash damage and were equipped with the original factory-installed windshield and side windows. It has been suggested that the windshield and its bond to the vehicle frame can contribute up to 30 percent of the strength measured in the test (Friedman and Nash 2001).

In total, tests of 11 roof designs provided the data for the study. Some of these designs were shared by corporate twins, so the number of vehicle models in the study exceeds 11.

Static Stability Factor

Moffatt and Padmanaban (1995) and Padmanaban *et al.,* (2005) found that vehicles with larger aspect ratios had lower rates of serious driver injury. The authors did not discuss the implications of this finding, although the 2005 study suggested it was not due to any increased headroom of taller vehicles. Assuming identical suspension properties, taller and narrower vehicles are less stable than wider shorter ones, leading to rollovers at lower speeds and with less severe tripping events. It is possible that these lower speed rollovers are less likely to cause serious injury, meaning that when rollovers do occur, less stable vehicles may have lower severe injury rates simply because they roll more easily. Harwin and Emery (1989) reported this from a sample of 3,000 rollover crashes in Maryland. The present study included static stability factor (SSF) as a predictor in the logistic regression. SSF is a better measure of stability than aspect ratio because the height of the center of gravity is measured instead of the height of the roof. NHTSA uses SSF to assign rollover risk ratings to the vehicle fleet, and these publicly available data were used in this study.

Roof Strength Metrics

Because performance in the FMVSS 216 test has not been shown to affect injury risk, it is not clear that a baseline SWR within 5 inches of plate displacement better predicts injury outcome than other strength metrics that can be calculated from the same test data. The energy absorbed by the roof may be more relevant to injury risk than the peak force it can withstand, or the roof's performance over a plate displacement other than 5 inches could better predict injury risk. The contribution of vehicle mass to rollover crashworthiness also is unknown.

In the present study the following metrics were evaluated: peak force, SWR, energy absorbed, and equivalent drop height. SWR is peak force divided by vehicle curb weight, and equivalent drop height is energy divided by curb weight converted to inches. The term "equivalent drop height" is used because this metric can be considered the height from which the vehicle could be dropped on its roof to produce the same level of crush as observed in the test (under an ideal condition where the roof deforms identically in the dynamic and quasi-static conditions). Each of the metrics was calculated within 2, 5, and 10 inches of plate displacement. Two inches was chosen based on the highly linear characteristic of the force-deflection curves up to this displacement. Ten inches represented the maximum deflection in 10 of the 11 tests.

Because there were 11 tested roof designs, the evaluations using peak force and energy absorption had 11 available values for comparison. The use of curb weight for calculating SWR and equivalent drop height produced many more unique values. Corporate twins were separated where curb weights differed, and two-wheel drive vehicles were separated from four-wheel drive versions due to their lower weights and varying SSF values. These 31 vehicles produced 28 unique values of SWR and equivalent drop height. Table 1 lists the vehicle test data used in the analysis. Appendix A reports the other metrics for these vehicles as well as the other models for which these data can be applied. The results for the 1996–2001 Ford Explorer and Mercury Mountaineer reflect the use of averaged values obtained from two tests. The Mitsubishi Montero Sport was omitted from the 10-inch displacement evaluations because NHTSA's test of this vehicle did not continue beyond 7.4 inches. This omission did not substantially affect the results; the Montero Sport had the smallest exposure of all vehicles in the study.

Table 1.—FMVSS 216 Roof Strength Test Results

Model years	Make	Model	Peak roof strength (lb_f) 2 in	5 in	10 in
1996–2004	Chevrolet	Blazer	4,293	7,074	7,337
2002–2005	Chevrolet	TrailBlazer	6,896	8,943	8,943
1998–2003	Dodge	Durango	6,409	9,138	9,138
1996–2001	Ford	Explorer	5,901	7,072	8,196
2002–2004	Ford	Explorer	6,895	9,604	12,372
1996–1998	Jeep	Grand Cherokee	5,497	8,455	8,455
1999–2004	Jeep	Grand Cherokee	5,073	6,560	7,090
2002–2005	Jeep	Liberty	8,226	10,374	10,544
1997–2004	Mitsubishi	Montero Sport	6,063	10,069	N/A
2000–2004	Nissan	Xterra	9,431	11,996	11,996
1996–2000	Toyota	4Runner	5,269	8,581	8,581

Rollover Crash Data

Data for single-vehicle rollover crashes were obtained from the State Data System. The system is maintained by NHTSA and consists of data from police-reported crashes submitted to the agency by certain states. Qualifying states had data available for some part of calendar years 1997–2005, had event and/or impact codes allowing single-vehicle rollovers to be identified, and had available information on vehicle identification numbers sufficient for determining vehicle make, model, and model year. Twelve states met these criteria: Florida, Georgia, Illinois, Kentucky, Maryland, Missouri, New Mexico, North Carolina, Ohio, Pennsylvania, Wisconsin, and Wyoming. All of these states use the KABCO injury coding system, where "K" represents fatal injuries and "A" represents incapacitating injuries as assessed by the investigating police officer.

Logistic Regression

Logistic regression was used to assess the effect of roof strength on the likelihood of fatal or incapacitating driver injury. The final models controlled for state, SSF, and driver age. Controlling for state is necessary because of differences in reporting methods, terrain, urbanization, and other factors that could result in state-to-state variation in injury rates. The potential influence of SSF on rollover crash severity was discussed previously, and age has been found to affect injury risk (Li *et al.,* 2003). A separate model was fit for each roof strength metric at each plate displacement distance, yielding 12 models. The effect of roof strength was assumed to be constant across all states. Because rollovers resulting in fatal or incapacitating injuries are fairly rare events, the odds ratios resulting from these models are reasonable approximations of relative risks and are interpreted accordingly.

Other covariates initially were examined in the models. These included coded belt use, driver gender, vehicle drive type (two- vs. four-wheel drive), and vehicle age. Driver gender, drive type, and vehicle age did not have significant effects on injury likelihood and were excluded from the final model. Coded belt use did affect injury risk in rollover crashes, and there was concern that belt use may confound the observed effects of roof strength. To study this possibility, separate models were fit for drivers coded as belted, unbelted, and unknown despite the unreliability of this information from police reports.

Tests that provided data for the 2002–04 Ford Explorer and 2000–04 Nissan Xterra were conducted with an alternative tie-down procedure that NHTSA was investigating for a change to the laboratory test procedure specified by the Office of Vehicle Safety Compliance (NHTSA 2006). At least one manufacturer has expressed concern that this tie-down procedure produces different results than the procedures used in its own compliance tests (Ford Motor Company 2006). The test procedure employed by General Testing Laboratories for this study differed from both the alternative being investigated by NHTSA and the procedure used by Ford. Two supplemental analyses addressed these procedural variations. First, results for the Explorer and Xterra were excluded and the data were modeled again. This also addressed any potential confounding resulting from the 15 percent installation rate of side curtain airbags in the 2002–04 Explorer. Second, a sensitivity analysis was conducted. This consisted of 10 separate regression models in which the roof strength inputs to the model varied by up to 10 percent above or below the measured strength. These values were sampled from a distribution using a random number generator.

One difficulty associated with using fatal and incapacitating injury counts as the measure of crash outcome is the subjectivity with which police can code incapacitating injuries. To check potential error from police judgment, separate models were fit for fatal injuries alone to ascertain that they followed the same pattern as models including incapacitating injuries.

Estimated Lives Saved

The present study has direct bearing on any future upgrades to FMVSS 216. Most of the study vehicles would require stronger roofs if the SWR requirement increased from 1.5 to 2.5 without any other modifications to the test procedure. To estimate the number of lives saved by such a change, data were extracted from the Fatality Analysis Reporting System for 2006. Fatalities were counted for occupants in front outboard seating positions in single-vehicle rollover crashes for each of the study vehicles. For vehicles with SWRs below 2.5, the increase required to achieve this level of strength was used to scale the effectiveness estimates of the final logistic regression model, producing vehicle-specific effectiveness values. These values were applied to the number of fatalities in each vehicle to produce an estimate of total lives saved. A second estimate was calculated using a target SWR of 3.16, the highest level achieved by any of the study vehicles. No compliance margin was included in these estimates; it was assumed that the roof strength values would not be greater than the target strength value.

Results

Figure 1 shows the unadjusted relationship between the rate of fatal or incapacitating driver injury and peak SWR within 5 inches of plate displacement, the metric used in FMVSS 216. The circles represent the raw injury rate data; circle sizes are proportional to the total number of rollover crashes in the state databases for each study vehicle, and hence to that vehicle's contribution to the weighted regression line that is plotted. The slope of the line represents an injury rate 24 percent lower than average for an SWR one unit higher than average, but no adjustment was made for potentially confounding factors.

After controlling for state effects, SSF, and driver age the logistic regression models estimated changes in the odds of fatal or incapacitating driver injury for greater roof strength. Lower injury rates were associated with higher values of peak force, SWR, energy absorption, and equivalent drop height at 2, 5, and 10 inches of plate displacement. All of these findings were statistically significant at the 0.05 level. The model for peak SWR within 5 inches predicted that a one-unit increase in SWR would reduce the risk of fatal or incapacitating driver injury by 28 percent. These findings were based on 22,817 rollover crashes in the 12 states.

Figure 1
Rates of fatal or incapacitating driver injury by peak strength-to-weight ratio (SWR) within 5 inches of plate displacement

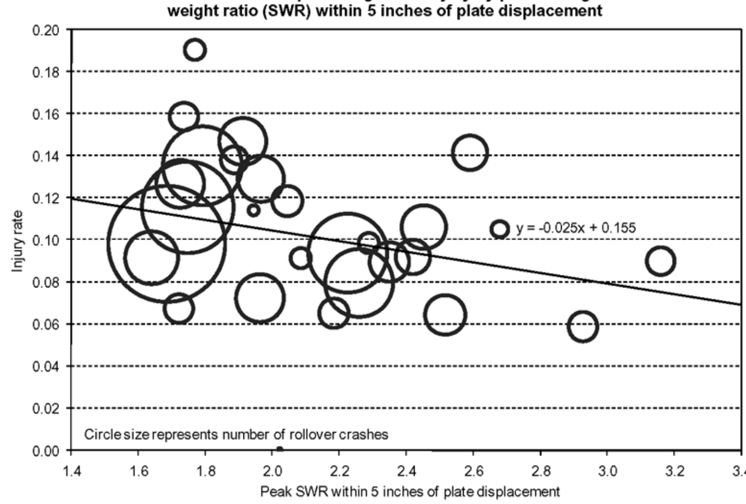


Table 2 lists the odds ratios for fatal or incapacitating driver injury for higher roof strength values. Odds ratios less than one indicate that greater roof strength is associated with lower injury risk. The units vary by metric. Peak force is given in English tons, SWR in increments of vehicle weight, energy absorption in kilojoules, and equivalent drop height in inches. One-unit differences in these metrics do not represent equivalent changes in roof strength, so the point estimates in the first column should not be directly compared against one another. To facilitate comparison, the second column lists the range of roof strength test performance for the study vehicles, and the third column lists the effect associated with a difference of this amount. For example, the lowest peak force within 2 inches of plate displacement was 4,293 lb_f (2.15 tons), observed in the test of the Chevrolet Blazer. The highest peak force was 9,431 lb_f (4.72 tons) for the Nissan Xterra, or 2.57 tons greater than the force in the Blazer test. A strength difference of 2.57 tons was associated with a 49 percent lower injury risk for the stronger roof.

The effects of driver age and SSF also are listed in Table 2. SSF values ranged from 1.02 to 1.20 for the study vehicles, so the effect of a 0.1 unit increase in SSF was evaluated. Results did not show a clear trend in injury risk by SSF. The effect of age was very consistent and statistically significant. Each 10-year increase in driver age was estimated to increase injury risk, given a single-vehicle rollover had occurred, by 12–13 percent.

Table 2.—Results of Logistic Regression Models for Risk of Fatal or Incapacitating Driver Injuries

		Roof strength			SSF	Driver age
Strength metric	Plate displacement	Odds ratio for 1 unit increase	Range	Odds ratio for observed range	Odds ratio for 0.1 unit increase	Odds ratio for 10 year increase
Peak force (tons)	2 in	0.77*	2.15–4.72	0.51*	1.05	1.13*
	5 in	0.82*	3.28–6.00	0.58*	1.06	1.12*
	10 in	0.74*	3.55–6.19	0.46*	1.06	1.13*
SWR	2 in	0.55*	1.05–2.48	0.43*	0.98	1.13*
	5 in	0.72*	1.64–3.16	0.61*	0.96	1.12*
	10 in	0.57*	1.77–3.16	0.45*	0.93	1.13*
Energy absorbed (kJ)	2 in	0.34*	0.45–0.97	0.57*	1.01	1.13*
	5 in	0.71*	2.58–4.51	0.52*	1.08	1.13*
	10 in	0.82*	6.28–8.96	0.59*	1.06	1.13*
Equivalent drop height (in)	2 in	0.56*	0.96–2.25	0.48*	0.95	1.13*
	5 in	0.85*	5.56–10.5	0.45*	0.98	1.13*
	10 in	0.89*	13.6–20.5	0.44*	0.93	1.13*

*Statistically significant at 0.05 level.

Eighty-three percent of drivers in the study were coded as belted. Logistic regression models using only these drivers produced estimates for the effectiveness of roof strength in preventing injury that were very similar to those of the regression models for all drivers. All estimates were statistically significant. Ten percent of drivers were coded as unbelted, and regression models restricting to these crashes found small effects of roof strength on injury risk that were not statistically significant. Police reported unknown belt use for the remaining 7 percent of drivers. Roof strength effect estimates for these crashes were similar to the overall model, although not all were statistically significant at the 0.05 level. Results are listed in Table 3.

Table 3.—Results of Logistic Regression Models for Risk of Fatal or Incapacitating Driver Injuries By Police-reported Belt Use

	Plate displacement	Odds ratios for 1 unit increases in roof strength, by police reported belt use			
		All drivers	Belted	Unbelted	Unknown
Peak force (tons)	2 in	0.77*	0.79*	0.93	0.79
	5 in	0.82*	0.82*	1.00	0.90
	10 in	0.74*	0.76*	0.94	0.81
SWR	2 in	0.55*	0.59*	0.85	0.54*
	5 in	0.72*	0.73*	0.99	0.78
	10 in	0.57*	0.59*	0.90	0.59
Energy absorbed (kJ)	2 in	0.34*	0.40*	0.64	0.34
	5 in	0.71*	0.73*	0.95	0.79
	10 in	0.82*	0.85*	0.95	0.86
Equivalent drop height (in)	2 in	0.56*	0.62*	0.79	0.54*
	5 in	0.85*	0.86*	0.98	0.86
	10 in	0.89*	0.91*	0.97	0.88*

*Statistically significant at 0.05 level

The two supplemental analyses addressing test procedure differences produced results comparable with the overall results in Table 2. The odds ratio for fatal or incapacitating driver injury associated with a one-unit higher SWR at 5 inches of plate displacement, originally 0.72, was 0.74 for the regression model excluding the Explorer and Xterra and ranged from 0.67 to 0.78 for the 10 regression models with varying roof strengths. These results remained statistically significant at the 0.05 level.

Of the 22,817 rollover crashes in the state data set, 1,869 drivers sustained incapacitating injuries and 531 sustained fatal injuries. Because these injuries were split among 12 different states and up to 28 unique SWR values, fatality counts were quite small. Nevertheless, results from the fatality models were similar to results from the models that also included incapacitating injury, and in 11 of 12 cases were statistically significant at the 0.05 level. Results are presented in Table 4.

Table 4.—Results of Logistic Regression Models of Risk of Driver Fatality

	Plate displacement	Odds ratio for 1 unit increase
Peak force (tons)	2 in	0.61*
	5 in	0.80*
	10 in	0.58*
SWR	2 in	0.36
	5 in	0.76
	10 in	0.43*
Energy absorbed (kJ)	2 in	0.11*
	5 in	0.54*
	10 in	0.62*
Equivalent drop height (in)	2 in	0.35*
	5 in	0.79*
	10 in	0.80*

* Statistically significant at 0.05 level.

In 2006, 668 occupants in front outboard seating positions were killed in single-vehicle rollover crashes involving the study vehicles. It was estimated that 108 of these lives (95 percent confidence interval: 63–148) could have been saved by increasing the minimum SWR required by FMVSS 216 from 1.5 to 2.5. Increasing the minimum SWR to 3.16 could have saved 212 lives (95 percent confidence interval: 130–282).

Discussion

The present study demonstrates that roof strength has a strong effect on occupant injury risk. This is in contrast to previous research relating roof test results to injury rates in field rollover crashes (Moffatt and Padmanaban 1995; Padmanaban *et al.,* 2005). To fully investigate these differences, the detailed roof strength data from the previous studies would need to be compared with the data reported here. Unfortunately, these earlier data are confidential and a precise reason for the difference in results cannot be established. Nevertheless, the differing methods employed by the studies offer some potential explanations.

One of the biggest differences is that confounding effects associated with vehicle type largely were ignored in earlier research. Passenger cars, minivans, pickups, and SUVs all were included, and vehicles were classified by aspect ratio (roof height divided by track width). The substantial differences in driver demographics, rollover kinematics, and other factors associated with these vehicle types were unlikely to be captured with a measurement based solely on two exterior vehicle dimensions.

The only consideration of vehicle type was a secondary analysis in the Moffatt and Padmanaban (1995) study in which sports cars were grouped with pickups and SUVs, while non-sports cars were grouped with minivans. This attempted to control for the likelihood of drivers engaging in risky driving maneuvers, but likely only served to exacerbate differences in rollover crashes. Sports cars typically are the least rollover prone of all vehicles, with low centers of gravity and wide track widths. By grouping sports cars with SUVs and pickups, the authors combined vehicles requiring very severe roll-initiation events with vehicles requiring less severe initiation. Calculations using data reported by Digges and Eigen (2003) showed that for belted non-ejected occupants in rollover crashes, more than 20 percent of those in passenger cars were exposed to two or more roof impacts, whereas less than 10 percent of SUV and pickup occupants were in rollovers this severe.

Another difference was that these two previous studies did not control for differences among the states used in the analysis. NHTSA analyses of rollover crashes using state data controlled for these differences (Office of the Federal Register 2000), and the present study did so as well.

Belt Use and Ejection

Schiff and Cummings (2004) found that police reports overestimate belt use as compared with NASS/CDS, which is regarded as a more reliable source of this information. The authors found the most disagreement in cases where occupant injuries were least severe; for uninjured occupants coded as unbelted in NASS/CDS, police reported positive belt use 47 percent of the time. Because of this discrepancy, including restraint use as a predictor of injury would produce regression models that overestimate the true effect of belt use and reduce the apparent effect of other variables, such as roof strength.

The present study did not include police-reported belt use in the final regression model. Preliminary models separately analyzed drivers coded as belted and unbelted. Regression models for drivers with reported belt use estimated roof strength effects nearly identical to the effects estimated for all drivers. This is not surprising given the high percentage of reported belt use, but it does imply that belt use is not confounding the results of the final regression model. The models for drivers reported as unbelted did not find a significant relationship between roof strength and injury risk. Roof strength may have less of an effect on injury risk for unbelted drivers, but results are inconclusive given the limited sample of drivers reported as unbelted and the inaccuracy of restraint use from police reports.

Thirty-eight percent of drivers who police said were unbelted also were reported as ejected. Digges *et al.,* (1994) reported that 42 percent of unrestrained occupants who were ejected exited the vehicle through a path other than the side windows, such as the door opening or the windshield. Increased roof strength potentially can reduce the integrity loss that can lead to doors opening or windshields being displaced. As the number of vehicles with side curtain airbags increase, the likelihood of ejection through the side windows should decrease. However, weak roofs could compromise the protection afforded by these airbags if they allow the roof rails to shift laterally and expose occupants to contacts with the ground.

Injury Causation

In finding that vehicles with stronger roofs are more protective of occupants, this study does not directly address injury mechanisms. It is possible the occupant protection provided by increased roof strength mitigates crush injuries by maintaining head clearance, reduces diving injuries by changing vehicle kinematics, or some combination of the two.

The possibility that roof strength influences vehicle kinematics was identified by Bahling *et al.,* (1990). The authors observed substantial differences in rollover tests of production and rollcaged sedans. The production vehicles had a greater "velocity and duration of the roof-to-ground impact of the trailing roofrail" due to more roof deformation earlier in the roll. In addition, the actual number of far-side roof impacts among the rollcaged vehicles was less than half the number among the production vehicles. For far-side occupants, these changes produced a dramatic reduction in the number and average magnitude of neck loads surpassing 2 kN.

Various Roof Strength Metrics

The present study evaluated roof strength with multiple metrics calculated from NHTSA's quasi-static test data. Logistic regression analyses found rollover injury risks were significantly lower for vehicles with stronger roofs, regardless of which strength assessment was used. Based on this finding, it is difficult to determine whether any one metric may be more predictive of injury outcome than the others. To permit an indirect comparison of the metrics, the one-unit effect estimates were converted to estimates for strength level increases equal to the range of study vehicle roof strengths. However, it is not known how much the relationship between these ranges would change with samples of other vehicles. For the vehicles in this study, such comparisons showed a range of predicted injury risk reductions but did not reveal any single combination of strength metric and plate displacement distance that stood out above the others.

For the study vehicles, higher peak roof strengths and SWRs within 2 and 10 inches of plate displacement predicted greater reductions in injury risk than roof strengths within 5 inches of displacement. The federally regulated metric of SWR evaluated within 5 inches predicted the smallest reduction in injury risk of all 12 metric and displacement combinations. Across all three displacement distances, higher values of equivalent drop height predicted the most consistent reductions in injury risk but the differences from other metrics were not large. Future analyses of the quasi-static test condition's relevance to real-world rollovers should further evaluate the equivalent drop height metric.

The metrics that accounted for vehicle curb weight were somewhat better predictors of injury risk than the metrics that did not. The importance of weight may be stronger across the entire vehicle fleet, where the range of curb weights is much wider than for the study vehicles. More than 80 percent of the rollover crashes in this study occurred among vehicles with curb weights between 3,800 and 4,200 pounds.

Other Covariates

All of the logistic regression models estimated significant injury risk increases of 12–13 percent for each 10-year increase in driver age. The findings for SSF were not statistically significant. Although the full range of SSF values for the study vehicles was 1.02–1.20, 74 percent of the rollover crashes in this study involved vehicles with SSF values between 1.06 and 1.09. This could explain the inconclusive injury risk estimates because such small variation in SSF values may be outweighed by other differences that affect vehicle stability and cannot be captured in SSF calculations, such as wheelbase or suspension and tire properties. A stronger trend may exist across the wider range of SSF values found in the entire fleet, with the most stable vehicles typically having values of 1.50 (Robertson and Kelley 1989).

Implications of Testing Used Vehicles

The analyses required vehicle models that have been in the fleet for enough years to accumulate sufficient crash data, so it was necessary to test used vehicles. According to vehicle manufacturers and NHTSA, roof strengths of used vehicles may not be equivalent to those of new vehicles (Office of the Federal Register 2006). Vehicles in the present study had no crash damage or corrosion that could have affected test results. Factory-installed windshields and side glazing still were present. However, it is possible that different results would have been obtained for new models. To some extent, this concern was addressed with the sensitivity analysis. The injury risk findings did not vary substantially when roof strength values were varied up to 10 percent.

Test results for the study vehicles may better represent the roof strengths of vehicles involved in rollover crashes than results for vehicles used in compliance testing and those used in earlier research. Previous studies included tests of production vehicles, prototypes, and vehicles "representative of production" that were "deemed satisfactory for compliance . . . [based on] engineering judgment" (Moffatt and Padmanaban 1995). The authors did not specify how many values were obtained from production vehicles.

Relevance To Proposed FMVSS 216 and Estimated Lives Saved

The estimated number of lives saved by increasing the regulated SWR to 2.5 is considerably higher than the estimated 13 and 44 lives saved indicated in NHTSA's 2005 NPRM, despite the fact the agency's estimates cover the entire passenger vehicle fleet. Estimates presented here are limited to the 11 study vehicles for two reasons: peak roof strength values for other vehicles mostly are unknown, and the effectiveness of roof strength in reducing injury may vary across vehicle types. Another difference in the estimates comes from the NPRM's modified plate displacement criterion, which allows roof intrusion for each vehicle until head contact with an ATD. The NPRM details 10 research tests in which plate displacement ranged from 3.2 to 7.3 inches at roof contact with the ATD. Because the present study looked at midsize SUVs with a narrow range of headroom values relative to the entire fleet, results could not directly address the headroom criterion proposal.

The number of rollover fatalities in the future will be affected by other changes to the vehicle fleet in addition to roof strength, such as wider availability of ESC and side curtain airbags, especially those designed to inflate in rollovers. Nevertheless, an upgraded standard requiring an SWR value of 2.5 likely would produce much greater reductions in fatal and incapacitating injuries than estimated by NHTSA. Further increasing the minimum SWR requirement beyond 2.5 would prevent even more deaths and serious injuries.

Conclusions

Increased vehicle roof strength reduces the risk of fatal or incapacitating driver injury in single-vehicle rollover crashes. This finding contradicts those from two previous studies on the topic, but the present study more tightly controlled potential confounding factors. The study focused on midsize SUVs, but there is no obvious reason similar relationships would not be found for other vehicle types, although the magnitudes of injury rate reductions may differ. Any substantial upgrade to the FMVSS 216 roof strength requirement would produce reductions in fatal and incapacitating injuries that substantially exceed existing estimates.

Acknowledgment

This work was supported by the Insurance Institute for Highway Safety.

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Appendix A: Table A1.—All Study Vehicle Make and Model Combinations With Roof Strength and SSF Data; Vehicles Grouped by FMVSS 216 Test Result; Only 4 Door Models Were Included in the Study

First model year	Last model year	Make	Model	Drive type	SSF	SWR			Energy absorbed (J)			Equivalent drop height (in)		
						2 in	5 in	10 in	2 in	5 in	10 in	2 in	5 in	10 in
1996	2004	Chevrolet	Blazer	2wd	1.02	1.16	1.91	1.98	447	2,575	6,282	1.1	6.2	15.0
1996	2004	Chevrolet	Blazer	4wd	1.09	1.06	1.75	1.81	447	2,575	6,282	1.0	5.6	13.7
1996	2001	GMC	Jimmy	2wd	1.02	1.14	1.89	1.96	447	2,575	6,282	1.1	6.1	14.8
1996	2001	GMC	Jimmy	4wd	1.09	1.05	1.73	1.79	447	2,575	6,282	1.0	5.6	13.6
1996	2001	Oldsmobile	Bravada	4wd	1.09	1.05	1.74	1.80	447	2,575	6,282	1.0	5.6	13.6
2002	2005	Chevrolet	Trail Blazer	2wd	1.16	1.58	2.04	2.04	729	3,482	7,647	1.5	7.0	15.5
2002	2005	Chevrolet	Trail Blazer	4wd	1.18	1.52	1.97	1.97	729	3,482	7,647	1.4	6.8	14.9
2002	2005	GMC	Envoy	2wd	1.16	1.58	2.04	2.04	729	3,482	7,647	1.5	7.0	15.5
2002	2005	GMC	Envoy	4wd	1.18	1.52	1.97	1.97	729	3,482	7,647	1.4	6.8	14.9
2002	2004	Oldsmobile	Bravada	2wd	1.16	1.56	2.02	2.02	729	3,482	7,647	1.5	7.0	15.3
2002	2004	Oldsmobile	Bravada	4wd	1.18	1.50	1.94	1.94	729	3,482	7,647	1.4	6.7	14.7
1998	2003	Dodge	Durango	2wd	1.20	1.46	2.08	2.08	694	3,405	7,483	1.4	6.9	15.1
1998	2003	Dodge	Durango	4wd	1.16	1.39	1.98	1.98	694	3,405	7,483	1.3	6.5	14.3
1996	2001	Ford	Explorer	2wd	1.06	1.50	1.79	2.07	710	2,966	7,064	1.6	6.6	15.8
1996	2001	Ford	Explorer	4wd	1.06	1.40	1.68	1.96	710	2,966	7,064	1.5	6.3	14.9
1997	2001	Mercury	Mountaineer	2wd	1.06	1.48	1.77	2.05	710	2,966	7,064	1.6	6.6	15.6
1997	2001	Mercury	Mountaineer	4wd	1.06	1.40	1.68	1.96	710	2,966	7,064	1.5	6.3	14.9
2002	2004	Ford	Explorer	2wd	1.10	1.64	2.29	2.95	838	3,713	8,780	1.8	7.8	18.5
2002	2004	Ford	Explorer	4wd	1.14	1.57	2.18	2.81	838	3,713	8,780	1.7	7.5	17.7
1996	1998	Jeep	Grand Cherokee	2wd	1.07	1.53	2.35	2.35	577	2,971	6,443	1.4	7.3	15.8
1996	1998	Jeep	Grand Cherokee	4wd	1.07	1.45	2.23	2.23	577	2,971	6,443	1.3	6.9	15.0
1999	2004	Jeep	Grand Cherokee	2wd	1.09	1.33	1.72	1.86	661	2,645	6,376	1.5	6.1	14.8
1999	2004	Jeep	Grand Cherokee	4wd	1.11	1.27	1.64	1.77	661	2,645	6,376	1.5	5.9	14.1
2002	2005	Jeep	Liberty	2wd	1.10	2.12	2.68	2.72	962	3,896	8,959	2.2	8.9	20.5
2002	2005	Jeep	Liberty	4wd	1.12	1.99	2.51	2.56	962	3,896	8,959	2.1	8.4	19.2
1997	2004	Mitsubishi	Montero Sport	2wd	1.07	1.56	2.59	N/A	667	3,473	N/A	1.5	7.9	N/A
1997	2004	Mitsubishi	Montero Sport	4wd	1.11	1.46	2.42	N/A	667	3,473	N/A	1.4	7.4	N/A
2000	2004	Nissan	Xterra	2wd	1.09	2.48	3.16	3.16	967	4,514	8,708	2.3	10.5	20.3
2000	2004	Nissan	Xterra	4wd	1.12	2.30	2.93	2.93	967	4,514	8,708	2.1	9.7	18.8
1996	2000	Toyota	4Runner	2wd	1.08	1.51	2.45	2.45	612	2,896	6,618	1.5	7.3	16.7
1996	2000	Toyota	4Runner	4wd	1.06	1.39	2.26	2.26	612	2,896	6,618	1.4	6.7	15.4

INSURANCE INSTITUTE FOR HIGHWAYS SAFETY
Arlington, VA, May 13, 2008

Hon. NICOLE R. NASON,
Administrator,
National Highway Traffic Safety Administration,
Washington, DC.

Supplemental Notice of Proposed Rulemaking; 49 CFR Part 571, Federal Motor Vehicle Safety Standards, Roof Crush Resistance; Docket No. NHTSA–2008–0015

Dear Administrator Nason:

The Insurance Institute for Highway Safety (IIHS) has conducted a study that demonstrates a direct relationship between roof strength and injury risk reduction in rollover crashes (Brumbelow *et al.,* 2008). We included this study in our previous comment to the docket (IIHS, 2008) because of its relevance to the National Highway Traffic Safety Administration's (NHTSA) rulemaking under Federal Motor Vehicle Safety Standard (FMVSS) 216.

Finding that stronger roofs reduce the risk of injury in rollover crashes, the IIHS study contradicts two previous studies on the topic (Moffatt and Padmanaban, 1995; Padmanaban *et al.,* 2005). Two authors of these earlier studies have submitted a comment and additional analysis to NHTSA (Padmanaban and Moffatt, 2008), questioning the IIHS study and concluding that "stronger roofs are not safer roofs."

The comments by Padmanaban and Moffatt (2008) contain misleading statements about the IIHS study that are detailed in item 6 of the attached document, "Logical and Statistical Errors in Comments by Padmanaban and Moffatt on the Insurance Institute for Highway Safety Study, 'Roof Strength and Injury Risk in Rollover Crashes.'" In addition, the analytical tactics recommended and used by Padmanaban and Moffatt depart in fundamental ways from appropriate use and interpretation of statistical results (see item 4). Of most concern is their insistence on including ejection, belt use, and alcohol use as control variables in their analysis when, in fact, these variables are either direct outcomes of roof crush strength or affected by the dependent variable, injury risk. Inclusion of them in the analysis obfuscates the real effects of roof strength on injury risk (see items 1–3).

These concerns are detailed in the attachment. We would be happy to discuss the issues further if NHTSA has questions.

Sincerely,

ADRIAN K. LUND, PH.D.,
President.

cc: Docket Clerk, Docket No. NHTSA–2008–0015

ATTACHMENT

Logical and Statistical Errors in Comments by Padmanaban and Moffatt on the Insurance Institute for Highway Safety Study, "Roof Strength and Injury Risk in Rollover Crashes"

1. *Ejection is an outcome of rollover and is influenced by roof strength. Including ejection as a predictor of death or serious injury in a rollover crash masks a major benefit of roof strength.*

Padmanaban and Moffat argue that IIHS should have included a number of additional variables in the predictive model of injuries and deaths in rollovers. One of these variables is ejection. Their argument is that ejection greatly increases the risk of injury while "ejection is . . . likely to be unrelated to roof strength" (pg. 1).

a. This argument is illogical. Roof strength may not affect injury risk once a person is ejected, but a strong roof may prevent occupants from being ejected in the first place. Preventing an occupant compartment from collapsing obviously can reduce ejection risk by preventing broken glazing and deformed structure, which create ejection paths.

b. This argument is testable. Using the midsize SUVs in the IIHS study, IIHS researchers investigated the relationship between roof strength and ejection risk with an additional analysis. The risk of ejection was 31 percent lower for each 1-unit increase in peak roof strength-to-weight ratio (SWR) measured within 5 inches of plate displacement (p-value of 0.004). Appendix A reports details of this analysis. Clearly, ejection risk is not "unrelated to roof strength."

c. By treating ejection as a risk factor unrelated to roof strength, when reduced ejection risk is one of the benefits of stronger roofs, Padmanaban and Moffatt bias their analysis against finding a relationship between roof strength and injury risk.

d. Padmanaban and Moffatt's concern about ejection implies that roof strength does not matter if ejected occupants are not counted. However, a new IIHS analysis limited to drivers coded by police as not having been ejected reveals that stronger roofs reduced injury risk among these drivers. Many of the fatal and incapacitating injuries in the overall analysis were sustained by ejected drivers, but risk reductions for drivers not ejected were statistically significant and very similar to the overall analysis. Appendix B reports the full results.

2. *Belt use cannot be used in a model evaluating roof strength and injury likelihood because information about belt use in crashes is inaccurate, incomplete, and subject to influence by the injury outcomes.*

Another variable that Padmanaban and Moffat argue should be included as a control (predictor) variable in the IIHS study is police-reported belt use. According to Padmanaban and Moffat, "It is well known that the majority of rollover KA injuries and fatalities are to unbelted occupants, mostly ejectees" (pg. 2) and, later, ". . . 56 percent of the fatalities and 28 percent of the serious/fatal injuries were unbelted and completely ejected" (pg. 5). As a result, Padmanaban and Moffat conclude that belt use should have been a predictor variable. However, because this variable is difficult to know with precision, inclusion as a predictor variable can bias any analysis of roof strength.

a. The principal source of bias in belt use codes is that police-coded belt use is subject to distortion by crash outcomes. No official typically is present to observe belt use prior to a crash. Instead, police must *judge* belt use based on information gathered after the crash including statements by occupants about their own belt use, statements by witnesses to the crash and, significantly, the presence of injuries and whether police believe they are consistent or inconsistent with belt use. In other words, Padmanaban and Moffat include in their analysis a variable that is itself subject to influence by the outcome (injury severity and pattern) to be predicted. In addition, occupant statements about belt use are influenced by the fact that it is illegal in most states to be unbelted. A result of these twin biases is that belt use in crashes can be overestimated, especially for occupants with lesser injuries whose claims of belt use are more believable (Schiff and Cummings, 2004). Models including belt use as a predictor of injury severity not only introduce general inaccuracy but also overestimate the effect of belt use on reducing injury, simultaneously masking the effects of any other variables.

Evidence of the bias toward overestimating belt use in the dataset used in the IIHS study is provided by comparisons with NHTSA's National Occupant Protection Use Survey (NOPUS), which records rates of belt use for the general population observed during daylight hours. During the calendar years of the IIHS study, NOPUS data show driver belt use averaging 70–75 percent, which is lower than the 83 percent recorded by police for drivers in the rollover crashes in the IIHS study. It is unlikely that drivers involved in single-vehicle rollover crashes, many of which occur at night when belt use rates are lower (NHTSA, 2005, 2007), were wearing belts more often than the general population during daylight hours.

b. Because of these problems, IIHS did not include belt use as a predictor. However, IIHS did examine whether the effects varied by coded belt use. As reported in the study, additional statistical models were run for occupants coded as belted (83 percent), for those coded as unbelted (10 percent), and for those coded as unknown (7 percent).

i. For those coded as belted, the pattern of effects of roof strength varied little from the overall analysis. This is not surprising because most drivers in the study were coded as belted. In addition, if belt use is miscoded, as argued above, then many of the drivers actually were unbelted, again meaning that this analysis is very similar to the overall analysis.

ii. For those coded as unknown, the pattern also was quite similar to the overall analysis. Again, this is not surprising because the unknown group also included both belted and unbelted occupants.

iii. Effects estimated for those coded as unbelted were much smaller, but this would be expected from the twin biases noted in item 2.a. It is likely many of those coded as unbelted received their codes because their injuries were serious and inconsistent with belt use. This bias would occur for both weak and strong roofs, masking the effect of roof strength by assigning higher weight to the (overestimated) effect of belt use.

The conclusion from these separate analyses is that coded belt use does not affect the estimated effect of roof strength on injury severity, except in a way that would be expected from the biases and inaccuracies inherent in police-coded belt use.

3. *Like police-coded belt use, police-coded alcohol involvement in crashes is incomplete, inaccurate, and may be related to the injury severity. Besides, Padmanaban and Moffatt offer no justification other than the empirical relationship, which could be spurious, for including alcohol use codes in the prediction equation.*

a. Results of blood alcohol concentration (BAC) tests are the most objective measures of the presence of alcohol, but only a small percentage of crash-involved drivers typically are tested. Queries of the state databases used in the IIHS study show that about 11 percent of the drivers studied were tested. Padmanaban and Moffatt report using a combination of BAC test results and "had been drinking" codes. They do not specify in their comments to NHTSA what percentage of the codes resulted from actual BAC tests, what codes were used for those not tested, or the extent of missing data. In response to an IIHS inquiry, they provided this additional information:

i. Of drivers identified in their analysis as positive for alcohol use, about 18 percent were tested. About 13 percent tested positive, and 5 percent were coded as having positive alcohol use despite negative BAC tests. Thus 5 percent were coded as positive for alcohol despite chemical tests to the contrary.

ii. For drivers without BAC test results, Padmanaban and Moffatt determined alcohol use from a variety of codes regarding police judgment of alcohol use or factors contributing to the crashes. When alcohol was not listed as a factor, alcohol use was coded as negative.

b. It is incorrect to assume that all of the drivers not tested were alcohol-free based on police not listing alcohol as a contributing factor to the crashes. According to Moskowitz *et al.,* (1999), police most often cite breath odor in determining alcohol involvement in traffic offenses, but the ability to detect this odor is unreliable even under controlled laboratory conditions.

c. It is likely that reported alcohol use is spuriously related to injury outcome because more seriously injured people are more likely to undergo close examination. About half of the states included in the IIHS study mandate BAC testing of fatally injured drivers (NHTSA, 2004), creating inherent reporting bias because the likelihood of testing is correlated with injury outcome. Padmanaban and Moffatt do not report or account for this bias.

d. It is likely that factors such as crash severity, vehicle damage, and driver age and gender have some influence on whom police choose to test for alcohol as well as which crashes they judge to be influenced by alcohol. Previous research has found that driver age and gender affect which drivers at sobriety checkpoints are judged not drinking (Wells *et al.,* 1997).

e. Although alcohol clearly increases crash likelihood, Padmanaban and Moffatt offer no explanation of how alcohol increases the likelihood of K/A injury, given that a crash already has occurred. Absent convincing evidence that alcohol increases the susceptibility of human tissue and bones to injury, the primary determinants of whether an injury occurs to alcohol-impaired or sober occupants are the forces experienced during the crash. It might be argued that sober drivers' rollover crashes would be more severe, and their injurious forces greater, than those of drinking drivers because more extreme circumstances would be required for the sober drivers to lose control of their vehicles or leave the road. But this argument leads to the opposite of the effect claimed by Padmanaban and Moffatt. Any empirical relationship to the contrary observed between alcohol and K/A injury likelihood is likely to be spurious and related to the absence of objective evidence of alcohol involvement after a crash has occurred.

4. *Padmanaban and Moffatt's docket submission is based on unsound and inconsistent statistical treatment. It contains numerous misstatements and omissions that undermine its conclusions.*

a. They either misunderstand or misconstrue the fundamental concepts of statistical estimation and significance testing. The object of a study of roof strength is to obtain the best estimate permitted by the data. In this context, statistical significance is only a way of representing how often one expects to be wrong in concluding that the observed estimate is indicative of a real non-zero effect. Padmanaban and Moffatt claim that if the estimated effect of roof strength on injury risk is found to be "not significant, then the lives saved [by strengthening roofs] could just as well be zero or negative" (pg. 2). This trivializes the process of statistical estimation in a way that is fundamentally misleading.

i. It is misleading to treat any estimate with a p-value slightly above 0.05 as if it were drastically different from estimates with p-values slightly below 0.05. For example, among the effects estimated for reductions in the likelihood of driver death with increased roof strength, the p-value for SWR within 5 inches of crush was slightly greater than 0.06. This means that if one were to conclude that an effect this large is different from zero, one would expect to be wrong about 6 times out of 100 (a p-value of 0.05 would lower the error risk only slightly, to 5 times in 100). This 6 percent error risk also means that the likelihood of seeing effects as large as that estimated for roof strength when the true effect is zero or negative is only about 3 in 100. Padmanaban and Moffatt misrepresent the logic of statistical estimation and misconstrue the implications of significance testing.

ii. This illogical approach leads them to ignore the overwhelming consistency of the results of the IIHS study. Their docket submission suggests that a single IIHS estimate for injury risk reduction that was not significant at the 0.05 level contradicts and invalidates the overall finding that stronger roofs reduce injury risk. Of the 12 estimates for K/A injury risk related to roof strength measured in 4 different ways and at 3 different crush distances, all were significant at $p < 0.0001$. For the 12 estimates for K injury risk, 9 were significant at $p < 0.0001$, 2 at $p < 0.05$, and 1 at $p < 0.07$. Robustness of an empirical pattern when measured in different ways is much more important than the fact that 1 of 24 tests did not meet an arbitrary level of $p < 0.05$.

b. The docket submission does not include sample sizes for any of Padmanaban and Moffatt's 7 statistical models. In response to subsequent requests by IIHS, they indicated sample sizes ranging from 1,352 to 20,010. These details should have been included in the discussion of their statistical modeling, especially given their ill-advised reliance on levels of statistical significance for interpretation of results. For example, they emphasize that odds ratios in the IIHS study were not statistically significant for the subset of drivers that police coded as unbelted, asserting that this means roof strength is not beneficial for these occupants. However, these drivers account for only 10 percent of the total sample, limiting the power to detect statistically significant effects.

c. Padmanaban and Moffatt do not give parameter estimates for the predictors of injury risk they chose to include in their comment. Without these, it is unknown whether the effects being estimated by their models are consistent or realistic relative to some underlying reasonable theory. Subsequent IIHS inquiries produced some, but not all, of the parameter estimates (see item 5.a.i. below).

d. Padmanaban and Moffatt do not present p-values for their additional parameters in the model that looked at fatality risk, saying only that roof SWR was not significant at a p-value of 0.10. It is possible that some variables previously claimed to be major factors (alcohol, belt use, ejection status) in injury outcome were not significant in this model.

5. *Padmanaban and Moffatt's docket submission is based on questionable engineering judgment.*

a. They stress the importance of aspect ratio (height divided by track width) in previous research and criticize IIHS for excluding it. In their reproduction of the IIHS study, they find it statistically significant. This is problematic for 4 reasons:

i. Based on data provided to IIHS, their models predict greater injury risk in SUVs with larger aspect ratios. This directly contradicts their previous studies, which reported decreased injury risk for vehicles with larger aspect ratios. Padmanaban and Moffatt do not explain or even disclose this fact in their submission to NHTSA.

ii. They do not offer a hypothesis for how the shape of these SUVs, as defined by aspect ratio, would affect injury risk. This also is true of their previous research, although they have stated that it is unrelated to differences in headroom. If the small geometric differences between these midsize SUVs are important in the rollover crash dynamics, more meaningful measurements would include maximum vehicle width or vehicle width at the height of the roof.

iii. The range of aspect ratios given for these vehicles is very small. Height and track width vary by up to only about 2 inches.

iv. There is enough variation in the specified height and track width measurements between model years of several of the study vehicles to invalidate whatever data were used.

b. Padmanaban and Moffatt do not seem to understand the IIHS motivation for including static stability factor (SSF) in the statistical models, stating that "the purpose of the IIHS study and of ours was to evaluate the likelihood of serious/fatal injuries given a rollover and not the likelihood of rollovers." The IIHS study clearly explains why SSF may be correlated to crash severity: By definition, more stable vehicles require more severe events to cause them to roll over.

c. Padmanaban and Moffatt do not explain why vehicle weight should be included in two different places in their statistical models. They include it both as an independent variable and in the calculation of SWR.

6. *Padmanaban and Moffatt misrepresent the IIHS study.*

a. They say they "agree [with the IIHS study] that SWR within 5 inches is the most useful and universally accepted roof strength metric," but the IIHS study makes no such claim. Its calculations of lives saved use this metric simply because FMVSS 216 uses the same metric. SWR within 5 inches of plate displacement is 1 of 12 roof strength metrics IIHS evaluated, and several of the other metrics predict greater reductions in injury risk across the range of tested vehicles. Even with their problematic predictors, it is possible that Padmanaban and Moffatt would have found statistically significant results with different roof strength metrics.

b. Padmanaban and Moffatt claim that the regression line in Figure 1 of the IIHS study is the "primary finding" and later in their submission to NHTSA dedicate much time to discussing this line. However, they separately state their understanding that the plot is included "solely to present a visual representation of their raw data. [IIHS does] not rely upon it in any way for their conclusions." This second statement is correct, and it is disingenuous to criticize the statistical fit of a plot presented for visualization and understood to be uncorrected for known confounding factors.

c. They claim IIHS used the estimate for the reduction of fatal and incapacitating injury in the lives-saved calculations because the fatality estimate alone was not statistically significant (see items 4.a.i. and 4.a.ii. above). However, the former estimate was used because it is based on more observations (of injuries) and therefore likely to be more accurate. For the other 11 roof strength metrics, little variation was observed between effect estimates for K/A injury and for fatal injury, so the choice was well founded.

d. Padmanaban and Moffatt say their analysis does not "differ significantly from [IIHS] raw data counts" but do not give any details. Responses to subsequent requests from IIHS indicate their analysis includes 2,807 fewer drivers overall and 100 more drivers with fatal or incapacitating injuries. These differences are not explained. Padmanaban and Moffatt fail to demonstrate that their data and analysis replicate the IIHS study before including additional predictor variables. If their initial analysis cannot replicate IIHS's, then none of their subsequent claims are applicable to the current discussion.

7. *Padmanaban and Moffatt's docket submission and associated analysis cannot be fully evaluated due to the lack of detailed information about data sources, methods, and results.*

In contrast, IIHS methods and findings are fully described in the study. IIHS staff further assisted JP Research in understanding the construction of the statistical models used in the study. All information necessary to reconstruct the IIHS study is available to the public.

a. For some additional predictor variables, unexplained discrepancies exist between the data counts in the state files and the counts JP Research reported to IIHS. For example, JP Research reports that ejection status was known for all but 2,198 drivers, whereas IIHS observed that ejection status was coded as unknown or completely missing for 8,713 drivers in the state data files. It would be useful to know how JP Research obtained the ejection status for their analyses.

b. The docket submission includes statements about the methods used in their two previous studies that were not disclosed in that research. For example, the submission claims that both earlier studies controlled for ejection and rural/urban land use, but their 2005 study mentions neither among the factors included in the logistic regression models. The docket comment says "all our previous models also controlled for states, though it was not explicitly stated in the reports" (pg. 3). It is impossible to judge the credibility of any study when important details are omitted about how the research was conducted.

c. Padmanaban and Moffatt report access to the results of other roof strength tests of the IIHS study vehicles that differ substantially from the IIHS results. These other results are not public, so it is impossible to determine their relevance. Previous research by Padmanaban and Moffatt included confidential tests conducted by vehicle manufacturers on non-production vehicles (Moffatt and Padmanaban, 1995; Padmanaban *et al.,* 2005), and we do not know the nature of any additional test data on IIHS study vehicles.

d. As detailed above, Padmanaban and Moffatt exclude several important facts that were revealed to IIHS only after follow-up inquiries to JP Research (see items 3.a., 4.b., 4.c., 5.a.i., 6.d. and 7.a.).

Appendix A—Relationship Between Roof Strength and Ejection Risk

To address Padmanaban and Moffatt's claim that ejection is "likely to be unrelated to roof strength," IIHS conducted a logistic regression analysis of ejection likelihood based on roof strength. Vehicle and crash data were the same as in IIHS's analysis of vehicle roof strength and injury risk (Brumbelow *et al.,* 2008). Figure 1 shows the relationship in the raw data between peak roof SWR within 5 inches of plate displacement and ejection rate before adjusting for any potentially confounding factors. Of 22,817 rollover crashes of study vehicles, police coded 13,086 drivers as not ejected, 1,018 as fully or partially ejected, and the rest were coded as unknown or had missing values. Only the drivers with known ejection status were included in this analysis. Table 1 presents results of the logistic regression model controlling for the effects of state, driver age, and vehicle SSF. For a 1-unit increase in peak SWR, ejection risk was reduced 32 percent. For each 10-year increase in driver age, there was an 11 percent decrease in ejection risk. Both of these results are statistically significant at the 0.05 level. An increase in SSF of 0.1 was predicted to increase ejection risk by 4 percent, but this result was not statistically significant at the 0.05 level.

