Center for Auto Safety White Paper on Concerns With Chrysler Recall of the Jeep Grand Cherokee and Liberty Presented to NHTSA July 1, 2013

Chrysler has responded to the National Highway Traffic Safety Administration's request that it recall the Jeep Grand Cherokee and Liberty that have fuel tanks installed behind the rear axle for defects in their fuel systems with several specious arguments

1. The subject Jeeps have had fuel system failures only in very high energy crashes.
2. The subject Jeeps have a crash fire experience that is typical of other vehicles of the same generation currently operating on public roads.
3. The placement of a fuel tank behind the rear axle is not inherently dangerous, is not precluded by Federal fuel system integrity standard, and such fuel tank placement was typical of other vehicles.
4. The subject Jeeps complied not only with the applicable FMVSS 301, Fuel System Integrity, but fail only in crashes in which the energies are in excess of the energy involved in the significantly more stringent current standard.

1. Crash Energy

Since occupants in all 44 fatal rear impact fire crashes cited by NHTSA survived the trauma of the crash only to die by fire, crash energy is a red herring argument raised by Chrysler. Energy is only one factor in the severity of a crash. The definition of crash energy and how it is applied is more important. For its analysis, Chrysler calculated the kinetic energy of the striking vehicle (using questionable estimated impact speeds in some cases to inflate crash energy),[1] not the amount of energy absorbed by the struck vehicle (which is a more relevant measure of crash energy).

A striking vehicle typically has kinetic energy by virtue of its motion. It may strike a vehicle that is stopped or one that is moving (and thus has its own kinetic energy). After the impact, both vehicles will be moving using some of the kinetic energy that the vehicles initially had. It requires a much more sophisticated calculation than Chrysler has done to determine the amount of energy absorbed by the struck vehicle which is a more accurate measure of crash severity.

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[1] In the September 1, 1999, New York crash involving a 2300# Toyota MR2 striking a 4100# 1997 Grand Cherokee, Chrysler states the speed of the MR2 is 60-mph. The police report has no speed listed and no speed violation where the speed limit is 55-mph.. Plaintiff counsel content the speed of the MR2 on impact is less than the 50-mph. In the March 6,2012, Georgia crash involving a 1996 Dodge Dakota striking a 4200# 1999 Grand Cherokee, Chrysler states the speed of the Dakota is 65.8-mph. Again, the police report has no speed listed and no speed violation where the speed limit is 55-mph. Both the Dakota and its crash recorder have been impounded so Chrysler's precision to the tenth of a mph is inexplicable. The 1997 Dakota has a single point sensor SRS which typically doesn't store acceleration much less prior event parameters.

Furthermore, whether the crash energy concentrated is also critical.[2] By analogy, one can kill a human being by stabbing him or her in the chest with a sharp pen-knife using a very small amount of energy. But swatting the same person on the bum with the same energy as applied to the knife will result in little more than modest embarrassment.

In a frontal crash into a barrier, virtually all of the vehicle's kinetic energy goes into deformation of the vehicle. However, in a collision of a moving vehicle into a stationary vehicle of roughly equal size and weight, the speed of the striking vehicle would have to be at least twice the speed of a single vehicle going into a barrier to result in the same crash severity and vehicle damage. (In other words, a 35 mph barrier crash as in the New Car Assessment Program is roughly equivalent to a vehicle going at 70 mph into another stopped vehicle of the same size and weight – both are survivable crashes.)

In the case of a rear impact crash, the FMVSS 301 (fuel system integrity) rear impact by the old flat plane on a moving barrier distributed the force. Because the barrier is moving at 30 mph, the severity of this crash test is equivalent to having the Jeep back into a wall at around 15 mph – not a very serious crash. Chrysler claims that the energy of this impact is 121,000 ft-lbs, but if viewed as a Jeep backing into a wall at 15 mph, the energy is less than 30,000 ft-lbs.

