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March 9, 2016

The Honorable Mark R. Rosekind, Administrator
National Highway Traffic Safety Administration
1200 New Jersey Ave. SE
Washington, DC 20590

Dear Dr. Rosekind:

This letter concerns the September 28, 2015, petition from Alan Cantor, *et al*, of ARCCA, Inc. to amend and upgrade 49 CFR 571.207, FMVSS 207-Seating Systems and provides additional comments and evidence to support the Cantor petition.

An occupied seat that meets Federal motor vehicle safety standard 207 can and does fail in a serious rear impact. In such a crash, the seatback may distort in relation to the seat base or the entire seat may detach from its track or mounting. In either case, the occupant of the seat will no longer be restrained and will be thrown into the rear seat area or even out of the vehicle. He or she may be injured. The front seat occupant or failed seat may also injure someone sitting in the rear seat.

This petition is not the first one on the subject received by NHTSA. Mr. Cantor petition the agency on February 28, 1990, with a detailed argument and evidence on the subject. NHTSA rejected his petition on November 16, 2004[1] with the comment, "Since 1989, NHTSA has granted four petitions related to seating system performance in rear impacts."[2]

In that notice, the agency gave several arguments and a promise that was mostly ignored:

> . . . the agency will continue to monitor issues related to rear impact protection, and specifically the performance of seats in this crash mode. Research into this area will continue as priorities allow, particularly as it relates to the goal of unifying FMVSS Nos. 202 and 207 into a single comprehensive rear impact protection standard.

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[1] Federal Motor Vehicle Safety Standards; Seating Systems: Termination of rulemaking, 69 FR 220, November 16, 2004.

[2] Following the agency's receipt of the first Cantor petition, on October 28, 1997, Paul N. Wagner, President, Bornemann Products Incorporated, petitioned NHTSA "to initiate rulemaking on the necessary test procedures for a seating system that incorporates all safety belt anchorages on the seating system . . ." Another petition, from 1989, was from Dr. Kenneth Saczalsky of Environmental Research and Safety Technologists requesting that the agency "increase the seat back [strength] requirements in Standard No. 207." Mercedes-Benz supported the Saczalsky petition by recommending that a dynamic test – possibly in connection with the FMVSS 301 test – be used for rear impact performance. NHTSA did not act on either of these petitions.

NHTSA described some research that it had conducted that should have provide a basis for rulemaking on seat performance:

> NHTSA funded the University of Virginia to perform seat computer modeling to assess how changes in seat design might affect occupant kinematics in rear impacts. Similarly, EASi Engineering Inc., was awarded a multiyear contract to address design issues for an advanced seat. One of the parameters it assessed under that contract was rear seat performance. The agency itself performed static tests on 25 different vehicle seat designs to determine their force deflection characteristics. More recently, NHTSA has funded dynamic sled testing of seats and seat mock-ups in simulated rear impacts at the Johns Hopkins Applied Physics Laboratory. In addition, over the past several years, the agency has added extra instrumentation to the test dummies and seats in vehicles tested under the FMVSS No. 301 rear impact compliance test program.

In terminating the rulemaking, the agency failed to cite a study where NHTSA itself demonstrated front seats in five out of nine vehicles collapsed by more than 25° in FMVSS 301 30-mph rear impact crashes. The worst performing vehicle, a Hyundai Accent, collapsed by 52°. According to the NHTSA researchers:

> The Accent seat back completely collapsed and was found in contact with the rear seat post-test. The recliner mechanism was inspected after the tests to determine the cause of the collapse. The teeth of the recliner were not sheared off and there were no noticeable scratches on the sides of the recliner mechanism. In addition, the recliner worked properly after the test. Therefore, the exact cause of the large seat back rotation could not be determined."