Figure 1 – Rates of full or partial driver ejection by peak SWR within 5 inches of plate displacement

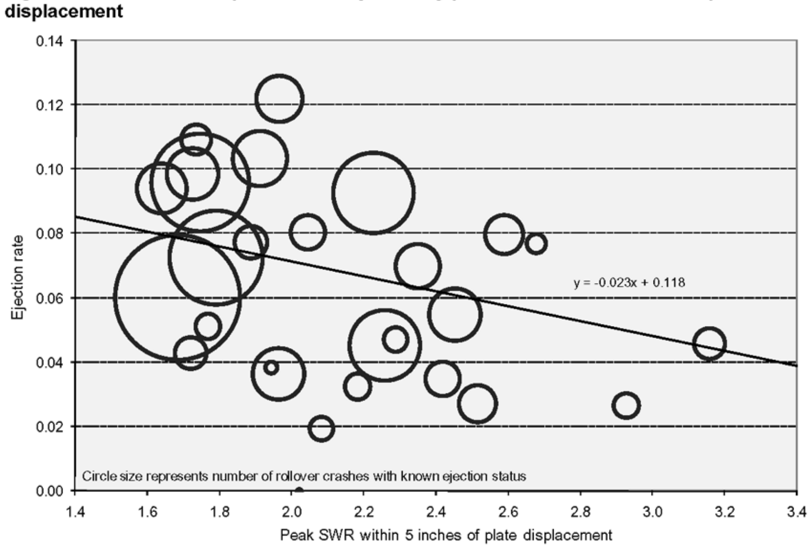

Table 1.—Results of Logistic Regression Model for Risk of Ejection

Parameter	Odds ratio
Roof SWR within 5 inches (1-unit increase)	0.68*
Driver age (10-year increase)	0.89*
SSF (0.1-unit increase)	1.04

*Statistically significant at 0.05 level.

Appendix B—Relationship Between Roof Strength and Injury Risk for Drivers Coded as Not Ejected

The logistic regression model described in Appendix A demonstrates that reducing the risk of driver ejection is one benefit of stronger roofs. Also of interest is how stronger roofs benefit drivers who remain inside a vehicle during a rollover crash. Police coded 13,086 drivers in the IIHS study as not ejected. Figure 2 shows the relationship between the rate of fatal or incapacitating injury among the nonejected drivers and the peak roof SWR measured within 5 inches of plate displacement for each of the vehicles. The figure plots the raw data before adjusting for any confounding factors. Controlling for state effects, SSF, and driver age, a logistic regression model estimated a 27 percent reduction in the risk of fatal or incapacitating driver injury for a 1-unit increase in peak SWR within 5 inches of plate displacement. Nearly identical to the risk reduction estimated for all drivers in the IIHS study (see Table 2), this result is not surprising because nonejected drivers represent 93 percent of all drivers with known ejection status. A 10-year increase in driver age was predicted to increase the risk of K/A injury by 18 percent. A 0.1-unit increase in SSF was associated with a 6 percent increase in K/A injury risk. The odds ratios for SWR and driver age were significant at the 0.05 level, but the odds ratio for SSF was not.

Figure 2 – Rates of fatal or incapacitating driver injury by peak SWR within 5 inches of plate displacement

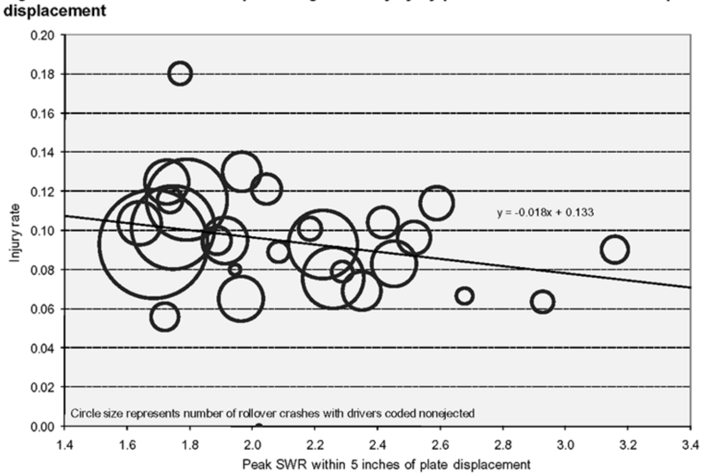

Table 2.—Results of Logistic Regression Model for Risk of Fatal or Incapacitating Injuries for Drivers Coded as Nonejected by Police and for All Drivers

Parameter	Odds ratio for drivers coded as nonejected	Odds ratio for all drivers
Roof SWR within 5 inches (1-unit increase)	0.73*	0.72*
Driver age (10-year increase)	1.18*	1.12*
SSF (0.1-unit increase)	1.06	0.96

*Statistically significant at 0.05 level.

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Insurance Institute for Highway Safety—*Status Report*—Vol. 43, No. 2, March 15, 2008

ROLLOVER

Rollover in your SUV, and you want the roof to hold up so you're protected from injury, including harm from the roof caving in on you. Every passenger vehicle meets Federal requirements for roof strength, measured in a test, and some exceed the requirements by substantial amounts. The question has been whether stronger roofs actually reduce injury risk in real-world rollover crashes. Some studies have concluded that the strength of a vehicle's roof has little or no effect on the likelihood of injury, but a new Institute study indicates that roof strength definitely influences injury risk.

Researchers tested SUVs in a procedure similar to what the government requires automakers to conduct to assess roof strength and then related the findings to the real-world death and injury experience of the same SUVs in single-vehicle rollover crashes. The main finding is that injury risk went down as roof strength increased.

Injury rates vary considerably among vehicles in rollovers, and there are still a lot researchers don't know about these crashes. For example, is injury risk primarily from the sudden crushing of the roof? Is it because people crash into the roof when the vehicle is upside down? Or does the main risk come from full or partial ejection of occupants when vehicle doors and windows break open during rollover crashes?

"We don't know just what happens to people in these crashes or what the injury mechanisms are. What we do know from the new study is that strengthening a vehicle's roof reduces injury risk, and reduces it a lot," says Institute president Adrian Lund.

Extent of the rollover problem: About 35 percent of all occupant deaths occur in crashes in which vehicles roll over. This problem is worse in some kinds of vehicles than others. About 25 percent of occupant deaths in crashes of cars and minivans involve rolling over. The proportion jumps to 59 percent in SUVs.

Of course, the best way to prevent these deaths is to keep vehicles from rolling over in the first place, and electronic stability control is helping. It's reducing rollover crashes, especially fatal single-vehicle ones, by significant percentages.

"But until these crashes are reduced to zero, roof strength will remain an important aspect of occupant protection," Lund points out.

What the U.S. government requires: Federal Motor Vehicle Safety Standard 216 establishes minimum roof strength for passenger vehicles. Compliance testing involves the application of a metal plate to one side of a roof at a constant speed. The roof must withstand a force of 1.5 times the weight of the vehicle before reaching

5 inches of crush. Thus, a vehicle weighing 4,000 pounds has to withstand 6,000 pounds of force while sustaining 5 or fewer inches of crush.

This requirement, in effect since 1973 for cars and 1994 for other passenger vehicles, is in the process of an upgrade. One of the government's main proposals, issued in 2005, is to boost the specified force to 2.5 times vehicle weight (see *Status Report*, Jan. 28, 2006; on the web at *iihs.org*). Last month the government indicated it may consider further altering the standard by testing both sides of vehicle roofs instead of applying the force to one side only. When the changes were proposed in 2005, the Institute voiced general support but noted the "surprising lack of evidence" connecting the requirements of the standard to real-world rollover crash outcomes.

The new Institute study provides some missing evidence. Across 11 SUVs at 3 different degrees of roof crush—2, 5, and 10 inches—the strongest roofs are associated with injury risks 39 to 57 percent lower than the weakest roofs. Peak roof strength at 2 and 10 inches of crush is more highly related to injury risk than at 5 inches. Based on these findings, the researchers estimate that if the roofs on every SUV the Institute tested were as strong as the strongest one, about 212 of the 668 deaths that occurred in these SUVs in 2006 would have been prevented.

"These are big risk reductions, bigger than what the government or anybody else has established," Lund says.

The researchers estimate that a 1-unit increase in peak strength-to-weight ratio—for example, from 1.5 times vehicle weight to 2.5, as the government proposed in 2005—reduces the risk of serious and fatal injury in a rollover crash by 28 percent. Increasing roof strength requirements beyond 2.5 times vehicle weight would reduce injury risk even further.

New findings vs. previous studies: Before the Institute's study, there was no conclusive evidence about the specific contribution of a vehicle's roof strength to occupant protection. The government estimated that proposed changes in Federal roof strength requirements would save 13 to 44 lives per year.

"This was based on assumptions that were conservative in the extreme," Lund explains. "For example, the government assumed zero benefit for unbelted occupants. We don't know exactly what the benefit of an upgraded roof strength standard would be for these occupants, but it would be likely to exceed zero."

Meanwhile two studies sponsored by automakers, one in 1995 and the other a decade later, found no relationship at all between roof strength and injury risk in rollovers. Findings of the first study prompted General Motors to tell *The Detroit News* in 2002, "Good science, long established and well reviewed in the technical literature, has conclusively demonstrated that there is no relationship between roof strength and the likelihood of occupant injury given a rollover." Four years later, Ford told the government that "substantial and compelling real-world crash data and laboratory testing have confirmed that simply increasing roof strength will not measurably reduce the risk of injury or death to vehicle occupants in rollovers."

A main problem with these studies is that they included all kinds of passenger vehicles with their substantial differences in driver demographics, rollover propensity, and other factors that confound the results. In contrast, the Institute's new study focuses on one kind of vehicle, midsize 4-door SUVs, and tightly controls for other factors that could confound the results. While the findings are about a limited number of SUVs, the researchers conclude that the overall finding of reduced injury risk as roof strength increases would hold for other kinds of vehicles, although the magnitude of the injury rate reduction may differ among vehicle groups.

Lund adds that the findings "prompt us to expand our research on roof strength with an eye to supplying consumers with comparisons of how well vehicles protect people in rollover crashes. A dynamic test with dummies instrumented to measure injury risk in rollovers would be desirable, but there is a sticking point. First we have to understand how the movement of dummies in controlled tests could reflect how real people move in real-world rollovers. Meanwhile, simpler roof strength measurements could provide useful consumer information."

Details of the study: The Institute study is a two-part analysis involving vehicle testing and examination of the outcomes of real-world rollover crashes. Eleven midsize 4-door SUVs were subjected to a test similar to the one run by automakers to comply with Federal roof strength requirements (the manufacturers' own test data aren't public information). The 11 SUVs exclude features that might affect injury rates in rollovers such as side curtain airbags and electronic stability control (see p. 2). To assess the range of roof strength among the SUVs, researchers applied force to the roofs until crush reached 10 inches, measuring the peak force required for 2 inches of crush, 5 inches, and 10 inches. Because crush in a rollover can depend on vehicle weight as well as roof strength, the researchers calculated strength-to-weight ratios for each degree of crush. They also measured the amount of energy absorbed by each roof at each degree of crush and, again taking vehicle weight into account, the height from which the vehicle would have to be dropped to produce equivalent energy absorption.

By almost any of these measures, the strongest roof was on the 2000–04 Nissan Xterra while one of the weakest was on the 1999–2004 Jeep Grand Cherokee. Within 5 inches of crush, the Jeep withstood a force as high as 6,560 pounds, which amounts to 1.64 times the weight of the 4-wheel-drive version and 1.72 times the weight of the 2-wheel-drive. The corresponding figure for the Xterra was 11,996 pounds, or 2.93 times the weight of the 4-wheel-drive and 3.16 times the 2-wheel-drive.

Having established the range of roof strength among the SUVs, the researchers studied almost 23,000 real-world rollovers of the same 11 SUVs during 1997–2005. This information was collected from 12 states with sufficient data on police-reported crashes to comply with study criteria.

Logistic regression was used to assess the effect of roof strength on the likelihood of driver injury in the rollover crashes of the 11 SUVs. The regression controlled for state-to-state differences in methods of reporting crashes, terrain, urbanization, etc.; vehicle stability; and driver age. Results indicate the various injury risks given the various SUV roof strengths.

"No matter what measurement of roof strength we used or whether we measured at 2 or 5 or 10 inches of crush, we found a consistent relationship between roof strength and injury risk," Lund points out.

The relationship between roof strength-to-weight ratio and injury risk was stronger at 2 inches than at 5 inches, the crush specified for testing under the Federal standard (the government doesn't require automakers to assess roof strength at 2 or 10 inches). At 5 inches, the predicted injury risk for people in SUVs with roof strength-to-weight ratios as strong as the Xterra's would be 39 percent lower than for people in vehicles with roof strength like the Grand Cherokee's. At 2 inches of crush, the difference in predicted injury risk is 51 percent.

The 11 SUV designs in the study include the 1996–2004 Chevrolet Blazer, 2002–05 Chevrolet TrailBlazer, 1998–2003 Dodge Durango, 1996–2001 Ford Explorer, 2002–04 Ford Explorer, 1996–98 Jeep Grand Cherokee, 1999–2004 Jeep Grand Cherokee, 2002–05 Jeep Liberty, 1997–2004 Mitsubishi Montero Sport, 2000–04 Nissan Xterra, and 1996–2000 Toyota 4Runner.

For a copy of "Relationship between roof strength and injury risk in rollover crashes" by M.L. Brumbelow *et al.,* write: Publications, Insurance Institute for Highway Safety, 1005 N. Glebe Rd., Arlington, VA 22201, or e-mail *publications@iihs.org*.

The rate of neck injury complaints is 15 percent lower in cars and SUVs with seat/head restraint combinations rated good compared with poor. The results for serious injuries are more dramatic. Thirty-five percent fewer insurance claims for neck injuries lasting 3 months or more are filed for cars and SUVs with good seat/head restraints than for ones rated poor.

These are the main findings of a new Institute study of thousands of insurance claims filed for damage to vehicles, all 2005–06 models, that were struck in front-into-rear impacts. Conducted in cooperation with State Farm and Nationwide, the study is the first time seat/head restraint ratings based on dynamic tests conducted by the Institute have been compared with real-world neck injury results.

"In stop and go traffic, you're more likely to get in a rear-end collision than any other kind of crash, so you're more likely to need your seat and head restraint than any other safety system in your vehicle," says David Zuby, the Institute's senior vice president for vehicle research. "This is why it's so important to fit vehicles with seats and head restraints that earn good ratings for saving your neck."

The Institute has been measuring and rating head restraint geometry since 1995. The higher and closer a restraint is, the more likely it will be to prevent neck injury in a rear collision. In 2004 the Institute added a dynamic test simulating a rear crash to refine the ratings. Vehicles are rated good, acceptable, marginal, or poor based on both restraint geometry and test results (see *Status Report,* Nov. 20, 2004; on the web at *iihs.org*). The same rating system is used internationally by a consortium of insurer-sponsored organizations, the International Insurance Whiplash Prevention Group.

An estimated 4 million rear collisions occur each year in the United States. Neck sprain or strain is the most serious injury in one-third of insurance claims for injuries in all kinds of crashes. The annual cost of these claims exceeds $8 billion annually.

While findings about real-world neck injury in vehicle seats rated good and poor are clear, those for seats rated acceptable and marginal aren't as clear. There wasn't any reduction in initial neck injury complaints for acceptable and marginal seats, compared with poor, though long-term neck injuries were reduced.

"The long-term injuries are the very ones we want to reduce because they're the most serious," Zuby points out. "While many neck injuries involve moderate discomfort that goes away in a week or so, about one of every four initial complaints still was being treated 3 months later. These longer term injuries involve more pain and cost more to treat. They're being reduced about one-third in vehicles with seat/head restraints rated good compared with poor. Serious neck injuries also are being reduced in seats that are rated acceptable or marginal.

Improvements: More and more passenger vehicles are being equipped with seats and head restraints rated good. When the Institute started evaluating and comparing the geometry of the head restraints in 1995 model cars, only a handful were rated good and 80 percent were poor. Then the automakers responded, and by 2004 about 4 of every 5 head restraints had good or acceptable geometry (see *Status Report,* Nov. 20, 2004; on the web at *iihs.org*). Similarly, the dynamic performance of seat/head restraint combinations is improving. Only 12 percent of 2004 model cars had combinations rated good, but by the 2007 model year the proportion had increased to 29 percent (see *Status Report,* Aug. 4, 2007; on the web at *iihs.org*).

These improvements are being driven not only by ratings of seat/head restraints published by the Institute and other insurer-sponsored groups but also by a U.S. standard that will require the restraints to extend higher and fit closer to the backs of people's heads by the 2009 model year. In the United States, automakers also have been spurred by the Institute's *TOP SAFETY PICK* award. To win this designation, a vehicle has to earn good ratings in all three tests—front, side, and rear.

How the injuries occur: When a vehicle is struck in the rear and driven forward, its seats accelerate occupants' torsos forward. Unsupported, an occupant's head will lag behind this forward torso movement, and the differential motion causes the neck to bend and stretch. The higher the torso acceleration, the more sudden the motion, the higher the forces on the neck, and the more likely a neck injury is to occur.

Factors that influence neck injury risk include gender and seating position in addition to the designs of seats and head restraints. Women are more likely than men to incur neck injuries in rear crashes, and front-seat occupants, especially drivers, are more likely to incur such injuries than people riding in back seats.

The key to reducing whiplash injury risk is to keep an occupant's head and torso moving together. To accomplish this, the geometry of a head restraint has to be adequate—high enough and near the back of the head. Then the seat structure and stiffness must be designed to work in concert with the head restraint to support an occupant's neck and head, accelerating them with the torso as the vehicle is pushed forward.

About the study: To correlate seat/head restraint ratings with real-world neck injury risk, researchers studied about 3,000 insurance claims associated with rear crashes of 105 of the 175 passenger vehicles (2005–06 models) for which the Institute has ratings based on both restraint geometry and seat performance in dynamic tests. The claims were filed with State Farm Mutual Insurance and Nationwide Insurance, which together account for more than 20 percent of the personal auto insurance premiums paid in the United States in 2005. The researchers modeled the odds of a neck injury occurring in a rear-struck vehicle as a function of seat ratings (good, acceptable, marginal, or poor), while controlling for other factors that also affect neck injury risk, such as vehicle size and type and occupant age and gender.

The percentage of rear-struck drivers with neck injury claims was 16.2 in vehicles with seats rated good, based on dynamic testing. Corresponding percentages were 21.1 for seats rated acceptable, 17.7 for marginal seats, and 19.2 for poor ones. Neck injuries lasting 3 months or more were reported by 3.8 percent of drivers in good seats, 4.7 percent in acceptable seats, 3.6 percent in marginal seats, and 5.8 percent in seats rated poor.

"What these data show is that we're pushing seat designs in the right direction," Zuby says, "Results for acceptable and marginal seats weren't as clear as for good seats. Initial neck injury claims weren't significantly lower than for poor seats. Still we saw reductions in claims for serious neck injuries in acceptable and marginal seats as well as in good ones."

This is the third study the Institute has conducted that indicates the superiority of seat/head restraint combinations rated good for reducing neck injury risk. In 1999 the Institute found that head restraints rated good for geometry alone had lower insurance claims for neck injuries. In 2003 Institute researchers expanded the data, finding that modern features such as head restraints that automatically adjust in rear-end collisions and seats that absorb energy also reduce insurance claims.

For a copy of "Relationship of dynamic seat ratings to real-world neck injury rates" by C.F. Farmer *et al.,* write: Publications, Insurance Institute for Highway Safety, 1005 N. Glebe Rd., Arlington, VA 22201, or e-mail *publications@ iihs.org*.

Importance of ESC and Side Airbags

Vehicle roof strength is crucial to occupant protection in rollover crashes. Other features are effective, too, in both preventing such crashes in the first place and protecting people when their vehicles do roll. Researchers estimate that electronic stability control, or ESC, reduces the risk of a fatal single-vehicle rollover by about 69 percent for all passenger vehicles and 72 percent for SUVs in particular. Side curtain airbags are expected to reduce the risk of death in the rollovers that still occur.

"These technologies are essential," Institute president Adrian Lund points out, "but electronic stability control doesn't completely eliminate rollover crashes, and side airbags aren't the only protection occupants need if they do roll over. This is why we have to pay attention to the roof. If a vehicle's roof is strong enough to absorb the energy of a rollover without caving in on its occupants, injury risk goes down."

Electronic stability control monitors vehicle response to driver steering and applies the brakes on individual wheels to maintain the path that's indicated by the steering wheel position (see *Status Report,* June 13, 2006; on the web at *iihs.org*). This technology is standard or optional on about two-thirds of all current passenger vehicle models. Side airbags are standard or optional in about 80 percent.

Strong vs. Weak

The difference in roof strength was obvious when the Nissan Xterra and Ford Explorer, both 2000 models, were subjected to a crushing force of up to 10,000 pounds. The Xterra's roof crushed about 2 inches, and damage is hardly visible except for a cracked windshield. Meanwhile the Explorer's roof crushed 10 inches, caving far into the occupant compartment even before reaching 10,000 pounds of force.

Rollovers in Which Drivers Died Demonstrate Need for Strong Roofs on SUVs

The drivers of these SUVs died when their vehicles overturned. It's a big problem—more than half of all occupant deaths in SUVs occur in rollover crashes. New research indicates that strengthening vehicle roofs would reduce this problem. If the roof on every SUV were as strong as the best one the Institute tested, injury risk in rollover crashes could be reduced 39 to 57 percent. These are very big risk reductions, bigger than the Federal Government or anybody else has established.

Injuries in Rear Crashes

These vehicles didn't sustain a lot of damage when they were struck from behind, but the drivers were treated for injuries suffered in the impacts. Neck sprains and strains are the most serious problems reported in about 1 of 3 insurance claims for injuries. This problem could be reduced by equipping vehicles with seat/head restraints rated good, based on Institute tests. Twenty-nine of all recent model cars and 22 perent of other passenger vehicles have systems rated good for protection against neck injury.

Senator PRYOR. Thank you.

Mr. Strassburger?

STATEMENT OF ROBERT STRASSBURGER, VICE PRESIDENT, VEHICLE SAFETY AND HARMONIZATION, ALLIANCE OF AUTOMOBILE MANUFACTURERS

Mr. STRASSBURGER. Thank you, Mr. Chairman.

As an engineer, I'm here today representing the thousands of auto engineers who are working around the clock to make cars safer. We show up to work each day to make a difference.

At the Alliance, safety is our highest priority, and therefore, we support Congress's comprehensive plan to further reduce rollover-related risk, injury risk, including strengthening roofs.

Rollovers are a significant safety problem. In 2006, roughly 10,000 people died in rollover crashes, but government data also show that rollover rates are declining. In fact, over the last 10 years, the SUV rollover fatality rate is down by about 30 percent, and we want them to go even lower.

There are many reasons for this decline, including the voluntary introduction, installation of advanced safety technology, such as electronic stability control, side-curtain airbags, safety belts with pretensioners, safety belt reminders, increased safety belt usage, and consumer information. We are proud of our successes in voluntarily introducing safety advancements that help drivers avoid rollovers and enhance occupant protection in rollover crashes.

Rollovers are complex, violent events that require a number of solutions. Congress wisely recognized this when it adopted its comprehensive plan in SAFETEA–LU, which we supported. As the committee exercises oversight of the proposed roof-strength rule, it is important to keep in mind that the proposal is one element of this comprehensive plan. If there is no rollover crash, there will be no rollover fatality or injury. Therefore, our first priority must be to reduce the occurrence of rollovers.

As directed by SAFETEA–LU, NHTSA adopted an electronic stability control rule last spring which the agency estimates will prevent at least half of all rollovers. Alliance members are proud of the fact that we began installing this technology on vehicles well before the rule was finalized. Over 80 percent of model year 2008 cars and trucks have ESC available already. Our goal is to make ESC available on 100 percent of the fleet well in advance of the model year 2012 requirement.

Should a rollover occur, however, the priority becomes keeping occupants inside their vehicles. While safety belt use remains the lynchpin safety technology, SAFETEA–LU directs NHTSA to implement supplemental occupant ejection mitigation technologies. Here again, automakers are ahead of the regulatory curve, with over three-quarters of new vehicles having side-curtain airbags available.

Turning to the specific issues associated with this rulemaking, the relationship between roof strength and rollover injury risk is controversial. There are more than three decades of risk analysis debating whether or not there is a causal relationship between these parameters. A new analysis by IIHS, just described by Mr. Oesch, asserts a causal relationship between roof strength and injury risk. While we welcome the IIHS's input to try to shed light on this controversial issue, we cannot agree with the conclusions of their study, for the reasons described in the Alliance's written statement.

On the issue of testing, the Alliance agrees with NHTSA that dynamic rollover tests for assessing roof strength are not practicable or repeatable. Repeatability is a problem with dynamic tests, as slight differences from one test to the next can significantly change the test outcome.

In conclusion, Alliance members have demonstrated that motor vehicle safety is our number one priority, through voluntary and public policy initiatives and through expenditure of many millions of dollars in safety research and development.

With regard to rollover safety, in particular, Alliance members have voluntarily implemented technologies that will help drivers avoid rollovers in the first place and better—and help them better survive them when they occur.

Reducing injuries and fatalities from auto crashes is a significant public health challenge. We appreciate the leadership shown by the members of this subcommittee to address these issues, and we look forward to continuing to work with you to make our roads the safest in the world.

Mr. Chairman, members of the *subcommittee,* I would be happy to answer your questions.

[The prepared statement of Mr. Strassburger follows:]

PREPARED STATEMENT OF ROBERT STRASSBURGER, VICE PRESIDENT, VEHICLE SAFETY AND HARMONIZATION, ALLIANCE OF AUTOMOBILE MANUFACTURERS

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 marketplace. 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.1" 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	Pub. L. 106–414	68 Fed. Reg. 59250	MY 2004
Door Latches and Locks	Pub. L. 109–59	72 Fed. Reg. 5385	MY 2010
Electronic Stability Control	Pub. L. 109–59	72 Fed. Reg. 17236	MY 2012
Side Impact Protection	Pub. L. 109–59	72 Fed. Reg. 51908	MY 2013
Roof Strength	Pub. L. 109–59	Due 07/01/08	tbd
Occupant Containment	Pub. 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 percent standard; 20 percent 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 percent standard; 2 percent 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 2005	Production Year 2006	Production Year 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 percent standard; 13 percent 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 percent standard; 6 percent 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* airbags 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 let 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 (50th 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 a 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

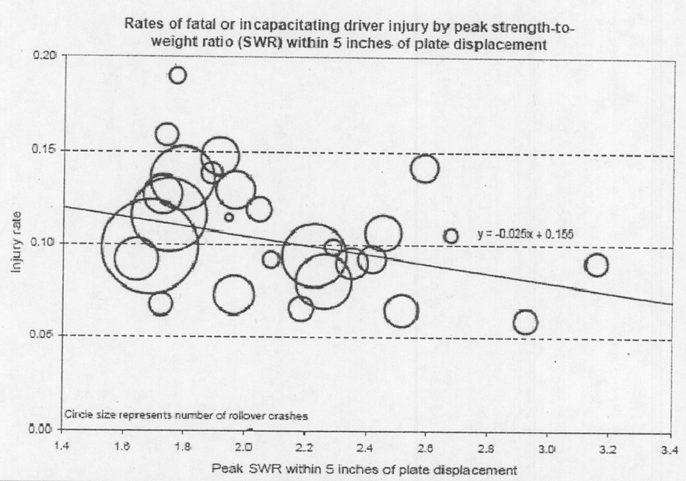
show no difference between far-side/near-side occupants and associated injury risk.

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.

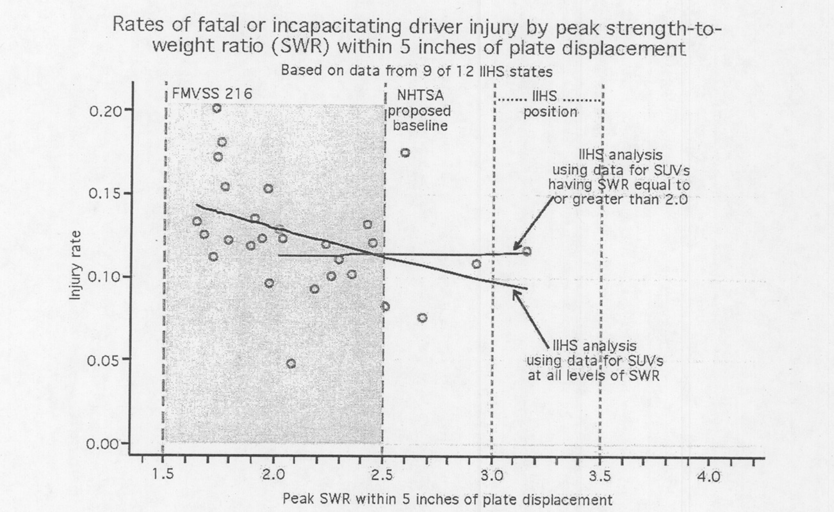
IIHS Figure 1



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 ≥ 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 Vehicle Weight	Effect of Modifications to Reach: †		
		SWR 2.5_{20}	SWR 3.0_{20}	WR 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 SWR2.5_{20} means NHTSA's proposal: a SWR of 2.5 times the vehicle's unloaded vehicle weight, plus a 20 percent 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 percent, 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 (50th 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*

Senator PRYOR. Thank you.

Ms. Claybrook?

STATEMENT OF HON. JOAN B. CLAYBROOK, PRESIDENT, PUBLIC CITIZEN

Ms. CLAYBROOK. Thank you so much, Mr. Chairman. We at Public Citizen, appreciate the opportunity to testify today.

Every day there are 29 fatalities from rollover crashes. If there were 29 fatalities from an airplane crash every day, I think this Congress would be in a revolutionary state about what to do to remedy that. And yet, for the past 7 years, the National Highway Traffic Safety Administration has diddled in its rulemaking activities and come up with a terrible proposal that is not going to really make any difference. It's going to save between 44 and 476 lives out of 10,600, which is, in itself, an indicator of the lack of capacity of this rulemaking to make any difference.

Rollover crashes, it's really important to say, are highly survivable. That's the most important thing to know, because the physics of rollover crashes are indisputable. They occur over a 4- to 6-second time interval, which is a very long period of time, whereas, other crashes are milliseconds. There is time for the body to adjust to the rollover; it just has to be protected when that occurs. Consequently, the forces acting on the occupants are mild, and the focus then becomes threefold. Do the restraints properly and safely keep the occupant in the survival zone of the vehicle? Does the vehicle structure maintain occupant survival space? And do the portals of ejection—*i.e.,* the side windows and doors—stay intact, and thus, prevent exposure to partial ejection, a hideous and terrible consequence of rollovers? These questions can best be answered by a dynamic test standard.

Public Citizen recommends the following. First, NHTSA should issue one unified, dynamic rollover injury prevention crashworthiness standard for rollover, for all aspects of rollover. We know it's practicable. The Volvo XC90, built by one small auto manufacturer, shows that a vehicle that protects occupants in most rollover crashes can be built and sold successfully. In order to do this, of course, the deadline for this rulemaking needs to be extended.

NHTSA needs to go back to the drawing board and re-envision its rollover crashworthiness program. Instead of tackling the rollover problem in a piecemeal way, which is what it's doing now, it should issue a comprehensive rollover crashworthiness standard that mimics real-world crash conditions using an injury prevention metric that addresses the three elements of rollover occupant protection: ejection prevention, adequate and effective restraint, and assurance that occupants are not killed or injured by an intruding roof. These dynamic tests should cover belts and belt pretensioners, door locks, door retention, side-curtain airbags, glazing, ejection potential, and roof crush. That could all be done in one test. Such a dynamic standard would subsume the ejection final rule, which is required by the 2005 legislation and is due by October 1, 2009. NHTSA, for that standard, is now merely looking at a totally inadequate quasi-static head-form test.

NHTSA has known of the problem of rollover since 1970, when it first, with the airbag rule, issued a voluntary dynamic rollover test. I want to repeat that. A dynamic rollover test was developed in 1970, called the dolly rollover test, which industry has been using for years in its own internal testing.

And now there is a vastly improved privately designed system called the Jordan Rollover System. Two brilliant engineers, in California one of whom is here in the audience—Don Friedman—developed this; the other, Acen Jordan, is a renowned developer of test equipment and has done many designs for industry.

We recommend, as well, that the language on preemption restricting victims access to the courts be removed. And, in the interim, we recommend that a new consumer information program be designed using a static test with a much improved requirement so that, in the interim, while the redesign of the test is going on, consumers at least can get some information, using the static test, about the performance of the airbags.

This is totally feasible. All of the other standards of significance that NHTSA has issued are dynamic tests. The front crash is a dynamic test. The side is a dynamic test. The rear is a dynamic test. Why not a rollover dynamic test? It makes no sense.

In my statement, I mention a number of criteria that have not been met by NHTSA that are in the SAFETEA–LU requirements, including the word "upgrade"—this is not an "upgrade"—"tested on both sides," "consider dynamic testing," and then there are a number of technical difficulties that I mention.

I'd like to conclude with a brief 17-second film showing the Jordan Rollover System, so that the committee can see how well it works.

This has no signal. Well, technology always intervenes, doesn't it?

Well, I'll just say that this system is inexpensive. The vehicle is put on a spit. The vehicle is upside-down, it's lowered so that the roof has contact with a roadway running underneath, at whatever miles per hour it is designed to be. This test can be done with a vehicle in white, which is very inexpensive, before it's all painted, with the engine, and so on. It can be adjusted to any angle and way that you want to test it. And it very much mirrors the real world of a rollover crash. And without a dynamic test, it's not possible to really figure out how this vehicle is going to perform. The JRS has done over 80 rollover tests, and it is a remarkable system. And it is shameful—it is shameful that NHTSA has not really—they said they had done testing with the JRS; they have done no testing with the JRS. So, it's been most unfortunate.

Senator PRYOR. Well, I'll tell you what, if we get the video working here in a minute, we'll go back——

Ms. CLAYBROOK. Thank you very much.

Senator PRYOR.—to it, but——

Ms. CLAYBROOK. Thank you very much, Mr. Chairman.

Senator PRYOR.—you bet.

Ms. CLAYBROOK. I appreciate the opportunity to testify.

[The prepared statement of Ms. Claybrook follows:]

PREPARED STATEMENT OF HON. JOAN B. CLAYBROOK, PRESIDENT, PUBLIC CITIZEN

Chairman Pryor and members of the subcommittee, I am grateful to be here today to discuss the National Highway Traffic Safety Administration's utter and complete failure to provide the public with the protection that it needs in rollover crashes. I am Joan Claybrook, president of Public Citizen, and I have worked on auto safety issues for more than 40 years, first as a congressional staffer during the drafting of NHTSA's organic act, then as the special assistant to the first administrator of NHTSA, later as the administrator of NHTSA during the Carter administration, and ever since then as an advocate for the public.

In 1969, there were just 1,400 deaths in rollover crashes—at the time, pickup trucks were predominately work vehicles, and SUVs marketed as passenger-carrying vehicles had not entered the product mix.[1] As Congress has learned over the years, the rollover problem we now face is a direct result of the industry's marketing campaign to make SUVs the station wagon of the future.

Rollover crashes should be highly survivable. The forces felt by an occupant who has a rollover pretention restraint and who does not contact the roof are not as violent as those experienced in a frontal impact crash. The physics of rollover crashes are indisputable: rollover crashes occur over a 4–6 second time interval, whereas other crashes are over milliseconds. Consequently, the forces acting on occupants are relatively mild and the focus becomes threefold: (1) whether the restraint properly and safely keeps the occupant in the survival zone of the vehicle; (2) whether the vehicle structure maintains the occupant survival space; and (3) whether the portals of ejection, *e.g.,* side windows, stay intact thus preventing exposure to partial ejection.

In 2007 there were 10,698 fatalities in rollover crashes, accounting for 33 percent of all highway occupant fatalities.[2] By contrast, there have been fewer than 100 fatalities in plane crashes in the past 3 years combined.[3] If there were as many fatalities in plane crashes as there are in just rollover crashes, there would be overwhelming public outcry for the FAA to more strictly oversee the airline industry. Motor vehicle accidents are the number one killer of people aged 3 to 33, and rollover crashes account for a disproportionate and unnecessary number of these deaths.

To say that this is a national crisis ignores the fact that this has been a problem for almost twenty years, and yet, I am back before the Senate, asking that you revisit this issue again—for the sake of the over 10,500 families who lose a loved one each year in crashes that should be survivable and for the tens of thousands of others whose lives are irreversibly damaged by paralysis. Since 1991, when Congress

[1] 36 FR 166 (January 6, 1971).

[2] National Highway Traffic Safety Administration, DOT HS 810 837. September 2007.

[3] National Transportation Safety Board, Aviation Accident Statistics. Available at *http://www.ntsb.gov/aviation/Stats.htm*.

first acted in the Intermodal Surface Transportation Efficiency Act (ISTEA)[4] and instructed NHTSA to take action, more than 155,000 Americans have died in rollover crashes. These figures are appalling and reflect a clear lack of action on the part of the auto industry and, unfortunately, NHTSA.

After 20 years of pushing for a response from NHTSA to the problem of far too many rollover fatalities, we recommend that the agency do the following:

- Issue a comprehensive rollover crashworthiness standard that dynamically tests the performance of seat belts and belt pretensioners, door locks and door retention, side curtain airbags, glazing retention, ejection potential and roof crush resistance. The agency must abandon the current useless rulemaking and do it right.
- Until the agency can issue a dynamic crash test standard, it should provide widely publicized consumer information about roof strength using a static test that consists of two sequential platen tests. First, the platen is applied at a 10 degree pitch angle and a 25 degree roll angle for the first side, and then at a 40 degree roll angle for the second side. The roof should be able to reach a 3.5 times gross vehicle weight rating strength-to-weight ratio.

History

In 1970, NHTSA first addressed rollovers as a voluntary part of the airbag rule, Federal Motor Vehicle Safety Standard (FMVSS) 208, with a dynamic dolly rollover test. It was never made mandatory, but was used by industry internally to test their vehicles for decades. In 1971, NHTSA issued the mandatory static roof crush standard, FMVSS 216, but the final rule at GM's urging was seriously cut back from a two-sided test to a weak one-sided test which resulted in almost no improvement in roof strength. This standard is still in effect today.

It wasn't until a large number of consumers were driving pickup trucks and SUVs that fatalities due to rollover started to rise that Congress called for a reevaluation of rollover. It has taken nearly twenty years more for the agency to address rollover fatalities than when Congress first called for action, and the work is still not done.

Seventeen years ago Congress first acted to address this problem. In 1991, Congress passed the ISTEA, which directed NHTSA to develop a stability standard, and issue a rule by May 1994 to reduce head injury from contact with the upper interior of a vehicle. The stability standard has never been issued and was abandoned after an advance notice of proposed rulemaking in 1992. The rulemaking action was terminated in 1994, and American drivers are still waiting for a meaningful, comprehensive approach to rollover fatalities.[5]

Frederico Peña, then Secretary of Transportation, announced a plan to replace the terminated rulemaking with a comprehensive regulatory and information regime. This would include the consumer information on rollover propensity, as well as an upgrade of the side-impact and door retention standard and an examination of an upgrade to the roof crush standard.[6] The head injury rule was issued as a final rule in August 1995[7] and became effective in September 1995, with a phase-in through September 1998. The standard required padding on the door pillars, roof interiors and windshield headers for cars, pickup trucks and SUVs.

In May 2000, following an exposé by Houston television reporter Anna Werner of station KHOU, highlighting litigation relating to some of these very problems, NHTSA opened an investigation into the 47 million Firestone ATX and ATX II Wilderness tires Ford used on the Explorer. There were more than 200 deaths and 700 injuries just in rollover crashes of Ford Explorers equipped with the faulty Firestone tires. In August, there was a voluntary recall of 6.5 million of these tires. The Ford-Firestone experience prompted Congress to pass the Transportation Recall Enhancement, Accountability and Documentation (TREAD) Act,[8] which required a dynamic rollover test for consumer information. The dynamic test NHTSA used for this purpose only measures rollover *propensity,* it does not provide any information about rollover *crashworthiness.* In 2001, NHTSA issued its ANPRM on roof crush; however, nothing came of the rulemaking effort until just before the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA–LU)[9] was signed into law in 2005.[10]

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[4] Pub. L. 102–240. December 18, 1991.
[5] See 57 FR 242 (January 3, 1992) and 59 FR 33254 (June 28, 1994).
[6] 59 FR 33254.
[7] See 60 FR 43031, 43061(August 18, 1995).
[8] Pub. L. 106–414. November 1, 2000.
[9] Pub. L. 109–59. August 10, 2005.
[10] 66 FR 53376, 53385 (October 22, 2001).

NHTSA decided to disseminate consumer information about rollover propensity through the New Car Assessment Program (NCAP). From 2001–2003, NHTSA based its NCAP rollover ratings on a measure of the vehicle's geometry, meant to estimate the relation between a vehicle's center of gravity height and track width, which is referred to as the static stability factor (SSF). In 2004, NHTSA added two dynamic rollover test maneuvers which estimate a vehicle's on-road, untripped rollover threshold. Although important, NHTSA's action failed to address the roughly 95 percent of rollover crashes that are tripped—that is when a vehicle starts to slide laterally and is tripped by mechanisms such as curbs, soft soil, pot holes, guard rails, or wheel rims digging into the pavement.

But in light of NHTSA's failure to provide consumers information about *occupant protection* in rollover crashes, inadequate information about rollover propensity, no improvement in the roof strength standard since it took effect in 1973, and no requirement for belt performance in rollover crashes, rollover fatalities continued to increase, with 10,590 fatalities in 2004. In 2005, Congress passed the SAFETEA–LU, which mandated rollover prevention, occupant ejection mitigation, and roof crush occupant protection upgrades.

In 2006 NHTSA issued its rollover prevention rule to much fanfare,[11] with NHTSA Administrator Nicole Nason calling electronic stability control the "the greatest life saving improvement since the safety belt." [12] By contrast, the proposed upgrade to the roof crush resistance standard was published just 8 days after SAFETEA–LU was signed into law.[13] In response to the voluminous debate in the 2005 docket—containing 281 documents from the auto industry, public interest groups, and private engineers—as well as the results of additional two-sided static tests conducted by the agency, and results of independent dynamic tests conducted by the Center for Injury Research, NHTSA issued a Supplemental Notice of Proposed Rulemaking (SNPRM) in January of 2008.[14]

This latest proposal failed to correct the significant deficiencies in the 2005 proposal—NHTSA still neither mandates testing on both sides of the roof, nor has it considered dynamic testing, as the 2005 law requires. It also continues the misplacement of the test device that makes it easier to pass the test, but not protect occupants. Further, NHTSA's latest proposal was not accompanied by a new regulatory impact analysis, as the White House Executive Order 12,866 requires. Therefore, there is no estimate of the relative benefits of the regulatory options provided in the proposal, making fully-informed public comment impossible.

In its 2005 NPRM, NHTSA estimated that its proposed increase in roof strength would save between 13 and 44 lives. The "target population" of potentially avoided fatalities estimated in NHTSA's 2008 proposal is 476. These estimates show that NHTSA has neither looked at the problem of rollover fatalities in a new light nor made a real attempt to correct the problem. In the face of more than 10,000 fatalities a year, an "upgraded" rule that barely addresses 5 percent of the fatalities is just gross negligence.

Furthermore, the agency has callously included language that expresses the agency's view that injured parties should not be compensated by automakers whose vehicles comply with this weak Federal standard even if those vehicles fail to protect occupants with catastrophic failure of structural components of the roof.

So now three Congressional mandates later, NHTSA has failed time and again to address the rollover crisis. There have been more than 155,000 rollover fatalities—that's almost three times the number of U.S. Armed forces killed in Vietnam—and more than 17 years to develop the standards and practices needed to prevent these unnecessary deaths, since Congress first intervened. It is a tragedy that I am here before the Committee again, asking for Congress to send a message to the agency: Issue a comprehensive rollover occupant protection standard that actually saves lives.

Rollover Crashes Wreak Unspeakable Havoc on Too Many Families

Jonathan Arreola was just 19 when his 2000 Toyota 4Runner rolled over in California. The roof crushed in on his head, fracturing his skull and ending his life. His sister, who was 7 when he died, told her mother that she feels bad that her brother will never meet her kids when she gets older. This has left a void in his family's life. His mother asks: "With a top heavy SUV, how can a company not be mandated

[11] 72 FR 17236, 17322 (April 6, 2007).

[12] See "DOT Proposes Anti-Rollover Technology for New Vehicles," Press Release. National Highway Traffic Safety Administration. September 14, 2006.

[13] 70 FR 49223, 49248 (August 23, 2005).

[14] 73 FR 5484, 5493 (January 30, 2008).

to test this factor?" The sad truth is that Congress *did* mandate that companies test this factor—but NHTSA callously decided not to.

Before the rollover crash that left Patrick Parker a quadriplegic, automobile safety was one of the last things on Patrick's and his wife Dena's mind. They had other things to think about at their Texas dream home in a rural part of the state: paying the bills, taking care of their house, finding time to relax on weekends. But their lives changed the tragic day that Patrick swerved to avoid a deer while driving to work. He missed the deer he saw, but he hit a second and his pickup truck flipped. Though he was wearing his safety belt, the roof crushed to nearly the level of the hood of the truck, breaking his neck. His Ford pickup cab was designed with doors that opened from the center to facilitate removal of tools and other equipment from the rear of the cab. But this type of door weakened the roof because there was no B-pillar by his shoulder.

In an instant, Patrick lost so much. The hunting and outdoor activities he once loved he can now only enjoy as memories. Months of intensive physical therapy have failed to improve his condition, and he now gets around his 30-acre ranch in a motorized wheelchair. His devoted wife Dena has struggled with him, helping him each morning for the 3 hours it takes him to get up, eat breakfast, take a shower, and get dressed. His best time of day, he explains, is when he goes to sleep and no longer feels the pain. At least his successful lawsuit means the Parkers do not have to leave their beloved ranch.

The sad fact is that this story gets retold day after day, year after year, with 29 fatalities *each day,* and more than 300 catastrophic injuries per week. Families will keep being broken until there is a comprehensive dynamic rollover standard that covers belt performance, door and glazing retention, and roof crush.

Need for Dynamic Testing

A rollover crash is a complex and dynamic event, with many interrelated hazards that all contribute to the risks vehicle occupants face. However, despite its complexity, the remedies are well-known and proven. It is NHTSA's responsibility to understand these crash dynamics and set a performance standard using a test that, as well as being practicable and repeatable, protects occupants from the impact of crash forces. A test of the strength for a vehicle roof that is neither inverted nor in motion cannot demonstrate the risk to occupants in a real-world rollover, where occupants are both inverted and in motion.

In order to be realistic and meaningful, any performance test must be two-sided. The risk to vehicle occupants varies depending on whether the occupant is seated in the "near side" or the "far side" of the vehicle. Imagine looking at a vehicle as it rolls sideways, in slow motion: as it rolls over, first one side of the vehicle roof will make contact with the ground; then, the other side will make contact; and, depending on the speed of the vehicle crash, this sequence might repeat several times. In the first impact, the vehicle's windshield and windows often break, weakening the roof structure by as much as 30 percent, which means the "far" side occupant is protected by a roof up to 30 percent weaker than the occupant on the "near" side, that hit the ground first. In real-world crashes, this leads to a situation where the far seated occupant often suffers fatal injuries, while the near seated occupant walks away with only minor injuries.

NHTSA conducted 26 two-sided quasi-static tests as part of its evaluations for the January 2008 SNPRM. The agency found "the strength of the roof on the second side of some vehicles may have been increased or decreased as a result of the deformation of the first side of the roof." [15] The agency must explain in more specific detail what the implications of these results are in terms of occupant protection. The test results fail to show what happens dynamically when the first side of the roof striking the ground is followed by the second side of the roof striking the ground. This was what Congress meant to capture when it mandated NHTSA in SAFETEA–LU to "establish performance criteria to upgrade Federal Motor Vehicle Safety Standard No. 216 relating to roof strength for driver and passenger sides," [16] to develop performance criteria that account for the different forces that are experienced on the two sides of the vehicle.

The agency has not revisited nor studied the representativeness of the pitch and roll angles used in the test. Underpinning the technical details is the core concern: making the test represent occupant risk as a result of the changing crash forces in a rollover crash. The roof structure is supported by pillars which join the roof and glazing components connected to the frame of a vehicle. They are typically described

[15] *Id.* at 5487.

[16] Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA–LU), Sec. 10301(a). (Pub. L. 109–59).

in alphabetical order from the windshield to the back window—so the front windshield supporting pillar is known as the A-pillar, the pillar that is beside the driver's seat back is known as the B-pillar, and the pillar which supports the rear windshield is the C-pillar. Some vehicles have no B-pillar, and some, like station wagons or SUVs may have a D-pillar which supports the rear glazing, and the C-pillar is behind the second row windows.

When a vehicle rolls in a real-world crash, the weight of the engine pulls the front of the vehicle down, such that much of the impact is borne by the A-pillar, which almost always causes the windshield glass to break.[17] The static test that NHTSA has been using since 1973 pushes a flat metal plate against the roof of one side of the vehicle at 5 degrees of pitch and 25 degrees of roll. This places an unrealistic burden on the B-pillar, allowing automakers to design vehicles which pass NHTSA's roof strength standard on the strength of the B-pillar, when the A-pillar gets the brunt of the force in real-world rollovers. Without being stringently tested by NHTSA's roof crush test, A-pillars in the vehicle fleet are weak, exposing occupants to significant danger of head or neck injury in rollovers.

A dynamic test provides more realistic evaluation about the changing forces a roof experiences in a rollover crash. Use of a dynamic test would allow NHTSA to develop a performance standard of occupant protection that could include measurements of dynamics of the crash dummy. In the current static test, the dummy is not in motion, and therefore, no measurements are taken of neck deflection, or other injury potential measures that would more accurately portray risk to occupants in real crashes.

Another benefit of dynamic testing is that NHTSA could test multiple elements of rollover crashworthiness all at the same time in one test. For example, under SAFETEA–LU, Congress mandated that NHTSA initiate rulemaking on performance standards to reduce complete and partial ejection of occupants. One dynamic test standard should include rollover performance standards for safety belts, including performance of belt pretensioners, side curtain airbag performance, window glazing retention, and door locks and door retention, in addition to roof crush. NHTSA was also required to complete an upgrade of the FMVSS 206 standard, pertaining to door locks and retention. All of these elements could be tested using a dynamic test, making this type of testing efficient, as many different performance standards can be tested on the same apparatus, and theoretically, even in the same test, cutting the cost and time for the tests.

Although GM and Nissan have both recently made public new rollover test facilities, neither company has released test results to the public, so Public Citizen is unable to comment on whether or how these automakers could reconfigure existing test apparatus to test for roof strength or a comprehensive dynamic standard. NHTSA is empowered and, in fact, obligated, to investigate these test methods and assess whether they could be used for other purposes, or request test results for research purposes in developing a test that would work best for roof strength testing.

Autoliv, a major supplier of safety systems for light duty vehicles, including seat belts and airbags, commented that the static platen test may not be able to measure the response of "active" roof systems. As an alternative, Autoliv recommends that NHTSA "[e]stablish an alternate dynamic rollover test or drop test for vehicles with active roof structures."[18] Autoliv specifically cites problems with the potential for delay between subsequent tests on either side of the vehicle, stating that "[t]he duration of this test may well exceed the time in which certain active roof structures can be effective," (that is, dynamic testing).