The revised FMVSS 301 phased in over 2007 models (40% of a manufacturer's total production), 2008 models (70%) and 2009 (100%) is more like a rear impact by a passenger car. (FMVSS 301 Final Rule – December 1, 2003) The bumper standard puts the bumpers of a car about 16 to 20 inches above the ground and the "bumper" form of the FMVSS 301 moving barrier is at a height of 11 to 19 inches. The bottom of the Grand Cherokee's rear bumper is roughly 21 inches above the ground,[3] so that most passenger cars, and the FMVSS 301 rear impact barrier, will underride the rear bumper of a Jeep and strike the gas tank which hangs six to eight inches below the rear bumper. Thus, an impact by a passenger car concentrates the force on a highly vulnerable part of a Jeep that is struck in the rear.[4]

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[2] Chrysler itself admits that in trying to explain away the August 9, 2006, California crash of a motorcycle into a 1994 Grand Cherokee where the kinetic energy of the bullet motorcycle is about half the energy of the old FMVSS 301 standard by claiming the energy is focused on the trailer hitch which sliced into the fuel tank.

[3] The appendices to Chrysler's response to NHTSA's letter recommending a recall claimed that the distance from the ground to the bottom of the rear bumper of the Grand Cherokee ranges from 16.5 to 19.25 inches. However, this measurement is made to the cosmetic covering of the rear bumper. The actual height to the structural part of the rear bumper is approximately 21 inches. Chrysler's appendix also states that the distance from the lowest part of the bumper to the lowest part of the fuel tank is slightly more than 6 inches. However, with a correct bumper height dimension, this number would be greater than 8 inches.

[4] It is interesting that although Chrysler claims that crashes in which Jeeps caught fire were mostly above the energy level involved in the amended FMVSS 301, Chrysler has not claimed that these vehicles could pass the amended standard in which the rear of a vehicle is struck by a moving barrier with a passenger car like structure at the front.

If the impact forces are concentrated on the left rear of the Jeep, it is likely to damage its fuel filler tube. The poor design of the fuel systems in these vehicles make them particularly vulnerable to a loss of integrity in a common rear impact.

2. Crash Experience of Various Production Vehicles

Chrysler has produced various tables that claim to show that Jeep Grand Cherokee and Liberty models have crash fire rates that are no worse than most other vehicles. We looked at the FARS files from 1992-2011 for the 31 vehicles where some or all of the vehicles were made in 1993 or later and found quite a different picture. Figure 1 shows that the Grand Cherokee and Liberty had 21 crashes (15 for the former and 6 for the latter) where fire was listed as the most harmful even and 39 crashes where there was fire (29 and 10, respectively). By comparison, eleven of the Chrysler so-called comparable vehicles did not have any crashes where fire was the most harmful event. Thirteen more vehicles had only one or two rear impact fire crashes. Only the 1994-2004 Ford Mustang has a comparable Fire-MHE fire rate. [5] What Chrysler was doing was counting trauma deaths along with fire deaths knowing that compact vehicles like the 2300# Toyota MR2 would always have a higher fatality rate due to trauma versus fire compared to the 4100# Grand Cherokee.

We could find no cases of post 2004 Jeep Grand Cherokees or post 2007 Jeep Liberty's with the fuel tanks ahead of the rear axle where a rear impact had resulted in a fire. Had Chrysler adopted this design earlier, many tens of burn victims would still be alive today.

Looking at Chrysler's own chart which normalized these results (Figure 2) for the Grand Cherokee – with 12 cases where fire was the most harmful fatal event – had 4.4 per hundred thousand vehicle-years of use. The Honda Passport, which is a sister of the Isuzu Rodeo and should have been included with them, had only one crash on this chart, but when we looked at this case it was not even a rear impact but rather a frontal with a Chevrolet Tahoe.[6] (Also, because of the small population of these vehicles, there were a

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[5] However, just because there is another company with a bad performer does not mean the first bad performer is not subject to a recall. As former NHTSA Associate Administrator for Enforcement Lynn Bradford said: "We are just like a traffic cop, we pull over one offender at a time."