The researchers pointed out the dangers to children of 12 and under from collapsing seat backs: "Further, fatalities and injuries to rear child occupants due to seat back collapse of the front seat in rear impacts have also been reported. This is especially of concern since NHTSA recommends to the public that children of age 12 and under should be placed in the rear seat." ("*Performance Of Seating Systems In A FMVSS No. 301 Rear Impact Crash Test*," Saunders et al., 18th International Technical Conference on the Enhanced Safety of Vehicles, May 2003, Tokyo, Japan.) This danger is the basis for a petition for rulemaking submitted today by the Center to warn parents to place to place children behind an unoccupied seat where possible.

In its rejection of the petitions, the agency cited a paucity of statistics relating to serious to fatal injuries resulting from poor seat performance:

> According to the National Automotive Sampling System (NASS) Crashworthiness Data System (CDS), rear impacts represent about 8 percent of crashes severe enough to make it necessary for a vehicle to be towed from the crash scene. In comparison, frontal crashes represent 56 percent; side crashes, 26 percent; and rollover crashes, 8 percent (NASS annualized data 1992–2001). However, rear impacts cause less than two percent of moderate-to-severe injuries. Similarly, the Fatality Analysis Reporting System (FARS) shows that about 3 percent of all traffic crash fatalities involved occupants of vehicles struck in the rear

(FARS annualized data 1998–2002). Thus, in comparison to other crash modes, there is considerably less data available to assess the potential benefits of upgrading FMVSS No. 207 for higher speed rear impacts.

These arguments are an indictment of crash data reporting more than an indication of whether vehicle seating systems pose a hazard to occupants in rear crashes. Based on an analysis of 64 seatback collapse lawsuits and police reports, we have found that police accident reporting rarely includes any comment on seatback failure even when it is obvious. There is no place on a PAR for reporting such a failure other than the narrative description of the crash. This means that FARS also does not include any information on the role of seat performance in fatal crashes. The NASS coding for seat performance is minimal as well. As a consequence, an analysis of NASS and FARS cases that does not go beyond the recorded data will miss a number of cases where poor seat performance contributed to injuries or fatalities.

To get some indication of how many cases may have had seatback failure as a cause of a rear seat child occupant's death in FARS, we commissioned a search (Attachment A) of all cases where a child, aged 0 to 12 years old, seated as recommended in the rear seat, had died in a rear impact where the front seat in front of the child was occupied. The numbers are shocking: over the past fifteen years, an average of 50 children were killed annually in rear seats in rear impacts. Even if only a minority were killed as a consequence of front seat failure, the number is too high. We call on NHTSA to do what it hasn't done, investigate each and every one of these child deaths to determine which ones were caused by seatback collapse. To simply say as NHTSA has done so often in the past and that FARS shows an insignificant number of seatback collapse deaths is nothing more than an excuse for inaction because FARS doesn't identify seatback collapse in crashes.

Using the National Automotive Sampling System (NASS) Case Viewer program on the NHTSA web site, we looked at all 24 rear impact cases in the NASS 2014 files where the PDOF was between 150° and 210° and the delta V was at least 25 mph. Photographs from these cases of the degree of rear impact damage and the resultant seatback failure are shown in attachment B. A compilation of the key data from these cases is shown in attachment C. We found is that the issue of seatback failure is not well documented in these files. Photographs do not always show the degree of seatback failure and the public files show no measurements or detailed documentation of seat failures. Nor do these case reports discuss the contribution of seatback failure to occupant injury (either to the occupant in the seat or the occupant seated behind a failed seat). Furthermore, the post-crash position of a seatback may not reflect the degree of deformation because there may have been some elastic return with some seat designs. We did not see any cases where the seat came adrift of its tracks, so the problem seems to be primarily with the strength of the seatback.

We suggest a review of the procedures and documentation in NASS for seatback performance so that such failures can be properly documented. We further recommend a study of NASS crashes over the past decade for the degree to which seatbacks fail and the consequences of such failures.