NHTSA has since the very beginning been committed to dynamic testing. Even in 1971, the agency proposed an optional dynamic rollover test—the dolly rollover test. The agency uses dynamic tests for frontal, side, and rear impact crashworthiness tests.[i] This type of testing provides crucial information about how injuries occur, which provides automakers with information about how to design vehicles that protect occupants in real-world crashes. The automobile safety advances we've had in the past thirty years would not be possible without dynamic testing. NHTSA's opposition to dynamic rollover testing is neither scientifically based, nor is it consistent with its approach to vehicular testing.

Need for One Unified Rollover Standard

NHTSA needs to go back to the drawing board and re-envision its rollover crashworthiness program. Instead of tackling the rollover problem in a piecemeal way,

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[17] Carl Nash and Allan Paskin, "A Study of NASS Rollover Cases and the Implication for Federal Regulation." 19th Conference on the Enhanced Safety of Vehicles, 2005, Paper No. 05–0415.

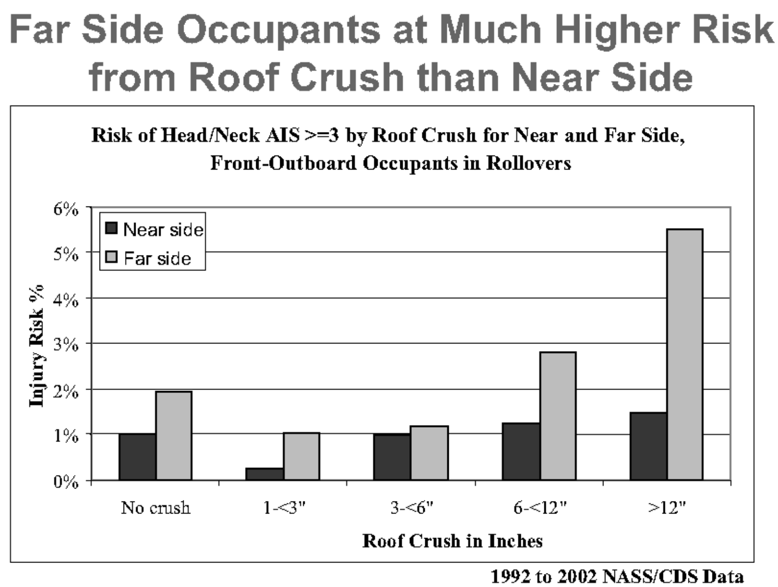
[18] See Comments of Autoliv at Docket No. NHTSA–2008–0015, at 0079.1 (March 31, 2008), available through *www.regulations.gov*.

it should issue a single, unified rollover crashworthiness standard that tackles the three elements of rollover occupant protection: prevent ejection, provide adequate restraint, and ensure that occupants are not injured or killed by an intruding roof by issuing a dynamic two-sided roof strength standard that measures occupant injury potential.

A single standard need not be more complicated or expensive to administer—and could even be more cost effective while better protecting public safety. NHTSA does it for other crash modes: frontal- and side-impact crashes are both tested in a way that considers all of the occupant protection systems at the same time. In a frontal impact crash, occupants are protected by seat belts, airbags, steering components, and front crumple zones. Testing all these systems together led to improvements in occupant protection—airbags work better when occupants are belted, steering columns collapse toward the dashboard, and front crumple zones provide crash force dispersion so that when crash forces get to the occupant they have been diminished.

Better occupant protection design doesn't happen overnight—just ask Volvo, which took considerable care in developing an SUV that took a whole-vehicle approach to safety design.

The Volvo XC90 approaches occupant protection with both crash avoidance and crashworthiness in mind. It is equipped with an electronic stability control system that includes the most state-of-the-art rollover prevention equipment available, significantly beyond the minimal system described in the 2007 NHTSA rulemaking to mandate the inclusion of electronic stability control systems in all vehicles, with the phase-in to be complete for all vehicles in model year 2012. The XC90 was also designed to protect occupants in the event of a rollover. These occupant safety features include a strong roof, laminated glass in the windshield and side windows,[ii] side curtain airbags, and seat belt pretensioners. All of these features—both crash avoidance and occupant safety features—work together to make rollover crashes more survivable.



The Volvo can achieve a strength-to-weight (SWR) ratio of nearly 4 in the 1973 FMVSS 216 static test, which is almost three times what NHTSA currently mandates. A dynamic test of the XC90 measured an SWR of just 2, suggesting that the platen test fails to represent realistic crash forces. Most contemporary vehicles that Xprts, LLC of Santa Barbara, California has tested can barely reach an SWR of 1 in a modification of NHTSA's test, the M216 test.[iii] This also shows that manufacturers can currently "game" the system, by developing vehicles with a strong B-pillar, which bears the majority of the force in the agency's proposed platen test, rather than developing vehicles that adequately protect vehicle occupants in rollover crashes with stronger A-pillars and other features we have discussed.

The XC90 is not simply proof of the concept that safer vehicles are possible; it is also proof that safety does not have to break the bank. The total cost for upgrading a Ford Explorer to have the roof strength performance of the XC90 is a mere $81, plus one penny, per vehicle.[19]

The Volvo XC90 documents submitted by Ford Motor Company in the Duncan case in Florida several years ago are in the agency's possession, but Ford has objected to their release in the public docket. However, the agency is well aware from this information how the XC90 performed in rollover tests and how Volvo went about designing a comprehensive approach to rollover occupant protection. NHTSA should use this knowledge in developing the final rule.

SAFETEA–LU set a statutory deadline for the roof crush rulemaking to be complete by July 1, 2008. However, NHTSA may contact the Senate Committee on Commerce, Science, and Transportation, and House of Representatives Committee on Energy and Commerce and request an extension. The work that NHTSA has done to meet its obligation under SAFETEA–LU is wholly inadequate. The agency needs extend the deadline for this standard and to go back to the drawing board to issue a real, life-saving, comprehensive rollover standard.

Electronic Stability Control

In April 2007, NHTSA issued its final rule on electronic stability control (ESC).[20] The agency has time and again praised ESC as being the biggest breakthrough in auto safety since air bags; however, at this time, there is not enough real-world data on the effectiveness of ESC. The agency estimated that ESC would prevent 71 percent of single-vehicle passenger car rollover and 84 percent of single-vehicle light truck rollover.[21]

The agency's estimates are based on a study of a broad range of vehicles that already had ESC installed by model year 2006. Electronic stability control is a blanket term for a variety of combinations of technologies, which typically use braking intervention controlled by a computer algorithm to allow the driver to maintain stability and stay on the road. Each manufacturer installs a proprietary form of ESC, or even multiple systems for different vehicles, making it difficult to estimate the effectiveness of any one system. The effectiveness of the ESC rule is likely to be less than what NHTSA estimated, due to the fact that NHTSA required an ESC system so minimal that every vehicle with ESC exceeds the technology required by NHTSA.

Furthermore, estimates of the effectiveness of ESC are irrelevant in the crashes that ESC does not prevent. If a vehicle is involved in a maneuver that overwhelms the ESC, then drivers will still lose control, leave the roadway, their vehicles will be tripped and roll over. It is for occupants in vehicles that do rollover that NHTSA must provide crashworthiness, as part of a comprehensive response.

Deficiencies in NHTSA's Rulemaking

Both the 2005 NPRM and 2008 SNPRM have failed to meet the requirements set by SAFETEA–LU to provide a meaningful upgrade to the 1971 standard. The proposals together have the following deficiencies:

- NHTSA's proposed test procedure has no scientific basis;
- in the two-sided tests NHTSA conducted, there was not a uniform test protocol, confounding the public and the agency from drawing meaningful conclusions from these results;
- there was no consistent limit on dummy head contact;
- the agency had no analytical basis for the first and second side tests;
- NHTSA produced no new regulatory impact analysis for the 2008 SNPRM, nor;
- did NHTSA make a specific recommendation for regulatory action.

NHTSA's 2005 NPRM Failed to Make a Substantial Upgrade.

NHTSA has failed to make a meaningful effort to upgrade the roof crush standard. It has not proposed an injury criterion for occupants in rollover crashes, nor has it upgraded the insufficient static test to account for crash dynamics in real-world rollovers.

Instead, NHTSA proposed that the static platen test be applied to a vehicle's roof at a force equal to 2.5 times the vehicle's weight, a small upgrade to the 1.5 times vehicle weight standard that has been in effect since the 1970s.[iv] NHTSA has not

[19] See Erin E. Hutter, "Improving Roof Crush Performance of a Sport Utility Vehicle" (Ohio State U., 2007), NHTSA–2008–015–0005, at 63.
[20] 72 FR 17235, 17322 (April 6, 2007).
[21] *Id.* at 17236.

attempted to account for the fact that in a real-world crash, a vehicle's roof can contact the ground several times, losing strength with each impact. NHTSA's proposed test does not account for multiple impacts. Also, the two sides of a vehicle's roof will contact the ground at different angles, but NHTSA's proposed test only applies force at one angle. NHTSA's one-sided test does not comply with Congress's mandate in SAFETEA–LU that NHTSA issue an upgrade in roof protection for both the "driver and passenger sides."

NHTSA's proposed test would retain a pitch angle of 5 degrees, which is not reflective of the pitch angle in real-world rollovers. SUVs and pickups are front-heavy and pitch forward during a rollover to an angle of 10 degrees or more. NHTSA has not published additional research about whether the pitch and roll angles are representative of real-world crash data. Through the Fatality Analysis Reporting System (FARS) and the National Automotive Sampling System (NASS), NHTSA has a wealth of data to conduct such analyses.

The proposed rule wrongly allows the strength provided by the window to be measured as part of the roof strength test. Vehicle windshields are frequently broken or separated from their bonding in rollovers, yet NHTSA's proposed test allows vehicles to be tested with windows intact, as in the 1970s standard. NHTSA has found that roof strength is reduced by about one-third after bonded windshields are broken.[22] The minimal estimated benefit—of just 13 to 44 lives—to occupants for NHTSA's 2005 proposal alone illustrates the assertion of Donald Friedman and Carl Nash in the 2001 Enhanced Safety of Vehicle Conference that FMVSS 216 "provides poor emulation of the conditions of actual rollovers that result in serious injury."[23] Friedman and Nash further explain:

> If the force of FMVSS 216 were applied at a greater roll angle, a typical roof would be as much as 30 percent weaker. However, a greater roll angle more accurately simulates what occurs in a real rollover.
>
> Dynamic roof loading in rollover almost always fractures or separates the windshield from its frame when the roof first contacts the ground.[v] Without the strength provided by its windshield, the roof is much more likely to deform and buckle upon its subsequent impact with the ground.[24]

The agency has subsequently learned the same lesson: it found in its two-sided testing program that roof deformation on the first side results in cracked or broken glazing, and says that "the first side test generally produces a weakening of the structure."[25]

The proposed test, which applies a slow constant force to a vehicle's roof, does not account for roof buckling as a source of injury. Yet roof intrusion occurs at speeds up to 22 mph and can cause devastating spinal and thoracic as well as head, face and neck injuries to both restrained and unrestrained occupants. The forces on a vehicle's roof during a rollover are always changing, and include lateral deformation, which cannot be replicated with a test that only pushes in a single direction. Even the two-sided static test proposed by the agency will fail to replicate the ever-changing forces across the entire roof.

NHTSA proposes to change its requirement that a roof sustain the force of 1.5 times the vehicle weight sustaining no more than five inches of roof crush to a headroom requirement. The proposed rule requires that a vehicle's roof not contact a dummy's head when crushed during testing. But the degree of roof crush, irrespective of headroom, is important in protecting occupants from ejection. If the roof of a vehicle resists more than three inches of crush, the side windows are much less likely to break, preventing ejection.[26] Also, with less roof crush, safety belts better retain their original geometry, doors are more likely to stay shut, and side curtain airbags retain their correct positioning, all of which are critical to reduce ejection potential.

The "no-head-contact" substitute requirement is flawed. Ensuring headroom during NHTSA's proposed static test does not ensure headroom in a real-world rollover, as occupants will be thrown toward the roof and within the range of roof intrusion allowed under the flawed NHTSA proposal. Worse, the proposal only requires main-

[22] Don Friedman, "Deficiencies of NHTSA's Current and Proposed Static, One-Sided Test of Roof Strength, FMVSS 216," at 22, (April 11, 2005).

[23] Donald Friedman and Carl Nash. "Advanced Roof Design for Rollover Protection," 17th Conference on the Enhanced Safety of Vehicles, 2001, Paper No. 01–S12–W–94.

[24] *Id.*

[25] 73 FR 5487.

[26] Don Friedman, "Deficiencies of NHTSA's Current and Proposed Static, One-Sided Test of Roof Strength, FMVSS 216," at 22, (April 11, 2005).

tenance of headroom sufficient for a 50th percentile male, neglecting taller occupants.

The proposed rule will only minimally increase roof strength. NHTSA estimated for the 2005 NPRM that the proposed standard would save at most 44 lives, or less than half of 1 percent of the lives lost each year in rollover crashes. Nearly 70 percent of the current vehicle fleet would require no improvement to meet the standard proposed in 2005. The agency's SNPRM, which is really just a series of options, fails to correct the problem, and the estimated costs for vehicles requiring improvement is a measly $10.61.[27]

Manufacturers can, and do, make vehicles that adequately protect occupants in rollovers. One example is the Volvo XC90, which shows good performance in real-world rollover crashes,[28] and has a 3.5 SWR and a high-strength, non-buckling, steel rollover and side impact structure. As described above, Volvo took a comprehensive, whole-vehicle approach to designing the XC90 to protect occupants in rollover—something that a dynamic NHTSA standard would encourage all manufacturers to do for *every* vehicle.

NHTSA's Supplemental Notice Fails to Improve the Deficiencies of the 2005 Proposal

The SNPRM does not serve as a replacement for the 2005 proposal, but merely adds for consideration the results of the 26 two-sided platen tests NHTSA completed.[vi] However, NHTSA leaves it up to the industry to make the case again, as it did in 1971, that a one-sided test was sufficient to measure roof strength. NHTSA solicits comments on: "the cost implications associated with different stringency requirements and different design strategies."[29] But NHTSA didn't provide a new regulatory impact analysis for its supplemental notice, making it almost impossible for commenters to provide precise feedback to the agency.

The agency's 2008 SNPRM is procedurally inadequate as it makes no specific regulatory recommendation. This is exacerbated by the absence of a regulatory impact analysis. It has not given the public enough information to assess the relative benefits of different regulatory options it lays out in the proposal, and therefore competent comment is impossible.

In spite of multiple appeals in person to agency officials, communications at congressional and agency headings, hundreds of pages of documents, and even a visit from NHTSA researchers to the Jordan Rollover System facility in California to witness a live dynamic rollover test, the agency has not fully "considered" dynamic testing for its rule. Even changing from a one-sided to two-sided platen test will not accurately assess risk to occupants in rollover crashes.[vii]

In addition to not effectively addressing the need for dynamic testing, the agency has also failed to re-envision the platen test to focus primarily on occupant protection, and a key change that must be made is the "no-head-contact" requirement. The agency proposes replacing the limit of five inches of platen travel in the existing standard to a requirement that at 2.5 times SWR the roof not make contact with a 50th percentile Hybrid III male dummy. The use of a 50th percentile male dummy ignores injury potential to tall occupants, and the biofidelity of the Hybrid III dummy head for rollover has been questioned: "The human head traveled farther downward and over a longer period of time, while the Hybrid III head rebounded faster after translating downward a smaller distance."[30]

The standard should be written from an injury prevention perspective, rather than limiting inches of roof crush. The "no-head-contact" provision should be abandoned in favor of a post-crash headroom requirement that maintains a survival space around occupants. This would avoid the problem of significant variation in allowable roof crush in vehicles with different amounts of headroom. Considering the standard from this perspective would also promote the development of vehicles that protected occupants in the event of rollover.

As we have stated above, the platen test described by the agency cannot adequately predict the potential for occupant injury in real-world rollover crashes. If the agency retains inches of platen travel as a measure of injury potential in the interim while it works to develop a dynamic test for occupant protection, then it should lower the allowable intrusion and require a minimum level of residual headroom. This course of action is preferable because the agency found "positive post-crash headroom" (residual space over the occupant's head after the rollover) reduced

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[27] 70 FR 49225.

[28] Real-world rollover performance of an XC90 showing good structural integrity was recorded in NASS–2003–79–57.

[29] 73 FR 5490.

[30] Herbst, Brian, Stephen Forrest, *et al.,* "Fidelity of Anthropomorphic Test Dummy Necks in Rollover Accidents," 16th Conference on the Enhanced Safety of Vehicles, 1998, Paper No. 98–S9–W–20.

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.[31]

Since 1978, there have been more than 300,000 rollover fatalities. There is no excuse—Congress told NHTSA to fix this problem 17 years ago, and NHTSA has delayed and delayed. While there has been a 7.5 percent decrease in overall highway fatalities since 1991, rollover fatalities have increased almost 20 percent over the same period. This is unconscionable—NHTSA's mission is to protect Americans on the highways, and with respect to rollover crashes, the agency has been grossly negligent.

Results of NHTSA's Two-Sided Testing Suggest Need for More Inquiry

For the SNPRM, NHTSA conducted 26 two-sided tests.[viii] In 22 of the 26 tests, the peak force measured for the second side at five inches of platen travel was less than that of the first side, suggesting that the deformation experienced by the test on the first side changed the strength of the second side. In 4 of the 26 cases, the peak force measured for the second side was greater than that for the first side. NHTSA says "[w]e concluded that the strength of the roof on the second side of some vehicles may have been increased or decreased as a result of the deformation of the first side of the roof."[32]

The agency does not provide further explanation for why the roof strength on the second side may have increased or decreased. The auto industry has long argued that they design vehicles such that the roof strength is the same on both sides, and therefore there is no need for a two-sided test. NHTSA's conclusion that it cannot be predicted how the roof strength will change refutes the industry claim that a vehicle will performs the same on both sides in the platen test.

The results of NHTSA's two-sided testing, it concluded, justify that the agency "consider" two-sided testing. However, NHTSA was already directed by SAFETEA–LU to produce an upgrade to FMVSS 216 that "relat[es] to roof strength for driver and passenger sides." The results of NHTSA's two-sided testing confirm what observers of vehicles involved in rollover crashes could ascertain by looking at them—that the amount of intrusion is not the same on the far side. This makes a stronger recommendation to the agency than "considering" two-sided testing. The agency is now obligated to determine how to best conduct two-sided testing that estimates the risk to occupants in rollover crashes.

Two-sided Dynamic Testing Is Possible

The Jordan Rollover System shows that a cost-effective dynamic test is possible.

The Jordan Rollover System (JRS) is a flexible, efficient, dynamic test that can be used to test for roof crush, but can also be used to test ejection and injury potential. The device was developed by Acen Jordan and Don Friedman, a test designer and a mechanical engineer. Acen Jordan worked on the Experimental Safety Vehicle and the Research Safety Vehicle and developed test sleds that are widely used by the industry. Don Friedman worked on the Sidewinder missile development, the Lunar Rover, air bags, offset frontal crash testing and rollover crash safety, and was selected to design NHTSA's Research Safety Vehicle in a competition with large auto companies.

The way the JRS device is designed provides adequate flexibility for the agency to use the device in a number of different ways. The test is efficient, because multiple safety systems could be tested in a single test, which would reduce the burden on the agency and auto companies to conduct compliance testing. The most important element of the test device is its ability to better approximate real-world roll dynamics in a controlled manner, unlike other dynamic tests.

The JRS can be used to test roof crush resistance under a variety of metrics. Donald Friedman has conducted tests using the JRS for research purposes using a protocol that measures intrusion velocity and dynamic roof crush. The test apparatus can be used in a number of different configurations to suit whatever metric the agency chooses for a compliance standard. The agency can change the test protocol, and the basic mechanism in the test device serves to rotate the vehicle in such a way to realistically replicate rollover crashes.

A dynamic rollover test conducted on a device like the JRS could simultaneously test multiple rollover safety standards in the same test. This should include performance standards for safety belts in rollovers, including performance of belt pretensioners, side curtain airbag performance, and window glazing and door retention as well as roof crush.

[31] 70 FR 49237.
[32] 73 FR 5487.

The agency has a responsibility to consider a dynamic test that mirrors real-world crashes. This test has the potential to give the agency valuable information for the development of performance standards, as well as efficient compliance testing for rollover occupant protection.

The JRS can provide valuable information for the design of safer vehicles. The JRS can be configured to collect information about roll dynamics, which can then be used by manufacturers to improve vehicle design to enhance safety. As with frontal, side and rear impact crashes, the use of dynamic testing has provided industry with information that allows for the improvement of vehicle design to withstand crashes of that type. As a result, there has been a reduction in fatalities, particularly in frontal and side impact crash modes.[33]

A similar approach must be taken with respect to rollover crashes. Occupant protection, through reduced roof crush as well as ejection mitigation, would effectively reduce rollover fatalities. Vehicle design decisions must be made with the use of representative data about rollover dynamics. Improvements in vehicle design to improve performance on a test that is not representative will not serve to improve occupant safety and is a waste of resources. A dynamic test, like the JRS, can provide manufacturers with the information needed to improve occupant protection.

The information gathered from dynamic testing such as the JRS can be used to write meaningful performance standards for ejection mitigation equipment. Rollover performance of belts, side curtain airbags, window glazing, and door locks will all play a critical role in preventing ejection. This performance standard must be developed in accordance with SAFETEA–LU requirements to issue a performance standard for ejection mitigation equipment by October 1, 2009.

As part of their desperate attempt to fend off legitimate product liability litigation against them, several automobile manufacturers have challenged the validity of the JRS as a legitimate vehicle test instrument. They have inappropriately used the Daubert test defined by the Supreme Court to control the use of junk science in trials involving testimony of technical experts.

Unfortunately, some judges have acquiesced to these industry objections even though the JRS is fully based on traditional scientific principles: Newtonian physics, and analysis of rollover crash investigations and data, and the biomechanics of human injury. This has potentially affected the roof crush rulemaking in that the industry now claims that these successful challenges to the JRS demonstrate that the JRS is not an objective instrument for conducting rollover roof crush or occupant protection testing.

The Center for Injury Research (C*f*IR) has invested substantial private resources in developing and demonstrating the JRS—conducting the research that NHTSA should have been conducting over the past decade—to provide the basis for more realistic and reliable evaluation of vehicle rollover occupant protection performance. Automaker litigators should not be permitted to derail this important work as part of their questionable courtroom tactics, and 30 years' opposition to effective testing of occupant protection in rollover crashes.

Dynamic Test Results Using the Jordan Rollover System

A total of 81 JRS tests have been conducted by Xprts, LLC since January 2003. The Center for Auto Safety, with the support solicited of the Santos Family Foundation by Public Citizen has conducted both quasi-static (M216 two-sided tests at a 10 degree pitch angle) and dynamic tests (JRS) of the roof crush performance of the Volvo XC90. The vehicles used for the test were donated by State Farm Insurance. The XC90 performed exceptionally well in all tests, demonstrating that it has been practicable for at least the past 5 years to build production vehicles with adequately strong roofs, in combination with other safety features to achieve superior rollover protection. As far as we can determine, no one has been seriously injured or killed in a rollover of an XC90 in the years it has been on the highway.

When briefed on the JRS, NHTSA asked for a demonstration of repeatability of tests conducted on the JRS. The Santos Family Foundation provided support for a series of tests that were conducted on three Subaru Foresters. The result of the repeatability series showed that the tests were in agreement to at least the same degree as NHTSA's and the Insurance Institute for Highway Safety tolerances for dynamic testing: a variation of about 10 percent.[34] No other dynamic test device, specifically the CRIS system used by industry, can provide the repeatability of the JRS.

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[33] *Priorities for EU Motor Vehicle Safety Design.* European Transport Safety Council. 2001.

[34] Machey, John M. and Charles L. Gauthier, *Results, Analysis and Conclusions of NHTSA's 35 MPH Frontal Crash Test Repeatability Program,* Office of Marketing Incentives, National Highway Traffic Safety Administration, Washington, D.C.: 1984. SAE 840201.

Under a new Santos Family Foundation grant, additional tests have also been conducted on three vehicles provided by State Farm that were the same models tested by NHTSA: the 2007 Toyota Camry, 2006 Hyundai Sonata and 2006 Chrysler 300. The results of these tests are that the residual roof crush for the 2.5 SWR Chrysler 300 leaves negative headroom on both JRS tests at 5.6 and 7.4 inches of residual crush at the A-pillar. By contrast the 3.2 SWR Hyundai Sonata had just 2.6 inches of residual crush [ix] at the A-pillar on the first roll. The 4.3 SWR Toyota Camry had the least residual roof intrusion on the first roll at 1.6 inches but 4.3 on the second roll. These results have been submitted to NHTSA's docket for the SNPRM.[35] Further tests of vehicles in this series are currently being conducted.

The Industry Is Rapidly Moving To Adopt Dynamic Testing as Well

The industry has recently resumed dynamic rollover testing. In the 1970s GM conducted drop tests. The Malibu tests, also conducted by GM were conducted using the FMVSS 208 dolly rollover procedure, where a vehicle is rolled off of a dolly rolling at around 30 mph.[x] Ford has conducted tests using the Controlled Rollover Impact System, in which a vehicle carried at the back of a tractor/trailer is rotated until it reaches a steady state roll before the vehicle is dropped on its roof. However, this device has been misused primarily to support the industry's claim that roof crush does not cause occupant head or neck injury.

Recently, the auto industry has been developing dynamic testing for purposes other than assessing roof strength. General Motors unveiled its new rollover test facility in December of 2006. The rollover tests chosen by General Motors are deliberately designed to avoid measuring roof crush. In one test, the vehicle is driven on a ramp, and then tips onto its side.[36] This test can be used to evaluate the deployment of side curtain airbags, which General Motors has publicly announced it will be installing in all its vehicles by 2012, but fails to provide any information about roof crush. Ford has also conducted dolly rollover tests of the Ford Explorer.[xi] The vehicle never fully inverts, and so the test fails to realistically represent a rollover crash. Nissan also recently announced publicly that it has developed an apparatus that is capable of fully inverting a car.[37] The stated purpose of this apparatus is to test seat belt performance.

Neither GM crash test results nor Nissan car flip results are available to the public, so Public Citizen is unable to comment on whether or how these automakers could reconfigure existing test apparatus to test for roof strength. NHTSA could investigate these test methods and assess whether they could be used for other purposes, or request test results for research purposes in developing a test that would work for roof strength testing.

Roof Crush Causes Injury

For more than three decades the auto industry, led by General Motors, has conducted a campaign to convince courts of law, NHTSA, and the public that "there is no relationship between roof strength and the likelihood of occupant injury given a rollover."[38] GM conducted an extensive two-part test program, referred to as Malibu I (unrestrained occupants) and Malibu II (fully belted occupants) that it claimed supported its thesis. In half of the tests of each series, the vehicles were equipped with full roll cages emulating a strong roof. However, although the company published and presented research papers making that claim, it would not release the underlying data and film until forced to do so in a major lawsuit. In fact, the company only this year released high quality, complete copies of the film recorded in these tests.

Analysis of the extensive data, film and analyses of the Malibu tests has demonstrated that in fact roof crush is directly related to neck injury which occurred only in tests of production roof Malibus. Film of these tests show definitively how these injuries are a direct result of the roof failures and that when the roofs are strong, with rollcages, the test dummies in the vehicles indicate the potential of only minor to moderate injuries from which an individual would fully recovery. We have submitted this evidence to NHTSA and attach a letter from the C*f*IR as an appendix to this testimony.

[35] *See* Submissions of Center for Auto Safety, Docket No. NHTSA–2008–0015 at 0061, 0062, and 0063. (March 27, 2008).

[36] David Shephardson, "GM to Put Rollover Bags in All Models" *The Detroit News,* (December 5, 2006).

[37] Hans Greimel, "The upside of upside down: Better belts." *Automotive News.* (February 25, 2008).

[38] Robert C. Lange as quoted in *The Detroit News,* "GM, NHTSA Unfairly Treated in Series," (March 19, 2002).

C*f*IR has conducted further research using the JRS which shows how the Hybrid III dummy which is commonly used for crash testing can be used effectively in dynamic rollover testing. They have shown that changes in neck instrumentation and the positioning of the dummy to be more like the position of actual occupants in a rollover can overcome the limitations of the Hybrid III which has a very simple neck structure that only poorly represents the complexities of the human neck. Again, these developments are discussed in detail in the C*f*IR letter to the committee.

Martha Bidez, a biomechanical engineer, has done a detailed study of the Ford Autoliv tests of the Ford Explorer. She concludes:

> During each of the three FMVSS 208 dolly rollover tests of Ford Explorer SUVs, the far-side, passenger [anthropomorphic test dummies] exhibited Peak neck compression and flexion loads, which indicated a probably spinal column injury in all three tests. . . . In all three tests, objective roof/pillar deformation occurred prior to the occurrence of Peak neck loads . . . and Peak neck loads were predictive of probable spinal column injury.[39]

Dynamic testing is needed to study the dynamic motion of occupants in rollover. The role of properly functioning restraints, ejection, and biomechanical factors such as neck preflexion must be taken together to get a complete picture of occupant risk in rollover crashes.

Docket

The public dockets for different stages of the roof crush rulemaking have resulted in hundreds of public comments from the auto industry, public interest groups, independent engineers, legal experts, and interested citizens. With tens of thousands of affected families each year, the problems of rollover and roof crush are of significant public concern.

After the close of the docket for the 2005 NPRM, the debate didn't stop—over 100 more submissions were made from December of 2005 until the opening of the docket for the SNPRM in January 2008. These submissions provided the agency with substantial additional materials, including multiple submissions from the auto industry, as well as multiple submissions from the public interest community about dynamic testing.

Overview of Additional Comments From the Auto Industry

Additional auto industry comments to the 2005 docket can be found at docket number NHTSA–2005–22143 at the following: July 25, 2006 (#232), August 3, 2006 (#233), August 11, 2006 (#234), September 7, 2006 (#236 and #237). Public Citizen, Advocates for Highway and Auto Safety (Advocates) and the Center for Auto Safety responded with a letter on August 3, 2006 requesting a meeting to discuss these submissions.

These late submissions deal with industry objections to the proposed tie down procedure, a request for authority to use FMVSS 220 for long roofline vehicles, and concerns about low roofline vehicles. The manufacturer submissions represent several considerations that are significantly different than the proposed rule and, if incorporated into the final rule, would result in an even greater deviation from NHTSA's legal obligations. Some of these major changes would make compliance easier to achieve, because the standards to which a vehicle would comply could effectively be tailored to that vehicle, allowing more vehicles to pass—at a significant cost to public safety. Further, the late submissions of industry expose the failure of the platen test to adequately represent real-world crashes. Public Citizen has directly addressed these issues in comments to the SNPRM Docket.[40]

Overview of Additional Contact With Public Interest Groups

Several meetings have occurred since the close of the 2005 docket on issues related to the need for significant revisions to the NPRM, and to reiterate the need for dynamic testing, two-sided testing. Meetings were also held with representatives from the Center for Injury Research and Xprts, LLC to present research findings of the dynamic test apparatus—the Jordan Rollover System (JRS). These meetings and comments can be found in NHTSA docket NHTSA–2005–22143 at: October 18,

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[39] Martha Bidez, John E. Cochran, Jr., *et al.,* "Occupant Dynamics In Rollover Crashes: Influence of Roof Deformation and Seat Belt Performance on Probably Spinal Column Injury." *Annals of Biomedical Engineering,* Vol. 35, No. 11. (2007) pp. 1973–1988. See Comments of Martha Bidez at Docket No. NHTSA–2008–0015, at 0030 (March 17, 2008).

[40] *See* Comments of Public Citizen at Docket No. NHTSA–2008–0015, at 0076.1 (March 27, 2008).

2006 (#240), February 6, 2007 (#251), May 14, 2007 (#266), August 21, 2007 (#271), September 18, 2007 (#276), January 1, 2008 (#280) and February 19, 2008 (#281).

We wish to emphasize that the agency was given ample opportunity to inquire and consider dynamic testing. However, the agency's response has thus far been to give lip service to the idea of dynamic testing, but take no steps to evaluate it. NHTSA was offered the opportunity by C*f*IR to test a number of vehicles on its JRS or the option to buy the test device for its testing, but the agency took no initiative to do either.[xii] As a result, it has issued a 1970s SNPRM instead of an advanced, 21st century one. An Australian engineering group, which has worked on developing roof strength regulations in Australia responded to NHTSA's assessment of dynamic testing criticizing NHTSA for citing "repeatability issues [with dynamic testing] and other pseudo-science references reflect a callous preference for bureaucratic process over function." [41]

NHTSA Is Attempting To Block Injured Consumers' Access to the Court

NHTSA asserts in the preamble to the 2005 NPRM that its final rule should preempt state tort law jury verdicts. The agency argues that a court liability decision is equivalent to a state performance requirement for greater levels of roof crush resistance that would "frustrate the agency's objectives by upsetting the balance between efforts to increase roof strength and reduce rollover propensity." [42] Their view is a massively overbroad reading of the Supreme Court decision in *Geier* v. *Honda,* which provided protection from product liability litigation to an automaker who had not installed an airbag in its vehicle, where the relevant safety standard rule had given manufacturers a choice among various technologies and giving automakers that choice was seen as a key component of the rule.[43]

Given that the agency's rule, in its own estimation, will save merely 7 percent of the affected population, its statements on preemption, and the risk that the agency will destroy any incentive to exceed its *de minimis* standard or to save the remaining 93 percent of affected occupants is a serious dereliction of the agency's mandate. This power grab by Federal authorities would leave victims uncompensated and remove incentives to improve safety designs beyond the weak new proposed rule—imposing a ceiling on safety and stripping victims like Marcia Arreola and Patrick Parker of their right to seek compensation for harm done to them.

The agency has not made a compelling case for preemption based on any scientific or policy basis. NHTSA states a higher standard would make vehicles more rollover prone from the heavier roof; however, the Volvo XC90 far exceeds NHTSA's standard and yet is one of the safest SUVs on the road. The use of advanced high strength steels and other lightweight materials can strengthen roofs without a weight increase. NHTSA's data show the impact of weight increases on raising a vehicle's center of gravity is immeasurably small, and rollover and stability control systems can more than compensate for any small increase in weight.

NHTSA does not suggest that it would be unsafe to exceed the standard, nor does it provide penalties or disincentives when vehicles do so. NHTSA has provided no examples of vehicles with elevated rollover risks due to the weight of the roof. If rollovers are significantly more survivable because of a stronger roof, the actual risk of injury is reduced even if there is a marginal increase in rollover propensity. The tort system provides the best incentive for automakers to make design decisions that will not increase rollover propensity—an outcome NHTSA's design-neutral standard does not guarantee. NHTSA is compounding public risk by reducing automaker accountability.

When NHTSA suggests a higher standard would interfere with its "comprehensive" package of rollover safety measures, the agency gets it exactly backward. A weak roof deforms such that the geometry of safety belts is compromised, making them far less effective. Without a strong roof, side windows will shatter and allow side impact air bags to flop out through the broken window, providing little protection and increasing the risk of deadly full or partial ejection. A stronger, not a weaker, roof is required for a successful, truly comprehensive approach to rollover injury reduction.

Meanwhile, the agency's static roof crush standard fails to measure the comprehensive interaction between safety systems in a real-world rollover crash. A dynamic test comprehensively measures the safety protection from the roof, windows, doors, belts and airbags working together. The agency's main duty to Congress and the public is to improve motor vehicle safety. Because liability law enhances safety

[41] *See* Comments of DV Experts at Docket No. NHTSA–2008–0015, at 0010 (March 4, 2008).
[42] 70 FR 49245.
[43] *Geier* v. *Honda Motor Corp.* 529 U.S. 861, 884. (2000).

by providing continual incentives to improve, the agency's action violates its core mission.

Those in a position to prevent injury or death should be held responsible for that injury or death when they fail to act. It is far more cost-effective, and the most responsible way to reduce the number lawsuits brought against is to avert harm in the first place. Adequate regulatory protection is also the ethical duty we owe to others out of respect for human life. Victims of roof crush cases deserve justice because automakers have known for years (since the late 1960s at least) how to prevent injuries in rollover crashes but have not designed vehicles to prevent this harm. In fact, the 1928 Ford Model A had superior roof protection than today's vehicles. Instead, auto companies cut costs to maximize profits, impose gag orders to cover up harm, and lobby regulators to weaken new rules. Victims of misconduct should be fairly compensated by the perpetrator. When those who can prevent harm, yet choose not to, and then are let off the hook, they, rather than society should pick up the tab, paying medical bills and higher insurance costs, etc., caused by the wrongful actions of a few.

In addition, improved motor vehicle safety—and particularly rollover occupant protection—would have major positive economic implications. Using NHTSA's own economic estimates of the cost of injury, the more than 10,000 fatalities and more than 17,000 serious injuries cost society more than $50 billion annually. Even if building cars with strong roofs cost manufacturers as much as $100 per vehicle, that would amount to a total annual cost of only $1.5 billion, which would be more than justifiable if it only reduced rollover casualties by 10 percent. In fact, appropriate changes in vehicle performance to reduce rollover casualties would save a majority of the more than $50 billion cost of these crashes.

Consumer justice attorneys stand with citizens, both the weak and the strong, to ensure that injured people are compensated by wrongdoers. NHTSA has not upgraded its "temporary" roof crush vehicle safety standard, issued in 1971, for 34 years, while the death toll from rollover crashes continued to mount at an astounding rate. In light of the egregious failure of NHTSA to protect the public many of these attorneys are calling for a substantial upgrade to the standard against their own interest, as these type of cases are a bread and butter issue for some of them. NHTSA's new proposal is deeply flawed, and will save few lives. In contrast, tort law establishes a duty of care that protects citizens when the government is too slow to act, when minimum standards are insufficient to prevent harm, or when standards are inadequately enforced. The tort system also brings to light useful information—most of the information about the harm from roof crush, its all-too-long history and its prevention has come from cases brought by injured plaintiffs.

This rule is not the only one in which NHTSA has interfered with harmful preemption language. Attached is a list of 51 regulations or proposed regulations in which language has been included which would make it more difficult for injured parties to seek redress, of these 20 of the regulations or proposals were issued by NHTSA.

While most citizens do not have a real voice in the regulatory decisions, they do understand what is fair. Juries charged with articulating ethical standards for a community define a common sense standard for reasonable care. They cannot be lobbied by either side and are generally free of political coercion. Our reliance on the collective wisdom of ordinary people to hold companies who cause harm accountable is a crucial democratic safeguard and a fundamental right of all citizens.

Conclusions

NHTSA has not produced an adequate upgrade to FMVSS 216 to meet its mandate under SAFETEA–LU. As part of a comprehensive approach to reducing rollover fatalities, NHTSA should offer an upgrade to its roof strength standard that produces a meaningful estimation of the risk to occupants in rollover crashes from intrusion of the roof. The agency must produce a regulatory impact analysis that estimates the relative benefits of different compliance options. The Senate Committee on Commerce, Science, and Transportation has the authority to agree to an extension of the rulemaking period to give the agency yet another chance to produce a roof strength proposal that protects occupants in deadly rollover crashes.

But the agency should give substantial thought to reimagining the standard. Roof strength is only part of developing comprehensive vehicle design approaches to protecting occupants in rollover crashes, which kill more than 10,000 people every year. The objective of FMVSS 216 is to prevent occupant injury by maintaining the structural integrity of the vehicle when it rolls over. Significant progress has been made in reducing injury from frontal, rear and side impact crashes with dynamic test standards. This standard should govern occupant protection from one more direction—the top. Adoption of a dynamic test would give valuable information about how occupants are injured in rollover crashes, which would in turn produce the industry, NHTSA, and the public information to design safer vehicles. A dynamic test can be used to test other elements of occupant protection, such as side curtain air bags, seat belt performance and belt pretensioners.

In the meantime, NHTSA immediately has the authority to provide consumer information through the New Car Assessment Program. It could use a modified version of the quasi-static platen test to estimate the roof strength, and provide this information, along with information on such things as whether a vehicle had rollover-triggered safety belt pretensioners and side curtain air bags, and whether a vehicle had more effective safety belt use reminders to provide a preliminary rating of the rollover occupant protection provided by current production vehicles. We will shortly make such a proposal to the agency.

Public Citizen would like to see the most expedient possible conclusion to the roof strength standard upgrade practicable; however, we support an upgrade to the standard that is significantly more protective than the existing standard. NHTSA must exercise its authority to set an extended deadline for this rulemaking, which is permitted under SAFETEA–LU, although the law mandates the standard be issued by July 1, 2008. NHTSA should go back to its 2003 plan and complete research programs into developing a more representative two-sided test for occupant protection in rollover crashes, and that research must include state-of-the-art dynamic testing.

NHTSA cannot produce a final rule until it has first returned to the drawing board and produced a notice of proposed rulemaking that outlines a two-sided testing regime that provides a scientifically-based estimate of risk to occupants in rollover crashes. This new proposal must:

- Be accompanied by research for each regulatory option and an assessment of the relative life-saving, injury-averting benefits to the public from each option;
- include dynamic testing, including the possibility of using a dynamic test to assess roof performance in addition to the performance of seat belts, door locks and latches, and windows;
- protect the public, including persons not represented by a 50 percent male dummy, using a performance test that does its utmost to mimic real-world crash conditions while using an injury prevention metric; and
- consider the significant benefit of combining all rollover occupant protection measures under a single comprehensive dynamic test standard resembling FMVSS 208.

In the meantime, the agency should immediately issue a consumer information standard that will allow consumers to make a meaningful assessment of the potential safety concern of vehicles on the market. This consumer information standard should include an estimate of roof strength that is based on an improved two-sided platen test, as well as highlighting other safety equipment such as belt pretensioners and side curtain airbags.

Members of the Subcommittee, I thank you for this opportunity today to testify on these critical needs of children for improved motor vehicle safety. I am eager to address your questions.

Footnotes

[i] Frontal impact protection is governed by FMVSS 208, side impact by FMVSS 214, and rear impact by FMVSS 223. In addition to these tests, FMVSS 301L and 301R are dynamic tests for fuel system integrity. FMVSS 212 is a dynamic test which assesses windshield mounting.

[ii] In later model years, laminated glazing was removed from side windows in the XC90 for "cost" reasons.

[iii] The M216 test subjects vehicles to two sequential platen tests. The platen is applied at a 10 degree pitch angle and a 25 degree roll angle for the first side, and a 40 degree roll angle for the second side. This test provides sequential measurements, which give information about the "sequential effect"—that is the difference in loading on the near versus far sides.

[iv] The 1971 standard limited the force to 1.5 times gross vehicle weight rating (GVWR) with a 5,000 pound ceiling. At that time, many passenger cars exceeded 5,000 pounds GVWR, so they could meet a standard of less than even 1.5 SWR.

[v] This is consistent with what NHTSA researchers found in the two-sided roof crush tests conducted for the SNPRM "We note that in all 26 tests, the windshield cracked before completion of the first side test." (73 FR 5487.)

[vi] The agency did not use a consistent test procedure for all the tests, which makes it impossible to compare the results of the tests.

[vii] Secretary of Transportation Mary Peters was questioned by Senator Mark Pryor during the October 18, 2007 oversight hearing of the Department of Transportation held before the Senate Committee on Commerce, Science, and Transportation. Senator Pryor asked Secretary Peters several questions about the roof crush rulemaking, including whether the yet-to-be-released SNPRM would include two-sided testing and whether it considered "any different types of test-

ing." Secretary Peters responded that she believed that inquiry into different types of testing was the purpose of the SNPRM.

[viii] NHTSA does not provide an explanation in the SNPRM as to how it selected the 26 vehicles for two-sided testing.

[ix] When a vehicle is tested dynamically, there may be a larger amount of peak dynamic crush, that is the greatest extent to which the roof crushes in when in contact with the simulated road. When the vehicle is turned back upright, the roof may spring back to a small extent. The "residual" crush is the amount of roof crush that is measured after the roof springs back.

[x] The dolly rollover test was proposed as an optional requirement as part of the 1971 rulemaking, but has not been used for Federal compliance testing.

[xi] These tests were conducted at Autoliv ASP in Auburn Hills, Michigan on 8/10/99 (Autoliv Test B190042); 12/9/98 (AutolivTest B180219); 8/11/99 (Autoliv Test B190043); and 12/10/98 (Autoliv Test B180220).

[xii] NHTSA has not made public records of any dynamic testing it has conducted if any has been conducted since it issued its ANPRM on roof crush in 2001.

APPENDIX I

The Sad History of Rollover Prevention—30 Years, Thousands of Deaths and Injuries, and Still No Safety Performance Standard

Rollover crashes are responsible for a full one-third of all vehicle occupant fatalities, yet meaningful Federal action to reduce these crashes has been delayed for more than three decades.

April 1973	The National Highway Traffic Safety Administration (NHTSA) issues an Advanced Notice of Proposed Rulemaking (ANPRM) on a rollover resistance standard "that would specify minimum performance requirements for the resistance of vehicles to rollover in simulations of extreme driving conditions encountered in attempting to avoid accidents." No safety standard has ever been issued.
1986	NHTSA analysis shows that rollover crashes are the most dangerous collision type for passenger vehicles.
Sept. 1986	Rep. Tim Wirth, the Chairman of the House Commerce Committee petitions NHTSA to issue a rollover standard based on Static Stability Factor (SSF)—a geometric measurement concerning the relationship between vehicle height and track width.
Dec. 1987	Rep. Tim Wirth petition denied by NHTSA on the basis that SSF does not accurately predict rollover propensity. SSF was later adopted in the year 2000 as the basis for the agency's rollover resistance consumer information program, but not as a minimum safety standard.
Feb./July 1988	The Center for Auto Safety (CAS) and the Safety First Coalition (SFC) petition NHTSA to initiate a defect investigation on the highly rollover-prone Suzuki Samurai.
June 1988	Consumers Union petitions NHTSA to protect occupants against "unreasonable risk of rollover."
Sept. 1988	NHTSA grants Consumers Union petition and states that it is already undertaking research into rollover safety and that the petition is consistent with the agency's "steps to address the rollover problem." NHTSA simultaneously denies the CAS and SFC petitions to investigate the Samurai.
1988–1993	NHTSA conducts an investigation and data analysis of more than 100,000 single-vehicle rollover crashes.
Oct. 1991	Congress requests report from NHTSA regarding rollover and roof crush standards (FY92 DOT Appropriations Act, Pub. L. 102–143, S. Rept. 102–148).
Dec. 1991	Congress requires NHTSA rulemaking to prevent unreasonable risk of rollover. An ANPRM or Notice of Proposed Rulemaking (NPRM) was required no later than May 31, 1992 and completion of a rulemaking action on rollover within 26 months of publication of the ANPRM. Yet Congress allowed the rulemaking to be considered completed when NHTSA either published a final rule or announced that the agency would not promulgate a rule.
Jan. 1992	NHTSA publishes an ANPRM proposing multiple options for establishing a reasonable metric baseline for acceptable rollover propensity. The ANPRM states that NHTSA is considering regulatory action to reduce the frequency of rollovers and/or the number and severity of injuries resulting from vehicle rollovers. A Technical Assessment Paper was also published discussing testing activities, results, crash data collection and data analysis (NHTSA–1996–1683–4).

April 1992	NHTSA issues Report to Congress, *Rollover Prevention and Roof Crush,* highlighting the research and its plans to address rollover prevention and survival.
Sept. 1992	NHTSA delivers the agency's planning document, *Planning Document for Rollover Prevention and Injury Mitigation,* at Society of Automotive Engineers Conference, giving an overview of the rollover problem and the action NHTSA was examining to address it, including vehicle measures for rollover resistance; improved roof crush resistance to prevent head and spinal injury, and improved side window glazing and door latches to prevent occupant ejection.
June 1994	Rollover standard rulemaking terminated following a cost-benefit analysis that used out-dated late 1980s data regarding the prevalence of light trucks in the vehicle population and ignored the significant trend of increasing rollover-prone vehicles, namely SUVs, as a percentage of new vehicle sales and an increasing presence on the highway.
June 1994	Secretary of Transportation, Federico Peña, announces NHTSA's plans to substitute a "comprehensive regulatory and information strategy" for the rollover propensity standard. This strategy included (1) a safety sticker to be placed on all vehicles that includes their rollover likelihood rating (watered down following Industry complaint, it now only mentions a generic likelihood of rollover); (2) the consideration of new standards for side windows and door latches (promulgated after SAFETEA–LU); and (3) examination of an upgraded roof crush standard (NPRM 2005 and SNPRM 2008).
July 1994	NHTSA issues a notice of rulemaking on a vehicle safety consumer information label for rollover stability.
July 1994	Advocates for Highway and Auto Safety (Advocates) and Insurance Institute for Highway Safety (IIHS) petition NHTSA to reconsider decision to terminate rulemaking on rollover standard.
Sept. 1994	Congress requires National Academy of Sciences (NAS) study of vehicle safety consumer information (FY95 DOT Appropriations Act, Pub. L. 103–331, *see* H. Rept.103–543, Part 1); NHTSA suspends rulemaking on vehicle rollover safety consumer information labeling until study is completed.
Aug. 1995	Responding to a 1991 ISTEA requirement that NHTSA initiate and complete a rulemaking to address "improved head impact protection from interior components of passenger cars (*i.e.,* roof rails, pillars, and front headers)," the agency issues a final rule amending FMVSS 201 to require passenger cars and light trucks with a GVWR of 10,000 pounds or less to provide greater protection when an occupant's head hits upper interior components (such as A-pillars and side rails) during a crash. A rulemaking intended to address roof crush is thereby transformed into a rule on interior padding.
March 1996	NAS issues study of vehicle safety information, *Shopping for Safety,* on NHTSA's proposed consumer information program, stating that consumers need more information then they are currently provided and that a safety label, like the one currently used for displaying fuel economy, should be displayed on all new passenger vehicles sold at U.S. dealerships listing standardized safety ratings.
May 1996	NHTSA issues *Status Report for Rollover Prevention and Injury Mitigation,* with a description of NHTSA's planned development of a dynamic rollover propensity test.
June 1996	NHTSA re-opens 1994 rulemaking docket on a rollover consumer warning label.
June 1996	NHTSA denies Advocates/IIHS July 1994 petition for reconsideration of decision to terminate rulemaking on rollover prevention standard, stating that a standard based on static vehicle measurements would eliminate a "very popular vehicle type"—the compact SUV and was not justified on cost-benefit grounds.
Aug. 1996	Consumers Union petitions NHTSA to develop a standard that would produce meaningful, comparative data on the emergency-handling characteristics of various SUVs and to provide test results to the public as consumer information.
May 1997	NHTSA grants CU petition, stating: "NHTSA will initially focus on exploring whether it can develop a practicable, repeatable and appropriate dynamic emergency handling test that assesses, among other issues, a vehicle's propensity for involvement in an on-road, untripped rollover crash."
April 1998	NHTSA issues an NPRM on a SUV rollover warning label for the vehicle visor.