[6] **Error! Main Document Only.Wreck leaves 3 dead on I-10**

The Baton Rouge Sunday Advocate, February 16, 2003, News 2 B

Three people died Saturday in a highway crash so violent that two trucks fused then burst into flames, leaving the dead so charred that authorities are unsure how to identify two of them. Three people survived what Trooper Johnnie Brown of State Police called one of the worst accidents he has seen. "This is the first one I've ever worked where there was nothing left, not even a license plate," Brown said.

He said the following about the wreck: At 1:30 p.m., about 20 miles south of Baton Rouge, between the Airline Highway and Gramercy exits, a Honda Passport heading east on Interstate 10 lost control and crossed the median. The Passport flipped as it left the median and crashed head-on into a Chevy Tahoe heading west in the right lane. The two trucks left the road together to the right and came to rest at the edge of a grassy slope, beside a wooded area. . . .

very small number of vehicle years of use). None of the other vehicles in this chart had a rate greater than 2 per hundred thousand vehicle years of use.

Chrysler included (Appendix D) an extensive discussion of confidence intervals in an attempt to show that one could not draw firm conclusions from the data where there were relatively small total numbers of relevant crashes. However, it is easy to see that the discrepancy between the performance of the subject Jeeps and other vehicles in Figure 1 is quite strongly indicative of a genuinely different crash experience between them and other vehicles in this chart. Similarly, the difference in the FARS data on Jeeps with fuel tanks mounted behind and ahead of the rear axle shows quite statistically different performance in the field. Chrysler does not discuss this appendix in the text of its June 18 letter because Appendix D shows that one cannot rely on the data behind its misleading comparison of various other makes and models to the Jeep Grand Cherokee and Liberty because the sample size and number of fatal fire crashes in such other models is so small.