Mar. 1999	NHTSA issues final rule on revised SUV rollover warning label, requiring a rollover warning sticker on the vehicle's visor or window that says "Warning: Higher Rollover Risk" and instructions to avoid abrupt maneuvers and excessive speed, and to buckle up, are written beneath the heading.
June 2000	NHTSA proposes rollover consumer information based on static stability factor (SSF) measurements as part of the agency's New Car Assessment Program (NCAP) that provides comparative vehicle performance information on the agency's website, but declines to require that the information be placed on the window sticker at the point-of-sale.
Oct. 23, 2000	Congress funds NAS study of NHTSA proposed rollover information rating based on SSF.
Nov. 2000	Following the Ford Explorer/Firestone tire tragedy, Congress requires dynamic testing of vehicle rollover be added to NHTSA's consumer information rating program with testing to begin by November, 2002 (TREAD Act, Sec. 12, Pub. L. 106–414).
Jan. 2001	NHTSA begins publishing rollover ratings based on a vehicle's static stability factor (SSF) on the agency's website.
July 2001	NHTSA issues request for comments on developing dynamic test as basis for rollover rating consumer information program beginning in 2003.
Sept. 2001	According to a Louis Harris poll commissioned by Advocates for Highway and Auto Safety, 85 percent of Americans support a Federal rollover prevention minimum standard.
Feb. 2002	NAS study, *Rating System for Rollover Resistance, An Assessment,* issued. The report recommends that NHTSA expand the scope of its program, consider metrics other than stars, and develop an overall measure of vehicle safety to be integrated into the vehicle label. The NAS also points that NHTSA should evaluate the appropriateness of a rollover rating program in the absence of a minimum standard (the other consumer information ratings, for frontal and side impact crashes, reward performance above a minimum compliance standard).
Oct. 2002	NHTSA issues NPRM on dynamic test procedure for rollover consumer information.
Feb. 26, 2003	Senate Commerce Committee holds a well-publicized hearing on SUV safety where Senators, auto industry representatives, the administrator of NHTSA and spokespeople from consumer safety groups speak about the rollover prevention and survivability.
April 2003	NHTSA publishes *Characteristics of Fatal Rollover Crashes* and reports the following: • Rollovers are more likely to result in fatality than other crashes are; • Rollovers constitute about one-fifth of all fatal crashes; • SUVs have the highest rollover fatality rate at 11.06 per 100,000 registered SUVs, followed by pickups at 7.52, vans at 4.09 and cars at 3.48 (for 1999).
June 2003	NHTSA issues *Initiatives to Address the Mitigation of Vehicle Rollover* —reporting that rollover mitigation is one of its four major priority areas, but proposing few concrete actions or deadlines. The other three priority areas include vehicle compatibility, safety belt use and impaired.
July 2003	NHTSA issues *Motor Vehicle Traffic Crash Injury and Fatality Estimates: 2002 Annual Report,* finding that rollover crashes accounted for 82 percent of the total fatality increase between 2001 and 2002. The report also reveals that in 2002, 10,666 occupants were killed in rollovers—one-third of all occupant deaths.
Oct. 2003	In accordance with the TREAD mandate, NHTSA adopts a "fishhook" maneuver as the dynamic test procedure to be combined with SSF in rollover consumer information ratings and to be used beginning with its 2004 model year tests.
Feb. 4, 2004	NHTSA issues first round of rollover ratings for 14 vehicle models and their corporate twins, based on a new dynamic test/SSF measurement. While the dynamic test provides an indication of on-road performance, the absence of a standard, or performance "floor" means that every vehicle starts with at least one star, and inflates the performance results on the tests (*i.e.,* with a two-star "floor," vehicles now earning three stars would receive substantially lower ratings).

Feb. 12, 2004	Senate passes S. 1072, the Safe, Accountable, Flexible, and Efficient Transportation Equity Act of 2003 (SAFETEA 2003), which includes safety provisions concerning rollover that would: • Mandate a rollover prevention standard that would assure the improvement of the basic design characteristics of vehicles under 10,000 lbs. to increase their resistance to rollover (NPRM 6–30–04, final rule not later than 18 months following NPRM); • Require the consideration of additional technologies that would increase handling and reduce the likelihood of instability (NPRM 6–30–04, final rule not later than 18 months following NPRM); and • Assign NHTSA to study Electronic Stability Control systems and report to Congress on their findings (due 12–31–05).
Aug. 10, 2005	S. 1072 is amended and re-introduced by the next Congress and passed into law as the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA–LU) is signed into law. SAFETEA–LU requires an upgrade of several rollover protection standards including: • Crash avoidance (electronic stability control); • ejection prevention; • door locks and door retention; and • roof crush resistance.
Aug. 18, 2005	NHTSA issues an NPRM on the roof crush resistance upgrade (73 FR 49223, 49248).
Nov. 21, 2005	Close of the formal comment period for the NPRM. Over 120 documents are submitted to the docket after its close.
Aug. 3, 2006	Public Citizen, Advocates for Highway and Auto Safety and the Center for Auto Safety submit a joint letter asking for a chance to respond to late industry comments to the docket.
Dec. 13, 2006	Representatives from Public Citizen, the Center for Auto Safety, the Center for Injury Research and Xprts, LLC meet with NHTSA to discuss concerns about the 2005 NPRM, including dynamic testing.
Feb. 23, 2007	Representatives from NHTSA travel to Goleta, California to see a test conducted using the Jordan Rollover System.
Oct. 18, 2007	Transportation Secretary Mary Peters responds to questions asked by Senator Mark Pryor of the Senate Committee on Commerce, Science, and Transportation regarding the roof crush rulemaking. Sen. Pryor asks specifically whether the SNPRM would include two-sided testing or address “different types of testing.” Secretary Peters responded that she believed the purpose of the SNPRM was to address different types of testing.
Jan. 30, 2008	NHTSA issues its SNPRM on roof crush resistance.
Mar. 27, 2008	End of formal comment period for 2008 SNPRM on roof crush resistance. Public Citizen submitted formal comments including response to late industry submissions to the 2005 NPRM docket, as well as concerns about the new proposal.
Jun. 4, 2008	Senate Commerce, Science, and Transportation Committee holds hearings to investigate NHTSA’s proceedings on the mandated upgrade of the roof crush rule.
Jul. 1, 2008	Statutory deadline in SAFETEA–LU for completion of roof crush rulemaking, if NHTSA does not seek an extension.

Appendix II

Legislative Language from the Safe, Accountable, Flexible, Efficient AppendixTransportation Equity Act: A Legacy for Users

SEC. 10301. VEHICLE ROLLOVER PREVENTION AND CRASH MITIGATION.

(a) IN GENERAL.—Subchapter II of chapter 301 is amended by adding at the end the following:

§ 30128. Vehicle rollover prevention and crash mitigation

(a) IN GENERAL.—The Secretary shall initiate rulemaking proceedings, for the purpose of establishing rules or standards that will reduce vehicle rollover crashes and mitigate deaths and injuries associated with such crashes for motor vehicles with a gross vehicle weight rating of not more than 10,000 pounds.

(b) ROLLOVER PREVENTION.—One of the rulemaking proceedings initiated under subsection (a) shall be to establish performance criteria to reduce the occurrence of rollovers consistent with stability enhancing technologies. The Secretary shall issue a proposed rule in this proceeding by rule by October 1, 2006, and a final rule by April 1, 2009.

(c) OCCUPANT EJECTION PREVENTION.——

(1) IN GENERAL.—The Secretary shall also initiate a rulemaking proceeding to establish performance standards to reduce complete and partial ejections of vehicle occupants from outboard seating positions. In formulating the standards the Secretary shall consider various ejection mitigation systems. The Secretary shall issue a final rule under this paragraph no later than October 1, 2009.

(2) DOOR LOCKS AND DOOR RETENTION.—The Secretary shall complete the rulemaking proceeding initiated to upgrade Federal Motor Vehicle Safety Standard No. 206, relating to door locks and door retention, no later than 30 months after the date of enactment of this section.

(d) PROTECTION OF OCCUPANTS.—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.

APPENDIX III

Summary of 2005 NPRM and 2008 SNPRM on FMVSS 216

NHTSA's 2005 Proposed Rule	NHTSA's 2008 Proposed Rule
Extend application of standard for multi-purpose passenger vehicles, trucks and buses up to 10,000 pounds	Extend application of standard for multi-purpose passenger vehicles, trucks and buses up to 10,000 pounds
Require vehicle subject to 2.5 times their unloaded vehicle weight	Require vehicle subject to 2.5 times their unloaded vehicle weight Option to introduce 2-sided test
Eliminate the limit of 22,240 Newton maximum force limit for passenger cars	Eliminate the limit of 22,240 Newton maximum force limit for passenger cars—upgrades to 2.5 times GVWR
Headroom requirement would be set that no roof component be allowed to contact a seated 50th percentile male dummy	Headroom requirement would be set that no roof component be allowed to contact a seated 50th percentile male dummy
Current test procedure would be retained—test configuration would be a 5–25 degree configuration and would not change load plate configuration	Current test procedure would be retained—test configuration would be a 5–25 degree configuration and would not change load plate configuration
	Second-side test would use the same angle as first side
Testing would occur with windshields in place	Testing would occur with windshields in place
Agency plans to evaluate whether both sides need be tested; agency believes changing the test plate angle is not necessary	Agency completed 26 two-sided platen tests, request comments on whether two-sided test balances with cost of vehicle design changes that would be required if vehicles had to pass two-sided test
Dynamic test would be rejected due to the fact the agency is "unaware of any dynamic test procedures that provide a sufficiently repeatable test environment"	No mention of dynamic testing
Agency proposes removal of secondary plate positioning	

APPENDIX IV

Preemption Language from 2005 Notice of Proposed Rulemaking

"F. Civil Justice Reform

This NPRM would not have any retroactive effect. 49 U.S.C. 30161 sets forth a procedure for judicial review of final rules establishing, amending, or revoking Federal motor vehicle safety standards. That section does not require submission of a petition for reconsideration or other administrative proceedings before parties may file suit in court. State action on safety issues within the purview of a Federal agency may be limited or even foreclosed by express language in a congressional enactment, by implication from the depth and breadth of a congressional scheme that occupies the legislative field, or by implication because of a conflict with a congressional enactment. In this regard, we note that section 30103(b) of 49 U.S.C. provides, "When a motor vehicle safety standard is in effect under this chapter, a State or a political subdivision of a State may prescribe or continue in effect a standard applicable to the same aspect of performance of a motor vehicle or motor vehicle equipment only if the standard is identical to the standard prescribed under this chapter." Thus, all differing state statutes and regulations would be preempted.

Further, it is our tentative judgment that safety would best be promoted by the careful balance we have struck in this proposal among a variety of considerations and objectives regarding rollover safety. As discussed above, this proposal is a part of a comprehensive plan for reducing the serious risk of rollover crashes and the risk of death and serious injury in those crashes. The objective of this proposal is to increase the requirement for roof crush resistance only to the extent that it can be done without negatively affecting vehicle dynamics and rollover propensity. The agency has tentatively concluded that our proposal would not adversely affect vehicle dynamics and cause vehicles to become more prone to rollovers. In contrast, the agency believes that either a broad State performance requirement for greater levels of roof crush resistance or a narrower requirement mandating that increased roof strength be achieved by a particular specified means, would frustrate the agency's objectives by upsetting the balance between efforts to increase roof strength and reduce rollover propensity.

Increasing current roof crush resistance requirements too much could potentially result in added weight to the roof and pillars, thereby increasing the vehicle center of gravity (CG) height and rollover propensity. In order to avoid this, we sought to strike a careful balance between improving roof crush resistance and potentially negative effects of too large an increase upon the vehicle's rollover propensity. We recognize that there is a variety of potential ways to increase roof crush resistance beyond the proposed level. However, we believe that any effort to impose either more stringent requirements or specific methods of compliance would frustrate our balanced approach to preventing rollovers from occurring as well as the deaths and injuries that result when rollovers nevertheless occur. First, we believe that requiring a more stringent level of roof crush resistance for all vehicles could increase rollover propensity of many vehicles and thereby create offsetting adverse safety consequences. While the agency is aware of at least several current vehicle models that provide greater roof crush resistance than would be required under our proposal, requiring greater levels of roof crush resistance for all vehicles could, depending on the methods of construction and materials used, and on other factors, render other vehicles more prone to rollovers, thus frustrating the agency's objectives in this rulemaking. Second, we believe that requiring vehicle manufacturers to improve roof crush resistance by a specific method would also frustrate agency goals. The optimum methods for addressing the risks of rollover crashes vary considerably for different vehicles, and requiring specific methods for improving roof crush resistance could interfere with the efforts to develop optimal solutions. Moreover, some methods of improving roof crush resistance are costlier than others. The resources diverted to increasing roof strength using one of the costlier methods could delay or even prevent vehicle manufacturers from equipping their vehicles with advanced vehicle technologies for reducing rollovers, such as Electronic Stability Control.

Based on the foregoing, if the proposal were adopted as a final rule, it would preempt all conflicting State common law requirements, including rules of tort law."[1]

[1] 70 FR 49223, 49248 (August 23, 2005) at 49245–46.

APPENDIX V

Associated Press List of Rulemakings Containing Preemption Language

FEDERAL REGULATIONS LIMIT CONSUMER LAWSUITS

By *The Associated Press*—May 13, 2008

A list by agency of 51 Federal health and safety regulations proposed or adopted since 2005 that could make it more difficult for consumers to sue businesses for faulty products:

National Highway Traffic Safety Administration

2005

June 22: proposed, designated seating positions and seat belt anchorage.
Aug. 19: proposed, roof crush strength.
Sept. 12: proposed, rearview mirror.

2007

Feb. 6: adopted, door locks and door retention.
April 6: adopted, electronic stability control.
May 4: adopted, head restraints.
July 12: final, tire pressure monitoring.
July 24: adopted, test procedures for installing child restraints to a child restraint anchorage system.
Sept. 5: adopted, occupant head protection in interior impact.
Sept. 11: adopted, side impact.
Sept. 25: proposed, occupant crash protection.
Oct. 9: proposed, electric-powered vehicles.
Oct. 9: proposed, brake hoses.
Nov. 2: adopted, occupant crash protection, fuel system integrity.
Nov. 21: proposed, school bus passenger seating.
Dec. 4: adopted, cargo carrying capacity.
Dec. 4: adopted, lamps, reflective devices.
Dec. 20: proposed, platform lifts for motor vehicles.

2008

Jan. 23: supplemental proposed, child restraint systems.
April 30: adopted, changes in vehicle identification number requirements.

Consumer Product Safety Commission

2006

March 15: adopted, mattress flammability standards.

Federal Railroad Administration

2006

Oct. 11: adopted, continuous welded rail.
Oct. 12: proposed, railroad operating standards.
Oct. 27: adopted, occupational noise exposure.

2007

Aug. 1: proposed, passenger equipment safety standards.
Sept. 4: proposed, electronically controlled pneumatic brake systems.

Federal Railroad Administration/Pipeline and Hazardous Materials Safety Administration

2008

April 1: proposed, improving safety of railroad tank cars.
April 16: interim, enhancing rail transportation safety.

Food and Drug Administration

Drug regulation:

2006

Jan. 24: adopted, prescription drug labeling.
Aug. 1: adopted, over-the-counter allergy medicine.
Aug. 29: proposed, skin bleaching drug products.
Dec. 12: proposed, over-the-counter drug labeling.
Dec. 26: proposed, over-the-counter analgesics.

2007

March 6: adopted, over-the-counter dandruff products.

March 29: adopted, over-the-counter laxatives.
Aug. 27: proposed, sunscreen labels.
Dec. 19: adopted, over-the-counter contraceptives.

2008

Feb. 1: adopted, lip protectant over-the-counter drug products.
Jan. 16: proposed, labeling changes for approved drugs, biologics and medical devices.

Food regulation:

2006

March 29: adopted, dietary sweeteners.
May 22: adopted, soluble fiber.
July 25: adopted, raw fruits and vegetables.
Dec. 13: adopted, dietary supplements.

2007

Jan. 5: proposed, calcium content claims.
Jan. 12: adopted, lean meat claims.
Feb. 6: proposed, soluble fiber, expand the use of health claims.
Sept. 17: interim, dietary sweeteners, adds a noncarcinogenic sugar.
Nov. 27: proposed, fatty acids.

2008

Feb. 25: interim, soluble fiber, additions to list of eligible sources.
Department of Homeland Security

2006

Dec. 21: proposed, rail transportation security.

2007

April 9: interim, chemical facilities.

Appendix VI

Safety Briefing on Roof Crush

HOW A STRONG FEDERAL ROOF CRUSH STANDARD CAN SAVE MANY LIVES AND WHY THE TEST MUST INCLUDE BOTH SIDES OF THE ROOF

Public Citizen *www.citizen.org*

The Importance of Far Side Safety in Rollover Crashes

The current National Highway Traffic Safety Administration (NHTSA) static test applies a platen on only one side of the vehicle.

Yet a NHTSA study from July 2004 (Roof Crush Analysis Using 1997–2001 NASS Case Review) stated "[g]enerally, it was found that roof deformation was most severe on the side of the vehicle opposite the side that makes first contact with the ground."

Of the 6,000 to 7,000 of people seriously injured or killed by roof crush every year, NHTSA officials have said that only a small number of lives (between 50 and several hundred) would be saved by the new standard.

A slight upgrade of the one-sided test would, in fact, be very ineffective in saving lives.

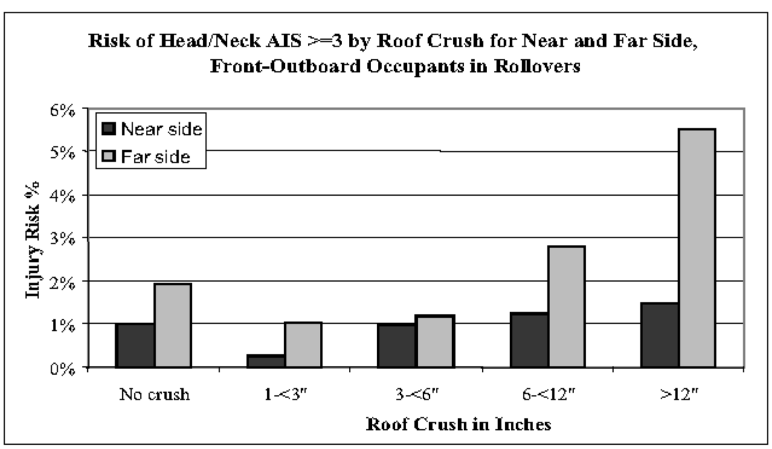
The Problem of Far Side Impacts:

In rollovers the roof is mainly crushed and people are seriously injured on the *far* side, opposite to the direction of roll (or *near* side).

Passenger (far side) injury

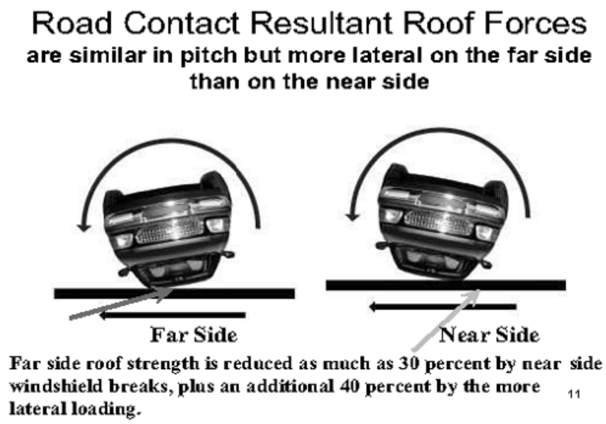
Driver (far side) injury

Far Side Occupants at Much Higher Risk from Roof Crush than Near Side



1992 to 2002 NASS/CDS Data

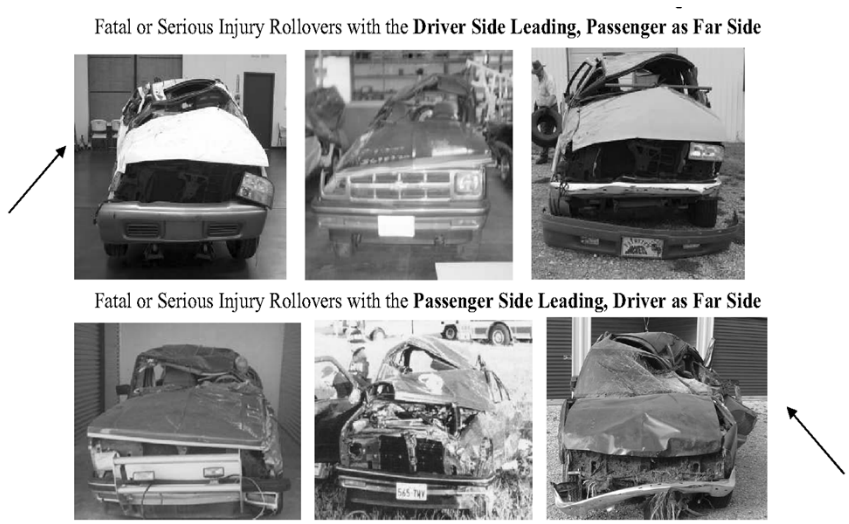
The second, far side impact in a rollover crash is different from the first impact in a number of ways. It has a different and more severe pitch angle and greater roll angle. The strength provided by the windshield and its bonding is gone after the first impact when both break, meaning that the roof is substantially weakened when the second or far side impact occurs.



For this reason, a one-sided test fails to diagnose a major cause of injury to occupants in rollovers, and far side roof strength is far more important than near side. *While near side tests pass vehicles that can support 1½ times the vehicle's weight in a static test, on the far side in a sequential test, many vehicle roofs cannot actually support even the weight of the vehicle. This is the reason for roof collapse in actual rollover crashes.*

In addition, a strong roof prevents breakage of the glass. Dynamic testing confirms that if the roof crushes less than 4 inches, the side window glazing is generally preserved, limiting ejection. In images of a Volvo XC90 in a multiple roll dynamic test available on the Public Citizen Website (*www.citizen.org*), the windows remain totally intact, even after multiple rolls.

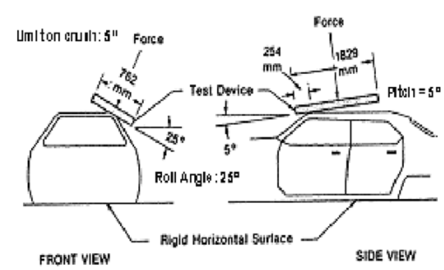
A one-sided test would not measure the roof crush on the far side in the images below:



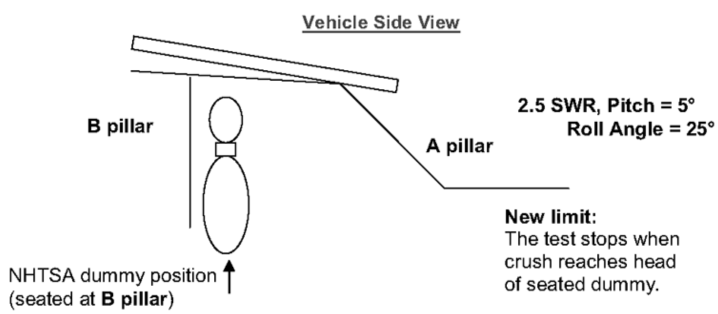
The Importance of A-Pillar Strength in Rollover Crashes

The current National Highway Traffic Safety Administration (NHTSA) static test applies a large platen on only one side of the vehicle's roof at a *pitch angle of 5°,* and a roll angle of 25°. The roof must be strong enough that with a force of *1.5 times* the vehicle's weight pushing on it, it does not crush more than 5 inches. The 1.5 times figure is called the Strength-to-Weight Ratio, or SWR.

Current Roof Strength Test



Based on agency officials' statements and reports it appears NHTSA is planning a minimal change to the standard, *increasing the Strength-to-Weight-Ratio (SWR) to about 2.5* and permitting the roof to crush until it contacts a dummy's head. The pitch angle and roll angle would not change, and the test would also still be performed on only one side of the roof.

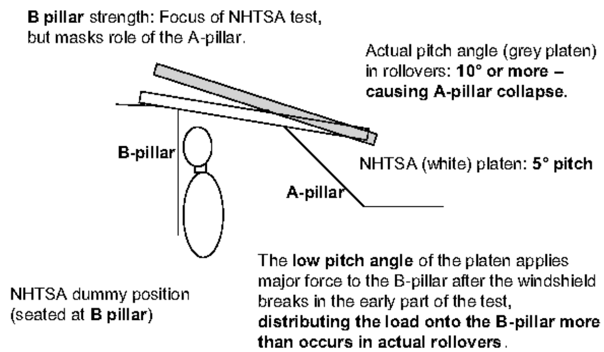


NHTSA officials have said that *only a small number of lives—50*—would be saved by the new standard, although roof crush in rollover kills 6,000 to 7,000 people a year, and *27,000 people annually are killed or seriously injured in rollover crashes.* This type of NHTSA rule would save few lives, in part because *data show the average roof strength of on-road vehicles is already 2.3 SWR,* and that many, if not most, vehicles now made can meet the anticipated NHTSA proposal. NHTSA tests in 2003 of recent models found that 8 of 10 vehicles would pass the anticipated new standard.

A major reason for the low benefits is that NHTSA's test conditions permit a very weak A-pillar (beside the windshield). *In addition to testing only the near side of the vehicle, the NHTSA test is unrealistic when compared to actual rollovers for three critical reasons:*

1. *It uses the wrong pitch angle—5°.* SUVs and pickups are significantly front-heavy and typically pitch forward during a rollover crash at an angle of 10° or even more—not 5°. In the test, the low pitch angle for the platen allows the B-pillar (beside the dummy's shoulder) to take up the load, whereas in an actual rollover the force is concentrated on the more forward A-pillar that holds the windshield.

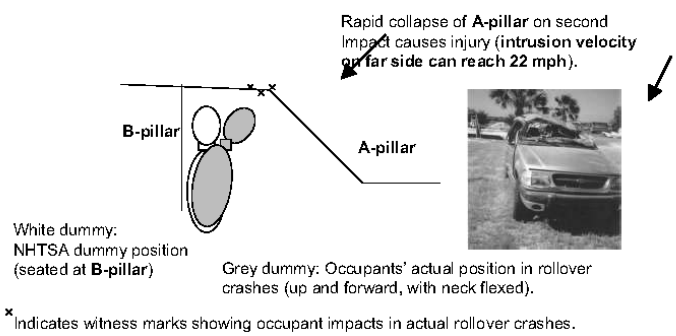
Load Placed on B-Pillar in Test Conceals A-Pillar Failure



2. *The dummy's head position is unrealistic*—In the NHTSA test, the test dummy's head is positioned straight up, where as in actual rollover crashes the occupant's head is tossed forward—essentially in-line with the collapsing A-pillar section of the roof.

3. *The test does not measure the speed of the roof's intrusion*—When a weak A-pillar buckles, it collapses into occupant survival space at a speed that inflicts injury.

NHTSA Dummy Position Focuses Incorrectly on B-Pillar Strength, Ignores Intrusion Velocity

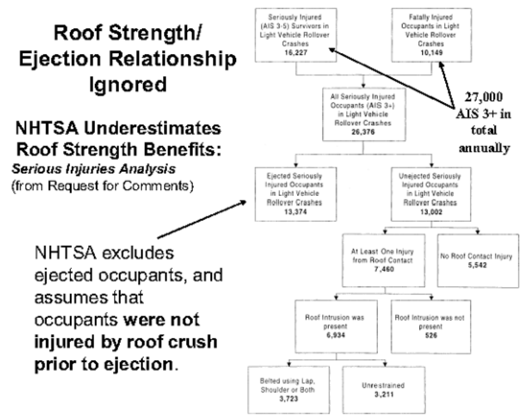


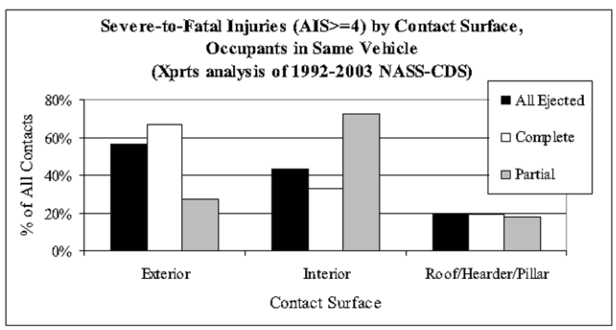
A weak A-pillar also allows side window glass to break, *allowing occupants' bodies, head and arms to be ejected through the side openings,* with devastating results. Due to all these factors, the NHTSA test is very poor at predicting the performance of vehicles in real world rollover crashes. *A dynamic test which simulates actual rollovers is needed.*

Roof Strength is Critical to Ejection Risk in Rollovers

Ejection is the most dangerous possibility for an occupant caught in a rollover crash. Between 1992 and 2002, *two-thirds* of people killed in rollovers were partially or fully ejected, and 20 percent of these were belted. There is no existing standard for belt performance in rollovers. The total number of people seriously injured or killed in rollover crashes in a single year is 27,000.

NHTSA ignores roof-strength/ejection link. NHTSA's roof crush analysis excludes ejection risks. Yet NHTSA data shows *45 percent of partially or fully ejected occupants contacted the inside of vehicle, including the roof, prior to ejection.*

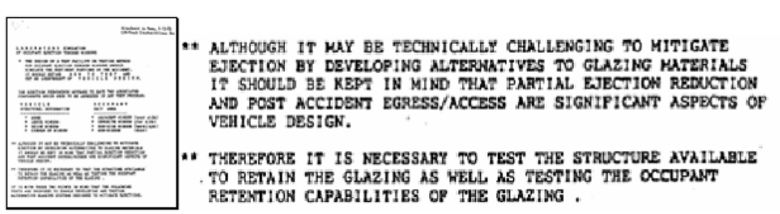




Roof strength is critical to ejection risk in a rollover: When a weak roof collapses, the supporting pillars deform, warping and shattering the windshield and side windows and unlatching the doors. This opens many potential portals through which occupants can be ejected.

Centrifugal forces exacerbate risk: The centrifugal forces of the rolling violently pull occupants outside of the vehicle, and without pretensioners, belts are too slack to hold occupants in place.

Industry documents prove ejection-roof strength relationship: In 1982, General Motors began a study of rollover occupant ejection and roof strength. GM engineer Ivar Arums found that the roof lost about one-third of its strength when the bonded windshield broke. Arums estimated a 23 percent reduction in ejections with tempered glass and a stronger roof. However, *GM failed to tell NHTSA about these results.*



** ALTHOUGH IT MAY BE TECHNICALLY CHALLENGING TO MITIGATE EJECTION BY DEVELOPING ALTERNATIVES TO GLAZING MATERIALS IT SHOULD BE KEPT IN MIND THAT PARTIAL EJECTION REDUCTION AND POST ACCIDENT EGRESS/ACCESS ARE SIGNIFICANT ASPECTS OF VEHICLE DESIGN.

** THEREFORE IT IS NECESSARY TO TEST THE STRUCTURE AVAILABLE TO RETAIN THE GLAZING AS WELL AS TESTING THE OCCUPANT RETENTION CAPABILITIES OF THE GLAZING .

Dynamic tests show the adequate roof strength prevents window breakage: Testing with the use of the dynamic rollover testing device the Jordan Rollover System (JRS) indicates that if the roof does not distort more than 3 or 4 inches, the rollover will not break the windows, and occupants cannot be ejected.

Summary: Roof Strength is Backbone of Rollover Safety, Dynamic Tests Needed to Reflect Actual Rollover Risks

Far Side Occupant Risks Ignored by NHTSA: In rollover crashes, the roof is mainly crushed and people are seriously injured on the far side. This impact occurs at a more severe pitch and roll angle, after the roof has been substantially weakened by windshield breakage from the first impact. NHTSA's current static test is a one-sided test, and *fails to measure roof crush or occupant risk on the far side*.

Weak A-Pillars Ignored by NHTSA: NHTSA's test conditions permit a very weak A-pillar (the pillars beside the windshield). SUVs and pickups are significantly front-heavy and typically pitch forward during a rollover crash at an angle of 10° or even more—not 5°, as in the NHTSA test. The low pitch angle in the test allows the B-pillar (behind the dummy's shoulder) to take up the load, whereas in an actual rollover the blow is concentrated on the A-pillar. Also, in NHTSA's test the test dummy's head position is unrealistic, positioned straight up instead of tossed forward as it would be in an actual rollover crash. Finally, NHTSA's static test ignores the speed of the A-pillar collapse, which is up to 22 mph—fast enough to injure or kill an occupant.

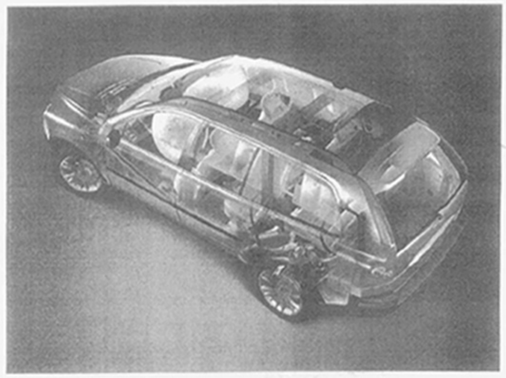
Ejection/Roof Strength Relationship Ignored by NHTSA: A vehicle's roof strength is closely tied to the risk of ejection during a rollover. If the roof is too weak, the supporting pillars deform and collapse when the vehicle's roof strikes the ground in a rollover, warping and shattering the windshield and side windows and unlatching the doors. This opens many potential portals through which occupants can be ejected.

An effective roof strength test would prevent thousands of deaths and serious injuries. A standard that limits crush to about 4 inches in a dynamic test, such as the dolly rollover which is currently an optional test part of Federal Motor Vehicles Safety Standard 208, would reduce ejections at least 50 percent—preventing at least 6,500 deaths and serious injuries, or 125 per week. Roof intrusion injury would also be greatly reduced, preventing another 100 deaths and serious injuries each week and bringing the total number to 10,000 each year. In order to minimize rollover deaths, a vehicle needs a stronger roof, in addition to advanced window glazing and rollover-sensitive belt and airbag systems—as is featured on Volvo's XC90 SUV.

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

5-4-04 DM
EXHIBIT
WIKMAN 9

Safety Product Development - XC90



XC90 Safety Product Development
Slide 1

VOLVO
Volvo Car Corporation

PRODUCED BY FORD SUBJECT TO A NON-SHARING PROTECTIVE ORDER

XC90 Safety Challenge

Focused areas when creating a Volvo SUV, based on field accident research:

- **Rollover**
  - Prevention
  - Protection
- **Compatibility**
  - Must cover all crash situations including.
  - SUV vs. other Cars
- **Third row seat safety**
  - Rear, Side and Rollover

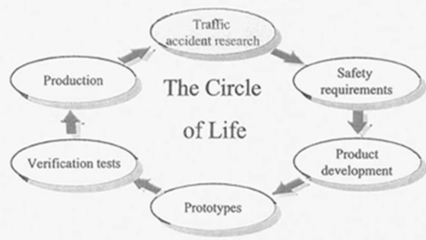
XC90 Safety Product Development
Slide 3

VOLVO
Volvo Car Corporation

PRODUCED BY FORD SUBJECT TO A NON-SHARING PROTECTIVE ORDER

Volvo Safety Work

Continuously improving real life safety



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Findings from the statistical databases (STO, NASS):

- Head and neck/spine are most frequently injured
- Higher amount of chest injuries in NASS compared to STO
- In-depth sample slightly more extensive car deformation
- Number of turns and ground contacts show similarities between samples

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Volvo Car Corporation

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Traffic accident research

Upper Structure Deformation Modes

XC90 Safety Product Development
Slide 7

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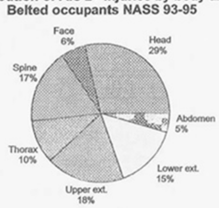
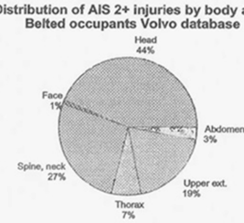
Traffic accident research

Distribution of AIS 2+ injuries by body area
Belted occupants NASS 93-95



Rollovers and multiple events including rollover
87 injuries AIS 2+

Distribution of AIS 2+ injuries by body area
Belted occupants Volvo database



"Pure" rollovers (no multiple events)
101 injuries AIS 2+

XC90 Safety Product Development
Slide 9

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Traffic accident research
Conclusions

Belted occupants:

- The head and neck/spine were found to be the most frequently injured body parts
- Partial ejection of the head caused the most severe injuries
- New rollover requirements and test methods needed to cover real life situations

Unbelted occupants:
Will have no benefit from improved seatbelt
also less benefit from improved roof structure

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Fact

- Field data with belted occupants shows that the majority of injuries in rollover accidents are related to the head and spine caused by impacts and partial ejection

Main design objective

- Eliminate head impacts and partial ejection in rollover accidents

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Requirements on a new Volvo SUV

- Same injury mechanisms in cars and SUV's.
- SUV's in general more exposed to rollover accidents

Main design objective

- Eliminate head impacts and partial ejection in rollover accidents

Basic Requirement: No contact between head and roof

XC90 Safety Product Development
Slide 13

VOLVO
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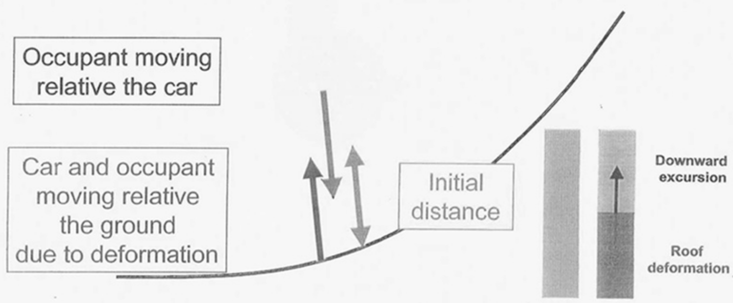
Occupant movement relative the ground



XC90 Safety Product Development
Slide 14

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Further requirements on the rollover systems

Pretensioners:
- Maximum peak and remaining forces on lap belt.
- Retention performance belt system, drop test.

IC:
- Out Of Position test
- Ejection mitigation component test
- Bottoming out component test
- Several side impact complete vehicle tests including pole front and rear.

Interior panels:
- Component head impact testing beyond legal (FMVSS201) locations.
- Frontal (including moose), side and rear end complete vehicle tests.

Rescue:
- Test to cut pillars to lift off roof to rescue occupants from inside the vehicle.

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Summary of test methods

- Development tests for retention system and roof characteristics:
  Drop tests with same energy level as FMVSS208.
- Occupant performance and vehicle performance:
  FMVSS208, SAE J857 (modified).
- Vehicle performance including activation of protection systems:
  FMVSS208 incl soil/curb tripped, SAE J857 (modified), TÜV screw rollover, ditch test.
- Vehicle performance, legal requirement:
  FMVSS216, static roof crush test.

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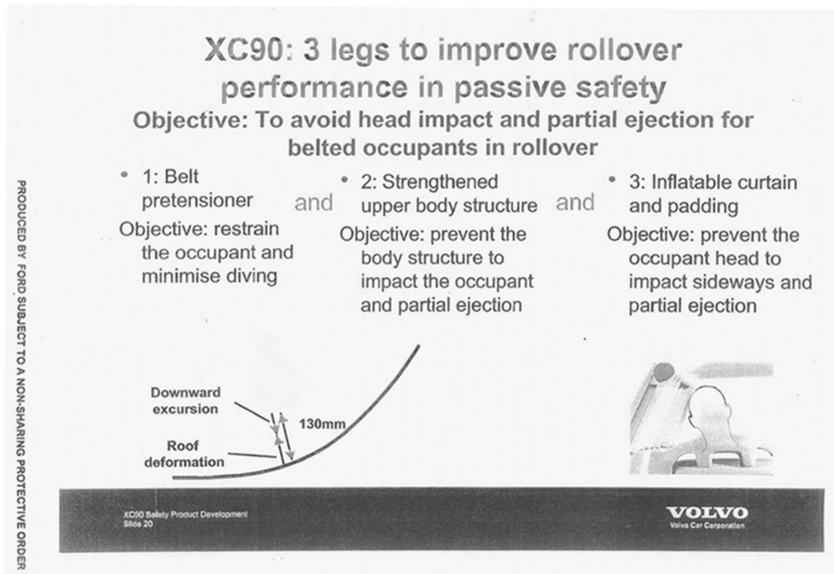
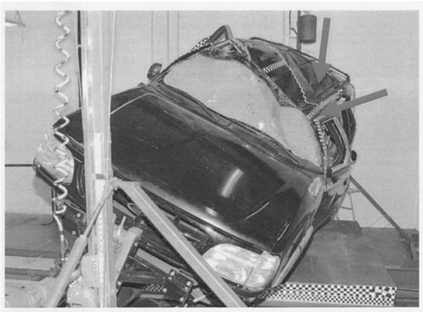
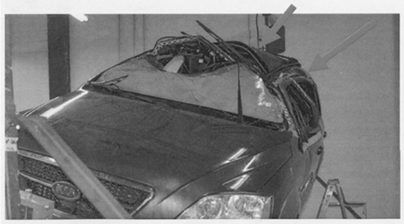




In both vehicles, the roof rail structure failed half way between the front and rear of the door frame colapsing inward and downward and the roof panel buckled downward, right over the Driver occupants seating position.



In Both vehicles, the weak A-Pillars and roof rack create a buckle that runs from front to rear, and is right over the drivers seating position and the panel bows upward in the center and the sunroof is shattered and gone.

APPENDIX VII

CENTER FOR INJURY RESEARCH
Goleta, CA, June 1, 2008

Hon. MARK PRYOR,
Chairman,
Senate Subcommittee on Consumer Affairs, Insurance, and Automotive Safety,
Washington, DC.

RE: OVERSIGHT HEARING ON PASSENGER VEHICLE ROOF STRENGTH

Dear Chairman Pryor:

The probability of serious to fatal injury in a motor vehicle rollover is a strong function of roof crush. If all vehicles in the fleet had an FMVSS 216 SWR of 3.5 or greater, the number of incapacitating and fatal injuries to occupants in rollovers could be cut in half.

We have a high degree of confidence in this conclusion based on the mutually consistent research and testing from three independent public, non-profit organizations (the National Highway Traffic Safety Administration, the Center for Injury Research and the Insurance Institute for Highway Safety) using three different methodologies and data sets. Their specific results are:

- NHTSA found that the probability of serious to fatal injury in rollovers on public roads is five times as high when residual roof crush goes beyond nominal head room (*i.e.,* is greater than 4 to 5 inches) in actual rollovers.
- C*f*IR found that there is a reasonable correlation between residual roof crush in the dynamic Jordan Rollover System (JRS) test and a vehicle's roof strength-to-weight ratio (SWR) in the government's test. We have also found that roofs with less residual crush also had lower peak roof intrusion speeds and that when appropriately instrumented and oriented dummies were used in such tests, they showed lower head and neck injury measures. As discussed later, we also found that the probability of side window failure (and therefore ejection) was a function of the degree of residual roof crush (and therefore a function of SWR).
- IIHS found a statistically significant correlation between the FMVSS 216 strength-to-weight ratio (SWR) and the risk of incapacitating and fatal injury in actual rollovers of mid-sized SUVs. Their analysis showed that an increase in the SWR standard from 1.5 to 2.5 would reduce the risk by 28 percent for these vehicles. If that relationship holds more broadly, increasing the strength to 3.5 would reduce the risk of such injuries by more than half.

It is interesting that although IIHS studied all rollovers of only a specific class of vehicles, and we tested a wide range of vehicles primarily for their ability to reduce head and neck injuries as well as ejections, the reduction in casualties in the IIHS study and the reduction in roof crush in our testing, per unit of SWR increase, was proportional.

These findings should be tempered by the fact that the current FMVSS 216 quasi-static test of roof crush resistance has serious limitations as a measure of rollover occupant protection. The FMVSS 216 test stresses a roof only in a specific direction; it stresses only one side of the roof, and does not apply forces with the dynamic shock of an actual roof impact in a rollover. Furthermore, this test invites manufacturers to design vehicles that can pass the test rather than vehicles that protect occupants.

NHTSA has traditionally preferred dynamic testing with dummies for frontal and side impact regulatory and consumer information testing. This philosophy should carry over to rollover testing. Such testing can provide substantially enhanced data on all aspects of rollover performance and permit development of more efficient designs for rollover occupant protection.

For these reasons, JRS tests or some equivalent dynamic tests should be used by NHTSA and automakers to evaluate rollover occupant protection performance.

More than 250,000 rollovers in the United States each year result in more than 10,000 fatalities and 20,000 serious injuries. Motor vehicle crashes are a leading cause of death to young people. The fatality rate in rollovers is six times that of police-reported frontal and side impacts and they inflict quadriplegia or serious, permanent head injuries on more than 6,000 of our fellow citizens.

Occupant protection in passenger car, light truck and van rollovers remains the most critical unsolved problem in motor vehicle safety. This submission for the hearing record is intended to provide your committee with information and perspective that will assist in its further formulation of Federal motor vehicle safety policy.

One of us (Nash) has shown, using National Accident Sampling System data, that between two-thirds and three-quarters of all rollovers do not involve significant complicating factors such as major collisions, so that the life savings from stronger roofs would be roughly 3,500 people each year, and serious injury savings would be as many as twice that number. This conclusion applies to all rollover injuries to the current population of belted, unbelted and ejected occupants.

It must be emphasized that the IIHS studies found a correlation between roof strength and lower rates of all types of injury to occupants regardless of restraint status and ejection. NHTSA and C*f*IR found that higher roof strength reduces the potential for direct head and neck injury from roof intrusion, and C*f*IR found that the potential for side window failure which provides an avenue for ejection (which itself is correlated with higher injury rates) is also a direct function of roof crush.

The Nature of Rollover Injury

In the late 1960s NHTSA recognized that the two critical mechanisms of rollover occupant injury are direct injury from roof intrusion and the increased potential for injury to partially or completely ejected occupants. The auto racing industry successfully addressed these issues for rollovers that are much more violent than typical public road rollovers by providing strong roll cages, highly effective occupant restraints, and driver head protection padding with helmets. This demonstrates that the human body can sustain the basic forces of a rollover if it is properly protected. The same principles of occupant protection can be afforded the public using protective features that are low in cost and that do not restrict an occupant any more than a conventional safety belt.

Occupant ejection can be controlled by ensuring the integrity of the occupant compartment: in particular by reducing side window breakage. Although safety belt use is important, even an unrestrained occupant cannot be ejected unless there is a major opening such as a broken window in the occupant compartment.

> *Rollovers are a sequence of low energy impacts easily tolerated by the human body in an occupant compartment that resists crush, contains its occupants, and is appropriately padded.*

The Biomechanics of Rollover Injury

There is no specific biomechanics issue concerning injury to ejected occupants. Once ejected, an occupant is subject to uncontrolled impacts with the ground and other external objects, or to being crushed by the vehicle itself. Virtually all experts in the field agree that good occupant restraint can reduce complete ejection, but partial ejection to belted occupants can result if side windows fail and particularly if the weak roof of a vehicle moves so that the resulting envelope of the vehicle no longer protects an occupant's head.

If an occupant is unrestrained but not ejected, he or she may tumble about the interior of the vehicle, but injuries are inflicted only if the occupant encounters hard or sharp objects in the interior of the vehicle. Again, there are no specific biomechanics issues, and experts generally agree that injury to occupants can be reduced by good restraints *that are used*.

The critical biomechanics issue arises when considering direct head or neck injuries to a restrained occupant from an intruding roof component. There is a significant body of biomechanical data from tests using human cadavers that show not only the mechanisms of neck injury from forces typical of rollovers, but the injury tolerance of humans. These data show that a typical injury mechanism is from a force on the head that results in a combination of compression loading of the neck and flexion (forward bending) of the neck. This type of injury is observed all too often in restrained vehicle occupants in rollovers who are seated under a part of the roof that has crushed extensively. The evidence from biomechanics research also shows that the speed of a head impact (such as by an intruding vehicle roof) is at least as important as the extent of roof crush.

Achieving a dynamic rollover test using anthropometric test dummies has been hampered by the fact that the neck of the existing dummy that is in common use—the Hybrid III—has poor biofidelity. Nevertheless, existing biomechanics research provides a basis for establishing neck injury criteria, and our recent work using dummies in the JRS shows how the Hybrid III can be used to better measure the potential for real world neck injury in dynamic tests.

Our JRS test protocol overcomes the lack of biofidelity of the Hybrid III dummy and shows a clear relationship between the speed and extent of roof crush and human head and neck injury.

Testing for Rollover Occupant Protection

It is clear that we can test a vehicle roof's resistance to crush and the speed of roof intrusion under various conditions. The test used in FMVSS 216 is an oversimplified version of such a test, and there are various dynamic tests that provide a much more realistic measure of roof performance in a rollover.

Virtually all experts in this field agree that dynamic tests have the potential to provide a better indication of a vehicle's rollover performance than the quasi-static test specified in FMVSS 216. The forces on a roof during a rollover vary substantially in both magnitude and direction during a rollover, and only a dynamic test can emulate those forces. The gold standard for automotive crash testing is dynamic testing using anthropometric test dummies to measure the potential for injury.

Quasi-static tests cannot provide direct information on the potential for human injury in a rollover, nor can they be used to evaluate the performance of designs and features other than roof strength that affect rollover occupant protection. The mechanism of injury and the protection of occupants in rollover can only be studied with repeatable, dynamic rollover tests. Instrumented anthropometric test dummies that have a high degree of biofidelity, and injury criteria that have been derived from biomechanics research can provide more definitive indications of the rollover occupant injury potential.

Although NHTSA has been generally committed to dynamic testing for crashworthiness and occupant crash protection since 1970 in all crash modes, it took decades to implement such testing for frontal and side impact crashes. The agency has yet to seriously consider dynamic testing for its rollover occupant protection regulations. It has said that it would take too long to develop a rollover occupant protection standard based on dynamic testing.

In 1970, NHTSA specified a dynamic test, the dolly rollover test specified in FMVSS 208, to measure the potential for occupant ejection in a rollover. The first major dynamic test program—dolly rollover tests using instrumented Hybrid III dummies to measure the potential for occupant injury—was General Motors' Malibu tests, conducted in 1983 (Malibu I with unrestrained dummies) and 1987 (Malibu II with restrained dummies). Half of the vehicles in these tests had roll cages emulating strong roofs and half were unmodified production vehicles.

In the early part of this decade Ford Motor Company sponsored the development of the Controlled Rollover Impact System (CRIS), a complex dynamic test of vehicle response to the forces of a rollover. We have developed a simpler, less expensive, better controlled and highly repeatable dynamic test called the Jordan Rollover System (JRS).

The primary debates concerning dynamic testing concern test protocols and conditions, how a dummy is used to measure the potential for injury, and the interpretation of such measures.

The industry has primarily relied on the Malibu tests to support its claims that occupant injury is not related to roof crush. We and others disagree based on analysis of the data and film from the same Malibu tests that has been grudgingly released in bits and pieces over the past decade. We have attached video from these tests, rendered to show what happens to the dummies in an inertial frame of reference (that is, with the horizon held steady). This film shows the relatively benign ride of the dummy in the Malibu with a strong roof (roll cage) while roof crush in the production Malibu produces devastating distortion of the dummy occupant's neck. In four cases, instrumentation on the restrained dummies demonstrated that the forces on the neck were sufficient to severely injure a human under the same conditions.

CRIS has been used to support Ford and General Motors defense positions in product liability cases rather than for the development of improved rollover occupant protection. Tests using this system have been designed to ensure that dummies in the test vehicles show high neck loads typical of diving injuries regardless of roof performance.

We have used the Jordan Rollover System to conduct dynamic tests, some with Hybrid III dummies, to better understand the mechanism of occupant injury and to determine how anthropometric dummies can be used to more accurately indicate the potential for neck injury in a rollover.

C*f*IR has demonstrated the value of the JRS as a dynamic test of rollover occupant protection and that it meets all of NHTSA's stated requirements for use in regulations and consumer information programs: reliability, repeatability, ability to predict injury and to replicate real world injury patterns. Despite this, except for tentative oral expressions of appreciation of the JRS, NHTSA has not acknowledged our submissions, requested more data, nor formally accepted or rejected the JRS as either a research tool or test instrument.

The agency never definitively responded to a 2005 proposal to conduct JRS research tests at nominal cost nor to a 2007 proposal to join us in defining the JRS test protocol for testing current production vehicles that had been tested as part of NHTSA's roof crush resistance program. With a major grant from the Santos Family Foundation through the Center for Auto Safety, we are currently conducting a series of JRS tests of the same contemporary vehicles tested by NHTSA. The vehicles have been contributed by the State Farm Insurance Company.

NHTSA should have a comprehensive rollover occupant protection program, using dynamic testing that covers the two primary causes of injury: direct injury from roof intrusion and ejection. Yet it has been unwilling to seriously consider a rollover standard based on dynamic testing, and seems determined to propose only a modest upgrade of its current standard based on a quasi-static roof crush resistance test.

> *Although we have demonstrated that the Jordan Rollover System dynamic test meets all of the criteria NHTSA has set forth, the agency has refused to acknowledge that a legitimate dynamic test of rollover occupant protection exists that could be the basis for its rulemaking. NHTSA remains stubbornly committed to static testing with arbitrary SWR criteria and will not even acknowledge that the body of JRS dynamic rollover test results demonstrate that the minimum quasi-static SWR criteria should be significantly higher than 2.5 or that a dynamic rollover test can substantially more accurately evaluate roof crush and predict injury potential.*

Jordan Rollover System Test Results

C*f*IR's dynamic research with the Jordan Rollover System (JRS) demonstrates that serious injury in a rollover results from rapid, irregular roof intrusion into the head of an occupant where that intrusion imposes both compression and flexion forces on the occupant's neck. Such forces result from roof intrusion of more than about 4 inches into the occupant survival space at a rate of more than 10 feet/second (7 mph). A static roof crush test cannot predict the severity or type of injury.

Figure 1 shows the residual roof crush from JRS testing as a function of FMVSS 216 SWR of vehicles including those identified as common to NHTSA's and IIHS's static tests and analyses. The red line represents the results of two roll JRS dynamic tests.

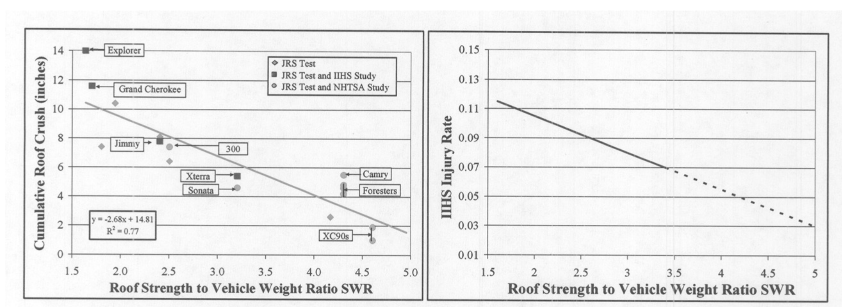


Figure 1 & 2: Residual roof crush post JRS tests of vehicles versus SWR (left) and IIHS Injury rate (right) of mid size SUVs versus SWR.

Figures 1 and 2 above, illustrate the coordination between the research of rollover roof crush from JRS testing and IIHS's statistical injury rate (using incapacitating injuries and fatalities to belted, unbelted and ejected drivers) of mid size SUVs versus SWR.

> *The combined results of NHTSA, CfIR and IIHS data indicates that the current fleet of vehicles which has an average SWR of around two represents a 10 percent risk of incapacitating injury and death (as also identified by NHTSA crash data) and that a future fleet of vehicles averaging an SWR of 4 would represent a 5 percent risk.*

Our most recent JRS test program involving contemporary vehicles with dummies included a Jeep Grand Cherokee (SWR = 1.8), a Chrysler 300 (SWR = 2.5), a Hyundai Sonata (SWR = 3.2), a Toyota Camry (SWR = 4.3), and a VW Jetta (SWR = 5.2). The video tapes of these tests are attached to this submission in a DVD format disk. They show the progressively milder stress to the dummy neck in the vehicles with stronger roofs.

As an example, we tested a 2006 Hyundai Sonata with an SWR of 3.2 which is 25 percent higher than what has been proposed by NHTSA. We used a Hybrid III dummy equipped with both upper and lower neck sensors and a lateral high speed camera to observe neck compression and flexion, with the dummy neck in a realistic orientation. Figure 3 shows the Sonata in the JRS fixture before the test and Figure 4 shows it inverted with the initially trailing (far) side roof at maximum crush.

Figure 5 shows a rear view of the occupant inside the Sonata before the test and Figure 6 shows the dummy when the vehicle is inverted at the time of maximum roof crush. The compression/flexion forces at this impact would be sufficient to cause a serious cervical spine injury to a human under the same circumstances.

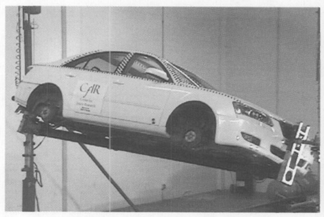


Figure 3: Pretest photo of the Sonata.

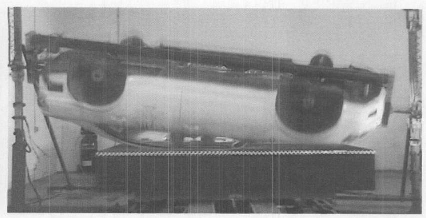


Figure 4: Far side roof impact of the Sonata

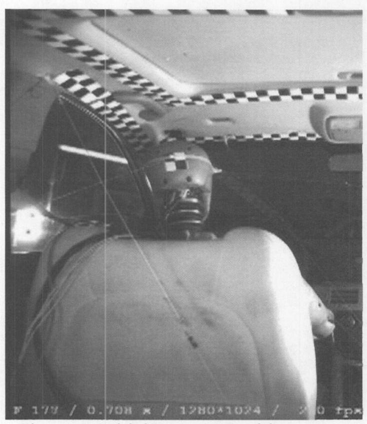


Figure 5: Initial Dummy Position

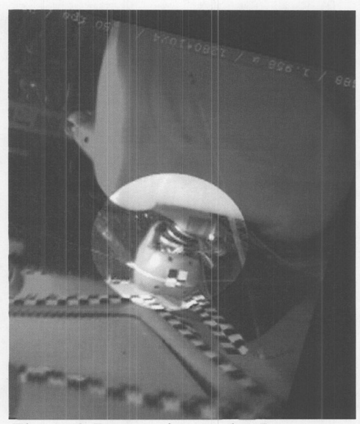


Figure 6: Dummy inverted at Impact

Figure 7 shows a sequence of side views of the dummy as the roof crushes into the occupant survival space in this test.

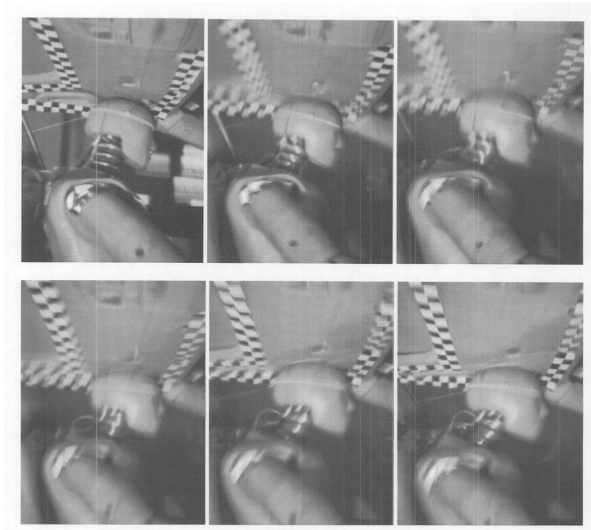


Figure 7: Side view of the head impact in a sequence of 8 millisecond frames during which the neck is subject to severe compression/flexion forces from roof intrusion.

A dynamic test provides detailed injury measures and the ability to assess real world human injury as a function not only of roof strength but of vehicle geometry and protective features such as padding, pretensioning of belts and activation of window curtain air bags.

Ejection and Roof Crush

An occupant can be ejected only if there is an avenue through which he or she can leave the occupant compartment. A restrained occupant is unlikely to be fully ejected unless there is a serious failure of the belt system. A restrained occupant can be partially ejected if a side window or sun roof is broken, and particularly if the roof collapses in such a manner that the envelope of the occupant compartment no longer contains the occupant's head. Nearly half of all rollover fatalities and serious injuries result from partial or complete ejection. We have observed that vehicle windows are unlikely to break if the roof structure over them is not significantly distorted. In the Malibu tests, a substantially higher proportion of side windows broke in the production vehicles than in the vehicles with roll cages emulating a strong roof.

In the JRS tests that have been conducted, we have also observed a correlation between window failures and lower vehicle strength to weight ratios. Figure 8 shows the JRS data (left axis) and data on ejections from the IIHS study of mid-sized SUVs (right axis).

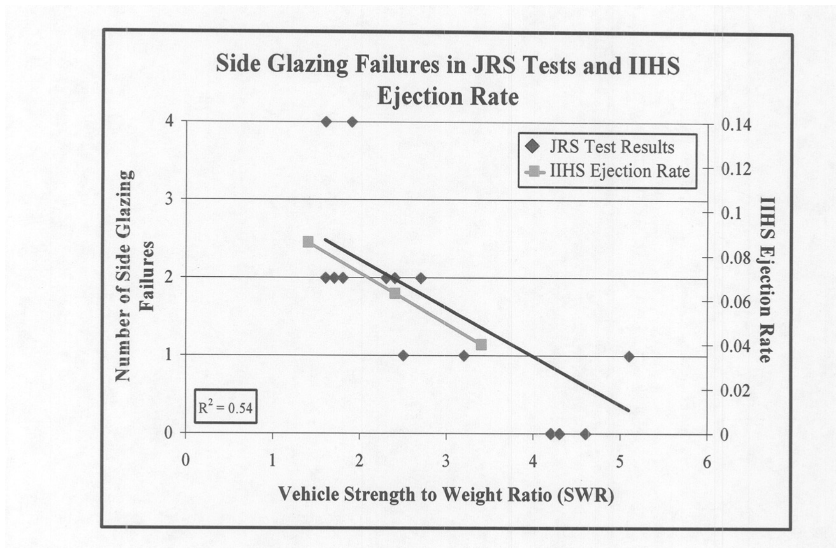


Figure 8: Data on window breakage in JRS tests shown with ejection data from the IIHS study of accident data on mid-sized SUVs.

> *These data confirm the fact that a dynamic test can provide a more reliable, comprehensive picture of a vehicle's rollover occupant protection capability. Vehicle geometry also has a significant effect on the dynamics of a rollover. The performance of safety belts, padding, seats and windows under rollover conditions cannot be assessed with a static test.*

Current Rulemaking: The January 2008 SNPRM

Both NHTSA and IIHS have analyzed crash data to demonstrate an obvious correlation between roof strength as measured in the FMVSS 216 test: a higher SWR will generally reduce rollover injuries. That relationship, while definitive, does not address the question of how greater roof strength reduces injury. The JRS can show specifically how injuries result from poor roof performance and the degree to which a strong roof can control ejection.

The current roof crush standard, established in 1971, specifies that a large platen be slowly pressed into a front corner of the roof at a shallow angle. In the test, the resistance force must exceed 1.5 times the vehicle weight before it reaches a depth of 5 inches (the limit before the "non-encroachment zone" or "occupant survival space" is violated).

In its 2005 proposal, NHTSA presented a highly flawed analysis as the basis for its proposed roof crush resistance standard. The proposal was that the minimum resistance force be raised to 2.5 times a vehicle's weight, that non-encroachment zone be defined according to interior headroom, and that the standard be expanded to cover heavier vehicles. It did not update its analysis in its 2008 SNPRM, with the only substantive change in its proposal being the possibility of sequentially testing both sides of the roof. It has ignored or misinterpreted its own research and has paid only perfunctory attention to data submitted to the rulemaking docket.

A major problem with the simple quasi-static test is that manufacturers are inclined to design vehicles to meet the standard, not necessarily to protect occupants. Many anomalies in design cannot be detected in a static test. As an example, several Toyota models have SWR in excess of 4, but reviews of detailed rollover investigations of Toyota rollovers shows that these vehicles have very weak windshield headers that often buckle in actual rollovers. We have observed this problem in our JRS testing, but it did not show up in FMVSS 216 testing.

Occupant compartment design affects occupant safety in all crash modes. Some manufacturers have indicated that they added strength to the roof areas of their vehicles in order to improve frontal or side impact performance. Figure 9 shows a correlation between side impact performance and roof crush resistance in the FMVSS 216 test.

NHTSA has asked for cost data for SWR 3 and 3.5. Government and industry calculations and estimates have ranged from 20 to 200 pounds and from $50 to $270 per vehicle. In fact, industry cost estimates have historically been substantially higher than the actual costs incurred in implementing standards. Furthermore, the cost of improved roof crush performance should be shared with the benefit of achieving better frontal and side impact performance. It is also the case that the economic losses from rollovers, as estimated using NHTSA's own economic cost of vehicle crashes, is thousands of dollars per vehicle, so that even modestly effective improvements can be easily justified on an economic basis.

The agency has mostly wasted the last 7 years since its request for information concerning the upgrading of rollover occupant protection. This should not be considered an excuse for a slapdash rule as has been proposed that will have only a marginal impact on rollover casualties. The Congress must oversee and direct this agency to take appropriate steps to promulgate rollover occupant protection standards that truly meet the need for motor vehicle safety using the best available data and scientific and technological developments in biomechanics, vehicle design, and testing.

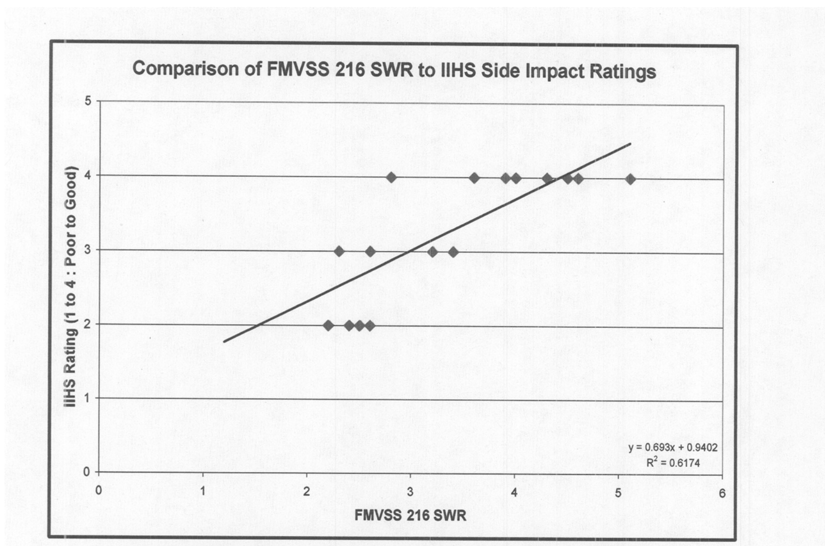


Figure 9: Side impact star rating versus SWR.

C*f*IR research has demonstrated that it has a dynamic test device and protocol that provides a better and more specific indication of actual rollover occupant protection performance. We have demonstrated why dynamic testing will facilitate the design of vehicles that provide protection more efficiently: at lower additional cost and weight; and that the improvement of rollover occupant protection is highly cost-beneficial. This conclusion will continue to hold even when all light vehicles are equipped with electronic stability controls that reduce (but do not eliminate) rollovers.

NHTSA needs the direction and support of the Congress in setting research priorities and the most effective and efficient standards in this area. We look forward to your leadership to ensure that the tragedy of rollover injuries and fatalities can be sharply curtailed by improved vehicle safety performance.

Increased roof strength per se is not likely to cost very much (in weight and dollars) in light of the vehicle improvements necessary to do well in dynamic testing for injury reduction in offset frontal and side impact crashes.

What is C*f*IR?

Since the National Highway Traffic Safety Administration (NHTSA) opened its current roof crush resistance rulemaking in 2001, the Center for Injury Research (C*f*IR) has been in the forefront of rollover occupant protection research and testing, and has been a major participant in NHTSA's rulemaking. C*f*IR is a non-profit organization founded by a former General Motors executive and a retired NHTSA Senior Executive.

In response to NHTSA's 2001 request for data, CfIR has submitted 34 comments consisting of data from more than 50 quasi-static tests and nearly 100 dynamic rollover tests. We have also provided extensive analysis and interpretation of government and industry roof crush tests, rollover accident data, and the biomechanical potential for occupant injury in rollovers.

Should the Committee staff need more information or clarification, we plan to attend the hearing and will be available in Washington on Monday and Tuesday June 2 and 3.

Sincerely,

DONALD FRIEDMAN
CARL E. NASH, PH.D.

DVD video Disk Attachments:
Malibu II Test 3—Production
Malibu II Test 2—Rollcaged
JRS Jeep Grand Cherokee (SWR = 1.8)
JRS Chrysler 300 (SWR = 2.5)
JRS Hyundai Sonata (SWR= 3.2)
JRS Toyota Camry (SWR = 4.3)
JRS VW Jetta (SWR= 5.2)

Senator PRYOR. Thank you.

Let's go ahead and proceed to Mr. Stanton.

And, like I said, maybe after Mr. Stanton and Ms. Gillan testify, maybe we'll have the video clip working.

Mr. Stanton, go ahead.

STATEMENT OF MICHAEL J. STANTON, PRESIDENT AND CEO, ASSOCIATION OF INTERNATIONAL AUTOMOBILE MANUFACTURERS, INC.

Mr. STANTON. Thank you, Mr. Chairman.

I'm Mike Stanton. I'm with the Association of International Automobile Manufacturers. And thank you for the opportunity to be here today.

In 2005, Congress directed NHTSA to address rollover crashes and related safety concerns through rulemaking to mandate the installation of electronic stability control systems, reduce occupant ejection, improve door lock performance, require the installation of side impact protection airbags, increase safety belt use, and improve roof strength, while also enhancing NHTSA's consumer information program through vehicle labeling.

NHTSA is well along in implementing these measures. In addition to the roof-strength final rule that we anticipate to be issued soon, NHTSA has already issued a final rule for ESC, has upgraded its side impact rule, and has issued a final rule to upgrade existing door lock and door retention regulations to help prevent occupant ejections. It is our understanding that the agency plans to propose new occupant retention requirements later this year.

Regarding the NHTSA roof-strength rulemaking, AIAM has provided comments in response to the agency's Notice of Proposed Rulemaking and also the supplemental notice. Our primary concern is that the agency provides adequate lead time for manufacturers to comply with the new roof crush requirements. Although we cannot yet fully quantify the impact of the agency's recently proposed two-sided test on current and future vehicles, as a general matter manufacturers would need to redesign the roof structure and all related components to comply with the new test requirements.

The SNPRM references a study indicating that weight increases may be avoided if sufficient time is provided in the final rule to allow for the necessary design and weight modifications to be incorporated at the time of full or major model changes. Changes implemented under these circumstances or other circumstances would tend to involve the addition of weight, which conflicts with NHTSA's new CAFE greenhouse gas standards.

If roof-related changes can be implemented at the time of full model change, high-strength materials and more sophisticated structures may be used to achieve a more favorable overall result. Therefore, we strongly urge the agency to provide sufficient lead time so that modifications to roof structure and related components may be implemented at the same time as major model changes. Since many major changes are on a 5- or 6-year cycle, we suggested, depending upon the requirements in the final rule, 3-year lead time and at least a 3-year phase-in period. Provisions for earning—early credits would also be appreciated.

In our comments on the SNPRM, we also noted the agency has proposed a number of significant changes from the 2005 proposal. Among these is the adoption of a two-sided test, but an updated cost-benefit analysis with the new changes is not yet available. Among the factors that we noted that are critical to the selection of optional test requirements in the final rule are, first, the need to consider actual maximum weight capacity of vehicle designs; two, incorporation of the safety benefits of ESC and side-curtain airbags; three, adjustments to a more realistic fuel price; four, a more definitive determination of the frequency of multiple roof contact crashes for various vehicle classes, and the safety significance of these crashes; and, finally, number five, consideration of compliance lead time in relation to vehicle design cycles.

The potential use of a new test device to measure head contact intrusion also presents a degree of uncertainty regarding the achievement of an optimal tradeoff between costs and benefits. Therefore, we requested that the agency provide an opportunity for comment on a full cost-benefit analysis reflecting the elements of the final rule. We cannot provide a detailed assessment of the roof-strength performance requirements until we have had the opportunity to review such an updated analysis, and this is consistent with what was being said earlier, it's more important to get it right than it is to get it done in the next 30 days.

Our comments also provided suggestions related to the proposed tests in order to improve the repeatability of the test results. Repeatability of compliance test results is critical so that manufacturers can be reasonably assured that their vehicles will meet the new standards when tested by the government. In particular, with regard to the test repeatability, we would oppose the required use of a dynamic test for assessing roof strength. We have seen no indication that such a test could be made repeatable to meet legal requirements, nor have we seen any indication that such a test would provide safety benefits beyond those of the tests that the agency has proposed.

Thank you, sir. This concludes my testimony.

[The prepared statement of Mr. Stanton follows:]

PREPARED STATEMENT OF MICHAEL J. STANTON, PRESIDENT AND CEO, ASSOCIATION OF INTERNATIONAL AUTOMOBILE MANUFACTURERS, INC.

Good Morning. My name is Michael Stanton, and I am President and CEO of the Association of International Automobile Manufacturers, or AIAM. AIAM represents 14 international motor vehicle manufacturers who account for 33 percent of all light duty motor vehicles produced in the United States. Fifty-five percent of all vehicles sold in America by AIAM members are produced in the United States. Nationwide, AIAM member companies have invested $39.3 billion in U.S.-based production facilities, have a combined domestic production capacity of 4.1 million vehicles, directly employ 92,700 Americans, and generate almost 600,000 U.S. jobs in dealerships and suppliers nationwide. AIAM appreciates the opportunity to present its views to the Subcommittee on the important matters of vehicle rollover crashes and enhanced roof strength.

To summarize our position, AIAM supports Congress' direction to NHTSA to issue upgraded roof strength requirements as part of a comprehensive strategy to address vehicle rollover crashes. We also support the agency's methodology in assessing the costs and benefits associated with various possible regulatory approaches, by focusing on the "target populations" that could potentially benefit from various remedial measures. AIAM continues to urge NHTSA to provide manufacturers adequate leadtime to comply with the upgraded requirements so that roof structure redesign may be incorporated in full vehicle model changes. We also urge the agency to take all appropriate steps to assure that the new roof crush test procedure is fully repeatable.

Rollover crashes are relatively rare events, yet they have disproportionately large safety impacts. On an annual basis, rollovers account for only about 3 percent of vehicle crashes, yet they account for approximately 10,000 occupant fatalities. This represents about one-third of all light vehicle crash fatalities. Therefore, a comprehensive effort to prevent rollovers and improve occupant safety in rollovers is an entirely appropriate priority for Congress, NHTSA, and vehicle manufacturers.

In its August 2005 proposal to upgrade roof crush standards, NHTSA identified several factors that relate to fatalities in rollover crashes, such as high vehicle speed, night driving, a preponderance of young, male drivers, alcohol use, and failure to use safety belts. Most rollover crashes are single vehicle, run-off-road crashes that occur at highway speeds. According to NHTSA statistics, nearly three-fourths of the people killed in rollover crashes are unbelted, with about two-thirds of the fatalities in all rollovers involving occupants being ejected from the vehicle.

Congress has mandated a comprehensive approach to addressing rollover crashes. In the 2005 SAFETEA–LU law, Congress directed NHTSA to address rollover crashes and related safety concerns through rulemaking to mandate the installation of Electronic Stability Control systems (ESC), reduce occupant ejection, improve door lock performance, require the installation of side impact protection air bags, increase safety belt use, and improve roof strength, while also enhancing NHTSA's consumer information program through vehicle labels. NHTSA is well along in implementing the measures specified in the SAFETEA–LU law. In addition to the roof strength final rule that we anticipate will be issued soon, NHTSA has already issued a final rule for ESC to prevent rollovers, has upgraded its side impact rule, and has issued a final rule to upgrade existing door lock and door retention regulations to help prevent occupant ejections. It is our understanding that the agency plans to propose new occupant retention requirements later this year.

Consistent with the Congressional direction, NHTSA proposed a comprehensive response to vehicle rollovers. This response begins with the preferred approach of preventing the occurrence of rollovers, through such measures as mandating the installation of ESC, the development of other electronic crash avoidance systems such as road departure warning systems, and the 2004 enhancement of the agency's New Car Assessment Program (NCAP) which provides consumers information on the rollover propensity of specific models. NHTSA also noted that enhanced enforcement of impaired driving laws and speed limits would reduce the frequency of rollovers. The agency also presented a series of measures that could mitigate rollover crash injuries, such as the installation of side curtain air bags, improved door and latch systems, improved occupant restraint systems, and enhanced roof structures.

AIAM fully supports this comprehensive approach to addressing vehicle rollovers, as envisioned in SAFETEA–LU and pursued by NHTSA. It is clear there is no single, "silver bullet" that will eliminate rollover crashes and their consequences, given the multiple causative factors and injury mechanisms. We believe the installation of ESC will provide substantial safety benefits—by helping drivers maintain control of their vehicles, ESC will help drivers avoid running off the road and rolling over in the first place. The new occupant ejection mitigation rule is likely to require enhancements to side air bag systems such as increasing the size of the air bags and assuring that the air bags remain inflated for longer periods of time to help prevent ejection. This has the potential to address some of the two-thirds of rollover fatalities involving occupant ejection. Continued efforts in the areas of alcohol countermeasures and speed enforcement will also provide significant benefits. Additionally, states and the industry have undertaken efforts to increase safety belt use, and in 2007 safety belt use in the United States was 82 percent.

AIAM supports NHTSA's approach for analyzing the costs and benefits of the various rollover mitigation initiatives. The agency's methodology focuses on a "target population" of injuries and fatalities that potentially could be addressed by a particular remedial measure, in an attempt to sort out the separate effects of these measures. Of the SAFETEA–LU rulemaking initiatives, AIAM believes that equipping vehicles with ESC is likely to provide the most significant reduction in serious or fatal injuries in vehicle rollovers. In fact, NHTSA estimates that ESC has the potential to prevent more than two-thirds of passenger car and SUV rollovers that would otherwise occur in single vehicle crashes. Manufacturers are working to install ESC in vehicles ahead of regulatory deadlines, and for Model Year 2008, AIAM members offer over 170 models with ESC as either standard or optional equipment.

Regarding the NHTSA roof strength rulemaking, AIAM has provided comments to NHTSA in response to the agency's August 2005 Notice of Proposed Rulemaking and the January 2008 Supplemental Notice of Proposed Rulemaking (SNPRM). A primary concern of AIAM is that the agency provide adequate lead-time for manufacturers to comply with the new roof crush requirements. Although we cannot yet fully quantify the impact of the agency's recently proposed two-sided test on current/future models, as a general matter manufacturers would need to redesign the roof structure and all related components to comply with the new test requirements. The NHTSA SNPRM references a study indicating that weight increases may be avoided if sufficient lead-time is provided in the final rule to allow for necessary design and weight modifications to be incorporated at the time of full or major model changes. Changes implemented under other circumstances would tend to involve the addition of weight, which conflicts with NHTSA's new CAFE/greenhouse gas standards and a market environment of sky-rocketing fuel prices. If roof-related changes can be implemented at the time of a full model change, high-strength materials and more sophisticated structures may be used to achieve a more favorable overall result. Therefore, AIAM has strongly urged the agency to provide sufficient lead-time in the final rule so that modifications to roof structure and related components may be implemented in accordance with the timing of full or major model changes. Since many full or major model changes are on five, six, or more year redesign cycles, we suggest, depending on the requirements in the final rule, 3 years lead time in addition to at least a three-year phase-in period. Provisions for earning credits for early compliance should also be adopted.

In our comments on the SNPRM, we also requested that there be a Small Volume Manufacturer (SVM) provision that would delay compliance to the 100 percent date for manufacturers that produce less than 5,000 vehicles for the United States market. NHTSA has included a SVM provision in major recent rulemakings (FMVSS 208, 214, and 301 for example) to allow low volume/single line manufacturers sufficient time to redesign and test their vehicles. Without such a provision, the smaller companies would, in effect, have to meet the requirements for 100 percent of their vehicles at the beginning of the phase-in period.

In our comments on the SNPRM, we also noted the agency has proposed a number of significant changes from the 2005 proposal. Among these is the adoption of a two-sided test, but an updated agency cost-benefit analysis reflecting the new changes is not currently available. Among the factors that we noted that are potentially critical to the selection of optimal test requirements in the final rule are: (1) the need to consider actual maximum weight capacity of vehicle designs; (2) incorporation of the safety benefits of ESC and side curtain airbags; (3) adjustment to a more realistic fuel price; (4) a more definitive determination of the frequency of multiple roof contact crashes for various vehicle classes and the safety significance of these crashes; and (5) consideration of compliance lead-time in relation to vehicle design cycles. The potential use of a new test device to measure head contact/intrusion also presents a degree of uncertainty regarding the achievement of an optimal trade-off between costs and benefits. Therefore, AIAM requested that the agency provide an opportunity for comment on a full cost-benefit analysis reflecting the elements of the final rule. We cannot provide a detailed assessment of the roof strength performance requirements until we have had the opportunity to review such an updated analysis.

The AIAM comments also provided suggestions related to the proposed tests in order to improve the repeatability of compliance test results. Repeatability of compliance test results is critical, so that manufacturers can be reasonably assured that their vehicle designs will meet the new standards when tested by the government. In particular with regard to the test repeatability concern, we would strongly oppose the required use of a dynamic test for assessing roof strength. We have seen no indication that such a test could be made adequately repeatable to meet legal requirements, nor have we seen any indication that such a test would provide safety benefits beyond those of the tests that the agency has proposed.

Senator PRYOR. Thank you.
Ms. Gillan?

STATEMENT OF JACQUELINE S. GILLAN, VICE PRESIDENT, ADVOCATES FOR HIGHWAY AND AUTO SAFETY

Ms. GILLAN. Thank you, Senator Pryor. Good morning. My name is Jackie Gillan. I'm Vice President of Advocates for Highway and Auto Safety.

First, let me thank the subcommittee for holding today's hearing. Every year, on average, there are more than 10,000 deaths and over 200,000 injuries as a result of rollover crashes. For years, consumer health and safety groups pressed the National Highway Traffic Safety Administration to act on this critical safety problem, but the agency demurred. We then turned to Congress for help in demanding agency accountability, and you listened, and you acted. Because of the bipartisan leadership on this committee, the 2005 SAFETEA–LU bill included some of the most important vehicle safety measures ever signed into law.

Congress showed great vision by crafting a comprehensive and coordinated approach to rollover crash safety that includes rollover prevention, an occupant ejection standard, and an upgrade of the roof-strength standard. That approach could ultimately save thousands of lives and prevent tens of thousands of injuries if implemented in the manner Congress intended.

Unfortunately, I am here to inform you that NHTSA has not seized this opportunity to significantly advance safety. In each safety rule required by SAFETEA–LU, the agency has done considerably less than it could have or should have. As a result, SAFETEA–LU rulemakings will not achieve the potential level of safety envisioned by Congress or expected by the public.

I am here today to urge Congress to make it clear to NHTSA that the current roof-strength proposal is unacceptable and should not be issued as a final rule in July. The roof-strength standard was issued nearly 40 years ago, and will not likely be upgraded and improved for many, many years to come. If NHTSA's weak and ineffective proposal becomes final, generations of new vehicles will meet a weak standard that will put millions of Americans at risk of death or serious injury because NHTSA didn't get it right. We can do better—and, in fact, we must do better—to ensure that in the future, individuals like Dr. Garcia will be adequately protected in a rollover crash and avoid serious, costly, and lifelong injuries.

Let me just quickly go over some of the numerous problems with the agency's proposal.

One of the most fundamental faults of the proposed rule is that it relies on a static-force test for roof strength and proposes only a marginal improvement from the old standard. Most vehicles sold in the United States already meet the proposed rule, while some models greatly exceed it and provide superior lifesaving protection.

Instead of a static-force test, Advocates strongly support the use of a dynamic test that reproduces the real-world experience of vehicle roofs crashing into the ground, and how occupants and safety systems respond to those forces.

During a rollover crash, passenger vehicle roofs flex and recoil. Another failed feature of the proposed rule is that NHTSA ignores this and does not require a minimum intrusion limit or survival space over the heads of occupants. Instead, the agency has proposed a no-head-contact requirement. In addition, this no-head-contact requirement is compromised by the use of a 50th-percentile male test dummy, because anyone taller that is not protected by the proposed rule will suffer injury.

Let me briefly address the aspect of that rule as a mother of a teenaged son. The 50th-percentile male test dummy has a seated height of nearly 35 inches. Last night, I measured my son, whose overall height is about 5 feet 10 inches. He exceeds the seated height of the test dummy; therefore, the proposed upgrade of the roof-strength standard, which should protect him against deadly roof crash in a rollover crash, will fail him and most of his friends.

In January, NHTSA issued a Supplemental Notice of Proposed Rulemaking. This notice is an even stronger indictment of the inadequacy of the agency's proposed rule, and is plagued with procedural problems. For example, NHTSA's research program, testing both sides of the roof, relied on flawed methodology that resulted in inconsistent data, and the agency cannot rely on these tests to issue a final rule.

Furthermore, the agency drastically underestimates the potential benefits of a stronger rule, and the Insurance Institute for Highway Safety study shows that they are completely wrong on that count.

The supplemental notice proposes several regulatory benefits that are not supported by benefit-cost analysis. Instead of giving the public an opportunity to comment on these, NHTSA asserts a "just trust us" rationale, without affording the public any chance to review, challenge, or comment on their assertions.

In closing, Mr. Chairman, Advocates strongly supports an upgrade to the roof-crush standard that will save lives and provide strong occupant protection in rollover crash. However, this rule is too important, too many deaths have already occurred, and too many lives are at stake for the agency to rush ahead to issue a defective, deficient, and dangerous rule.

Thank you very much.

[The prepared statement of Ms. Gillan follows:]

PREPARED STATEMENT OF JACQUELINE S. GILLAN, VICE PRESIDENT, ADVOCATES FOR HIGHWAY AND AUTO SAFETY

Introduction

Good morning, Mr. Chairman and members of the Senate Consumer Affairs, Insurance, and Automotive Safety Subcommittee of the Committee on Commerce, Science, and Transportation. I am Jacqueline Gillan, vice-president, of Advocates for Highway and Auto Safety (Advocates). Founded in 1989, Advocates is an alliance of consumer, health and safety organizations, and insurance companies and associations working together to make our roads and highways safer. Advocates encourages the adoption of Federal and state laws, policies, programs, and regulations that save lives and reduce injuries in motor vehicle crashes on our Nation's highways.

Our organization has worked closely with the members and staff of the full Committee and has been integrally involved in generating many of the motor vehicle-related safety provisions contained in Section 10301 of SAFETEA–LU, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, Pub. L. 109–59 (Aug. 10, 2005). The vehicle safety-related rules required in title X, subtitle C of SAFETEA–LU were developed and adopted by this Committee in a bipartisan effort to improve public safety on our highways. Congress showed great vision in that legislation by crafting a comprehensive approach to rollover crashes that addresses both vehicle crash avoidance and crashworthiness, and requires both an upgraded roof strength regulation and a standard to reduce occupant ejections. Collapsing roofs and occupants thrown from their vehicles are the two leading reasons why rollover crashes are so deadly. The Congressional plan in SAFETEA–LU to address all major, interrelated aspects of rollover crash losses in a comprehensive and coordinated way ultimately could save thousands of lives and prevent tens of thousands of injuries annually if implemented in the manner Congress intended.

Unfortunately, I am here to inform you that despite clear, explicit Congressional direction to mitigate the problem of rollover crash deaths, the National Highway Traffic Safety Administration (NHTSA), the agency within the U.S. Department of Transportation that is charged with implementing the SAFETEA–LU provisions, has not seized this opportunity to strengthen its standards related to rollover protection by proposing optimally effective occupant protection countermeasures. Despite legislative instruction to address the necessary safety measures in a coordinated manner to prevent deaths and severe injuries in rollover crashes, the sad truth is that NHTSA is taking an inadequate and piecemeal approach to rollover safety. The agency has divided the rollover crash event into isolated, disconnected safety problems and devised improvements intended to achieve only marginal gains in safety.

To date, NHTSA has not followed the strong bipartisan leadership of Congress that directed vigorous agency responses to chronic vehicle safety problems. Instead, the agency has fashioned weak and incomplete regulatory responses to SAFETEA–LU rulemaking initiatives. In taking this understated approach to major safety issues affecting the lives of millions of vehicle occupants, NHTSA has failed to provide the necessary safety protection for current and future generations of drivers and passengers. This is true not only in its the proposed roof strength rule, the subject of today's hearing, but also in its earlier efforts to reduce side impact losses, a rule that is still pending, as well as in its research approach to ejection prevention, and even in the final rule on electronic stability control systems, which was published in 2007. In each case, the agency has so far done considerably less than it could have to advance safety and occupant protection. As discussed later in this statement, in each of these regulatory areas NHTSA has opted for marginal improvements in safety technology and benefits rather than adopt existing, state-of-the-art safety performance, test procedures, and technologies that would secure significantly greater safety benefits. As a result, SAFETEA–LU rulemakings will not achieve the potential level of safety envisioned by Congress.

NHTSA has not heeded Congress on roof strength. The agency has proposed a weak rule to improve roof strength that cannot achieve the legislative goal of ensuring enhanced, equal protection of front seat occupants, both the driver and passenger. I am here today to urge Congress to make it clear to NHTSA that the current rulemaking proposal is unacceptable and that the agency needs to dramatically rethink and revise its proposal in order to fulfill its statutory obligations and protect the American public.

Rollover Crash Background

There is perhaps no more terrifying or lethal motor vehicle crash than a rollover. When a rollover crash occurs, a car, pickup truck, or sport utility vehicle (SUV) is out of control in the fullest sense. A driver has no power to stop this catastrophic event. The tires are no longer gripping the road and evasive maneuvers using steering and braking are no longer possible. In a rollover crash the driver and other vehicle occupants are at the mercy of the laws of physics and are protected by only the effectiveness of safety systems that have been designed into their vehicle.

The outcome of rollover crashes is absolutely horrific. According to a NHTSA status report on rollover occupant protection research, rollovers are only 2 percent of all annual motor vehicle crashes, but resulted in 10,698 deaths in rollover crashes in 2006. *2006 Annual Assessment of Motor Vehicle Crashes,* NHTSA, Sept. 2007, updated January 2008, at 95. A total of 32,092 vehicle occupant deaths occurred that year in motor vehicle crashes, so rollover crashes alone account for *more than one-third of annual occupant fatalities. Traffic Safety Facts 2006,* NHTSA, National Statistics Summary, at 1.

These figures are staggering and completely unacceptable. Yet, NHTSA, the agency entrusted with protecting people in their passenger vehicles, has been reluctant to take any action on its own initiative to reduce the tens of thousands of deaths in rollover crashes that occur year, after year, after year. Although the agency has received petitions for a rollover stability standard since the 1980s, NHTSA did not see fit to establish such a standard. In 1991, Congress required the agency to consider the issue and the agency opened rulemaking in 1992 (57 FR 242, Jan. 1, 1992), but terminated that effort in 1994 (59 FR 33254, June 28, 1994).

Despite the involvement of roof crush in many rollover crashes, NHTSA took no action through the remainder of the 1990s to address the issue with a proposed rule strengthening the standard, even after its acknowledgement of the extent and severity of losses from rollovers. At the same time, with increased sales of narrow wheelbase, high center of gravity Light Trucks and Vans (LTVs), including pickup trucks and SUVs, the number of rollover crash deaths in these types of vehicles rose dramatically.

More than *120,662 people have died* in rollover crashes and over *2.9 million have been injured* since NHTSA terminated its rulemaking action in 1994. NHTSA Data Run, 1994–2006, prepared for Advocates for Highway and Auto Safety, National Center for Statistics and Analysis, NHTSA, May 27–28, 2008.

In short, NHTSA has not been diligent in responding to the enormous threat posed by rollover crashes. Although electronic stability control systems showed great promise in preventing rollovers, NHTSA took no action to require that technology until directed to do so by Congress in SAFETEA–LU. And, again, with respect to roof strength, even though roof crush is a major factor in rollover crashes, it was not until the enactment of SAFETEA–LU that the agency published its weak proposed rule.

1971 Roof Strength Standard

The current roof strength standard, Federal Motor Vehicle Safety Standard (FMVSS) No. 216, *Roof Crush Resistance,* was originally adopted in 1971 (effective Sept. 1, 1973), and after 37 years, it remains the only standard that addresses vehicle crashworthiness in a rollover. This outdated standard still relies on 1960s thinking to provide protection to occupants in 21st century vehicles. The standard is extraordinarily weak, requiring that a plate press on one front corner of the roof at only 1.5 times the weight of the vehicle—the gross vehicle weight rating (GVWR)—but only up to 5,000 pounds for passenger cars. 23 CFR § 571.216S4(a).

The standard is even weaker for LTVs. In the early 1990s, NHTSA extended the test still using only 1.5 times the vehicle weight, to these other types of passenger vehicles—but only up to 6,000 pounds GVWR. 55 FR 15510 (Apr. 17, 1991). Incredibly, the agency excused all LTVs over 6,000 pounds from even being tested. As a result, there is *no* standard for roof strength for large SUVs, big pickup trucks, and large passenger vans. *Id.*, § 571.216S4(b).

Many researchers have documented the major role that roof crush plays in rollover crash deaths and injuries, and that a stronger standard could prevent many deaths and serious injuries. Despite this research, the standard has remained essentially unchanged despite the thousands of annual deaths and injuries from rollover crashes. Against this backdrop NHTSA has proposed an upgrade to the roof strength standard that, by the agency's own reckoning, will save very few lives in rollover crashes.

The 2005 Proposed Rule is Badly Flawed

The 2005 NHTSA notice of proposed rulemaking (NPRM) on roof strength, 70 FR 49223 (Aug. 23, 2005), is badly flawed in several fundamental ways. First, the 2005 NPRM retains the static plate (platen) test developed four decades ago and fails to require a dynamic, real-world rollover crash test that adequately models what actually happens to passenger vehicles and their roofs in rollover crashes. Second, the proposal only requires vehicles be tested at 2.5 times the weight of the vehicle which is a 2.5 strength-to-weight ratio (SWR). This represents only a marginal increase in roof strength, a level already met by two-thirds of the current makes and models in production today.

In addition, the proposed rule actually weakened the existing standard by removing any limit on the amount of permitted intrusion of the roof into the occupant compartment. Instead, the agency substituted a strict "no head contact" criterion with the top of the head of a 50th percentile male test dummy. *Id.* at 49232. If there is any amount of space, no matter how small, between the roof and the head of the test dummy, the vehicle passes; any roof contact with the dummy's head and the vehicle fails. Taking this course of action would allow vehicles that already have very low roofs close to the heads of drivers and passengers to continue to be manufactured and sold as long as the roof did not actually touch the head of the dummy during the static test.

This means, however, that occupants taller than the 50th percentile male test dummy are provided no assurance of any head protection from a collapsing roof in a rollover crash. Indeed, NHTSA's minimalist contact/no contact criterion guarantees that taller people, including as much as half of all male drivers, will be at greater risk of being struck by a collapsing vehicle roof in a rollover crash.

The 2008 Supplemental Proposed Rule (SNPRM) is Defective

NHTSA published a supplemental notice of proposed rulemaking (SNPRM), 73 FR 5484 (Jan. 30, 2008), in part to address the issue of affording protection on both the driver's and passenger's sides of the vehicle in response to Section 10301 of SAFETEA–LU. The SNPRM supplied additional test results and summarily mentioned alternative regulatory options. Yet, the SNPRM builds on the weak foundation laid in the prior 2005 NPRM, since it augments and encompasses but does not replace the prior proposal. Thus, references in this statement to the SNPRM include both the prior 2005 NPRM as well as the 2008 SNPRM.

The SNPRM is both substantively unacceptable and legally inadequate. The fundamental flaws in the agency's approach include: the failure to consider a dynamic test in place of the old, 1971-era static test; the inadequacy of the agency's testing procedure for each side of passenger vehicle roofs; the gross underestimation of safety benefits from a stringent roof strength standard; and the failure to provide benefit/cost analyses for suggested alternative roof strength options, including the lack of a benefits assessment for specific alternative regulatory proposals included in the agency rule. These problems fatally undermine the SNPRM, and as a result require the agency to rethink and revise its approach to roof strength, including documentation of specific proposed regulatory alternatives, and issuance of a new proposal before a final rule is adopted. NHTSA cannot move forward to a final rule on the basis of the SNPRM. My statement addresses each of these problems in turn.

No Consideration of a Dynamic Test

It appears that NHTSA refused to credit new developments on potential dynamic tests and to explore them carefully as Congress urged the agency to do in Section 10301 of SAFETEA–LU: "The Secretary may consider industry and independent dynamic tests that realistically duplicate the actual forces transmitted during a rollover crash." These are not idle words—Congress expected that NHTSA would examine and review a new generation of dynamic roof strength tests now in use by manufacturers and independent researchers. However, the agency has not indicated in the SNPRM that it actually acquired or conducted comparison tests on any of the dynamic test systems in use today.

Advocates supports the use of a dynamic test that shows the real-world behavior of passenger vehicle roofs crashing into the ground, and how occupants respond to those terrific forces, including the performance of active and passive restraint systems, seating systems, door locks and latches, and vehicle windows (glazing). Real-world, dynamic testing is the best means of modeling what occurs in actual rollovers and determining what safety countermeasures should be proposed.

NHTSA's proposal to press down only on the front corner of a vehicle roof with a plate at an undemanding force level does not reproduce real-world crash forces. This compliance test can show nothing about occupant kinematics, that is, how people in actual rollover crashes respond to rollover forces and are injured, or how the multiple in-vehicle safety systems contribute to protecting occupants from death and severe injury. Instead, the agency has proposed an inadequate approach to improving resistance of passenger vehicle roofs to deformation and intrusion that can result in severe or lethal head and neck trauma.

Before NHTSA issues a final rule it must test and evaluate the current technologies used for dynamic rollover testing to determine roof strength performance. This should include actual testing of the Jordan Rollover System (JRS), the Controlled Rollover Impact System (CRIS), used for in-house testing by a least one manufacturer, and other similar test devices. Until the agency conducts its own tests and acquires first-hand experience with these dynamic test devices, it has not fulfilled its obligation under SAFETEA–LU and to the public.

Since NHTSA continues to rely on the static test as the basis for rulemaking, Advocates has analyzed the substantive and procedural problems we have found in the SNPRM. Advocates' comments filed with the agency SNPRM rulemaking docket analyzed these problems in detail and those comments are submitted for the hearing record. This statement addresses the major problems we found.

NHTSA's Testing Procedure is Inadequate

In the SNPRM, NHTSA provides new static roof test results that reveal a fundamental flaw in the agency's testing methodology. In conducting testing on both the driver and passenger sides of existing vehicle makes and models, NHTSA has undermined its ability to use the results of its new round of tests by adopting a flawed testing protocol. This is not just a minor matter of technical procedure but a basic mistake in gathering scientific databased on sound testing methodologies. In conducting tests on each side of vehicle roofs, the agency failed to heed its own proposed standard of a 2.5 times vehicle strength-to-weight ratio (SWR) when conducting the tests on the first side of the roof. Instead of conducting a first-side test to a specific minimum strength level in accordance with its own proposed test regime to lay the foundation for testing the second side of the roof, NHTSA simply continued applying pressure to the plate on the first side of the roof regardless of the strength level achieved. The agency stopped the test only when the roof touched the head of the test dummy, or the windshield cracked, or 5 inches of crush had been attained. In doing so, NHTSA made it impossible to use the test of the first side of the roof to obtain consistent results regarding how the second side would perform when crushed with the plate. Not surprisingly, the actual second side test results were inconsistent and varied widely. Some vehicles had stronger roofs, that is, resisted crush better when the second side was tested, while others were weaker, sometimes substantially weaker, when the plate was pressed on the other corner of the roof.

Since NHTSA appears committed to the static force platen test, it is essential that any first-side test must be properly conducted to demonstrate how a roof will perform when a subsequent crushing force is applied to the second side of the roof. By allowing any amount of force application to be used and plate intrusion limited by either a maximum of 5 inches, or windshield cracking, or dummy head contact, the agency rendered its tests worthless for determining how first-side roof crush affected second-side crush. The crux of the matter is whether both sides of a vehicle roof meet a standard using a demanding force application level, such as 3.5 or 4.0 times the vehicle weight, controlled by limits on maximum intrusion and minimum residual headroom. NHTSA must redo properly the first test to determine how well the first-side crush response predicts the response of the second side. So far, the agency has no basis from the data generated for consideration in the SNPRM to adopt a standard that ensures that both the driver and the passenger have a high level of protection from roof crush and intrusion. NHTSA has to conduct these tests at different strength-to-weight ratios based on the SNPRM, from an SWR of 2.5 up to 4.0 and offer a specific choice based on a realistic assessment of benefits and costs. Until the agency performs these new tests and offers documentation to support one or more specific regulatory alternatives for notice and comment, it cannot move forward to a final rule.