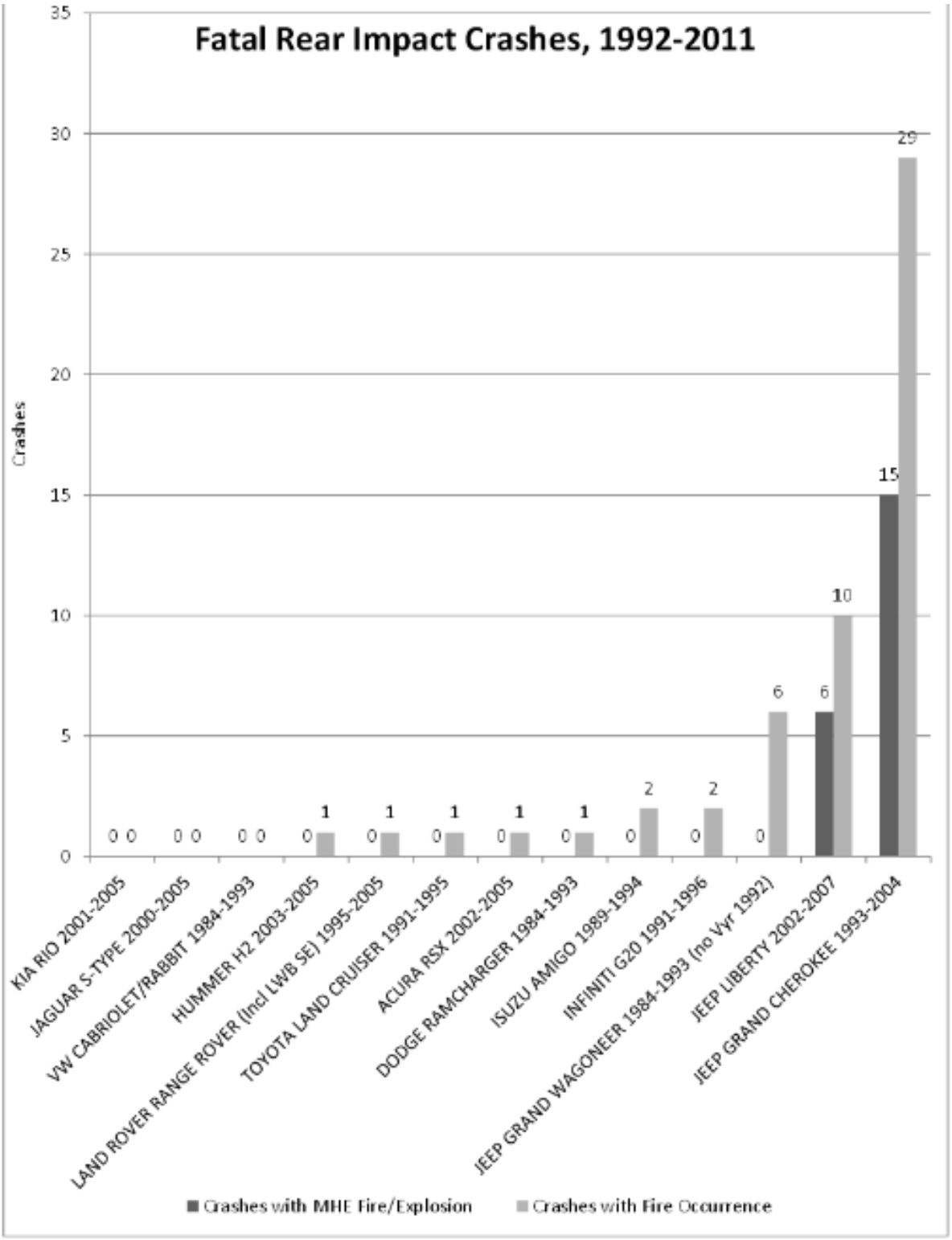

Figure 1. A comparison with the subject Jeeps and other vehicles that Chrysler had purported to show had worse rear impact fire performance but which had no deaths due to fire in FARS in rear impacts where there was a fire in the listed vehicle.