No Requirement for Survival Headroom

Another essential safety aspect that is lacking in the proposed rule is a requirement for minimum residual headroom—to ensure that in real-world rollovers there is survival space maintained over the heads of occupants after the dynamic response of the roof to rollover forces. One of the cardinal rules of safety design in recent years has been the importance of maintaining the integrity of the passenger compartment in a crash. This philosophy has been used to improve crash survivability in frontal and side impacts and should be applied to protect against roof crush and intrusion.

Research analysis shows that even though the roof actually comes down onto the heads of occupants in a simulated rollover crash, the vehicle roof can, nevertheless, show some post-crash space over the head of occupants. Passenger vehicle roofs flex and recoil in real-world rollovers. A dynamic test could show what actually happens in the interaction between a deformed roof and the vehicle occupants during a rollover crash. To account for this movement of the roof, a static roof strength test must require residual headroom to assure an adequate level of occupant safety when the roof deforms in a rollover. A residual survival space or headroom requirement is only a surrogate for the safety margin that could be provided through a dynamic test, but far better than the minimal "no contact" criterion proposed in the SNPRM. The no-contact/contact, pass/fail criterion is an inherently defective approach to approximating what is needed to protect occupants in actual rollover crashes, and it cannot ensure that the roof will not actually injure occupants in real-world rollover crashes. A given vehicle can pass both the strength and no-contact criteria of the supplementary proposed rule, yet that same roof can still injure or kill occupants. Thus, a regulation based on a static test should include a minimum headroom requirement to ensure occupant survival space.

Reliance on Windshield and Windows to Improve Static Test Results

Another aspect of the proposed standard that is objectionable is the fact that the static test is conducted with the vehicle windshield in place and the vehicle side windows rolled up. In many rollover crashes, the windshield frequently pops out of its frame when force is applied to the front of the roof in a rollover. In addition, window glazing made of tempered glass shatters during the initial contact in a crash if it is not retracted. Nevertheless, the proposed roof strength rule continues to rely on an artificial test protocol that involves testing the roof with the windshield in place and all side windows in a closed position. Testing a vehicle roof with the added strength of the window glazing in place provides an artificial result and a false sense of security. Passing the static strength test conducted in this manner provides no assurance that the same vehicle will not suffer glazing failure roof deformation and intrusion in a real-world rollover crash.

The SNPRM Implies a Severe Underestimation of Safety Benefits

NHTSA has revised downward its estimate in the SNPRM of the population that would benefit from stronger roofs from the number presented in the 2005 NPRM on the basis of yet-unrealized claims about the influence of electronic stability control systems on rollover crash occurrence. After NHTSA successively whittles down the number of lives that are relevant to a stronger roof crush resistance standard through one rationalization after another, the agency concludes that stronger roofs would affect the lives of only 476 people. 73 FR 5485. This is not the number of lives saved, but rather the target *population* within which the agency believes that benefits of saving lives can occur with a stronger roof standard. In the 2005 proposed rule, NHTSA estimated that the target population was 595 fatally injured occupants who could be affected by a stronger standard. 70 FR 49229. But within that target population estimated for the 2005 proposed rule, the agency guessed that as few as *only 13 or 44 lives would be saved annually from stronger roofs. Id.* at 49242. As a result, the agency's unstated benefits estimate for a 2.5 SWR standard, given a smaller target population calculated for the SNPRM, would inevitably be even lower, in fact, lower almost to the vanishing point.

An agency benefits assessment of a stronger roof crush resistance standard must also be forged in light of the important study performed by the Insurance Institute for Highway Safety (IIHS). IIHS's analysis, contained in its publication, *Roof Strength and Injury Risk in Rollover Crashes* (March 2008) (IIHS Roof Strength Study), demonstrates that real-world benefits can accrue to many occupants who are not part of the agency's benefits target population because other crashworthiness system features operate to save lives in tandem with much stronger roofs. IIHS Roof Strength Study at 13.

IIHS found that increasing the SWR to about 3.16 would save 212 lives in single-vehicle rollovers. *Id.* at 11. This figure of 3.16 SWR is as far as IIHS's data analysis would permit it to judge benefits in lives saved. However, the IIHS submitted comments to the SNPRM docket stating that a standard at 3.5 SWR could save even more lives. Even at just 3.16 SWR, IIHS estimates that the number of lives saved would be almost double the number for a standard indexed to 2.5 SWR. Advocates firmly believes that benefits would further increase at some unknown but nevertheless exponential rate if the agency raised the static test requirement to at least 4.0 SWR along with adopting all of Advocates' other suggested revisions, including the need for a maximum intrusion limit and a minimum survival-headroom limit, that we have shown to be necessary.

It is also true that NHTSA acknowledges the limitations of its own benefits assessment. The agency has only 32 crash cases from which it has previously inferred benefits, as pointed out in the IIHS Roof Strength Study at 2. Such a small number of cases has several data shortcomings. The agency itself states that "the characteristics of this limited sample may not accurately represent the full benefits from the proposed roof crush resistance upgrade." 70 FR 49242. The agency is correct. It should place no confidence in its meager estimate of lives saved from stronger roofs cited in the 2005 NPRM or the updated target population figure used in the 2008 SNPRM.

NHTSA Makes No Determination of Cost Estimates in the SNPRM

Finally, with regard to cost estimates for more protective vehicle roofs, there is no definitive analysis accompanying the SNPRM. The agency cites high cost figures provided by industry sources, including claims that a standard based on a SWR of 3.5 would cost an additional $130 for a large SUV to comply with, could be even 50 percent higher (73 FR 5488), and might require an unbelievable additional 540 pounds of extra weight for an SUV that meets such a standard.

On the other hand, NHTSA also refers to a "tear-down" study conducted by Ohio State University that examined the Volvo XC90 and the Ford Explorer SUVs. 73 FR 5489, *Improving Roof Crush Performance of a Sport Utility Vehicle,* Ohio State University (2007). The inexpensive but highly effective roof strengthening of the

XC90 was applied to upgrade a Ford Explorer to the roof crush resistance of the Volvo. It was determined that achieving equivalent roof strength "would increase material and tooling costs by $81 and weight by 15 kilograms (33 pounds)." *Id.* Another study conducted by the National Crash Analysis Center of The George Washington University, *Cost, Weight, and Lead Time Analysis Roof Crush Upgrade,* "found that strengthening the 2003 Ford Explorer to 3.0 SWR would raise the vehicle's price by $33 to $35 and increase its weight by 5 to 10 kilograms (10 to 23 pounds)." *Id.*

The SNPRM provides no insight, however, regarding the agency's view of these varying costs. Since there is no adequate cost analysis presented for public review and comment, it was impossible for the public to provide the agency with informed comments on the potential costs and benefits of the different options that the agency indicated it was considering. NHTSA cannot proceed to a final rule without first presenting the public with an in-depth benefit/cost analysis of the different regulatory alternatives it is considering and stating which alternative it is proposing and supporting that choice.

The SNPRM is Procedurally Inadequate

It is apparent that NHTSA has not laid the necessary foundation in the rulemaking record in order to issue a final rule. As already mentioned, even though NHTSA offers several new alternative SWRs as potential candidates for testing roof crush resistance, it provides no assessment of the costs and benefits of the potential alternatives that it states could be chosen for a final rule. The alternatives laid out in the SNPRM range from a choice of a 1-side test at 2.5 SWR up to a 2-sides test at 3.5 SWR. Lacking credible test results and benefits analyses for selecting one alternative over another, NHTSA simply asserts a "just trust us" rationale. The SNPRM states that "regardless of which alternative is adopted in the final rule, the agency will ensure that the final rule is cost beneficial . . . ." 73 FR 5490.

This pronouncement is breathtaking in the context of agency rulemaking where publication of a benefit/cost analysis prior to adoption of a final rule is a baseline requirement of established rulemaking procedure. NHTSA must provide supporting documentation from test data and a benefits-cost analysis tailored to justify the regulatory alternatives it is considering. The agency must allow the public an opportunity to review and comment on its detailed regulatory analyses before it determines which option to adopt. NHTSA cannot proceed from the preliminary assessment of new, potential regulatory alternatives mentioned in the SNPRM without a full, detailed rulemaking proposal of those regulatory alternatives.

NHTSA's Flawed Approach to SAFETEA–LU

At the outset of this statement I mentioned the crucial topic of NHTSA's approach to the SAFETEA–LU passenger vehicle safety-related rulemakings. That approach is neither as forward-looking or comprehensive as Congress intended, nor is it justified under the circumstances.

For example, NHTSA's use of the 37-year-old static test for improving roof strength will inhibit the development of other safety regulations. Choosing an anachronistic, static test for roof crush resistance denies the agency the advantages of determining the value of improving other key safety design and performance features of passenger vehicles in rollovers. The isolated approach of simply applying a plate pushed against a front corner of a vehicle roof immediately undermines a systems engineering approach to rollover safety. It eliminates the possibility of the agency studying the effects of a dynamic roof strength test on other vehicle safety systems including door latches, locks, and hinges to resist failure leading to occupant ejection. Because it is a static, not a dynamic test, it also forgoes showing occupant kinematics and injury responses in actual rollovers. It dispenses with any possibility of determining restraint system effectiveness in achieving occupant containment and reducing occupant excursion within the vehicle cabin when rollovers occur. After all, these systems operate dynamically and not in isolation from each other. Rather, they work synergistically and nearly simultaneously to reduce injury to occupants by preventing excessive excursion or by providing forgiving surfaces to cushion occupant impacts with injury-inflicting vehicle interior features. NHTSA has instead chosen a roof crush resistance test approach that cannot provide any information in these areas and therefore impedes the development of other safety standards.

The SNPRM proposal continues the use of the static plate test stands in stark contrast to other major vehicle safety standards that have evolved from static or quasi-static to fully dynamic compliance tests, including different frontal crash tests and lower and upper interior side-impact crash tests. The need for full evaluation of rollover crashes under real-world test conditions was emphasized in comments filed by a group of international crash safety researchers, DVExperts International Pty. Ltd. (DVExperts). DVExperts stressed that "[e]ach of the other mandated crashworthiness standards rely on a systems approach to crashworthiness. A dynamic test [of roof strength] is necessary to evaluate the performance of the rollover protection system, which is made up of the restraints, airbags, glazing, and roof strength." DVExperts at 4.

This crucial point about the negative influence of a static test for roof strength on other crashworthiness standards should not be taken lightly. A bare-bones static test can directly impact the quality of allied rulemaking actions that NHTSA must undertake to fulfill Section 10301 of SAFETEA–LU, including the actions the agency must take to prevent partial and complete occupant ejection. Partially ejected occupants, as well as occupants who are unbelted but remain within the occupant compartment, would certainly benefit from a stronger roof strength rule that is based on a realistic dynamic test. It is likely that non-ejected, unbelted occupants, for example, could suffer fewer severe and fatal head, face, and neck injuries by preserving more rollover survival space which, in turn, would reduce the chances of an occupant striking rigid roof structures such as headers, rails, and sunroof frames, as well hitting the roof proper apart from these framing structures.

It is clear that a static test for determining roof strength in rollovers has far-reaching consequences for other crashworthiness safety countermeasures that Congress has charged NHTSA with improving and ensuring a high level of effectiveness. This raises the question of what shortcomings will be built into an agency proposed rule on ejection prevention. If the agency chooses a test using a surrogate measure for showing whether different features of vehicle interiors can prevent partial or complete occupant ejection, this again will not be a test of how people actually are ejected in different kinds of crashes, especially in rollover crashes.

NHTSA's shortsighted approach to effective standards may have compromised the potential safety benefits of electronic stability control (ESC) systems technology adopted in a final rule in 2007. 72 FR 17236 (April 6, 2007). ESC systems help prevent vehicle departure from their intended paths, and ultimately help to reduce rollover crashes due to loss of vehicle control. While requiring ESC on all new vehicles after September 1, 2011, the agency did not require that the most effective ESC systems be installed. The performance standard issued by the agency did not require ESC systems to include automatic braking, traction control, a performance criterion for vehicle understeer, or roll stability control for SUVs. The agency rule not only set the performance requirements below the current state-of-the-art level for ESC technology, it requires less sophisticated ESC systems than some manufacturers are already installing in production models. That ensured that less advanced ESC systems would remain in the marketplace for years to come. While the mandatory installation of ESC systems in all vehicles will save many lives, the adoption of a stronger, more sophisticated performance standard by NHTSA would have made the rule even more effective.

Another example of NHTSA opting for halfway measures is the still pending rulemaking on improving side impact protection for occupants, 69 FR 27990 (May 17, 2004), a rulemaking that Congress in SAFETEA–LU required NHTSA to complete by July 1, 2008. Although NHTSA took the right approach in the 2004 proposed rule to ensure full side impact protection for front seat occupants by essentially requiring upper and lower air bags, the agency failed to require the same demanding test for rear seat occupants that would lead to a similar use of side impact air bags. Advocates' comments to the rulemaking docket point out in detail how the agency has shortchanged providing equal protection for rear seat occupants, and we emphasized that the agency's proposed rule does not protect children under the age of 12 regardless of their seating position.

Congress, in response to this unacceptable agency action to deny improved side impact protection to rear seat occupants, included language in SAFETEA–LU to correct this omission. The Senate specifically directed that the Secretary shall complete a rulemaking proceeding to establish a standard "designed to enhance passenger motor vehicle occupant protection, *in all seating positions,* in side impact crashes." (Emphasis supplied.) The proposed rule issued in 2004 will not adequately protect rear seat occupants, especially with regard to head and neck injuries; does not protect children; and does not sufficiently address the special, additional injury-prevention needs of older occupants in side impact crashes. It remains to be seen if NHTSA heeds explicit legislative instruction on providing enhanced side impact occupant protection in all seating positions.

Conclusion

Advocates is compelled, in light of the problems with the pending rule, to recommend that NHTSA not issue a final rule upgrading Standard No. 216 by the statutory deadline of July 1, 2008. It is clear that the roof crush resistance supplementary proposed rule is incomplete, not properly documented, does not provide much greater safety for occupants, and is not ready to be issued as a final rule. Congress foresaw the possibility that the agency might require more time than allotted in SAFETEA–LU. As a result, Section 10301 grants the Secretary unilateral authority to delay a rule under the rollover protection provision that the Secretary determined could not be issued on time. In this instance, the Secretary should make such a determination and set a new, later date for issuing a final rule. Although Advocates has fought for many years to get this standard substantially upgraded, we would rather have NHTSA get it right than issue a weak and ineffectual rule that will surely remain in place unchanged for decades to come.

Recently, the White House Chief of Staff, Joshua Bolton, issued a memorandum to the heads of all departments and agencies regarding the issuance of regulations in the final year of the administration. *Memorandum: Issuance of Agency Regulations at the End of the Administration* (May 9, 2008). He emphasized that regulatory agencies have a responsibility to continue to ensure that regulations issued during the final year are "in the best interests of the American people." Bolton Memorandum at 1.

Mr. Chairman, I can state without hesitation that it would not be in the best interests of the American people for NHTSA to issue the roof strength rule in its present guise. The Bolton Memorandum went on to state that agencies should provide an appropriately open and transparent process including "robust public comment, and a careful evaluation of and response to those comments." Bolton Memorandum at 2. The roof strength rule lacks the necessary test results and benefit/cost analysis that must be presented to the public before the agency can issue a final rule. This rule is too important, too many deaths have already occurred, and too many lives are at stake for the agency to rush to issue a defective, deficient and dangerous rule.

That concludes my testimony, and I would be pleased to answer any questions that you may have.

1971 Roof Crush Standard—37-year Old Antiquated Standard Has Not Kept Pace With Changes in Technology or Vehicle Fleet

Dec. 8, 1971	National Highway Traffic Safety Administration (NHTSA) issues final rule establishing roof crush standard to take effect in 1973.
Mar. 22, 1973	Center for Auto Safety petitions NHTSA to apply Federal motor vehicle safety standards, including roof crush standard, to light trucks and multipurpose passenger vehicles with gross vehicle weight rating (GVWR) of 10,000 pounds or less.
Sept. 1, 1973	Roof Crush Resistance standard, FMVSS No. 216, takes effect for passenger cars.
Apr. 17, 1991	NHTSA issues final rule, effective Sept. 1, 1993, extending application of roof crush resistance standard amended to light trucks, vans, buses, and multipurpose passenger vehicles (MPVs) with GVWR of 6,000 pounds or less, specifically declining to extend the standard to light trucks, vans, buses and MPVs with a GVWR of up to 10,000 pounds.
Dec. 18, 1991	Intermodal Surface Transportation Efficiency Act (ISTEA) requires application of passenger car safety standards to light trucks, vans, buses, and MPVs with GVWR of 6,000 pounds or less, and ISTEA also directs NHTSA to commence rulemaking proceeding on a standard to prevent rollover crashes.
Jan. 3, 1992	NHTSA issues advanced notice of proposed rulemaking to establish a rollover prevention standard.
Sept 23, 1992	NHTSA releases *Planning Document for Rollover Prevention and Injury Mitigation* listing alternative actions agency could take to address rollover problem, including research into improved roof crush resistance to prevent head and spinal injury.
Jan. 22, 1993	NHTSA delays by 1 year, until Sept. 1, 1994, effective date for application of roof crush standard to light trucks, vans, buses, and multi-purpose passenger vehicles with gross vehicle weight rating of 6,000 pounds or less.
June 23, 1994	NHTSA terminates rulemaking on rollover stability standard, Secretary of Transportation instead announces that agency will address factors involved in preventing rollover casualties including roof strength requirements.
May 6, 1996	Petition for rulemaking including a request that the agency require "roll cages" as standard equipment on passenger cars filed with NHTSA.
Jan. 8, 1997	NHTSA grants petition requesting rulemaking to require "roll cages."

1971 Roof Crush Standard—37-year Old Antiquated Standard Has Not Kept Pace With Changes in Technology or Vehicle Fleet—Continued

Apr. 27, 1999	Roof crush standard procedure for placement of test device modified to accommodate vehicles with raised and highly sloped roofs, change in standard did not address underlying roof crush testing and strength requirements.
Sept. 2000	In wake of Firestone tire/Ford Explorer rollover fatalities, NHTSA Administrator states that agency needs to improve roof crush safety standard.
Oct. 22, 2001	NHTSA publishes notice and request for comments on roof crush resistance, describing agency roof crush research and testing as part of rollover program over past 30 years.
Sept. 17, 2002	NHTSA Administrator states that roof crush intrusion potentially contributes to serious or fatal injury in 26 percent of rollover crashes.
July 15, 2003	National Transportation Safety Board (NTSB) concludes roof crush contributed to severity of driver injuries and diminished passenger survivable space in Henrietta, Texas crash of 15-passenger van.
July 2003	NHTSA estimates that 1,339 serious or fatal injuries caused by roof crush intrusion are suffered by belted occupants each year. NHTSA lists proposed rule to upgrade roof crush resistance as possible 2004 action, and final rule as possible 2005 action, in *Vehicle Safety Rulemaking Priorities and Supporting Research 2003–2006*. However, no proposed rule is issued by the close of 2004.
Aug. 10, 2005	SAFETEA–LU legislation enacted, requires that NHTSA issue a proposed rule by December 31, 2005, to establish performance criteria to upgrade vehicle roof strength for driver and passenger sides, and may consider dynamic tests that realistically duplicate actual forces transmitted during a rollover crash, and issue a final rule by July 1, 2008.
Aug. 23, 2005	NHTSA issues decidedly weak upgrade of roof crush resistance standard that will not substantially improve roof strength in most vehicles, eliminates minimum headroom clearance requirement following testing and fails to require testing on both driver and passenger sides as provided in SAFETEA–LU. NHTSA proposed only a marginal increase in vehicle roof strength quasi-static piston test that even the agency estimates would save only either 13 or 44 lives. Most production vehicles already meet the proposed test criteria, and the proposal does not meet the 2-sided test requirements in SAFETEA–LU.
Nov. 2005	Advocates for Highway and Auto Safety, Public Citizen, Insurance Institute for Highway Safety and numerous other organizations file comments critical of NHTSA's proposed rule.
Jan. 30, 2008	NHTSA issues supplemental notice of proposed rulemaking (SNPRM). The initial agency proposed rule did not address the need for improving roof strength on both sides of the vehicle. The SNPRM discusses varying options regarding degree of strength-to-weight (SWR) ratio that could be required but presents no specific revised proposal and provides no economic or safety analysis of any of the options raised in the SNPRM.
Mar. 27, 2008	Advocates for Highway and Auto Safety, Public Citizen, Insurance Institute for Highway Safety and numerous other organizations file comments regarding SNPRM. Advocates points out both safety and procedural problems exist. IIHS study of vehicle roof strength finds roof strength has strong effect on occupant injury risk, refuting prior industry studies.
June 4, 2008	Senate Commerce, Science and Transportation Subcommittee on Consumer Affairs, Insurance, and Automotive Safety holds hearing on NHTSA's proposed upgrade of roof strength rule.

ADVOCATES FOR HIGHWAY AND AUTO SAFETY
Washington, DC, March 27, 2008

Docket No. NHTSA–2008–0015
National Highway Traffic Safety Administration
U.S. Department of Transportation

Federal Motor Vehicle Safety Standards—Roof Crush Resistance Supplemental Notice of Proposed Rulemaking, 73 FR 5484 (Jan. 30, 2008)

I. Introduction

The National Highway Traffic Safety Administration (NHTSA) has published a supplemental notice of proposed rulemaking (SNPRM) proposing a revised roof crush resistance standard (Federal Motor Vehicle Safety Standard No. 216). 73 FR 5484 (Jan. 30, 2008); 49 CFR § 571. On August 23, 2005, NHTSA published a notice of proposed rulemaking (NPRM) while Congress was considering a mandate to the agency to upgrade the roof crush resistance standard. 70 FR 49223 (Aug. 23, 2005). Section 10301(a) of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA–LU) (Pub. L. 109–59, Aug. 10, 2005) directed the Secretary to initiate a rulemaking proceeding "to establish performance criteria to upgrade Federal Motor Vehicle Safety Standard No. 216 relating to roof strength for driver and passenger sides[]" and to "issue a . . . final rule by July 1, 2008." [1] Codified at 49 U.S.C. § 30128(d).

The SNPRM, a quasi-static test of roof crush resistance, is essentially identical to the compliance protocol currently required in Standard No. 216 except for the current regulatory requirement of an intrusion limit and the substitution of a no head contract pass/fail criterion. Windshield glazing, as well as closing moveable glazing and locking doors, are required in conducting the roof crush resistance test. The SNPRM also adds a requirement to secure moveable and immoveable roof structures and to remove all "nonstructural components," such as roof racks. 73 FR 5484, 5492–5493. In contrast to the 2005 NPRM for amending Standard No. 216 that proposed a test of only one side of a passenger vehicle roof at 2.5 times unladen vehicle weight, 70 FR 49223, the supplemental proposal offers the potential adoption of a 2.5 times (2.5×), 3.0×, or 3.5× unladen vehicle weight platen force application near the front corners of the roofs of passenger vehicles less than 10,000 pounds gross vehicle weight rating (GVWR).[2] The agency is also considering whether an amended Standard No. 216 would require only a test of one side of a passenger vehicle roof (1-side test) or of both sides (2-sides test). The platen application would measure only peak forces, no intrusion limit would be specified in the amended standard, and a successful compliance test would hinge only on intrusion at the required platen force application without any roof component or portion of the platen contacting the head of a 50th percentile male anthropomorphic test device (ATD, test dummy). 73 FR 5491–5493.[3]

II. The Supplemental Proposed Rule Will Not Adequately Protect Occupants in Rollover Crashes

The proposed rule crush resistance rule as presented is seriously inadequate in several ways.

- The proposed compliance procedure is only a component test and cannot demonstrate actual roof crush resistance in rollover crashes.[4] Compliance with NHTSA's regulation as proposed would have no predictive value for determining what the actual impact response of a given passenger vehicle roof will be in rollover crashes of 2 quarter-turns or more.
- The agency has not shown the relationship between the quasi-static test metric at the 3 different proposed application forces (2.5×, 3.0×, 3.5×) to differences in real-world rollover occupant injury response.
- The proposed quasi-static test cannot show roof dynamic flexion or recoil and cannot show occupant excursion even when front seat occupants are belted. Both of these rollover dynamics can substantially reduce survival space and result in head and face roof impacts despite a given vehicle demonstrating Standard No. 216 compliance.
- The SNPRM quasi-static platen application procedure is not a real-world test because it directs manufacturers to close all moveable glazing, secure moveable or unmovable roof structures, and remove roof racks before testing for compliance. These actions increase the probability of compliance even though new vehicles will often be factory-equipped with roof racks, other roof structures, and will be operated with opened moveable glazing. 73 FR 5492.

[1] The preamble of the supplemental proposed rule does not cite this specific statutory mandate and only alludes to it in relation to the abbreviated public comment period that the agency claims was selected, in part, due to "the need to comply with a statutory deadline." 73 FR 5486.

[2] For all practical purposes, multiples of unladen vehicle weight and values for strength to weight ratio (SWR) are used interchangeably by NHTSA and in these comments, although technically the two metrics are not identical.

[3] Although the proposed text of the amended regulation contains alternatives for a 1-side or a 2-sides test, it still specifies a maximum force application of only 2.5 times unladen vehicle weight. Agency consideration of a 3.0X or 3.5X test is discussed only in the preamble of the SNPRM. 73 FR 5490.

[4] *See,* comments of DVExperts International Pty. Ltd., March 4, 2008 (DVExperts), NHTSA–2008–0015–0010.1, at 4.

- A roof meeting the most stringent regulatory alternative proposed in the SNPRM does not ensure that a belted occupant will avoid serious head-face-neck injury. In fact, this is implied by the agency's own 2005 benefits analysis based solely on a 2.5×, 1-side test: the lives saved—13 or 44, 70 FR 49225—were only a small fraction of the population defined (596)[5] as even susceptible of benefiting from the proposed rule.[6]
- The upright, safety belt-retrained ATD—the Hybrid (H)III 50th percentile male test dummy—has no dynamic function or injury measurement for the proposed compliance test. Its use cannot show the dynamic response of safety belts to translational forces and occupant inversion that can result in occupant contact with an intruding roof even if the vehicle passes the quasi-static platen test using the dummy head contact/no-contact compliance test criterion.[7]
- Use of only a 50th percentile male ATD for the compliance test immediately denies equal safety protection to taller occupants.
- The proposed quasi-static compliance test disregards dramatic differences in occupant injury response and morbidity related to occupant age, and ignores the fact that older occupants are much more prone to death and injury in rollover crashes than younger occupants.
- The SNPRM offers several regulatory alternatives without support from a cost-benefit analysis projecting lives saved and injuries averted or reduced in severity for each regulatory combination of SWR with a 1-side or 2-sides test. The failure to supply a cost-benefit analysis for each regulatory alternative denies the public an opportunity to evaluate the agency's comparative estimates of costs and benefits before submitting comments supporting one or more of the regulatory alternatives of the SNPRM.

III. The Proposed Quasi-Static Platen Test of Roof Crush Resistance Is Weak

The SNPRM relies on the belief that roofs designed to meet a higher strength requirement in a quasi-static test of applied plate force are more resistant to crush and intrusion and will maintain sufficient occupant headroom and survival space during real-world rollovers. But no correlation of the proposed 2.5× SWR metric based solely on no head contact without an intrusion limit has been made with actual occupant fatality and injury data of passenger vehicles in rollover crashes.[8] NHTSA's proposed surrogate measure of adequate roof strength—contact or no contact with the head of a 50th percentile test dummy—proves nothing about how any vehicle complying with the proposed quasi-static platen test will actually resist roof deformation and intrusion during rollover crashes and cannot predict occupant injuries in rollover crashes.

NHTSA has not shown in the SNPRM that passenger vehicle roofs that resist intrusion at greater, specific SWR force applications in such a quasi-static test also result in fewer occupant severe injuries or deaths. One major deficiency in the recent roof intrusion study published by NHTSA[9] is the fact that intrusion cannot be correlated with specific injury predictions even for the very conservative benefits target population except at a gross level of analysis. The 2007 NHTA Vertical Roof Intrusion Study only shows that "coefficient estimates for intrusion were negative indicating that an increase in intrusion tended to be associated with an increase in the level of injury severity; the coefficient estimates for post-crash headroom were positive, indicating that an increase in headroom tended to be associated with a decrease in the level of injury severity."[10]

This implies that, in general, stronger, more intrusion-resistant passenger vehicle roofs providing more post-rollover survival space will protect more front-seat occu-

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[5] *FMCSS 216, Upgrade Roof Crush Resistance, Preliminary Regulatory Impact Analysis,* National Highway Traffic Safety Administration, August 2005 (2005 PRIA), at IV–7.

[6] The target population in the SNPRM has been further reduced to 476 belted, non-ejected occupants.

[7] *See,* M. Bidez, *et al.,* "Occupant Dynamics in Rollover Crashes: Influence of Roof Deformation and Seat Belt Performance on Probable Spinal Column Injury," *Annals of Biomedical Engineering,* 35:11 (Nov. 2007), 1973–1988.

[8] "The energy absorbed by the roof may be more relevant to injury risk than the peak force it can withstand, or the roof's performance over a plate displacement other than 5 inches would better predict injury risk. M. Brumbelow, *et al., Roof Strength and Injury Risk in Rollover Crashes,* Insurance Institute for Highway Safety, March 2008 (IIHS Roof Strength Study), at 5.

[9] *The Role of Vertical Roof Intrusion and Post-Crash Headroom In Predicting Roof Contact Injuries to the Head, Neck, or Face During FMVSS No. 216 Rollovers—An Updated Analysis,* DOT HS 810 847, October 2007 (2007 NHTSA Vertical Roof Intrusion Study).

[10] 2007 NHTSA Vertical Roof Intrusion Study at 11.

pants from severe injuries and deaths. Yet, NHTSA has failed to provide any evidence in the SNPRM that a roof crush resistance standard based on the platen test can be correlated with substantial improvements in the real-world prevention of head, face, and neck injuries in rollover crashes.

This crucial point is emphasized in recent comments filed with the docket:

> The proposed standard raises the force level required to generate roof crush, *but it does not necessarily result in increased energy resistance or reduced roof crush in a rollover.* Individual vehicles with different peak loads can have similar energy resistance capabilities and therefore similar degrees of roof crush in a rollover, and, inversely, individual vehicles with identical peak loads can have dramatically different energy resistance capabilities and dramatically different degrees of roof crush. For this reason, simply requiring a minimum force level does not ensure that roofs will be able to resist a significant amount of energy in a rollover nor maintain the necessary structural integrity. Consideration for structural energy management is critical if the Agency's goal is to reduce roof intrusion.[11]

The Insurance Institute for Highway Safety (IIHS) has recently published an important study supporting the concept that more highly crush resistant passenger roofs will provide enhanced protection of front seat occupants from head, face, and neck injuries if based on a more stringent quasi-static test. The IIHS Roof Strength Study indicates that vehicle roof energy management is a major parameter relating to occupant injury.[12] NHTSA needs to evaluate these findings in light of its demurral on using an intrusion limit and energy absorption criterion to adopt a roof crush resistance standard based on the platen test of Standard No. 216. The IIHS Roof Strength Study comprised 22,817 single-vehicle rollover crashes involving drivers suffering both incapacitating injuries and deaths in 11 sport utility vehicle (SUV) models in police-reported crashes in 12 states. These crashes were matched with roof strength results from using the quasi-static platen test in which 8 midsized SUVs' roofs were crushed at 2, 5, and 10 inches of platen displacement. The highest SWR achieved by any of the study vehicles undergoing the platen test was 3.16. The study performed logistic regression analyses of the 12 states' single-vehicle rollover crashes, controlling for the state in which the crashes occurred, Static Stability Factor (SSF), and driver age. The results of the analyses found that lower incapacitating and fatal injury rates were associated not only with higher values of peak force and SWR, but also for energy absorption.

These findings support the need for NHTSA to adopt several, interacting metrics to a roof crush resistance compliance test that relies on a quasi-static platen test of intrusion. Using only a SWR multiple, such as 2.5×, 3.0×, etc., without an intrusion limit, no energy management requirement, and only a head no-contact/contact (pass/fail) criterion cannot provide sufficient assurance that a complying vehicle will provide substantially enhanced roof crush resistance, which, in turn, will produce lower rates of severe injury and death in rollover crashes. The IIHS Roof Strength Study found consistent trends in odds ratios for reduced risk of fatal or incapacitating driver injuries that were correlated with reduced platen displacement, higher SWRs, and higher energy absorption.[13]

Using the logistic regression models of driver fatality risk to calculate the odds ratio for a full 1-unit increase in peak force, SWR, and energy absorption, the study found that the lowest driver fatality risk was associated with a 2-inch peak force platen displacement, 2 inches SWR, and 2 inches energy absorption.[14] Overall, the

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[11] DVExperts at 5 (emphasis supplied). In its 2005 proposed rule, NHTSA specifically asked for comments on an energy absorption criterion added to the requirements of Standard No. 216 because two commenters argued that a peak force requirement alone is insufficient to prevent roof collapse after initial peak force is attained. The agency stated that it would have to conduct additional analysis to evaluate energy absorption to establish test parameters. 70 FR 49236. However, two and one-half years have elapsed since the agency asked for further comments on an energy management criterion for the standard, and there is no indication that the agency has conducted the additional analysis necessary to test vehicles for roof energy management in rollover crashes.

[12] IIHS Roof Strength Study at 5.

[13] *Id.* at 10.

[14] *Id.* at 11. The finding in the IIHS Roof Strength Study that occupant injury is strongly related to a higher SWR and the amount of intrusion is consistent with Advocates' prior comments that responded to the 2005 proposed rule. Advocates supported a SWR of at least 3.0X and, preferably, 3.5× and the restoration of an intrusion limit of a maximum of 3 inches, the platen test conducted without the windshield and with retracted side glazing. *See,* comments of Advocates for Highway and Auto Safety dated Aug. 23, 2005 (Advocates' 2005 Comments), to Docket No. NHTSA–2005–22143–0136, at 4–5, 13.

logistic regression analyses found that rollover injury risks were significantly lower for vehicles with stronger roofs regardless of which strength assessment was used. However, the IIHS Roof Strength Study could not determine whether any one metric is more predictive of injury outcomes than others.[15] This implies that NHTSA should act prudently and adopt several different metrics to ensure that the quasi-static platen test results in substantial safety benefits in injury prevention.

In order to be cautious in using a non-dynamic, surrogate measure of real-world vehicle roof responses to rollover impact forces, NHTSA should seriously consider establishing multiple measures for conducting a quasi-static platen compliance test if the agency continues to insist that it cannot adopt a dynamic compliance test. Given the agency's continued insistence on the quasi-static compliance test, Advocates supports the following as the main features of the test protocol, including the minimum number of metrics and their values:

- A SWR of no less than 4.0× [16]
- An intrusion limit of no more than 2 inches with maintenance of force level instead of simply achieving peak force.[17]
- A residual headroom limit of no less than 2 inches from the top of the head of a 50th percentile male ATD.[18]
- Moveable side glazing should be retracted or otherwise positioned to open side portals.[19]

Surprisingly, NHTSA takes no action in the SNPRM to factor in the amount of intrusion that should be permitted in a quasi-static platen test apart from an ATD head no-contact requirement, despite the fact that its own 2007 Vertical Roof Intrusion Study found "a statistically significant relationship between intrusion and injury for belted occupants . . ." and that, "together with other factors . . . will likely lead to slightly higher benefits than was estimated in the NPRM." 73 FR 5490. When this finding is framed by the more specific finding of the IIHS Roof Strength Study linking the level of force applied to a vehicle roof with the amount of intrusion for the extent and severity of occupant injury, NHTSA must appreciate that a revised roof crush resistance standard must incorporate an intrusion limit to accompany a SWR force level in the final rule. The agency cannot simply disregard its own finding that "a statistically significant relationship between intrusion and injury" has been determined through its own further investigation by offering a roof crush resistance regulation that has no specific intrusion limit other than avoidance of ATD head contact. This would be a capricious choice that is contrary to the evidence in the rulemaking record provided by NHTSA itself, IIHS, and DVExperts that a specific intrusion limit figure is necessary to produce injury prevention benefits.

IV. Without Requirements for an Intrusion Limit, Minimum Residual Headroom Space, and Sustained Force, the Proposed Quasi-Static Platen Test Can Be Easily "Gamed" By Manufacturers

Requirements that limit maximum intrusion, specify a minimum residual headroom space, and use sustained force and energy absorption as components of a strengthened quasi-static roof crush resistance test can substantially reduce the ability of manufacturers to manipulate other features of roof and roof support design that will translate into passing the compliance test. These measures will not nullify

[15] *Id.* at 13.

[16] A SWR of at least 4.0× is recommended by DVExperts. Advocates supported a SWR of at least 3.0× and desirably 3.5× in its comments filed in response to the 2005 proposed rule, but this stance was based on the agency eliminating reliance on the windshield and closed side glazing for the quasi-static compliance test. Since FMCSA appears to be resolute in allowing both to be used in complying with an amended Standard No. 216, Advocates has increased its recommended minimum SWR to at least 4.0×. *See,* Advocates' 2005 Comments at 15–16.

[17] DVExperts cites the roof crush resistance achievement of the Volvo XC90. Volvo requires that a minimum force level of 3.5X SWR be reached within 2 inches of platen displacement, but then maintained to within 7.9 inches, followed by a force level of 4.3X SWR maintained within 11.8 inches of platen displacement. DVExperts at 3–5. Volvo's test requirements result in a roof in a rollover crash that progressively becomes stronger as the forces of a rollover test roof crush resistance.

[18] Advocates continues to support the use of a 95th percentile male ATD in the test protocol if NHTSA continues to insist on the use of a dummy in the platen test. However, the use of the ATD has no relationship to any injury measure. For all practical purposes, the ATD used in the proposed platen test is a manikin. *See*, Advocates' 2005 Comments at 12; DVExperts at 6.

[19] Advocates urges the agency to reconsider barring the use of windshields in conducting the platen test.

the ability of manufacturers to "game" a quasi-static compliance test of roof components, as recognized by other commenters to the docket, but the use of more, specific test metrics for determining compliance will limit the ability of manufacturers to introduce compensatory design features to pass the platen test.[20] The simpler NHTSA renders the compliance test requirements, the easier it is for manufacturers to compensate for weak forward roof crush resistance by artful choices of other design changes. Test manipulation is strongly facilitated by NHTSA's binary compliance criterion of dummy head contact/no-contact while dispensing with a platen intrusion limit. The use of the HIII head for the criterion is gratuitous since the ATD has no injury response measurements even if head contact occurs. Even if the ATD had injury response measurement corridors, such as measurement of neck axial compression, flexion, or shear, complying with the quasi-static test shows nothing about how an occupant would actually respond in a real-world rollover crash because occupant kinematics in a rollover are categorically different from the static, belted ATD seated in an upright position used for such a binary compliance decision.[21]

If the agency chooses a quasi-static test at 2.5×, 3.0×, 3.5×, or some other SWR figure, the test should specify (a) a maximum intrusion limit of no more than 2 inches and (b) that limit must be reached at a distance no less than 2 inches from a 50th percentile ATD head, although Advocates urges the agency to require a greater residual head space that will respond to the safety needs of the 95th percentile of front seat male occupants. However, a choice of a lower SWR will substantially counter the benefits of a stringent intrusion limit and residual headroom requirement. NHTSA's crash data investigation showed that 9 percent of occupants with post-crash headroom above the tops of their heads nevertheless still experienced roof contact injuries to the head, neck, or face, while 34 percent suffered such injuries when headroom was below the tops of their heads. 70 FR 49237. This clearly shows that increasing residual headroom will commensurately increase benefits because of lower rates of head, face, and neck injuries, especially in connection with a more demanding SWR than 2.5×.

Removing an intrusion limit and substituting a binary criterion of head contact/no contact will allow manufacturers to design to maximum intrusion that falls just short of head contact, a design choice that can allow considerable intrusion reducing the margin of safety for preventing severe head, face, and neck injuries in actual rollovers. In real-world rollovers, manufacturers of low roofline vehicles can pass a head non-contact regulatory compliance platen test with only a small margin that will disappear in real-world rollovers due to excursion even of belted occupants, transient roof dynamic flexion and recoil, and roof structural failures that cannot be replicated in a quasi-static test. Measurable residual headroom found post-crash does not ensure that roof contact and consequent head, face, and neck injuries even to belted occupants did not occur.

A regulation based solely on a simplistic "no contact" compliance criterion cannot reach the agency's goal of "quantifiable benefits of limiting headroom reduction," and it allows manufacturers to manipulate the test for compliance that will continue to result in unacceptable occupant head, face, and neck injuries in rollovers. A no head contact criterion with no intrusion limit and no required minimum residual space above the heads of occupants simply indulges manufacturers to continue to produce compliant, low roofline vehicles with little margin before head contact, margins that easily will be exceeded in real-world rollover crashes with a high risk of severe injury.

Failure to specify an intrusion limit, which should be considerably less than 5 inches, and basing the test on peak force resistance rather than *sustained* resistance has no real-world correlation with multiple quarter-turn rollover crashes. A roof that might sustain, say, a 2.5× SWR load in the first impact of each side might subsequently fail in the second set of impacts in vehicles that suffer multiple full rolls. NHTSA tested several passenger vehicles with an inverted drop test and concluded that the quasi-static test of Standard No. 216 was as accurate in reproducing roof deformation as a drop test in producing deformation similar to real-world crashes. 70 FR 49231. All of these vehicles presumably complied with existing Standard No. 216, including the 5-inch intrusion limit. Yet, NHTSA also found a high percentage of vehicles that complied with the quasi-static test requirements of No. 216 but also suffered roof intrusion beyond 5 inches in real-world rollover crashes. Specifically, the agency found that 32 percent of cars and 49 percent of light trucks under 6,000 pounds exceeded 5.9 inches of vertical roof intrusion, and 55 percent of light trucks

[20] "There are ways to 'trick' the quasi-static simple test and achieve artificially high loads, by incorporating a strong B-pillar, for example, meanwhile ignoring the critical areas that bear loads in real world rollovers such as the A-pillar and windscreen header." DV Experts at 4.

[21] *See,* DVExperts at 6.

with a GVWR greater than 6,000 pounds and less than 10,000 pounds suffered vertical roof intrusion exceeding 5.9 inches. *Id.* at 49236.

This shows that, in fact, complying with a quasi-static test that claims to reproduce real-world deformation does not predict whether any given complying vehicle will nevertheless suffer roof intrusion exceeding the limits of such a standard. The agency's subsequent review of heavier passenger cars near or above 3,333 pounds GVWR, *id.* at 49237, found that several of these withstood 1.5× vehicle weight in the platen test. But this compliance result clearly has no predictive value for whether any of these vehicles would not suffer severe roof crush in real-world rollover crashes, including crashes that resulted in greater than 5 inches of vertical intrusion. NHTSA cannot substantially improve roof strength while also dramatically reducing occupant deaths and injuries based solely on a higher SWR value and an ATD no-contact compliance criterion.

V. SAFETEA–LU Requires NHTSA to Upgrade Passenger Vehicle Roof Strength In Standard No. 216 for Both Driver and Passenger Sides

NHTSA is required by law to upgrade "roof strength for [both the] driver and passenger sides." SAFETEA–LU, Sec. 10301(a), codified at 49 U.S.C. § 30128(d). In order to accomplish this, the agency must require a compliance procedure that demonstrates the strength of both sides of a passenger vehicle roof. This makes eminent sense because NHTSA cannot predict which side of a rolling vehicle will receive the first impact, and because vehicles in multiple quarter-turn rolls can suffer impacts to both sides of the roof. As a result, Congress understood that the agency must ensure that both sides of a passenger vehicle roof are strengthened in any upgrade of Standard No. 216, and a 2-sides test is the only realistic means for ensuring this goal of enhancing real-world occupant protection in rollovers.

It is clear from the agency's tabulated results of 1-side and 2-sides testing in the SNPRM, 73 FR 5486–5487, Tables 2 and 3, that compliance with the quasi-static test at the adopted force level for 1-side cannot determine whether the vehicle would comply with a sequential test of the 2nd side if tested with the platen. Even the agency's summary analysis of tests conducted for the 2005 proposed rule showed that first side test results cannot be used to predict second side test results using the platen test. In testing the second side of a Crown Victoria, local peak force was reduced 17 percent between 50–90 mm of crush in contrast with the first side test. 70 FR 49239. But a platen test of both sides of a Land Rover Freelander produced an increase in force during the second side test over that of the first side starting at approximately 40 mm of plate movement. As contrasted with the Lincoln LS test, local peak force was increased by 20 percent on the second side for the Freelander, whereas the Lincoln LS suffered a decrease in force beginning at 40 mm of platen intrusion, resulting in a 20 percent decrease in peak force for the second side. *Id.* As a consequence, NHSTA concluded that "some vehicles may have weakened or strengthened far side roof structures as a result of a near side impact." 70 FR 49239. NHTSA found similar disparities in the test results for 1-side and 2-sides tabulated in SNPRM, showing that 1-side peak force roof responses cannot be relied on to gauge second side responses, especially in light of the fact that increases, rather than decreases, in peak force in the second side tests were the exception rather than the rule. *See,* Table 3, 73 FR 5487.

Although NHTSA asserts in the SNPRM that it is actively considering whether to adopt a 1-side or a 2-sides compliance test, *e.g., id.* at 5490, the agency is arguably less able to relate the results of a 1-side test to real-world roof crush resistance in rollovers and occupant injury responses than even the use of a quasi-static 2-sides test. The statutory mandate cannot be satisfied with a 1-side platen test.

VI. The Proposed Platen Test Impedes Development of Other, Crucial Safety Performance Features for Reducing Injury in Rollover Crashes

Contrary to NHTSA's assertion that the SNPRM is "part of a comprehensive plan for reducing the serious risk of rollover crashes," 73 FR 5484, NHTSA's refusal to consider a dynamic test for determining roof crush resistance to intrusion in rollover crashes denies the agency the advantages of determining other key safety design and performance features of passenger motor vehicles in rollovers. Instead, the agency has chosen to perpetuate an outdated, simplistic method of applying localized force to the corners of an upright passenger vehicle roof near the A-pillars as a surrogate for the dynamic forces acting on vehicle roofs in real-world rollovers.

Perpetuating this anachronistic approach evades a systems engineering response to rollover crash occupant safety, an approach that would rely on a dynamic test protocol that simultaneously demonstrates occupant kinematics and injury responses in actual rollover crashes. The proposed platen test cannot show the effects of actual rollover crashes on vehicle safety systems, including door latch/lock and hinge strength to resist failure leading to ejection and restraint system effectiveness in sustained rollover events to maintain occupant containment and to reduce occupant excursion.[22] Restraint system performance, door component retention effectiveness, and occupant injury mechanisms in rollover crashes shown in compliance tests of a dynamic roof crush resistance standard would be immensely valuable in helping the agency to accelerate the adoption of more effective crashworthiness standards governing the safety performance of these vehicle systems. Instead, NHTSA has chosen a roof crush resistance test approach that cannot provide any information in these areas and therefore delays the development of standards based on dynamic tests in these areas. In fact, choosing a quasi-static platen test undermines the agency separately establishing both active and passive restraint system and seating system standards for rollover protection on the basis of dynamic testing.

The proposal to continue the use of the quasi-static platen test stands in stark contrast to the evolution of other major safety standards from quasi-static to fully dynamic compliance tests, including Standards Nos. 201, 208, and 214. This is recognized in comments filed with the docket: "Each of the other mandated crashworthiness standards rely on a systems approach to crashworthiness. A dynamic test is necessary to evaluate the performance of the rollover protection system, which is made up of the restraints, airbags, glazing, and roof strength."[23] The agency has previously documented the increases in benefits of lives saved and injuries reduced as a consequence of more stringent, effective vehicle design factors and safety performance resulting from dynamic testing, yet it has paradoxically ignored its own record showing the benefits of dynamic testing in the SNPRM.

VII. A Strong, Effective Roof Crush Resistance Standard Can Achieve Benefits Substantially Greater Than Previously Estimated By NHTSA

Although NHTSA contends that its revised estimate of the number of head injuries prevented by stronger roofs and the impact of electronic stability control (ESC) in reducing rollover crashes will erode benefits of a strengthened roof crush resistance standard,[24] the benefits analysis provided by the agency in the 2005 proposed rule artificially restricted potential benefits of reduced head, face, and neck injury to only belted, non-ejected front seat occupants.[25] The agency's target population for an amended Standard No. 216 is produced by its statistical approach to avoiding confounders in determining potential benefits and its compliance with the Office of Management and Budget's proscription on double-counting benefits for any proposed rule.[26]

This method of isolating the purported target population for the benefits of a stronger roof crush resistance standard is largely an artifact of the agency's statistical analysis[27] and thereby substantially underestimates potential benefits of a stronger Standard No. 216. Furthermore, even NHTSA has recognized that it has a very limited set of cases—32 crashes—from which to infer benefits,[28] some of the relevant cases within the sample lacked data elements, and certain individual cases were assigned very large sample weights. As a result, NHTSA admits that "the characteristics of this limited sample may not accurately represent the full benefits from the proposed roof crush resistance upgrade." 70 FR 49242.

The agency's analysis in the 2005 NPRM pointed out that about 64 percent of the 10,000 occupants fatally injured in rollovers each year are killed when they are either partially or completely ejected during the rollover. This means that about 6,400 fatally injured occupants die from ejection. NHTSA further states that about 53 percent of these fatally injured individuals are completely ejected, and 72 percent of

[22] These important benefits of a dynamic roof crush resistance standard are also emphasized in the comments of DVExperts at 2.

[23] *Id.* at 4.

[24] NHTSA projected in its 2007 final rule on ESC benefits of between 4,200 and 5,500 deaths prevented annually when full fleet implementation of ESC (beginning with Model Year 2012) occurs. 72 FR 17236 (April 6, 2006). Of the approximately 10,800 annual rollover crash fatalities, this means that ESC will not prevent as many as 60 percent of rollover fatalities. Even if many of those dying in rollover fatalities suffer fatal injuries because of ejection or because of trauma suffered to other body regions than the head, face, and neck, a strong roof crush resistance standard can ensure that many additional lives can be saved in rollover crashes that cannot be prevented by ESC alone.

[25] In contrast, the IIHS Roof Strength Study did not find that belt use was confounding the results of its final regression model. Preliminary models for drivers with reported belt use estimated roof strength effects nearly identical to the effects estimated for all drivers. *Id.* at 12.

[26] *See,* 2007 NHTSA Vertical Roof Intrusion Study at 3.

[27] *Id.*

[28] The IIHS Roof Strength Study emphasizes that the agency's benefits estimates are based on only 32 National Accident Sampling System/Crashworthiness Data System (NASS/CDS) rollover crashes. *Id.* at 2.

these are unbelted. 72 FR 49227. This amounts to about 3,480 fatally injured occupants who are only partially ejected.

These partially ejected occupants, as well as occupants who are unbelted but who remain within the occupant compartment, might benefit from a stronger roof crush resistance rule even though they do not fall within the agency's artificially restricted potential benefits population of only front-seat occupants who are belted and not ejected at the time of rollover crashes. It is likely that non-ejected, unbelted occupants could suffer fewer severe and fatal head, face, and neck injuries by preserving more rollover survival space gained by highly crush resistant roofs that reduce the chances of impacting rigid roof structures such as headers, rails, and sunroof frames, as well as with the roof proper apart from these framing structures. This inference appears to have at least partial support in the agency's concession that "seriously and fatally injured occupants who had a non-MAIS roof contact injury may also derive some benefit from decreased roof intrusion." *Id.* at 49229.

This inference that many occupants not part of NHTSA's benefits target population may avoid severe injury or death from roof crush in rollovers is also supported by IIHS in its recent *Status Report*[29] and the IIHS Roof Strength Study that properly point out that real-world benefits can accrue to occupants who are not part of the agency's benefits target population because other crashworthiness system features can have increased effectiveness in tandem with much stronger roofs.[30] Some of the occupants excluded from NHTSA's benefits target population[31] could nevertheless avoid death in rollover crashes if roofs were appropriately strengthened. In contrast to the agency's very low benefits estimates, the IIHS Roof Strength Study found that after controlling for major confounders, even amending Standard No. 216 to increase the SWR to 2.5× could save 108 lives of the 668 front outboard seat occupants who were killed in single-vehicle rollovers in 2006, and that increasing the SWR to 3.16× could have saved 212 lives.[32]

The increase to 3.16× SWR from 2.5× SWR is less than one full unit, yet the number of lives saved is almost double the number of a standard indexed to 2.5× SWR. Advocates believes that further increases in lives saved by each half-unit SWR increase in roof strength would rise at some unknown but nevertheless exponential rate. Adding a stringent maximum intrusion limit, such as 2 inches, and a minimum residual headroom space as compliance requirements would probably increase these gains by substantial amount while probably also increasing the exponent for each half-unit step in SWR magnifying the number of lives saved. These gains could move upward at even at greater rate given the additional strength supplied by windshield retention when a high SWR with stringent limits on intrusion and residual headroom space interact to ensure higher rates of windshield retention and resistance to cracking.[33] Even introducing fleet-wide effects of ESC benefits in preventing rollover fatalities, estimated at about 60 percent effectiveness for passenger vehicles, cannot reduce real-world benefits to only the untenably small numbers estimated in the 2005 proposed rule.

NHTSA also cannot reduce benefits in any final rule based on the exaggerated figures provided by the Alliance of Automobile Manufacturers (Alliance) for the weight and cost of complying with 2.5×, 3.0×, or 3.5× roof crush resistance standard. The Alliance estimates that it would cost an additional $130 for a large SUV to comply with a 3.5× alternative and that, based on NHTSA's cost studies, "total costs could be 50 percent higher." 73 FR 5488. Similarly, the Alliance estimates that the additional weight of the extra countermeasure design changes to meet a 3.5X SWR standard could be as much as 540 pounds. These inflated estimates are consistent with past Alliance claims that, in each instance, are intended to dissuade NHTSA from adopting a substantially stronger or a more demanding standard in a key crashworthiness safety area. Even NHTSA's own study of the comparative costs and weight needed to upgrade a Ford Explorer to the roof crush resistance level of a Volvo XC90 SUV "would increase material and tooling costs by [only] $81 and weight by [only] 15 kilograms (33 pounds)." *Id.* at 5489. These figures are cited and supported by comments already submitted to the docket.[34] The Alliance cost and

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[29] *Status Report,* IIHS, 43:2, March 15, 2008.

[30] IIHS Roof Strength Study at 13.

[31] NHTSA concluded from the evaluation of only 32 crashes in the NASS/CDS that, after excluding convertibles as a class, no benefits of more crush-resistant passenger vehicle roofs would accrue to occupants in one quarter-turn passenger vehicle rollovers, fixed object roof impacts, ejected occupants, unbelted occupants, rear seated occupants, and occupants with no coded roof intrusion over their seating positions. PRIA, Sec. IV; IIHS Roof Strength Study at 2.

[32] IIHS Roof Strength Study at 11.

[33] *See, id.* at 13.

[34] DVExperts at 2–3.

weight figures for substantial strengthening of passenger motor vehicles to better resist roof crush have no credibility, and NHTSA should continue to reject them.

VIII. The SNPRM Is Procedurally and Substantively Inadequate

A. The SNPRM Has No Supporting Cost-Benefit Analysis to Justify a Final Rule

The SNPRM has no cost-benefit analysis of the various combinations of test requirements (1-side at 2.5×, 2-sides at 3.0×, *etc.*) suggested by NHTSA as potential regulatory outcomes. The failure to provide the costs and safety benefits of different alternative combinations of SWR with 1-side or 2-sides testing denies the public an opportunity to evaluate NHTSA's justification for a final rule choosing one of these alternatives to amend Standard No. 216. Without the ability to review and critique alternative costs and benefits for different regulatory alternatives, the public is unable to show that a more demanding SWR (that is, a peak force requirement greater than 2.5×) on both sides of a vehicle roof is needed to appropriately reduce occupant deaths and injuries or to challenge an agency cost-benefit analysis that NHTSA believes supports its regulatory choice.

NHTSA states that a number of major factors will substantially change both benefits and costs of a final rule. 73 FR 5488. Among these are major revisions to the benefits population that is the target of the SNPRM because the agency has modified its analysis of the cause of death in rollover crashes, resulting in a reduction by one-third the number of annual fatalities attributable to head injury that were estimated in the 2005 Preliminary Regulatory Impact Analysis. *Id.* At 5485. Moreover, NHTSA states that the installation of ESC on new passenger motor vehicles as a result of the April 2007 ESC final rule, 72 FR 17236 (April 2007), "will significantly reduce both the target population and the safety benefits associated with FMVSS No. 216." 73 FR 5488. Further, the agency forecasts increased costs if a 2-sides regulation were adopted. However, figures for the costs and benefits of these major impacts on various regulatory alternatives are not provided for public review and comment. Instead, NHTSA asserts that "regardless of which alternative is adopted in the final rule, the agency will ensure that the final rule is cost beneficial. . . ." *Id.* at 5490. This conclusory assertion does not fulfill the agency's obligation to present the public with the regulatory alternatives it is considering.

B. The SNPRM Is Not a Proposed Rule

The SNPRM is incomplete and does not fulfill the requirements for a proposed rule. Without a cost-benefit analysis, without proposing a specific regulatory alternative for comment, and without an assessment of how the rule can be improved at a minimum with the addition of a specific intrusion limit figure and, desirably, with an energy absorption criterion, the supplementary proposal is only equivalent to an advance notice of proposed rulemaking seeking initial data, views, and arguments for various combinations of prescriptive requirements for a range of regulatory alternatives. NHTSA cannot move from this notice to a final rule without proposing a specific regulation and without a cost-benefit analysis of all regulatory alternatives, especially in light of major changes in costs and benefits that the agency anticipates because of the new considerations indicated in the foregoing paragraphs of *Section VIII* of these comments. That cost-benefit analysis must include an assessment of each regulatory alternative, including the alternative proposed by NHTSA for amending Standard No. 216. The cost-benefit analysis must also comprise an assessment of the injury prevention benefits of an energy management criterion, a maximum residual headroom limit, and the addition of a specific vertical intrusion limit to a SWR value governing an amended standard.

The SNPRM regulatory alternatives comprise several different possible combinations of SWR with a 1-side or 2-sides platen test, with a simple no head contact criterion. These are the principal components of a prospective final rule. It is clear that the agency cannot proceed to a final rule on the basis of this SNPRM given its own finding in its recent 2007 NHTSA Vertical Roof Intrusion Study, as buttressed by the more detailed findings of the IIHS Roof Strength Study, that the number of fatalities and the extent of severe injuries are directly linked to the interaction of roof crush resistance with the amount of intrusion.

C. NHTSA Has Authority to Establish a New Deadline for Issuing a Final Rule

Contrary to NHTSA's claim that it has to accelerate its rulemaking action to meet a statutory deadline by dispensing with a new assessment of costs and benefits for this SNPRM, SAFETEA–LU provides an opportunity for the Secretary to inform Congress that the enacted regulatory deadline cannot be met and to select a new deadline.[35] There are major unresolved issues and a lack of an adequate cost-benefit analysis impacting the supplementary proposed rule. There is no need or justification for NHTSA to short-circuit the rulemaking process by requesting comments without a complete cost-benefit analysis showing the impacts of different regulatory alternatives, including alternatives that must include evaluation of the benefits of an intrusion limit. The SNPRM openly compromises the public in responding to a specific proposed regulation with required supporting materials justifying the agency's choice. It is indefensible for the agency to issue a final rule without any justification in the SNPRM why, at a minimum, the agency needs to forego an adequate cost-benefit analysis of the regulatory alternatives it is considering, in light of the explicit discretion that Congress provided for NHTSA to set new rulemaking deadlines. It is too important to a major opportunity to advance public safety to rush the adoption of a rule that clearly is not ready, especially when Congress has provided the agency ample flexibility in giving full consideration to all options for improving rollover safety by requiring stronger roofs.

IX. Conclusion

The proposed rule as modified by the SNPRM is still inherently deficient at several major junctures. NHTSA is prepared to adopt a compliance test that, even if indexed to a higher SWR, is arguably weaker than the current standard because it lacks a maximum intrusion limit. The benefits of the agency adopting a much more demanding SWR figure, such as at least 4.0×, accompanied by a stringent intrusion limit of 2 inches and a minimum residual headroom limit of 2 inches, would result in many more lives saved each year even despite the growing contribution of ESC to reducing rollover crashes.

In part, those annual lives saved from reduced head, face, and neck trauma would be further augmented by lives saved from reduced occupant ejections because much stronger roofs would produce less portal deformation leading to loss of glazing and door component retention failures that result in open ejection paths. NHTSA may not be able to count these benefits in its artificially constrained cost-benefit analysis, but these benefits are real and they would be produced as corollary benefits from a much stronger roof crush resistance standard, even one based on a quasi-static roof component test. It is hard to understand why NHTSA, while continuing to demur on the adoption of a dynamic roof crush resistance standard, would pass up an opportunity not only to save many more lives from reduced head, face, and neck trauma due to weak roofs in rollover crashes, but also to gain the additional lives saved from reduced ejections. The agency can acknowledge that ejection benefits would be forthcoming just from a stronger roof crush resistance regulation even if it also had to state that such benefits could not be quantified in this rulemaking action.

A much stronger roof strength standard would also increase the effectiveness of upper interior air bags and curtains because front pillars, headers, and side rails would resist deformation far better and thereby increase the lifesaving benefits of these upper interior passive restraint systems.[36] This is particularly true if the agency also moves forward with upper interior head impact protection systems that are required to have sustained inflation throughout the protracted amount of time that a rollover crash can consume before the vehicle comes to a stop.[37] A weak roof strength standard undermines future agency efforts to combine different strategic responses to occupant compartment safety that provide the safety management synergism that a well-reasoned, systems engineering approach can provide. Even the IIHS Roof Strength Study and DVExperts appreciate the effect of a much stronger roof crush resistance standard on other, mutually dependent and interacting safety systems within the occupant compartment. NHTSA should not forswear these prospective benefits, much less undermine its future rulemaking actions in these and

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[35] SAFETEA–LU specifically provides the Secretary and NHTSA with discretion on meeting statutory deadlines for regulatory action:

(e) DEADLINES.—If the Secretary determines that the deadline for a final rule under this section cannot be met, the Secretary shall——

(1) notify the Senate Committee on Commerce, Science, and Transportation and the House of Representatives Committee on Energy and Commerce and explain why that deadline cannot be met; and

(2) establish a new deadline.

SAFETEA–LU, § 10301(a), codified at 49 U.S.C. § 30128(e).

[36] "As the number of vehicles with side curtain airbags increase, the likelihood of ejection through the side windows should decrease. However, weak roofs could compromise the protection afforded by these airbags if they allow the roof rails to shift laterally and expose occupants to contacts with the ground." IIHS Roof Strength Study at 13.

[37] DVExperts emphasizes this at 2, 8.

other crashworthiness design and performance areas, by refusing to adopt a much more demanding roof crush resistance standard along the lines suggested by Advocates in the foregoing comments.

Advocates also wants to emphasize here that NHTSA apparently regards any quasi-static test method for determining roof crush resistance to be essentially occupant age-neutral in its effects, despite its own 2007 NHTSA Vertical Roof Intrusion Study finding a statistically significant correlation of roof crush with front seat occupant age.[38] Unfortunately, that unstated assumption clearly is not the case. The IIHS study also found strong correlations of significant injury risk increases—12 to 13 percent—for each 10-year increase in driver age.[39] To date, NHTSA has offered a proposed roof crush resistance regulatory proposal that disregards the substantial greater propensity to injury of older vs. younger vehicle occupants, despite the fact that the 8 adjusted models of its 2007 Vertical Roof Intrusion study found that occupant age was one of the 4 statistically significant variables.[40] Given the rapid "squaring" of the demographic pyramid in the U. S., with disproportionately large increases each year in both the number and percentage of older passenger vehicle occupants, NHTSA has an obligation to err on the side of caution by adopting a standard that will afford substantially increased protection to older front-seat occupants who are more prone to severe injuries and death in rollover crashes where roof crush is the main cause of head, face, and neck trauma. The SNPRM foists starkly inequitable safety impacts on older Americans. If the agency does not adopt a standard that affords substantial protection to older vehicle occupants in rollover crashes involving roof crush, the agency will be imposing substantially more severe injuries and societal costs on a rapidly aging U.S. vehicle occupant population.

NHTSA cannot issue a final rule based on the SNPRM. The SNPRM is essentially procedural window-dressing without advancing a specific, substantive regulatory proposal for public review and comment. The proposal is incomplete without a specific assessment of injury and fatality prevention from the various regulatory alternatives on which the agency requests comments, without the consideration of a specific roof vertical intrusion limit and energy absorption criterion, and without an assessment of the different costs and benefits of these alternatives. The agency cannot issue a final rule without prior notice and comment that provides the public an opportunity to assess NHTSA's cost-benefit analysis and its injury and fatality claims for different regulatory alternatives taking these considerations into account. A final rule issued on the basis of the SNPRM and the existing rulemaking record would be subject to challenge. NHTSA should instead avail itself of the explicit statutory permission granted the agency to establish a later date for completing roof crush resistance rulemaking in order to provide a more reasonable and effective regulatory proposal with ample opportunity for public comments on the merits.

Respectfully submitted,

GERALD A. DONALDSON, PH.D.,
Senior Research Director.

Senator PRYOR. Thank you.

And thank you all for testifying today.

Let me go ahead and start, if I may. I think, in Mr. Stanton's testimony, he said that he was opposed to the dynamic test. I just want clarification, if I can, from Mr. Strassburger. Are you all equally as opposed to dynamic testing?

Mr. STRASSBURGER. We are opposed to dynamic testing, for the reasons I indicated. Despite decades of trying, there is yet still no dynamic test that is repeatable and reproducible such that it gives us the engineering data that we need to be able to design our vehicles. If a test gives us the three different answers to the same question, which of those answers do we, as engineers, use to design our vehicles?

Senator PRYOR. And is that——

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[38] 2007 NHTSA Vertical Roof Intrusion Study at 16.
[39] IIHS Roof Strength Study at 14.
[40] 2007 NHTSA Vertical Roof Intrusion Study at 16.

Mr. STRASSBURGER. The quasi-static test works well, it is representative of the deformation that we see in real-world crashes, and it should be retained.

Senator PRYOR.—and is that true with the vehicle test that Ms. Claybrook talked about, the Jordan Rollover——

Mr. STRASSBURGER. Our——

Senator PRYOR.—dynamic test?

Mr. STRASSBURGER.—our concerns with the Jordan Rollover Test are exactly the same; it's not repeatable, it's not reproducible.

Senator PRYOR. OK. Let me ask, if I may, Mr. Strassburger, about doing the test on both sides of the roof instead of just one side. Currently, NHTSA just tests one side. What's your association's position on testing both sides?

Mr. STRASSBURGER. Here again, we think that the quasi-static test, where the agency, at its option, can test either side of the vehicle, should be retained. We, again, have concerns about the reproducibility and the repeatability of the two-sided test. It adds additional test complexity, it adds additional test variability, but it doesn't give us additional engineering data to design our roofs.

Senator PRYOR. Mr. Stanton, do you have a position on the two-sided test?

Mr. STANTON. Yes, Senator, it's not terribly deep, in that we—we looked at the one-sided test, and you can test either the right or the left side, so you've got to build both sides the same way, but then when NHTSA came out with the SNPRM on the two-sided test, we just, quite honestly, didn't know enough. We looked at it, and we said it shows some promise, but, as of right now, we're not in a position to endorse it or to say that it's not a good test, either.

Senator PRYOR. So——

Mr. STANTON. We would like to see additional data on that.

Senator PRYOR.—OK. So, you're opposed to it, for the time being, at least.

Mr. STANTON. No, we're not opposed to it. We're—we just need additional information to find out whether or not it would be better and provide better data than the single-sided test.

Senator PRYOR. All right.

Mr. Strassburger, on that two-sided test, it seems to me that doing a two-sided test would give you more data to work with, and it seems to me that when there is a rollover, often times the integrity of the roof is compromised with that first crush. To me, it seems it would be important to know what happens when there is a second crush on the other side of the roof. Why I am wrong about that?

Mr. STRASSBURGER. It would seem to give you more data, but in the limited amount of data that the agency has provided, some of that data was in conflict with each other; they provided just two test series where they tested the same vehicle twice, and in each instance there was conflicting test data that was——

Senator PRYOR. But you're——

Mr. STRASSBURGER.—generated by those tests.

Senator PRYOR.—but you're basing that on NHTSA's data that they provided. What about your data? Because I know the auto manufacturers have a lot of data on this, as well.

Mr. STRASSBURGER. It is part of the rulemaking record, and I don't believe we provided any data that we had on two-sided tests.

Senator PRYOR. No, I understand you haven't provided it to NHTSA. But, your companies have internal data, I'm sure, on this kind of testing, on the two-sided testing.

Mr. STRASSBURGER. If they do, none of that has come to the Alliance.

Senator PRYOR. OK.

Mr. STRASSBURGER. We don't have that data.

Senator PRYOR. Well, there again, I think that the public's perception will be that a two-sided test is a better test than a one-sided test. If the public knows that that's available, I think the public would want to see a two-sided test.

While I have you, Mr. Strassburger, let me ask this. Is there a strength-to-weight ratio that most closely resembles a rollover, or are there just too many variables in a rollover?

Mr. STRASSBURGER. All of the—there are too many variables. There—the technical literature is rich with debate on the relationship—the causal relationship between roof strength and injury risk. To this date, even with the most recent IIHS study, we don't see a causal relationship with injury risk and roof strength. And we have concerns about the IIHS study. We've looked at it, haven't finished reviewing it. But, when we apply standard statistical tests to test the rigor of the assumptions that the IIHS study has adopted, their conclusions don't hold up.

Senator PRYOR. But, you would agree, as a general matter, that the stronger you make the roof, the less likely it is for you to have a serious injury or fatality in a rollover accident, wouldn't you?

Mr. STRASSBURGER. Intuitively, you would think that, but the data does not show that. And, at the end of the day, we're not going to improve motor vehicle safety through good intentions or because we think we will do so. We need to have some certainty or some reasonable expectation that things are going to change in the real world with the changes that we make.

Senator PRYOR. Ms. Claybrook, do you agree with what Mr. Strassburger just said?

Ms. CLAYBROOK. No, I don't, for a number of reasons. First of all, on the dynamic test device, of course, the industry hasn't ever attempted to use this, and neither has NHTSA. But, if you look at real-world crashes, which are referred to as other similar instances in the literature, and you look at the tests that occur with the JRS on the same model vehicle, you see they're quite similar. The JRS test device does mimic what happens in the real world.

There have been repeatability tests done. They have come out very close when the same vehicle has been tested again and again. Of course, this has all been done privately by a few individuals, and I believe that NHTSA should put some money into this, since it doesn't have any other test device that is dynamic that has this quality and capacity and is inexpensive.

The industry—for example, General Motors has a new test system, that they announced with great fanfare, that—where they test the vehicle. It tests the side head airbag, but it very specifically doesn't test for roof crush, because they don't want to have any data. And, of course, the trade association doesn't have the data.

It's the companies, as you point out, that have whatever data they have collected.

The CRIS device that Ford has is like the dolly rollover test, only more sophisticated, but it doesn't control the vehicle after it's thrown off the back of the vehicle in a way where they can assure repeatability. The brilliance of the JRS device is that it is totally controlled testing. And we now have the film. So, if it would be possible——

Senator PRYOR. Yes, let's go ahead and watch that.

Ms. CLAYBROOK.—to take a look at that—it's 17 seconds. Oh, we did, and now we don't? OK. Well—

[Laughter.]

Ms. CLAYBROOK.—hopefully——

Senator PRYOR. It wasn't meant to be.

Ms. CLAYBROOK.—hopefully, at some point, we'll get to see that better.

The other issue that has been raised is that the auto companies, since the early 1970s, have taken the position that if the roof crushes in, your head is already damaged because you hit the roof first. This has been shown, technically, in a number of papers and analyses, to be malarkey. And it's also, just by your own thought process, pretty much malarkey. But, if you look at who gets injured in crashes, if you look at just the crashes—at the vehicle after the crash, and who gets injured, it's the people sitting where the roof crushed in that are the ones who have the head injury and are quadriplegics and paraplegics. So, it's very obvious that when the roof crushes, the person sitting under it is often harmed.

The other issue about roof crush is this. When the vehicle is upside-down, the backbone of the vehicle is the roof. And so, the belt system isn't going to work right if the roof crushes in. The side head airbag isn't going to work right if the roof crushes in. The doors are going to come open if the roof crushes in. The windows are going to pop out or crack. The windshield is going to be damaged if the roof crushes in. The roof controls all those elements. And what causes ejection is when there is no side window or when there is—the windshield itself is not there, or when the doors open. If the belt has a pretensioner for rollover, which most of the vehicles today do not, and this should be required, that's not going to work properly if the roof crushes in. The roof is like the chassis when the vehicle is right-side-up. In rollover crashes the roof is the critical element in the performance of this vehicle and the survival space, as it's called, for the occupant inside.

These industry arguments are just arguments, they're——

Senator PRYOR. Let——

Ms. CLAYBROOK.—not facts.

Senator PRYOR.—let me ask this, Ms. Claybrook. If, assuming the NHTSA decides not to do the dynamic test, and I know you want them to do a dynamic test, but assuming they decide not to, does it make sense for NHTSA to then do the two-sided roof test?

Ms. CLAYBROOK. It should do a two-sided roof test, but it also should change where the platen is placed and the force that is used, because right now when a rollover occurs, the engine makes the vehicle tilt forward, when it's upside-down, which means that the occupants tilt forward, which means that the most critical part of the vehicle is the roof over the A-pillar, which holds the windshield. And so, when the windshield cracks on the first corner roll, then there is a 30 percent reduction in the strength of the roof, and that's the reason you have to have, a two-sided test. It should be done without the windshield in there, so that you really get what the true forces are that are experienced in that crash.

The way the current test is designed, the B-pillar is the part—the pillar by your shoulder—is the one that gets the most pressure, and the A-pillar does not get a sufficient test. In addition to a two-sided test, the platen should be smaller and at a sharper angle, it should exert more force, it should be moved forward, and the windshield shouldn't be there. That, if you're going to do a quasi-static test, is the one that would make a lot of sense.

Senator PRYOR. OK.

Dr. Garcia, let me ask you—I don't know if you're familiar with this proposed preemption that they're trying to do, where, basically, NHTSA would try to limit the ability to go to court after one of these. Do you have an impression of what that would do out there in the real world, what the preemption clause would do?

Dr. GARCIA. Right. It would definitely impact negatively the American people. I spent a lot of years—I came from a very poor background—to go to school. If I didn't have the ability to go to court and make my case, my life would have been totally lost by now, with no resources.

I mean, this impacts a lot of different situations. You know, the healthcare issue—I mean, you have to understand what it is to live with an injury like the one I have. Dr. Pena, behind me, is also living with it. You cannot take away that right. I went to court, and we won. We proved to a jury that the roof was defective. You cannot take away the right of the individual to go in there and have their day in court.

So, it will have an impact on the—not just on me, but potential people who will become injured. I mean, we're not just here just for us. We're already injured. We're here for people like you. We're here for your children, for this to finally come to an end. And closing the doors to the courtroom, I don't think that that is just. I think that's cruel and unusual punishment when you do that.

Senator PRYOR. Mr. Oesch, do you have a position on the preemption clause?

Mr. OESCH. We don't, sir, but I would like to address two other things, if you——

Senator PRYOR. Sure.

Mr. OESCH.—don't mind.

Senator PRYOR. Sure.

Mr. OESCH. Thank you.

You were right, when just a moment ago what you said intuitively was exactly what our study showed; that is, with increased roof strength, there was lower injury risk. Mr. Strassburger referred to a study that was commissioned by the Alliance, questioning those results. We'll be sharing with the Alliance, and we'd like to share with this committee, with your permission, our analysis of that study.

[The information referred to follows:]

INSURANCE INSTITUTE FOR HIGHWAY SAFETY
June 18, 2008

Hon. MARK PRYOR,
Chairman,
Subcommittee on Consumer Affairs, Insurance, and Automotive Safety,
U.S. Senate ,
Washington, DC.

Dear Chairman Pryor:

On June 4, 2008, the Senate Subcommittee on Consumer Affairs, Insurance, and Automotive Safety held an oversight hearing on passenger vehicle roof strength. I testified on behalf of the Insurance Institute for Highway Safety (IIHS) regarding a study we recently completed revealing that increased roof strength in the quasi-static test mandated under Federal Motor Vehicle Safety Standard (FMVSS) 216 reduces the risk of fatal or incapacitating driver injury in rollover crashes (Brumbelow *et al.,* 2008). While seemingly intuitive, this finding contradicts previous studies, funded by automobile manufacturers, that reported no relationship between FMVSS 216 results and injury risk in real-world rollover crashes (Moffatt and Padmanaban, 1995; Padmanaban *et al.,* 2005).

In testifying on June 4, the Alliance for Automobile Manufacturers (AAM), represented by Mr. Robert Strassburger, maintained its position that stronger roofs do not reduce injury risk and questioned IIHS's study based on a critique AAM commissioned from M. Laurentius Marais of Wecker Associates (AAM, 2008). However, Marais' critique does not support AAM's statements concerning the IIHS study. In addition, the critique misrepresents IIHS's research and is, itself, based on problematic statistical analyses.

AAM Claims Not Supported by the Marais Analysis

During the roof strength hearing, Mr. Strassburger said, "intuitively you would think that [stronger roofs reduce injury risk] but the data do not show that." He stated that the conclusions of the IIHS study "don't hold up" and that "we don't see a causal relationship with injury risk and roof strength." However, these comments are not supported by Marais' analysis, which also indicates an overall decrease in injury risk as roof strength increases. Rather than contradicting the relationship, Marais concluded that "the IIHS Study's 28-percent result cannot be validly extrapolated to roof strength in the relevant range from SWR 2.5 to 3.0–3.5 and beyond." Thus, Marais focused on whether the data in the IIHS study indicate that injury risk decreases by exactly the same amount for each incremental change in roof strength. This was not the research question the IIHS study was designed to address. Criticizing the study on this basis can be compared with criticizing a finding that hotter temperatures increase the incidence of heat stroke by saying that the data do not show the same rate of increase between 80 and 100 degrees as from 90 to 110 degrees.

Marais began his critique of IIHS's study by attempting to duplicate the research. He was unable to obtain data from 3 of the 12 states used in the IIHS study, somewhat reducing his sample size. Even with data from the 9 remaining states, it is not clear that Marais correctly duplicated the IIHS study, as Figure 1b in his analysis shows injury rates 36–43 percent higher than when IIHS counts are limited to the same 9 states. Despite this discrepancy, Marais' logistic regression with these data estimated a 27 percent reduction in the risk of fatal or incapacitating driver injury for a 1-unit increase in roof strength-to-weight ratio (SWR), which is similar to the IIHS study's estimate of a 28 percent risk reduction for the same increase in roof strength. This is the best estimate of the relationship between roof strength and injury risk with the data available. It answers the question IIHS research was designed to address, showing that roof strength as measured under FMVSS 216 is strongly related to the risk of injury in real-world rollovers.

Methods Used by Marais Are Inappropriate

Marais' main criticism of the IIHS study is based on his application of a "rainbow test" meant to determine whether the vehicles with the lowest and highest roof strengths show injury risk reductions of the same magnitude as vehicles with intermediate roof strengths. However, for such a test to be conclusive the low, intermediate, and high strength groups must each have enough data to be analyzed separately and produce meaningful results. This is not the case here, and Marais' manipulations of the data confirm only that this is a small dataset (11 roof designs), not that there is a level of roof strength above which there is no benefit of increased strength.

Beyond the criticisms resulting from his flawed "rainbow test," Marais performed 2 logistic regression analyses attempting to show the relationship of roof strength and injury risk for only those vehicles with the strongest roofs. The first was limited to vehicles with roof SWR values of at least 2.0, and the second included vehicles with roof SWRs at or above 2.5. These predicted injury risk increases of 2 and 3 percent, respectively, for each 1-unit SWR increase. Marais concluded there is "no statistically reliable indication of a reduction in the risk of injury in the range of SWR from 2.5 to 3.5." But these conclusions are highly sensitive to the SWR cutoff points Marais selected, as demonstrated by 3 additional logistic regression analyses of the IIHS study data. Cutoff values of 1.9, 2.0, and 2.1 produced injury risk predictions of a 32 percent decrease, 13 percent decrease, and 21 percent increase, respectively.

Furthermore, if Marais had estimated the risk of fatality alone (excluding incapacitating injuries) using his selected cutoff values of 2.0 and 2.5, he would have found risk reductions of 53 and 40 percent, respectively, for 1-unit increases in SWR. These comparisons demonstrate the potential bias from statistical analyses that use arbitrarily selected cutoffs in small datasets and confirm that these data are not sufficient to answer Marais' question of whether or not the effect of roof strength changes. The best estimates from the available data are those that consider all the vehicles in the IIHS study.

Marais Analysis Misplaces Burden of Proof

The IIHS study clearly shows that stronger roofs reduce injury risks, in contrast to previous research funded by members of AAM. If AAM believes there is a level of roof strength that is no longer beneficial for occupant protection, or that actually increases the risk of injury in rollover crashes, the burden of proof is on AAM to provide data demonstrating such a trade-off. The Marais analysis fails to do this.

It is true that the available data do not allow precise estimates of the benefit of roof strength for vehicles stronger than those IIHS has tested, and IIHS has not attempted to make such estimates. However, the large benefit that has been found for the vehicles studied is sufficient evidence that increasing the minimum roof strength requirement to SWR 3.0 or 3.5 would save many more lives than the National Highway Traffic Safety Administration previously has estimated.

Sincerely,

STEPHEN L. OESCH,
Senior Vice President, Secretary and Treasurer.

References

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Mr. OESCH. We can show that, in fact, our study demonstrates there is a consistent relationship between increased roof strength and lower injury risk. And that is why it is important for the Federal agency to adopt a standard that is going to require a high strength-to-weight ratio.

Senator PRYOR. And then, did you have a second point?

Mr. OESCH. Yes, sir. I just wanted to address, very quickly—and it's addressed in my testimony—the dynamic test. We think the dynamic test is, in fact, a gold standard. We don't think, however, that we currently know enough about that test to be able to establish all the test conditions. In addition the test dummies that are currently used in the other types of testing are not appropriate for the rollover crash. So, at this time, we would urge that there be additional research done on that issue.

Thank you, sir.

Senator PRYOR. Mr. Strassburger, do you have a position on the preemption clause?

Mr. STRASSBURGER. With respect to the preemption, we were surprised to see it in the proposal by the agency. We have submitted comments to the agency regarding that proposal. And should the— and we expect, as the agency goes through its final steps in the rulemaking and weighs all the input, it will make appropriate decisions, and we will abide by those decisions.

Senator PRYOR. And in your comments, did you support it or oppose it?

Mr. STRASSBURGER. In our comments, we specifically addressed whether or not the agency had authority to adopt such a preemption. The—we also commented, I believe, on the—some of the tradeoffs that the agency was looking to address with the preemption and their concern that it might lead to additional fatalities if it were absent. If those factors remain in place at the end of this rulemaking period, then we expect the agency will make appropriate decisions.

Senator PRYOR. I want to go a little bit out of order. Ms. Gillan, do you have a view on the preemption clause?

Ms. GILLAN. Senator, we don't have an official position on the preemption clause, but I will tell you, I've worked on highway safety and motor vehicle safety for over 20 years, inside and outside the Federal Government and through various administrations, and this is the first time that I've experienced or seen this kind of language put in these regulatory proceedings.

Senator PRYOR. Mr. Stanton, do you have——

Mr. STANTON. Yes, we—in the Notice of Proposed Rulemaking, we commented, but we treated it as the need for a national standard. It's very important, when you're building automobiles to sell in 50 states, that the same requirements apply to all the automobiles. So, we took it as a design standard and commented on that. And we would support that very strongly, that there be a single design standard for our vehicles.

Senator PRYOR.—OK. I would comment, though, that there has never been one before, in the history of the auto industry, but I understand what you're saying.

Mr. STANTON. Well, we don't—Senator, I think it goes to the point of, when we build a vehicle, and we meet national standards, we want to make sure that states don't set standards that are different than the national standard.

Senator PRYOR. Right. But, preemption—the part of the preemption clause I was talking about was really preempting state law——

Mr. STANTON. Yes. No——

Senator PRYOR.—on tort claims.

Mr. STANTON.—and we did not comment on that part.

Senator PRYOR. Yes, which is a little different.

I saved you for the last on this, Ms. Claybrook, because you're a former NHTSA Administrator. And during your tenure there, did the agency ever try to do preemption?

Ms. CLAYBROOK. No, Mr. Chairman, we did not. In fact, just the opposite. We actually thought that there was great value to having the individual lawsuits. And the reason why is that NHTSA standards are broad performance standards, and they don't deal with lots and lots of issues that arise in the course either of manufacturing or in the course of designing vehicles. And so, the proposed rollover rule encourages a court to find preemption even if the standard doesn't address the particular item that is defective. So, that's one big problem.

But, I would like to address the design issue here, if I have one second to do that. The position of the auto industry is that if a court makes a decision and says that, even though there is a Federal standard, there is negligence by the company, in terms of the way that they have designed the vehicle, they view that decision as the equivalent of a state standard. And so, they think that the lawsuit ought to be preempted, because the Federal Government has addressed this issue. But, the Federal Government really hasn't addressed this issue broadly. Even if it has, as Senator McCaskill pointed out, sometimes that standard's so out of date that it's almost irrelevant. And why should that preempt people who are injured from getting compensation.

If people are injured because of the failure of a safety system in a car, particularly a safety system, then they should be able to recover, because they have been injured by the negligence of the company in designing or manufacturing it.

And it is not as though, in this roof-crush area, that the companies haven't known for years of these deficiencies. In fact, NHTSA's 1971 proposed standard had a two-sided test, causing General Motors to test their vehicles, and they found they couldn't meet it, so they came back in to NHTSA and said, "Well, you don't really need a two-sided test, because both sides of the vehicle are the same," ignoring the fact, of course, that when one side's crushed in, the other side doesn't work as well.

Senator PRYOR. Yes, let me ask a little bit of a follow up on that, but also go in a little different direction because there is disagreement that I've read in the written testimony, and talking to folks in the industry and talking to the advocacy groups. There's a disagreement on how much strengthening the roof actually costs. I think NHTSA maybe has a view, and others have views. I've not been able to come up with a definitive number on that, and I know that part of that depends on what standard the roof has to meet. Let me ask this, if I can. If you all can give me your estimates, your best estimate, or best, maybe, rule of thumb, on what it would cost to actually strengthen these roofs to a level where you make a major improvement in roof-crush safety. I assume, Dr. Garcia, you would not have an opinion on that. So, I'll start with Mr. Oesch.

Mr. OESCH. We have not evaluated that issue, sir. We've concentrated on looking at the relationship, between roof strength and injury reduction, and have conclusively shown: stronger roofs, less injury.

Senator PRYOR. OK.

Mr. Strassburger, I know that part of what you consider, when you talk about that, is not just the materials in the roof itself, but you consider the engineering costs and retooling costs for redesign. So, how does that translate into cost per vehicle?

Mr. STRASSBURGER. First of all, Senator, let me say, in our normal deliberations within the Alliance, we don't consider costs at all. To the extent that we've provided cost information to—in this rulemaking, it has been at the request of the agency to develop such information.

My testimony does provide both variable-cost and fixed-cost information, as well as mass changes or weight changes to vehicles in two instances, one for a large SUV and another for a large pickup truck. And to quickly summarize here, when we're looking at a—going to a strength-to-weight ratio of 2.5, for those vehicles we're looking at a weight increase of the large SUV of between 60 and 67 pounds, and a variable cost, or per-vehicle cost, of about $38 to $58 a vehicle, versus a large pickup truck, where we're looking at between 38 and 68 pounds and a variable cost of between $55 and $185 a vehicle.

Senator PRYOR. OK.

Mr. STRASSBURGER. Those have been submitted to, not only this record, but to the agency, as well.

Senator PRYOR. Yes. We're going to leave the record open, by the way, for those of you who want to submit studies and documents, et cetera. So, we encourage you to do that.

Ms. Claybrook, do you have a sense of what it would cost to strengthen the roofs in such a way that you would have a major increase in safety?

Ms. CLAYBROOK. Well, Public Citizen does not have the capacity to do those individual kind of calculations. There was a study by Ohio State University that was submitted to the docket which shows that an after-market upgrade of the Ford Explorer to provide the same level of protection as the Volvo XC90 was about $81. And that's an after-market effort, it's not mass production. So, you really have to reduce that significantly. We would say between $40, max, to $50 is probably a high end for production vehicles, and we view that as being relatively inexpensive, in the scheme of things.

Senator PRYOR. Mr. Stanton, did you have an opinion on that?

Mr. STANTON. Yes, we did. We didn't comment on the cost, but we did comment on the lead time, and—which is extremely important. And, as I said in my statement, you know, 3-year lead time and 3-year phase-in, major redesigns of these vehicles, if we can do it during a major redesign, we can keep the costs down and we can do it right.

Ms. GILLAN. Senator——

Senator PRYOR. Ms. Gillan?

Ms. GILLAN.—advocates does not do studies about costs, but, in addition to the study that Joan Claybrook cited—and I have this in my testimony—the Ohio State University Study—we also cite another study, conducted by George Washington University, where they found that strengthening the 2003 Ford Explorer to 3.0 strength-to-weight ratio would raise the vehicle price by $33 to $35.

Senator PRYOR. OK.

Well, like I said, that's an issue—I mean, that's a practical consideration that we need to think about. And the estimates are all over the board. I think that's an important consideration.

We actually have a roll call vote going on right now, so what I'm going to do is conclude the hearing here in just one moment.

I would like to thank all three panels of witnesses. I appreciate your time and effort, not just to get here, but all your preparation and the materials that you've already submitted for the record.

We are going to leave the record open for 2 weeks. I anticipate that Senators will ask questions and submit those in writing to you, so we would ask you to get those back to us and give us thorough answers, if you possibly can, within the next 2 weeks.

And then, like I said, a couple of you have mentioned, a study or other additional documents that you'd like to submit for the record. Certainly, we'll take those.

Again, I want to thank you all for being here today, and tell you how much we appreciate it. It's an important matter for the Senate committee to look at and to familiarize ourselves with.

And I do think one of the messages, at least, that came through loud and clear today is that it's more important to get this right than to get it done fast. And I think pretty much everybody—in one way or another—almost everybody has said that today. We'll work with NHTSA and encourage them to do the right thing, even if it does take a little extra time. We want to affect the best public policy.

So, again, thank you for your time, and I appreciate you all being here.

And we will conclude the hearing.

[Whereupon, at 11:53 a.m., the hearing was adjourned.]

A P P E N D I X

Hon. MARK PRYOR,
Chairman,
Subcommittee on Consumer Affairs, Insurance, and Automotive Safety,
Committee on Commerce, Science, and Transportation,
U.S. Senate,
Washington, DC.

REQUIRE NHTSA TO UPGRADE ROOF STRENGTH SWR TO AT LEAST 4.0—
SUBMISSION FOR THE RECORD RE: HEARING OF JUNE 4, 2008 NHTSA
RULEMAKING ON PASSENGER VEHICLE ROOF STRENGTH

To the Hon. Senator Pryor:

As a 27-year-old member of the driving public, I am especially concerned about issues of auto safety. In 2006, nearly 43,000 Americans were killed in auto accidents. A large proportion of those (over 7,000) were in the 25–34 year old age group. Auto accidents claim more teen and young adult lives each year than any other cause of death. And roof crush accidents account for an estimated 25-percent of those. For these reasons I am concerned that the government and auto industry may not be working hard enough to ensure our vehicles are safe in rollover accidents.

I attended the hearing you conducted on June 4, 2008, and listened carefully to all of the testimony. At this time, I would like to submit my own comments for your consideration and for the official record.

While NHTSA and the auto manufacturers are attempting to "upgrade" the Federal Motor Vehicle Safety Standard for roof strength to require a vehicle's strength-to-weight ratio (SWR) of 2.5 or 3 times the weight of the vehicle, they make excuses why the requirement cannot be at least 4.0 times the weight of the vehicle. I own and drive a 2005 Toyota Scion tC with a roof SWR of 4.6. *Therefore I would like to refute three of NHTSA and the automaker's claims as to why they cannot increase roof strength:*

1. Automakers claim: *Requiring stronger roofs will take years of research and development.* WRONG. My 2005 Toyota Scion tC already has a strong roof with a SWR of 4.6.

2. Automakers claim: *Requiring stronger roofs will add weight to a vehicle, thereby decreasing its fuel economy.* WRONG. My 2005 Toyota Scion tC, with its strong roof, weighs about 2,900 lbs. and gets a respectable 20/25 miles per gallon. It is lighter than some of its competitors and gets better gas mileage . . . and has a stronger roof at the same time.

3. Automakers claim: *Requiring stronger roofs will add excessive cost to a vehicle.* WRONG. My 2005 Scion tC has a base price of $16,100. It is among the most economical vehicles available for purchase . . . even with its strong roof.

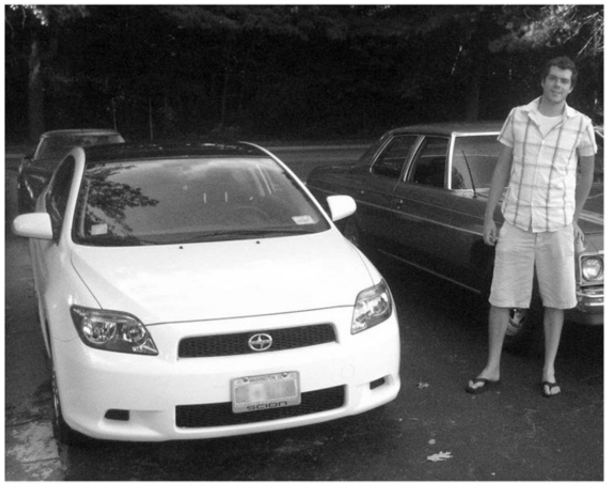
As you can see, the reasons offered by automakers as to why vehicle roofs cannot be strengthened are just poor excuses. If Toyota can mass-produce an inexpensive, fuel-efficient car in 2005 with a roof strength-to-weight ratio of 4.6, why can't NHTSA create a better roof crush standard and why can't automakers design and manufacture stronger roofs today? The technology is clearly feasible and available to provide stronger roofs in more mass produced cars on the road.

While NHTSA and the automakers work together to delay and weaken our roof crush standard and the safety of our vehicles, more young people will continue to die and be permanently injured in rollover accidents.

Please work quickly to upgrade the roof crush standard to require at least a 4.0 SWR.

Thank you for accepting my submission.
Sincerely,

BRANDON BLOCH,
Concerned Driver.



Me and my 2005 Toyota Scion tC (with a roof SWR of 4.6)

WHY THE NHTSA PROPOSAL FOR FMVSS 216 ON ROOF CRUSH MUST INCLUDE AT LEAST A STRENGTH-TO-WEIGHT RATIO OF 4.0 AND DYNAMIC ROLLOVER TESTING, AND MUST NOT INCLUDE "PREEMPTION" WHICH WOULD DEPRIVE INJURED VICTIMS

by Byron Bloch—March 14, 2008, *www.AutoSafetyExpert.com*

If vehicle testing is to have validity, it must be relevant to what happens in real-world accidents. As an experienced auto safety professional for about 40 years, I have documented the U.S. roof crush safety standard and its failure to ensure safe roofs. The U.S. fatality toll in rollovers used to be about 1,000 per year in the 1970s, and now it has climbed upward to over 10,000 per year in the U.S. Whats wrong with vehicle roofs, and why has the U.S. safety standard failed to ensure that vehicles would have safe roof structures ? And why is NHTSA, a regulatory agency, now trying to grant preemption from liability to automakers, and thereby deprive injured victims in rollover accidents of their right to seek justice for needlessly unsafe and defective roofs?

Crash testing must represent the reality of collision accidents… including rollover – roof crush accidents

The matrix of crash testing by some European automakers is a proclaimed effort to represent what happens in real-world collision accidents. As stated by GM-Opel in 1993, *"Because test standards are often too theoretical, the test program for Opel models focuses on reality—on real accidents on European roads."* But in the U.S., each of the FMVSS safety standards typically uses only a single crash test or static-load test as a *minimum* compliance test that's often unrealistic to what happens in real-world accidents. And the compliance test does not get upgraded or strengthened for 20 or 30 years, if at all.

However, beginning in the 1970s, many European automakers adopted dynamic rollover tests as their own requirement, possibly in anticipation that the U.S. compliance test would soon be upgraded, and also because they understood the validity of such realistic testing to represent what happens in actual rollover accidents.

After more than three decades of delay, there is now a controversy about finally upgrading FMVSS 216. The U.S. automakers (GM, Ford, Chrysler) are urging a slight increase in the "*slow push*" force requirements . . . but with the highly-controversial proviso that compliance would grant automakers automatic preemption from any future product-liability claims if someone was severely or fatally injured by an allegedly too-weak roof in a rollover accident. This would deprive injured car-crash victims of their rights to seek compensation via litigation, and would shift the medical and rehabilitation cost burdens to the states or nation.

The "Upgrading" of FMVSS 216 to a "Slow Push" Test at 2.5 or 3 Times the Vehicle Weight Is Grossly Inadequate, Far Too Minimal, and Well Below the State-of-the-Art

All other accident scenarios have U.S. safety standards that require dynamic crash testing . . . frontal impact, side impact, and rear impact. So why is rollover the only accident scenario that is not matched to dynamic testing?

- *FMVSS 216 only requires a "slow push" test on a portion of the roof.* Presently, only one frontal corner of the roof is tested, but the proposed new "upgraded" regulation will likely include testing of first one side, and then the opposite side. This is supposed to account for such potentially adverse factors as the breakage and/or separation of the windshield, which typically contributes a small percentage to the roof strength.
- *FMVSS 216 is only a "minimum requirement"* and when it was introduced back in 1973, it was supposed to be replaced with a dynamic dolly rollover test by 1978. But that never happened.
- *FMVSS 216 does not require any dynamic rollover test,* which would simulate what happens in real-world accidents. Such a dynamic rollover test would also evaluate the effectiveness of the seatbelt restraint devices, the interior surfaces and any injury-mitigation padding, the side window glass and its propensity for breakage, the effectiveness of inflatable side-curtain airbags, and the maintenance of proper seat anchorage and seat strength.
- *FMVSS 216 does not measure intrusion or penetration into the occupants' "survival space"* as the roof deforms and crushes downward and laterally and rear-

ward during the rollover. However, the pending upgrade to FMVSS 216 does include concern for the roof contacting the head of a seated dummy. But the new NHTSA proposal utilizes only a 50th-percentile average-size male test dummy, whereas the use of 95th-percentile size male test dummies would cover the greater range of at-risk sizes in the population.

- *FMVSS 216 has been unchanged since 1973, while fatalities in rollovers have increased from about 1,000 previously in the early-1970s to now almost 11,000 per year in the U.S.* Although rollovers account for about 2-percent of all accidents, they account for about 40-percent of all fatalities. This is certainly an indication that the so-called "safety standard"for Roof Crush Resistance, FMVSS 216, has not prompted sufficiently strong roofs in the vast majority of cars, pickups, SUVs, and vans here in the U.S.

Back in 1971, General Motors initially commented on the then-proposed new standard called "Roof Intrusion Protection". GM pointed out these main considerations: (*with emphasis added*)

- "*To help reduce the possibility of head and neck injuries in the event of occupant contact with the roof in any type of accident,* most 1971 General Motors passenger car models incorporate *a new double steel roof* with a contoured inner panel."
- "*In 1967 General Motors initiated development of a static roof crush test device and procedure similar to that proposed by the Administration. Although we know of no safety relationship correlating such a laboratory procedure with occupant protection in actual rollovers,* we have found it to be a useful development tool in evaluating the effects of structural changes."
- "General Motors recommends that any laboratory test procedure for roof strength be based on performance requirements . . . *using the concept of an interior 'non-enchroachment zone' for the front seat that is not dependent on ram travel.*"

Thus, GM was pointing out that the static-load or "slow push" type of roof test had ***no safety relationship with actual rollover accidents***. Yes, it was a repeatable type of test to evaluate different roof designs in a laboratory context, *but it did not evaluate what would happen in rollover accidents.* Only a dynamic rollover test would do so, and thats likely why many European automakers also began in the early-1970s to also include dynamic rollover tests, such as the lateral dolly rollover test, in developing and testing their vehicles. Many European cars over the years have thus had stronger roofs.

Ironically, NHTSA itself had contracted for a series of dynamic rollover tests "to evaluate a vehicle rollover procedure" and to assess "the repeatability of rollovers over a wide range of automobiles and small trucks." As noted in the Abstract and Conclusions of this NHTSA project: DOT–HS–800–615:

> "A series of tests were performed using a number of different sizes and configurations of recent models of motor vehicles to verify the rollover procedure called for in the 'Occupant Crash Protection Standard.'"
>
> "The tests proved the adequacy of this procedure to produce repeatable rollovers and to demonstrate the applicability over a large range of vehicle sizes and configurations."
>
> "Based on the results obtained from the tests conducted, it is concluded that the same make, model, and weight vehicle will roll the same number of times and sustain equivalent damage if rolled at the same speed."