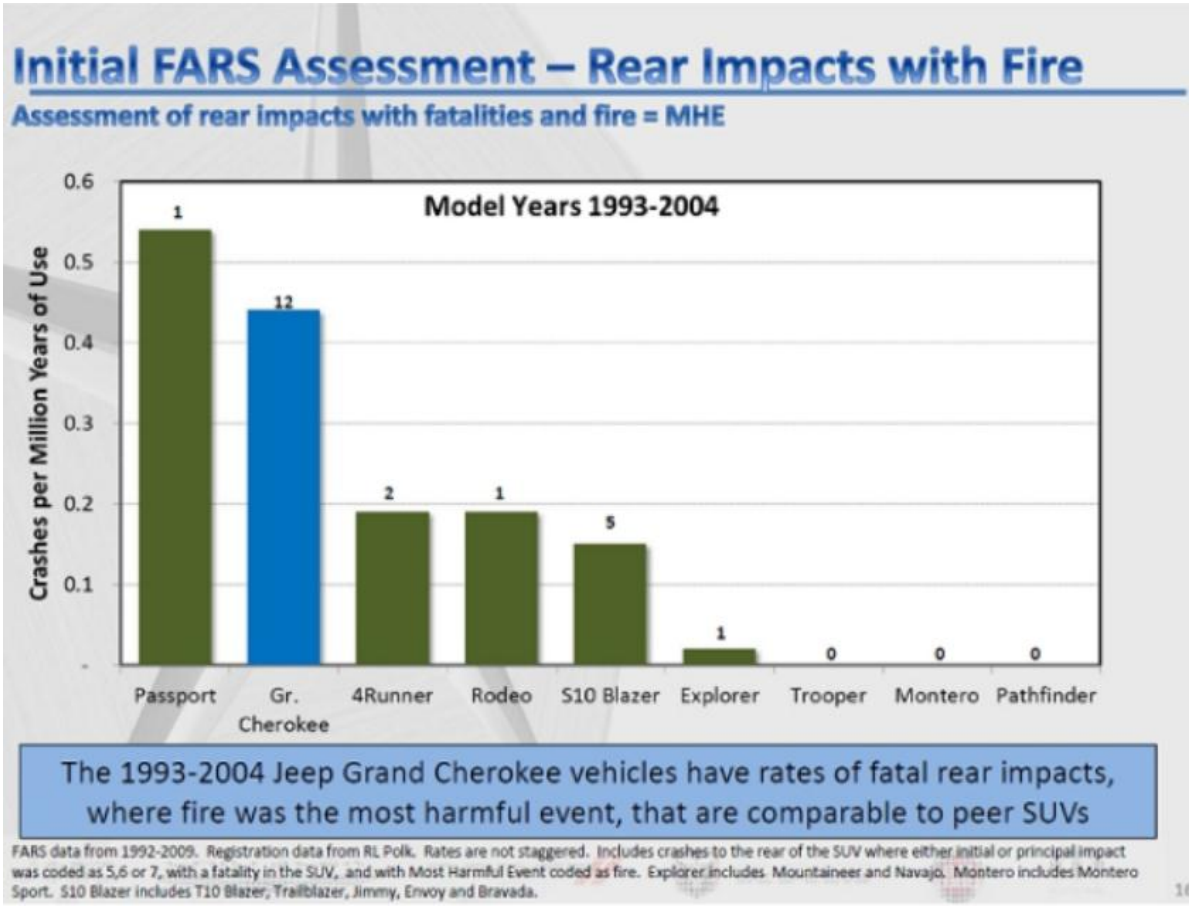

Figure 2. A chart submitted by Chrysler as part of their early response to NHTSA's investigation. Note that while Chrysler combined sisters and clones in most cases, it did not combine the very small volume Honda Passport with its sister Isuzu Rodeo.

3. Placement of the Fuel Tank Behind the Rear Axle

In the particular case of the subject Jeep vehicles, the placement of the tank is only one of its many design defects. Other vulnerabilities are:

- The plastic fuel tank hangs well below the rear bumper by six to eight inches, and can easily be struck by a passenger car that underrides the rear bumper. This situation can easily occur, particularly if the striking vehicle is sustaining brake dive.
- The frame around the tank is relatively weak, particularly in the early models that have a large hole in the left frame member through which the filler tube is routed.[7]
- The fuel filler neck has a weak connection to the fuel tank itself and the connection point is constrained so that if the rear frame rail is deformed, it can be subject to a shearing force that can dislodge it from the tank.
- The gas filler cap can be relatively easily dislodged by deformation of the rear fender to which the filler neck is attached.
- The fuel tank itself lacks an effective check valve to contain the fuel if the filler neck is damaged.

These deficiencies and failure modes were demonstrated in three crash tests in which Ford Taurus passenger cars struck the rear of Jeep Grand Cherokees. In an additional crash test conducted at the Federal Highway Administration's testing ground, a Ford Explorer with its fuel tank located ahead of the rear axle was struck in the rear by a Ford Taurus moving at 75 mph, and sustained no fuel leakage. The Explorer was fitted with an instrumented Hybrid II dummy that showed the driver would have survived this impact. This impact involved an impact energy more than three times that of the lowest speed Jeep Grand Cherokee impact conducted for the Center for Auto Safety in which there was major fuel leakage. Indeed, the enegy level of the striking Taurus of 630,500 ft-lbs was higher than 29 of the 40 crashes cited by Chrysler without considering whether Chrysler inflated the speed of the bullet vehicle.

There is no significant production vehicle currently sold in the U.S. with the fuel tank located behind the rear axle. Even at the time the subject Jeeps were sold, only a few vehicle lines had fuel tanks in this location. And ones like the Suzuki XL-7 have a steel structure encapsulating the fuel tank. (Attachment A.)

The particular difficulty with this location is that the same area of the vehicle is being asked to act as a crush zone (to absorb the energy of a rear impact and cushion the force on the occupants) and to protect the fuel tank and filler system from damage from crush. The design of the Jeep makes this area a fairly effective crush zone. As a result

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[7] It is interesting that Chrysler's proposed remedy is to install a trailer hitch which places additional structure under these weak frame rails to give added strength to the lower rear of the vehicle.

the ability of the rear structure to protect the fuel tank is seriously compromised. It appears that the designers gave little or no consideration to the conflict between these safety concerns. The fuel system design in the Jeep Liberty and Grand Cherokees is contrary to the 1978 engineering recommendations from Chrysler Automotive Safety Manager LL Baker who laid out the basic principles for fuel system safety for Chrysler cars and trucks based on the Ford Pinto which included moving the fuel tank ahead of the rear axle and ensuring the filler neck, cap and tube remained attached to the fuel tank to avoid fuel leakage.[8] In SUVs, Baker recommended a protective impact deflection system for the fuel tank recognizing the mismatch between bumpers that allow lower passenger car to come under and impact the fuel tank if it could not be relocated forward of the rear axle in an SUV. Yet none of these recommendations were carried out in the 1993-2004 Grand Cherokee or 2002-07 Jeep Liberty.

The Grand Cherokee was a new design in the 1993 model year and the Liberty was a new design in the 2002 model year. There was a good reason that designs since the 1980s have not had gas tanks behind the rear axle: it is because of the difficulty in ensuring fuel system integrity with the tank in this location while providing an effective crush zone in the same area.

The use of semi rigid plastic for the tank indicates that the designers did not plan for deformation of the tank that is likely in a rear impact. The poor design of the filler system did not take into account the likely differential deformation of various parts of the rear of the Jeep in a rear impact. The lack of a check valve (which was common practice at the time these vehicles were built) indicates a lack of fail-safe design.

The Jeeps do have a check valve in the tank to preclude back flushing when the gas cap is removed on a hot day. However, this valve lacks a simple spring that would keep it closed under any circumstances where the pressure in the tank is equal to or greater than atmospheric pressure. Such a spring would ensure that the fuel in the tank remained there (assuming that the tank itself is not damaged) even when the filler tube is damaged.

4. The Ford Pinto Complied with FMVSS 301, Fuel System Integrity

It is not relevant whether the subject Jeeps complied with the 30-mph flat barrier FMVSS 301 in effect at the time these vehicles were made any more than it was that the recalled 1971-76 Ford Pinto complied with FMVSS 301 at the time it was made. In fact the Ford Pinto did comply with FMVSS 301 because rear moving barrier took effect in 1977 after the Pinto was made just as the 50-mph moving barrier took effect in 2007-09 after the Jeeps were made. As noted above, the old FMVSS 301 test is exceptionally weak and cannot detect defects in fuel systems such as lack of a check valve, a filler hose that pulls loose or a plastic fuel tank that hangs below the rear bumper. The reason is

[8] "Fuel System Design – Chrysler Passenger Cars and Trucks," Memo from L.L. Baker, Manager Automotive Safety, to R.M. Sinclair, Director International Product Development, August 24, 1978. (Attachment A from Sheridan Submission to NHTSA Administrator Strickland, February 11, 2011.

that this standard uses a moving barrier at only 30 mph with a large flat plate that broadly engages the rear of the vehicle rather than concentrating the force on a vulnerable area of the Jeep as would happen if the impactor were a passenger car.

We are confident that the subject Jeeps could not pass the current FMVSS 301 despite Chrysler's claim that virtually all of the fatal fire crashes of Jeeps were more severe than this test. The last test conducted for the Center for Auto Safety was similar to the current fuel system integrity test except that it was conducted at 40 mph rather than 50 mph (about two-thirds of the energy). The tank failed in that test.