So back in 1971, NHTSA had test data and knowledge that the static-load test wasn't realistic enough to correlate with real-world rollover accidents, and that dynamic lateral dolly rollover tests were repeatable. And remember, FMVSS 216 is *only a "minimum requirement"* and when it was introduced back in 1973, *it was supposed to be replaced with a dynamic dolly rollover test by 1978.*

Dynamic rollover tests could and should have been phased in by the mid-to late-1970s. But that never happened. And now, with rollover fatalities in the U.S. approaching 11,000 per year, it is finally time to correct that oversight and needless delay.

NHTSA Tests of Current Production Roofs Show Variance in Strength-to-Weight Ratios . . . With Many Stronger Roofs in the 4 to 5 Range . . . So it Is Wrong to Settle for Only 3

During the past 3 years, 2005–2007, NHTSA conducted 35 tests in which the force was applied via an angled platen downward onto the driver's side of the roof. These were essentially FMVSS 216 type tests, and the strength-to-weight ratio (SWR) was recorded. Force was applied until there was 127 mm (5 inches) of travel, unless head contact occurred first.

More than half of the vehicles . . . cars, SUVs, pickups, and vans of mostly 2005–2007 vintage . . . had a strength-to-weight ratio of 3 or less. And 11 of those vehicles would have failed the proposed NHTSA upgrade of FMVSS 216 at the proposed 2.5 SWR compliance test level.

2007 TOYOTA CAMRY
NHTSA NO. C75113
FMVSS NO. 216

FIGURE 5.9
PRE-TEST OVERALL SIDE VIEW

However, 24 vehicles would have passed with each having a SWR above 2.5 and, therefore, according to a most unusual provision in the NHTSA proposal, those vehicles and their automakers would be exempt from any product-liability lawsuits alleging a defectively designed roof arising out of a rollover accident. The proposed NHTSA liability exemption would apply even if the roof strength had been needlessly compromised by designed-in structural weaknesses, and had buckled and collapsed and thereby caused fatal or quadriplegic injuries.

The legal-liability pre-emption provision is being severely challenged, including by key members of the U.S. Senate Judiciary Committee (Sen. Patrick Leahy, Sen. Arlen Specter), who don't believe that NHTSA has the legal authority, to grant such legal liability exemptions. In the National Traffic and Motor Vehicle Safety Act of 1966, which is the controlling Law enacted by Congress, there is a specific provision directly addressing this point:

> "Compliance with a motor vehicle safety standard prescribed under this chapter does not exempt a person from liability at common law."

Thus, it is clear that Congress expressly prohibited against any exemption from liability at common law. By now trying to include such unwarranted preemption for vehicles whose roofs would comply with a minimum SWR of only 2.5 or 3 (or even 4) NHTSA is clearly disregarding or violating the applicable law.

Stronger Roofs With SWR of 4 to 5-Plus Are Now in Production and Are Clearly Feasible, Economical, and State-of-the-Art

Importantly, in these NHTSA tests, there were 8 vehicles that had a strength-to-weight ratio of 4 up to 5.1. These production vehicles, mostly by Toyota, Volvo, and VW, thus prove that it is practical to have a significantly stronger roof without any major cost or weight burdens. As examples, the 2006 VW Jetta had a SWR of *5.1,* the 2007 Toyota Scion tC had a SWR of *4.6,* the 2006 Volvo XC90 was *4.6,* the 2006 Honda Civic was *4.5,* and the 2007 Toyota Camry was *4.3*.

The adjacent series of photos shows the FMVSS 216 "slow push" roof crush test of a 2007 Toyota Camry 4-Door Sedan, which weighs about 3,200 pounds. It has a roof crush Strength-to-Weight Ratio (SWR) of 4.3 which is well above the minimal requirement of either 2.5 or 3.0 that NHTSA is now considering to apply to future vehicles. *In other words, the current Toyota Camry, and many other vehicles,* ***are already well above*** *the level that NHTSA is considering for* ***future*** *vehicles.*

2007 TOYOTA CAMRY
NHTSA NO. C75113
FMVSS NO. 216
FIGURE [illegible]
POST TEST SIDE VIEW OF VEHICLE

2007 TOYOTA CAMRY
NHTSA NO. C75113
FMVSS NO. 216
FIGURE [illegible]
FULL LOAD FRONT VIEW

The preceding photo shows the Toyota Camry's roof crush at the full load of 13,960 pounds (62,097 Newtons) as applied by the angled platen to the driver's side of the roof, to the platen travel displacement of 5 inches. The photo below shows the headroom for the "head on a stick" test device, representing the driver, was still sufficiently maintained. As noted, the Camry's Strength-to-Weight Ratio was *4.3.*

2007 TOYOTA CAMRY
NHTSA NO. C75113
FMVSS NO. 216
FIGURE 5.21
FULL LOAD INTERIOR SIDE VIEW

A public-information rating system for roof strength should be based on the tested strength-to-weight ratio (SWR), so that prospective customers could select a vehicle with a stronger SWR of *5* over a competitive vehicle with a weaker SWR of only 3. This would also help stimulate the design and adoption of even stronger roofs in more vehicles.

Rollover Accident Case Examples Show How Roofs Actually Fail, and Why They Were "Defectively Designed" Even Though They Complied With FMVSS 216

Here are just two examples showing how terribly weak the roofs are in too many vehicles, all of which meet the archaic FMVSS 216 so-called "Safety Standard". In many such rollover accidents, FMVSS 216 was a failure.

Rollover—Roof Crush Accident Case A

This rollover accident occurred in 1996, in Louisiana. A young man was driving a 1989 Ford Escort 2-door hatchback when, to avoid another vehicle that had cut into his lane, the Escort left the road and rolled over at about 35 mph on the grassy center median.


In the rollover accident, the Ford Escort's roof buckled and crushed downward into his "survival space", causing forces that fractured his cervical vertebrae, rendering the seatbelted driver into a quadriplegic. The right-front passenger, seated where the roof did not buckle down, was basically uninjured.

In the 2007 trial in Louisiana, I testified about the roof's defective design, including its open-section windshield header with large hole cutouts, and A-pillar with minimal reinforcement of only the lower six inches. *I noted that though the vehicle complied with FMVSS 216, its roof structure was clearly inadequate.* The jury decided a verdict for the Plaintiff.

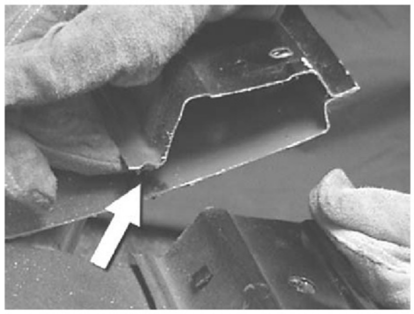
Rollover—Roof Crush Accident Case B

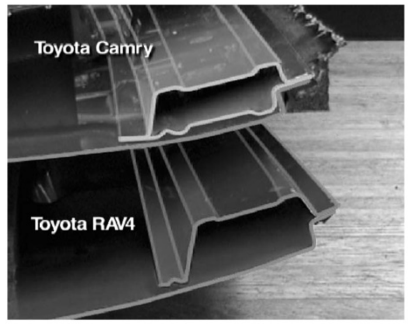
This rollover accident occurred in 2002, on a highway in New Jersey. A 1999 Toyota RAV4 Sport Utility Vehicle (SUV) was impacted in its side by an adjacent vehicle, causing the RAV4 to rollover. *The roof buckled and crushed downward into the "survival space" of the right-front passenger,* causing fracture of his cervical vertebrae, rendering him a quadriplegic. The driver, seated where the roof did not buckle down,was basically uninjured.


In the 2007 trial in New Jersey, I pointed out the roof's windshield header was a weak open-section design with large hole cutouts and structural discontinuities. I showed safer alternative designs, including from a Toyota Camry with a stronger closed-section header that would have helped to reduce excessive roof crush.

I noted that while the RA V4 roof complied with the FMVSS 216 "slow push" test, its roof structure was structurally inadequate and was prone to buckling and collapse. Toyota pointed out they had designed the vehicle roof to comply with FMVSS 216, and did not do dynamic rollover tests. The jury decided a verdict for the Plaintiff.

The two photos below show the poor-design "open section" windshield header, and then a comparison between the Toyota Camry's stronger "closed section" windshield header (in green) versus the weaker "open section" header of the Toyota RAV4 SUV (in red).



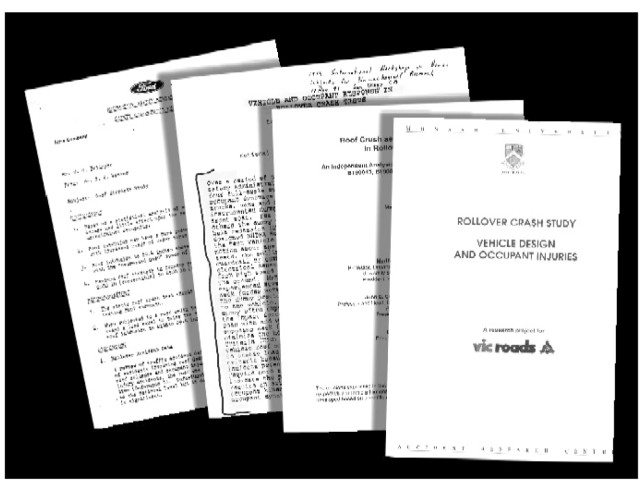


Affirmed: Roof Crush Causes Quadriplegic and Fatal Injuries . . . Even Though Some Automakers Say it Doesn't

In a rollover accident, it is imperative to maintain the occupants' "survival space." It is a well-established principle in vehicle safety and crashworthiness that a vehicle should be designed so as to prevent or minimize intrusion or penetration into the passenger compartment *"survival space"* in all types of foreseeable collisions . . . including front impact, side impact, rear impact, rollover, and underride. Automakers and vehicle safety specialists often refer to the critical need to provide a strong "*roll cage*" vehicle construction to protect the passengers.

However, in trying to rationalize why their vehicles have a particular roof strength that is allegedly too weak, some automakers argue that roof crush simply does not cause injuries to the head or cervical spine. In actual accident cases that lead to product liability litigation, the defendant automaker will often claim that the amount of roof crush is irrelevant to the cause of the plaintiff's quadriplegic or fatal injuries. The automaker's experts will cite the "Malibu series of rollover tests" as "proof" that roof crush does not cause head and spinal injuries. Thus, some automakers try to divert or negate the issue of a needlessly weak roof structure that buckled and crushed downward in the particular accident.

In contradiction to the automaker's strategy and the "Malibu tests", there is a long history of authoritative and empirical studies and tests that prove that, in fact, the extent of roof crush is definitely the cause of the severity of injuries to the occupant's head and cervical spine in the rollover accident. *The evidence is overwhelming in support of the strong causal relationship between roof crush and such injuries.*



In NHTSA's original NPRM in 2005 to amend FMVSS 216, NHTSA stated:

> "In sum, the agency believes that there is a relationship between the amount of roof intrusion and the risk of injury to belted occupants in rollover events."

Following is an overview of some of the major studies that affirm the direct relationship between the extent of roof crush to the cause of the injuries to the head and neck of the occupant in a rollover accident.

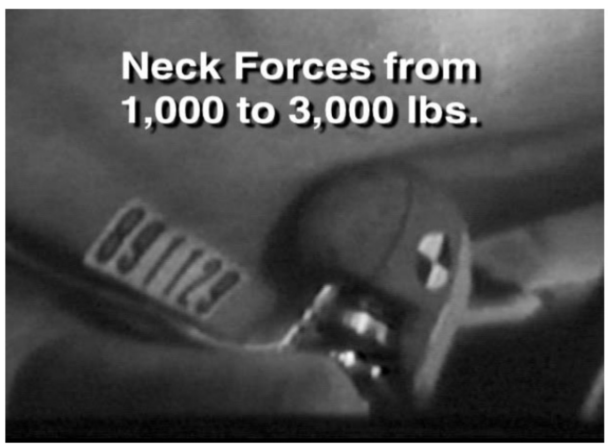
In 1982, the National Highway Traffic Safety Administration (NHTSA) issued a report on "Light Vehicle Occupant Protection—Top and Rear Structures and Interiors." (SAE Report 820244.) This comprehensive NHTSA analysis pointed out a significant correlation:

> *". . . accident statistics show that the degree of roof intrusion is highly associated with occupant injury severity and rate."*

In 1992, the major report "Vehicle and Occupant Response in Rollover Crash Tests" was issued as a coordinated effort by NHTSA and by The Armstrong Laboratory, of the Department of the Air Force. In its series of 24 rollover crash tests to study vehicle and occupant dynamics, roof crush varied from about 4 to 20 or more inches. The test dummies were instrumented to measure head and neck forces. Among the conclusions:

> *"Most of the tests resulted in significant roof crush. Often the body was trapped by the roof crush. In these cases, the head/neck system was vulnerable to large loads from the roof. "*

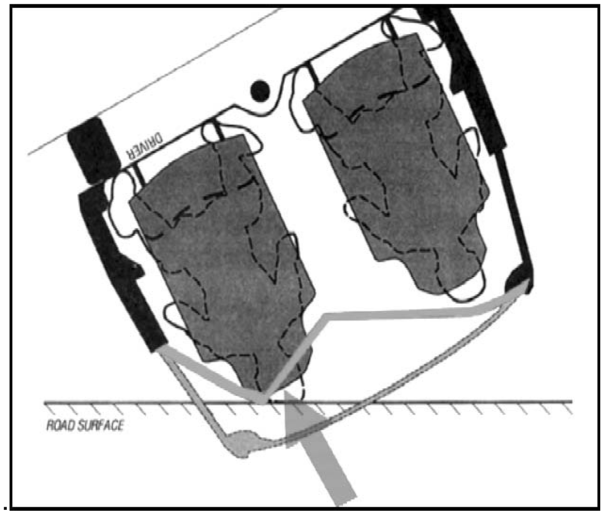
In many of the rollover tests, the dummies received major compressive and lateral loads to their necks and there were major forces to the cervical spine, with many in the 1,000 to 3,000 pounds range.



In the 1994 "Rollover Crash Study on Vehicle Design and Occupant Injuries" major report by Rechnitzer and Lane, from Monash University of Australia, the findings included this correlation:

> *"In mass data and other crash collections, the weight of evidence is in agreement with a relationship between roof crush and occupant injury. There is a convincing relationship between rollover and spinal cord injury. Finally, there is strong evidence of a connection between local roof crush and spinal cord injury."*

The Monash project analyzed many actual vehicle rollover accidents and injuries, including this example that shows how the passenger in the right-front seat was rendered a quadriplegic . . . because of cervical/spinal trauma . . . due to loading on head during rollover and roof crush. One of the Monash case examples is illustrated directly below, and I've added an arrow to show how the compressive load was exerted as the inverted vehicle's roof buckled and crushed inward into the survival space.



In 2005, a study by Bidez, Cochran, and King evaluated "Roof Crush as a Source of Injury in Rollover Crashes." The authors evaluated the data from instrumented dummies in a series of rollover tests of Ford Explorer SUVs, as conducted by Autoliv. Their conclusions included the following:

> *"Roof crush into the survival space of restrained dummies was the direct cause of neck loads, which were predictive of catastrophic neck injury in rollover crashes."*
>
> *"In the absence of significant roof crush into the occupant survival space, no dummy neck loads predictive of catastrophic injury were observed in this test series."*

In 2007, NHTSA published the study "The Role of Vertical Roof Intrusion and Post-Crash Headroom in Predicting Roof Contact Injuries to the Head Neck, or Face During FMVSS No. 216 Rollovers; An Updated Analysis." The report analyzed NASS CDS data for the 1997–2005 period, and conducted estimates from 24 different statistical models, 12 for intrusion and 12 for headroom. In all 24 statistical models, the relationship between injury severity and the explanatory variable of intrusion or headroom was statistically significant.

In its conclusion, this latest NHTSA report stated:

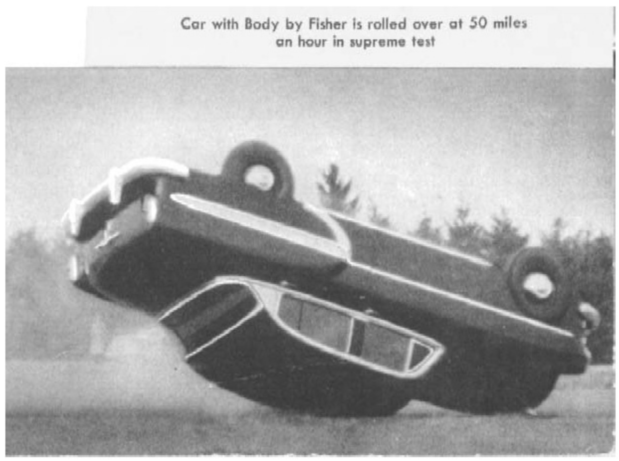
> *"This report shows that a statistically significant relationship existed between both vertical roof intrusion and post-crash headroom on the one hand, and maximum injury severity of head, neck, or face injury from roof contact."*

These many authoritative studies all point out and affirm the direct causal relationship between roof crush and spinal cord injuries. Importantly, roof crush also has a direct bearing on causing windshield and side window glass retention and breakage (re: potential occupant ejection), on seatbelt restraint integrity (such as shifting the shoulder belt upper anchorage on the B-pillar), and causing roof pillar interior surfaces and edges to buckle and exacerbate head trauma). Strong roof structures, if integrated with the total "safety cage" body construction, will also thereby offer benefits in reducing intrusion and increasing side impact protection. For many reasons, therefore, it is imperative for NHTSA to mandate a strong roof structure, and for automakers to maximize their designs and testing to ensure strong roofs in 40–50–60 mph dynamic rollovers that represent real-world accidents.

General Motors Finally Establishes U.S. Rollover Crash Test Facility in 2006 . . . for Dynamic Rollover Testing . . . and NHTSA Should Require Such Testing in FMVSS 216

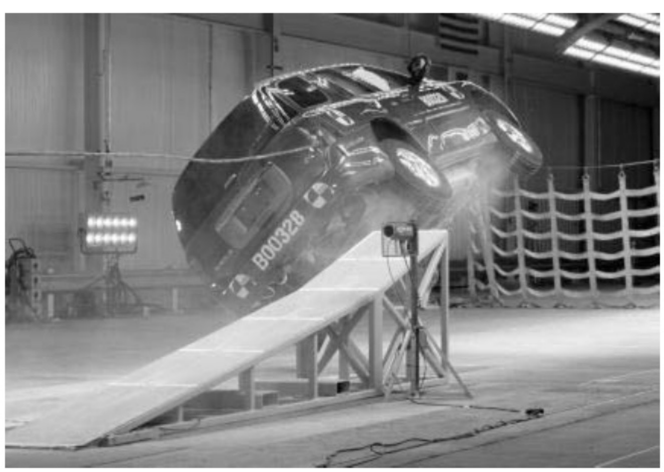
Up until 2006, General Motors in the U.S. did very little in rollover testing. Instead, they relied primarily on compliance with the "slow push" test of FMVSS 216, and their vehicle roofs have been in the weak 1.9 to 2.6 strength-to-weight ratio (SWR), as tested by NHTSA.

Historically, back in the 1950s, General Motors showed how their passenger cars could survive dynamic rollover tests at 50 mph with only minimal roof deformation. (Shown in photo below.) GM called this the "*supreme test*" as validation of their strong "*turret top*" roof structure design. But then GM did very little rollover testing in the U.S. in the following 1970 though 2000 era. In that same era, GM-Opel in Europe began conducting dynamic rollover tests for improving rollover safety in their European vehicles.



After decades of not conducting dynamic rollover tests in the U.S., GM in 2006 opened a $10-million state-of-the-art rollover crash test facility at their proving grounds in Milford, Michigan. When the facility was launched, NHTSA Administrator Nicole Nason was quoted as saying "*The work at this facility will contribute to fewer deaths and injuries from rollover crashes*."

Her praise is in contrast to NHTSA's present plans (in Spring 2008) to amend FMVSS 216 to only require a "slow push" test on either one or two frontal corners of the roof . . . but to *not* also require dynamic rollover testing to validate the performance of the roof and the other crashworthiness measures en total.



For their new facility in 2006, GM announced that multiple types of dynamic rollover tests will be conducted, including these descriptions in the GM press release:

Trip Over—The most frequent type of rollover, accounting for nearly 70 percent of rollovers. A driver loses control, slides sideways, and has the motion of the vehicle arrested by hitting a curb or sliding off of the road.

Ditch Fall-over—This simulates a driver driving off of the side of a road onto a steep embankment and over-correcting. The ditch fixture has four 5,500-pound panels that can be positioned to simulate different angles of descent.

Corkscrew Ramp Flip-over—This simulates a driver at high speed striking a rigid object like a center median and flipping over and remaining in the original lanes of travel (as opposed to going into oncoming traffic). The test speed in a demonstration was 46 mph.

Dolly Rollover—This test has been used in rollover research for more than 35 years and is conducted with the vehicle being pulled sideways on a platform at a 23 degree angle.

GM reportedly intends to conduct dynamic rollover tests of 150 to 200 vehicles each year. But the key will be how rapidly and effectively the test knowledge is transferred into their mass-produced vehicles . . . with stronger roof structures, more effective side-curtain airbags, safer side window glazing, more effective seatbelt restraints, interior energy-absorbing padding. In short, a more crashworthy vehicle to better protect occupants in rollover accidents. *But will GM share this critical safety information with NHTSA and with the American motoring public?*

To Be Truly Effective, the New NHTSA Roof Crush Safety Standard Must Require SWR of at Least 4, Plus Dynamic Rollover Testing at 40 mph . . . With Phased-in Upgrades

It is clear that sole reliance on a "slow push" test at a 2.5 or 3 strength-to-weight ratio (SWR) will not be sufficient to ensure safe roof performance in real-world rollover accidents. The auto industry has already shown that it is entirely feasible and economical to have roofs with a SWR of *at least 4 to 5* (as in the current VW Jetta, Toyota Scion tC, Volvo XC90, among others).

It is also clear that the auto industry has, for 30-plus years, been conducting valid and repeatable dynamic rollover tests, especially by European automakers. These have typically been lateral dolly rollover tests in the 30 mph-plus range. NHTSA likes to point to a series of unusual rollover tests it conducted with an "elevated" dolly rollover apparatus as not ensuring sufficient repeatability, and then proceeds to dismiss all dynamic rollover testing, rather than affirming the proven merits of rollover testing done by many European automakers over the years.

Such dynamic rollover tests are critically needed to ensure effective performance of ***the total system*** of side curtain airbags, seatbelts with pre-tensioners, windshield and side window glass integrity, interior padding, and other crashworthy measures.

If a "slow push" test is included in an upgraded FMVSS 216, it must be a sequential two-sided test that ensures a strength-to-weight ratio (SWR) of ***at least 4***, and with no injury-causation intrusion into the survival space of a seated 95th-percentile male test dummy that would cause a severity of head trauma or neck loads.

The strength-to-weight ratio (SWR) of the tested vehicle should be required to be legibly displayed on the data sheet affixed to each vehicle's window, and be available from NHTSA and the automakers. A publicly-available ranking list of SWR for each vehicle will enable the public *to compare the relative roof strengths* of competitive vehicles, and thereby help stimulate the automakers to make continuous improvements.

In addition to any "slow push" test, NHTSA must also require a dynamic rollover test to validate that all systems perform safely. A lateral dolly rollover at 40 mph would demonstrate validation of the total performance of the roof, seatbelt system with pre-tensioners, windshield integrity and retention, side window glass integrity and retention, interior padding, seat anchorage and seatback integrity, and other measures for optimal occupant protection and vehicle crashworthiness.

There is no legal or ethical basis for NHTSA, as a regulatory agency, to include pre-emption for any roof that complies with its incredibly minimal and unrealistic "slow push" test that requires a strength-to-weight ratio of only 2.5 or 3, or for any other test. The injured citizen's rights to seek justice through the courts is an inherent constitutional right in most civilized societies, and *an administrative regulatory agency is not empowered to rescind those rights.*

It is also of interest that various recent political appointees to NHTSA, including within its office of Chief Counsel, have come from the automakers, including Chrysler. Specifically who added that unwarranted preemption language to the NHTSA proposed roof crush rule . . . in an unjustified (and likely illegal) attempt to grant automatic preemption of liability to automakers?

After a reasonable phase-in of 3 to 5 years, the requirements should then be increased to a SWR of 5, and dynamic rollovers at 50 mph. And thereafter, NHTSA should consider increasing the roof strength-to-weight ratio (SWR) to *6,* and require validation of the roof's performance and all related safety systems in dynamic roll-over testing at *60 mph.* The goal is to eliminate deaths and severe injuries in roll-over accidents.

In summation, NHTSA should upgrade FMVSS 216 to require:

Initially Beginning with Model Year 2012

Roof Strength-to-Weight Ratio (SWR) of at least 4.0 In Sequential Two-Sided Roof Crush Test And Also Validation by Lateral Dolly Rollover at 40 mph With Instrumented Seatbelted Test Dummies (95th Percentile) To Record Forces to the Head and Cervical Spine, and Note Effects on Seatbelt Restraints, Window Glazing, etc.

Subsequently Beginning with Model Year 2016

Roof Strength-to-Weight Ratio (SWR) of at least 5.0 In Sequential Two-Sided Roof Crush Test And Also Validation by Lateral Dolly Rollover at 50 mph With Instrumented Seatbelted Test Dummies (95th Percentile) To Record Forces to the Head and Cervical Spine, And Note Effects on Seatbelt Restraints, Window Glazing, etc.

Upgrading to a "6–60" requirement may be needed, a roof SWR of at least 6.0 and dynamic lateral dolly rollover testing at 60 mph, especially if the continuing feed-back from real-world rollover accidents demonstrates that additional lives can be saved and severe injuries prevented if the roofs were mandated to be even stronger.

The compassionate and attainable goal is the elimination of severe injuries and fatalities in rollover accidents. The significant upgrading of FMVSS 216, as recommended herein, can be of significant help by mandating and encouraging automakers to design, develop, test, and implement notably stronger roof structures on an expedited basis.

The present rate of over 10,000 deaths per year in rollover accidents is much too high a burden to the individual victims and their families, and to our Nation and other nations that will be encouraged to adopt our standard.

This is a goal that is technically and economically feasible., and must be encouraged and supported by a strong NHTSA safety standard . . . as respectfully recommended herein.

Respectfully submitted,

BYRON BLOCH,
Consultant in Auto Safety Design
and Vehicle Crashworthiness,
www.AutoSafetyExpert.com

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARK PRYOR TO JAMES F. PORTS, JR.

Question 1. Has the NHTSA conducted adequate testing and data collection on the alternative SWRs of 3.0 and 3.5 to know what impact they might have on roof strength and passenger safety?

Answer. Yes. The Preliminary Regulatory Impact Analysis conducted in support of the August 2005 Notice of Proposed Rulemaking included an assessment of the 2.5 and 3.0 SWR (What is SWR) alternatives. Since that time, the agency has conducted additional roof crush testing and collected additional real world crash data to supplement our evaluation. Much of this was published in conjunction with the January 30, 2008 SNPRM. NHTSA will finalize our analysis, including the 3.0 and 3.5 SWR alternatives, in the Final Regulatory Impact Analysis for the final rule.

Question 2. Will the NHTSA share its research data conducted in testing the SWRs of 2.5 and higher for one-sided testing and two-sided sequential testing?

Answer. Yes. The majority of our testing to date was published with the NPRM and SNRPM. Any additional tests conducted since those publications will be made publicly available with the final rule.

Question 3. Will the NHTSA share with the Committee its complete results on all costs estimated with each SWR and the estimated lives saved with each SWR for both one sided and two sided tests?

Answer. The Preliminary Regulatory Impact Analysis published with the NPRM in August 2005 included costs and estimated lives saved for one-sided testing, but the agency had only limited two-sided testing available at that time. Such an analysis was not conducted for the SNPRM. The Final Regulatory Impact Analysis (FRIA) is now being completed in support of the final rule. The FRIA will be published along with the final rule and will include a full analysis of estimated lives saved and costs for each SWR alternative under consideration by the agency for both one- and two-sided testing.

Question 4. What is NHTSA's opinion of establishing a "star" rating system for judging vehicle roof strength?

Answer. Establishing a star rating system as a part of the agency's New Car Assessment Program (NCAP) for roof strength may be worth consideration, but first we are focused on completing the upgrade to the roof strength standard. Once we have decided upon that requirement, there may be merit in investigating enhancements to our NCAP rollover ratings including roof strength. Any such rating would need to reflect the real world risks based on crash data.

Question 5. Should it be up to Congress or the Administration to decide when an industry receives immunity from tort lawsuits?

Answer. We recognize that the first and most important step in considering the possible implied preemptive effect of a Federal regulation and its authorizing statute is ascertaining congressional intent. In the case of the Federal vehicle safety standards and the National Traffic and Motor Vehicle Safety Act of 1966, the Supreme Court considered the intent reflected in that Act's preemption provision and its savings clause in *Geier* v. *Honda,* 529 U.S. 861 (2000). It held that they are best read together as allowing the normal operation of the ordinary principles of implied preemption with respect to those standards.

While this decision was reached in the context of a standard that included express alternative compliance options and agency statements about the desirability of manufacturer experimentation with different types of technology, the Court did not suggest that implied preemption was unique to this particular standard. Since implied preemption turns upon the existence of an actual conflict, our task, as the agency charged with carrying out the purposes of the Act and technical expertise regarding the subject matter and purposes of the Federal vehicle safety standards, is to assess whether conflicts do or do not exist. In most cases, we find that they do not exist.

Question 6. When and how did the agency decide to change its longstanding position (that tort law complements Federal regulations) as it began to illustrate in preambles to regulations since 2005?

Answer. Given the public interest in preemption issues and the dependence of implied preemption on the existence of an actual conflict, we have sought in recent years to provide a fuller and more standardized discussion of preemption in our vehicle safety rulemaking notices and to focus those discussions on whether there is an actual conflict. In most cases we do not identify any conflict. Again, in the absence of a conflict, there cannot be any implied preemption.

Question 7. With the preemption clause, is the NHTSA effectively preventing roof crush victims from using state tort laws to hold a manufacturer accountable for poorly designed or manufactured roof structures?

Answer. In our notice of proposed rulemaking (NPRM), we identified potential State tort law actions that we believed could frustrate the agency's objectives by upsetting the balance between efforts to increase roof strength and reduce rollover propensity. We wanted to raise the possibility of preemption during the rulemaking process, when there is a chance to obtain and consider public comments, rather than after the fact during possible litigation.

The legal theory underlying roof crush lawsuits is that the vehicle has a defect. Plaintiffs may allege both design defects and manufacturing defects. The concerns we raised in the NPRM that could lead to preemption were not related to alleged manufacturing defects, *i.e.,* situations where it is alleged that a vehicle was not manufactured in accordance with the manufacturer's design specifications.

We received many comments about the issue of preemption, and we are continuing to analyze the comments. We will fully consider all of the comments as part of the rulemaking process.

Question 8. Please describe some of the effects weak roof strength has on other safety devises such as glazed windows, seat belts, side curtain airbags, and door retention devises.

Answer. Detrimental effects of roof crush on vehicle occupant protection systems will mainly affect the greenhouse (above the window sill) portion of the compartment. The primary occupant protection systems located in this region for belted occupants are the seat belt shoulder belt anchors and rollover side air bag curtains.

- Seat belt restraint system—seat belts reduce occupant ejection by 91 percent in the real world. This estimate is with the current roof crush requirements and factors in the effect of any B-pillar deformation or other reductions in structural integrity. The lap belt portion of the seat belt restricts the excursion of an occupant in a rollover and is not affected by roof intrusion.

- Side air bag curtains—agency data have not shown reduced effectiveness of rollover side curtain air bags due to roof crush. Rollover sensors of such systems are designed to deploy during the first ¼ turn roll of the vehicle. Thus, the rollover side curtain air bags deploy to provide protection prior to the occurrence of any roof crush.

Question 9. Do you believe keeping a passenger inside a rolling vehicle is the safest event for a passenger in a rollover?

Answer. Yes. As we have noted in our comprehensive plan, the first two priorities in protecting occupants are to first prevent the occurrence of the rollover, and if a rollover does occur to then ensure that the occupant is not ejected. The safest way to mitigate injuries in a rollover event is seat belt use since they are 91 percent effective in reducing occupant ejection. The fatality rate for an ejected vehicle occupant is substantially greater than for an occupant who remains inside of the vehicle.

Question 10. How many people are ejected in rollover events?

Answer. According to on our 2006 crash data files, NHTSA estimates that 15,120 occupants were ejected in rollover crashes that year.

Question 11. What is the survivability rate for ejections in rollovers?

Answer. According to on our 2006 crash data files, NHTSA estimates that the survivability rate for ejected occupants in rollovers was about 60 percent that year (8,956/15,120).

Question 12. Does the current system in place provide consumers with enough knowledge on tire health and is it easy for consumers to know the age of a tire or the health of a tire?

Answer. New labeling requirements for tires will become effective September 1, 2009. These new requirements will ensure that the production date of a tire is displayed on the outboard side wall of the tire. We think that this will make it easier for consumers to determine the age of their tires. Additionally, the agency has improved its consumer information material and has placed it at its main portal for vehicle safety consumer information, *www.safercar.gov*. This new section devoted entirely to tires, includes information on how to identify the age of the tire, and how to avoid conditions such as under-inflation or overloading that can lead to reduced tire integrity.

Question 13. Where is the NHTSA in meeting Section 10303 of SAFETEA–LU *Tire Research* on tire aging?

Answer. As required by SAFETEA–LU, the Department of Transportation delivered to Congress a report in August 2007 (copy enclosed).* In that report, we indicated that additional work needed to be done before we could make a regulatory decision on tire aging. That work is ongoing and is considering many factors including tire aging as a casual factor in crashes, solutions such as a tire expiration date, and the potential safety benefits of a regulatory tire aging requirement. We expect to complete that work in 2009.

Question 14. Are there other ways of improving knowledge of tire age to consumers and those performing maintenance on vehicles?

Answer. NHTSA has taken steps to improve the public's general awareness of proper tire maintenance including tire age. These include the periodic issuance of press releases and public service announcements, the inclusion of information related to tire age in our existing brochures, and the development of improved consumer friendly information on our *www.safercar.gov* website. We have also begun to work with key interested stakeholders such as the Rubber Manufactures Association and the National Automobile Dealers Association to develop material specifically focused at those who perform maintenance on tires. We will also continue to look for additional outreach programs and partners.

Question 15. Is RFID a viable technology for improving tire age and tire safety identification for consumers?

Answer. Radio frequency identification (RFID) may prove to be a viable technology to improve tire safety, particularly when a tire recall is involved. However, there are issues related to the standardization of the RFID chips for this purpose and, for the system to be most effective, tire dealers and vehicle service centers would need to purchase scanning tools and have access to a national database containing tire information. It is unclear at this point what additional safety benefits

* This document is retained in Committee files.

may be possible in the future. NHTSA continues to follow up the evaluation and applications of this technology.

Question 16. Is the NHTSA content with their current tire age identification system?

Answer. We believe that changes to the tire identification requirements for tire marking (effective September 1, 2009) will make it easier for consumers and service personnel to identify the date of manufacture and thus the age of a tire.

Question 17. Are all ESC technologies equal?

Answer. In 2007, NHTSA promulgated a final rule requiring that all electronic stability control systems operate using the same principles and the same system definition that would prevent the elimination of key sensor measurements in favor of software estimations. We know of no data showing significant performance differences in ESC systems in current production vehicles.

Question 18. How does ESC prevent rollovers in multiple vehicle accidents or when something triggers the tripping of the vehicle (*i.e.,* pothole, curb, soft soil, or guardrail)?

Answer. ESC prevents rollovers by eliminating a substantial number of loss-of-control crashes where the vehicle leaves the roadway. In cases where ESC cannot prevent vehicles from leaving the roadway, our data indicate that ESC acts to allow the vehicles to leave the road at a lower speed or facing less sideways. By mitigating the danger factors even if vehicles leave the roadway, ESC helps the vehicles to roll over less often.

However, if a crash with another vehicle is the cause of the rollover or the cause of road departure, we would not expect ESC to provide any benefit.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. CLAIRE MCCASKILL TO JAMES F. PORTS, JR.

Question 1. The agency included language in the preamble to the NPRM on roof crush which would preempt state law claims, if the preamble language is relied upon by courts. If an automobile manufacturer has the technology to improve safety above the Federal standard, and the addition of such technology is a reasonable cost for either the manufacturer or the consumer, doesn't the manufacturer have an obligation to the American public to install this technology? If the manufacturer does not do so, shouldn't an injured American have the ability to hold that manufacturer accountable?

Answer. In responding to this question, I note that it raises issues both about Federal preemption of State tort law and also about how State tort law should operate in situations where it is not preempted. While I can respond to your question as it relates to Federal law, the issue of how State tort law should operate where it is not preempted is a matter that is up to the individual States.

In our notice of proposed rulemaking (NPRM), we identified potential State tort law actions that we believed could frustrate the agency's objectives by upsetting the balance between efforts to increase roof strength and reduce rollover propensity. We wanted to raise the possibility of preemption during the rulemaking process, when there is a chance to obtain and consider public comments, rather than after the fact during possible litigation.

We raised the concern that some potential State tort laws could result in adverse safety consequences. We cited, for example, the possibility that a State tort law requiring greater levels of roof strength could lead to added weight to the roof and pillars of a vehicle, increasing the center of gravity and rollover propensity.

We received many comments about the issue of preemption, and we are continuing to analyze the comments. We will fully consider all of the comments as part of the rulemaking process.

Question 2. As discussed during the hearing, the agency is now including boilerplate language in all of its rules in an effort to preempt state tort claims. In each case, the agency relies upon the *Geier* v. *Honda Motor Co.,* 529 U.S. 861 (2000), decision to preempt state tort claims. Why is the agency suddenly relying upon the narrow *Geier* v. *Honda Motor* decision to make these claims, when it did not even reference that case in preambles to rules between 2000 and 2005? Why would the agency state that it believes its rules preempt state tort law when there is not even a potential conflict between state and Federal law in question? Doesn't the Supreme Court decision in *Medtronic* v. *Lohr,* 518 U.S. 470, 511 (1996) require the existence of a conflict prior to asserting preemption?

Answer. There may be a misunderstanding about our discussions of implied preemption of state tort law in our vehicle safety rulemaking notices. In most of our notices discussing that issue, we examined whether there might be a conflict, but did not find any. Without a conflict, there is, of course, no implied preemption. As we cannot perfectly predict the nature of the tort law decisions that might emerge in the future, we have stated that we cannot completely exclude the possibility that a conflict might be identified in the future.

Question 3. The rules listed below contain preemption language in the final rules. In addition, the agency also has included preemption language in the preamble to final rules *without* first providing for notice and comments in the proposed rules. How can the agency justify not providing notice and consultation to state and local associations, when this will clearly impact the ability of state courts to respond to the health and safety needs of its citizens?

This has occurred in the following instances:

- *February 6, 2007* Federal Motor Vehicle Safety Standards: Door locks and door retention (72 Fed. Reg. at 5397).
- *April 6, 2007* Federal Motor Vehicle Safety Standards: Electronic Stability Control (72 Fed. Reg. at 17300).
- *May 4, 2007* Federal Motor Vehicle Safety Standards: Head Restraints (72 Fed. Reg. at 38023–24).
- *July 12, 2007* Federal Motor Vehicle Safety Standards: Tire Pressure Monitoring Systems (72 Fed. Reg. at 38023–24).
- *July 24, 2007* Federal Motor Vehicle Safety Standards: Occupant Crash Protection (72 Fed. Reg. at 40257).
- *September 5, 2007* Federal Motor Vehicle Safety Standards: Side Impact Protection (72 Fed. Reg. at 50905).
- *September 11, 2007* Federal Motor Vehicle Safety Standards: Side Impact Protection; Electric Powered Motor Vehicles (72 Fed. Reg. at 51953).
- *December 4, 2007* Federal Motor Vehicle Safety Standards: Cargo Carrying Capacity (72 Fed. Reg. at 68458).
- *December 4, 2007* Federal Motor Vehicle Safety Standards: Lamps, Reflective Devices, and Associated Equipment (72 Fed. Reg. at 68265).

Answer. We believe that it is desirable to seek public comment in connection with those vehicle safety standard proposals in which we identify a possible conflict between one of our standards and potential tort law decisions. However, we did not identify any conflict with respect to any of the nine notices listed in this question. As previously noted, there cannot be any implied preemption in the absence of a conflict.

Question 4. Please explain why the agency has included a significant change in policy from prior versions of NHTSA rules to recently proposed versions, as indicated in the two examples below. Please also indicate who directed these changes. Were these changes made at the request of the Office of Management and Budget and/or the Office of Information and Regulatory Affairs, which reviews the rules prior to publication.

Example 1:

> *Dec. 14, 2004:* Federal Motor Vehicle Safety Standards: Head restraints. The preamble language states: "The final rule is not intended to pre-empt state tort civil actions."
>
> *May 4, 2007:* Federal Motor Vehicle Safety standards: Head restraints—final rule. The preamble language states: "Federal pre-emption questions can arise both in the courts' application of state common law—often state tort law—or in the application of a state statute or state or local regulation, ordinance or similar measure. In a state tort suit, the question may be whether imposing liability for particular activities would be consistent or inconsistent with Federal law or a Federal regulatory program."

Example 2:

> *Dec. 27, 2002:* Federal Motor Vehicle Safety Standards: Platform lift systems for accessible motor vehicles—final rule. The preamble language states: "The final rule is not intended to pre-empt state tort civil actions."
>
> *Dec. 20, 2007:* Federal motor vehicle safety standards: Platform lifts for motor vehicles; Platform lift installations in motor vehicles—proposed rule. The preamble language states: "In addition to the express pre-emption noted above, the Supreme Court has also recognized that state requirements imposed on motor vehicle manufacturers, including sanctions imposed by state tort law, can stand

as an obstacle to the accomplishment and execution of a NHTSA safety standard. When such a conflict is discerned, the Supremacy Clause of the Constitution makes their state requirements unenforceable. See *Geier* v. *American Honda Motor Co.* (2000). NHTSA has not outlined such potential state requirements in today's rulemaking, however, in part because such conflicts can arise in varied contexts, but it is conceivable that such a conflict may become clear through subsequent experience with today's standard and test regime. NHTSA may opine on such conflicts in the future, if warranted."

Answer. Given the public interest in preemption issues and the dependence of implied preemption on the existence of an actual conflict, we have sought in recent years to provide a fuller and more standardized discussion of preemption in our vehicle safety rulemaking notices and to focus those discussions on whether there is an actual conflict. In neither of the two documents identified in this question (the head restraint final rule issued in May 2007 or the platform lift proposal issued in December 2007) did we identify any conflict. Again, in the absence of a conflict, there cannot be any implied preemption.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN D. ROCKEFELLER IV TO JAMES F. PORTS, JR.

Question 1. I am interested in the role laminated glass, which is required in windshields, plays in providing structural support to vehicle roofs. Has NHTSA examined this during its testing protocols for the roof crush rule? What research do you have on the structural benefits to vehicle roofs of laminated glass windshields?

Answer. Yes. NHTSA has analyzed the contribution that the windshield laminated glass makes relative to the measured strength of the roof. In the agency's two-sided testing, the windshield was generally broken during the first side test. In the January 2008 Supplemental Notice of Proposed Rulemaking, we stated that on average the peak roof strength for the second side test was reduced by 8.7 percent from the first side test. The windshield provides some of that load bearing capacity. NHTSA will address this issue more thoroughly in the roof crush final rule.

Question 2. How will the agency address rear windows and occupant safety? Laminated glass is not required in rear windows. But, if it was, would that also provide additional strength to vehicle roofs? Has NHTSA considered this in developing its roof crush standards?

Answer. Rear occupant protection due to roof crush will be addressed in the final rule. NHTSA has examined the contribution of rear window glass to the strength of the roof in our proposed test requirements. The agency has observed less influence on the roof strength performance due to the rear window than occurs with the windshield.

Question 3. For years NHTSA and others have urged parents to put young children in the rear seat for maximum protection in a motor vehicle crash. Would laminated glass help protect rear seat occupants from ejection in a crash?

Answer. The agency is currently developing its proposal for ejection mitigation. SAFETEA–LU mandates establishment of performance standards to reduce complete and partial ejections of vehicle occupants from outboard seating positions. Rear seat outboard seating positions will be included in NHTSA's proposal. The performance requirements being developed anticipate side curtain and advanced glazing technologies as being likely countermeasures for ejection mitigation.

Question 4. Laminated glass is not required in side windows. Although laminated glass is not required in side windows, has NHTSA looked at any potential benefits it may provide in providing additional strength to vehicle roofs?

Answer. As was the case for the windshield, in the agency's two-sided testing the side windows were generally broken during the first side test. In the January 2008 Supplemental Notice of Proposed Rulemaking, we stated that on average the peak roof strength for the second side test was reduced by 8.7 percent from the first side test. The side window load bearing capacity is included in that reduction. The roof crush final rule will establish a strength performance requirement, but not any particular technology to attain that performance.

Question 5. A crushed roof can break the tempered glass now in the side windows thereby creating an opening in which an occupant could be ejected during rollovers or other crashes. In developing its roof crush standards, has NHTSA looked at multiple benefits to occupant protection, such as occupant ejection?

Answer. Yes, in developing its comprehensive rollover approach to prevent the crashes, mitigate ejections, and protect those occupants who remain within the compartment, the agency has given extensive consideration to the target populations that would benefit from each of the strategies and how each of these three initiatives must work together to address the various aspects of the rollover problem. The agency's target population estimates for roof crush were published in both the August 2005 NPRM and the January 2008 SNPRM. The roof crush final rule is targeting the group that is most effected when roof structures are compromised. Seat belts are 91 percent effective in reducing ejections, and this is the target population that most benefits from an increased roof strength. Unbelted occupants in a rollover crash are violently tossed about the compartment of the vehicle and are more effectively addressed in the agency's ejection mitigation initiative. Our analysis of potential benefits for unbelted occupants due to increased roof strength, public comments on this issue, and any modifications to the target population will be described in the final rule.

Question 6. Recently NHTSA updated its regulatory status report to include a timeline for an Advanced Notice of Proposed Rulemaking on the occupant ejection mitigation rulemaking as required by SAFETEA–LU. According to the status report an ANPR will be issued in the fall of 2008. I am interested in the testing methodology and results NHTSA will be using to develop the ANPR and how a "systems" approach combining both laminated side glass and side air curtains can provide the most potential benefit in preventing or mitigating occupant ejections.

- The SAFETEA–LU statute requires NHTSA to establish a performance standard to "reduce complete and partial ejections". Please provide test results (data, pictures, video footage, etc.) that illustrate how side curtain airbags and laminated glass perform as possible countermeasures for partial ejections as both stand alone technologies and as a combined system. Please include information illustrating how the individual technologies alone provide lesser performance than a combined system.
- In response to questions at his confirmation hearing, DOT Deputy Secretary, Admiral Thomas Barrett, has stated that both "side curtain and advanced glazing technologies are possible countermeasures that manufacturers could employ to meet the testing protocol." Please provide test results (data, pictures, video footage, etc.) that demonstrate the performance of these possible countermeasures as stand alone technologies and as a combined system.
- In response to questions at her confirmation hearing, DOT Secretary Peters stated: "NHTSA has conducted tests of side curtain air bags in combination with laminated glass. These tests have shown some level of improved performance over individual technologies." Please provide test results (data, pictures, video footage, etc.) that illustrate how the combined technologies provide improved performance including information illustrating how the individual technologies alone provide lesser performance.
- The DOT Secretary Peters further stated: "NHTSA is addressing full and partial ejections for all vehicle occupants. Research serving as the basis for the proposal has used both child and adult dummies in belted and unbelted conditions." Please provide test results (data, pictures, video footage, etc.) that illustrate the performance of possible countermeasures as stand alone technologies and as a combined system for individuals of varying size and age.

Answer. NHTSA is completing work on development of requirements for ejection mitigation, and we expect to publish a proposal this fall. The proposal will have performance requirements but not specific technologies necessary to meet them. Docket NHTSA–2006–26467 contains a testing procedure guideline for research into the performance of ejection mitigation countermeasures. While NHTSA may deviate from this guideline for the ejection mitigation proposal, it does reflect procedures that the agency has been using in our research. Testing by the agency has involved side curtain window airbags, advanced glazing materials, and combinations of these technologies. Two of our most recent publications presenting the results of agency ejection mitigation research are attached,* and document testing of prototype and production side curtain air bags alone and in combination with laminated side windows. Additional research and analysis supporting the agency's performance requirements will be released with the proposal.

Question 7. Airbag manufacturers have reported that the function of airbags can be supported by laminated glass because the laminated glass can provide a reaction surface for the airbag. Please provide test results (data, pictures, video footage) that illustrate how glass can support side airbag deployment by serving as a reaction surface.

*These documents are retained in the Committee files.

Answer. While some frontal air bags use the laminated windshield as a reaction surface for air bags in frontal occupant protection, not all do so. Side curtain air bags have evolved from solely side impact occupant protection systems to a countermeasure designed for rollover protection. The newer systems designed for rollover protection have increased coverage of the window opening and stay inflated for longer periods of time. In addition, they are tethered at the lower part of the window pillars to provide tension across the bottom edge of the curtain, thus mitigating the need for a reaction surface in rollover crashes.

Question 8. In the recent past, NHTSA has launched several investigations into deployment issues associated with airbag systems on production vehicles (*e.g.,* BMW, Nissan). Please provide data regarding the need for redundancy in occupant ejection prevention systems including the incidence of airbag malfunction.

Answer. Agency examination of the crash data has shown no indication that side curtain air bag systems developed for rollover crashes are not sufficiently robust to provide the intended occupant protection. Through our enforcement efforts we have continued to monitor all vehicle systems for potential malfunctions. Past investigations for non-deployment concerns, including the BMW/MINI Cooper, Nissan Armada and Quest vehicles, resulted in either an extended warranty program, a service campaign or were closed with no further action. The agency's investigations did not identify any crashes, injuries or fatalities associated with malfunction of the side air bag system. A table of side air bag defect investigations since 2003 is attached.* A second table * provides manufacturer voluntary safety recalls of side air bags.

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*These documents: *NHTSA's Crashworthiness Rollover Research Program*—by Stephen Summers, Donald T. Wilkie, and Lisa K. Sullivan, National Highway Traffic Safety Admmistration, U.S. Department of Transportation; and J. Stephen Duffy and Michael Sword, Transportation Research Center, Inc.; PowerPoint Presentation—*Status of NHTSA's Ejection Mitigation Research*—dated May 9, 2005, presented at SAE Government/Industry Meeting-by J. Stephen Duffy, Transportation Research Center, Inc.; *Recalls for Side Air Bag Deployment Malfunctions Improper/Reduced/No Deployment Since CY 2003*—dated June 10, 2008; and *Investigations of Side Air Bag Malfunctions Improper/Reduced/No Deployment Since CY 2003*—dated June 10, 2008, are retained in the Committee files.