5. The Chrysler Fix

Chrysler has proposed to install a trailer hitch at the rear of some of the vehicles that do not already have them to reduce the likelihood of a fuel system failure in a low to moderate speed rear impact. Yet Chrysler's former Executive Vice President for Vehicle Engineering at the time the Jeep Grand Cherokee was produced testified under oath: "The tow package [which includes the trailer hitch] does not protect the [fuel] tank."[9] The company must provide evidence from actual rear impact tests conducted in accordance with the new FMVSS 301 test procedures just as the Pinto was tested in accordance with the then new FMVSS 301 test procedures as to the effectiveness of this "repair."

Although Chrysler states the proposed trailer hitch recall remedy would provide some additional protection in low speed crashes, nowhere does Chrysler define what a low speed crash is. Furthermore Chrysler admits the trailer hitch would not provide protection in higher speed rear impacts but again fails to define what a higher speed crash is. By definition, the 44 fatal rear impact fire crashes cited by NHTSA is in its voluntary recall request were survivable crashes because the occupants died by fire, not by trauma. Importantly, Chrysler says nothing about whether the trailer hitch would provide any protection to the fuel filler neck or filler hose which pulled loose in two of the three Jeep Grand Cherokee crash tests conducted by FHWA and the Center for Auto Safety where the fuel tank was protected by a 3 millimeter steel shield. In the third test, the Jeep Grand Cherokee had no steel shield and the Taurus went under the bumper and punctured the exposed fuel tank of the Grand Cherokee.

The trailer certainly provides no protection for rear impacts in which the nose of the striking vehicle goes under the Jeep's bumper which it will also go under the trailer hitch because the fuel tank extends downward 8.5" below the rear bumper. At best the trailer hitch extends downward only 1.2 inches below the bumper leaving more than 7" of the fuel tank exposed.

Further testing of the Jeep with the trailer hitch installed is necessary to ensure that it provides a reasonable level of safety as was done with the Ford Pinto whose initial remedy proposed by Ford failed crash tests supervised by NHTSA engineers. Unless the Jeep Grand Cherokee and Linerty can pass the current FMVSS 301 with the trailer hitch installed, then Chrysler must come back with a new and improved recall remedy that can pass the new FMVSS 301 standard.

6. Unanswered Questions in NHTSA Investigation and Recall

a) Will NHTSA subject the recalled 1993-98 Jeep Grand Cherokee and 2002-08 Liberty to the new FMVSS 301 Test Procedure as it did for the Pinto in 1978?
b) How can a trailer hitch protect the fuel tank when a Chrysler Executive Vice President for Vehicle Engineering says it does not protect the fuel tank?

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[9] Deposition of Francois Castaing, Kline v. Morgan-Alcala, p 233, June 14, 2011.

c) How many crashes resulting in death and injury have occurred with vehicles having a trailer hitch as in [redacted] crash death?
d) What is a low energy crash and a high energy crash – which of the 44 fatal fire crashes identified by NHTSA in its recall request to Chrysler were low energy and which were high energy?
e) In what types of crashes in terms of impact speed and conditions will the trailer hitch provide protection?
f) Why weren't the 1999-2004 Grand Cherokees included in the recall?
g) Why weren't the 1993-2001 Cherokees included in the voluntary recall request?
h) None of the FHWA or Center for Auto Safety Jeep crash test suffered a fuel tank rupture or breachment with a 3 mm steel skid plate. Since Chrysler makes the plate available, would NHTSA recommend consumers install one?
i) What will NHTSA do in its continued investigation of the Jeep Cherokee, Grand Cherokee and Liberty?
j) What assurance does the public have that the Jeeps included in the defect investigation are safe if NHTSA does not crash test them as it did with the Ford Pinto?

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Exhibit A – Encapsulated Suzuki SL-7 Fuel Tank

Exhibit B Fuel Spray from FHWA Due to Filler Hose Pulling Loose

Exhibit C – Fuel Tank Connection Where Filler Tube Pulled Loose

Exhibit D –Leak from Ruptured Grand Cherokee Fuel Tank in 40-mph Impact

Exhibit E – Pre-Crash Photo Showing Exposed Fuel Tank