In our limited review of 2014 NASS cases we found one particularly severe, complex crash in which four of the five occupants (including two children) were killed (case 2014-09-045 involving a 2007 Acura TSX). In another, two occupants were killed in a rear impact into a 2006 Jeep Liberty where the failure of the fuel system led to a fire (case 2014-49-002). This case is an example of the failure of the recall of these defective vehicles. The failure of the seatbacks may have hindered the ability of the occupants to get out of the vehicle before it was consumed by fire. There was an AIS 5 thoracic injury in another complex crash (case 2014-09-016 involving a 2006 Nissan Altima). In all of these cases the seatbacks failed. We were surprised to find that in 20 percent of the cases we reviewed, the occupant injury was unknown; and recommend that NHTSA look into why there was such a high proportion of unknown injuries.

There were three AIS 2 injuries that could be related to seatback failure (cases 2014-9-039, 2014-73-086, and 2014-73-104). One interesting case (2014-78-043) involved a 2005 Chevrolet full sized pickup with seat mounted belts. The side of the seat on which the shoulder belt was mounted remained intact while the other side of the seatback distorted rearward. This seems to be a particularly poor design that should be further investigated as a potential safety defect. Attachments A and B are the results of our search of the NASS files: a summary table describing the crashes and pictures from the files.

Because of the paucity of NASS rear impact cases, we can draw no definitive conclusions from them beyond the fact that in more than half of these 2014 cases there was more than minor, permanent seatback distortion. This demonstrates yet another flaw in NASS – not enough data are gathered in enough cases to draw statistically valid conclusions about defects such as seat back collapse. NHTSA needs to bring NASS and FARS into the 21st Century by using modern technology to generate police reports with lower costs and better quality data.

We also have photographs from three other cases in which there were two deaths and one paraplegic injury to drivers showing the relationship between moderate rear impact damage, the degree of seatback failure, and the consequent injuries. Two of the cases went to trial and received verdicts of $14.5 million and $27 million. The third settled based on a demand letter only setting the overwhelming evidence on seat back collapse injuries. The photographs are shown in attachment D.

In 2002, Saczalski, et al, published a paper on injury of rear seated children in rear impacts.[3] This work was based on both analyses of actual crashes and tests. The authors concluded:

> . . . allowing a front occupied seat to collapse into the rear occupant space during rear impact is a hazardous situation for rear seated infants and children who are located behind the collapsing front seat, regardless of the type of child restraint employed. Although it has been suggested that a collapsing front seat is beneficial

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[3] Saczalski, Kenneth J., Joseph Lawson Burton, Keith Friedman, and Todd J. Saczalski; *Study of Seat System Performance Related to Injury of Rear Seated Children & Infants in Rear Impacts*, Proceedings of the ASME International Mechanical Engineering Congress & Exposition, IMECE2002-335, November 17-22, 2002: New Orleans, Louisiana.

> in mitigating injury to the front occupant during rear impact, it should be clear that the occupants and children seated directly behind the collapsing seats are at risk of being seriously injured, even in low severity impact . . . .
>
> . . . based upon the results of this study, it is concluded that stronger front seats, such as the "belt-integrated types, will improve protection to rear seated children, regardless of the child restraint type or seat position, and, if properly designed with good headrests, will also provide improved protection to the front seat occupant as well.[4]

Mr. Cantor has provided us a list of 253 seatback failure cases in which product liability lawsuits were opened since his earlier petition. We have prepared a table, Attachment E, of 64 of these cases for which we have documentation including lawsuit complaints, police reports and court decisions. In reviewing the police accident reports from these cases, we found only two in which the investigating officer cited seatback failure as a factor. Part of the problem as NHTSA recognized in its FMVSS 301 rear impact tests is that the seat may work properly after the crash even though there was a catastrophic failure. (See 2003 NHTSA Study on Seat Performance)

We note that in twenty-two of these cases, a child restrained in the back seat – as recommended by NHTSA – was seriously injured or killed as a result of an impact by the front seat adult occupant who was propelled into the rear seat area after the seatback failed. These cases alone should justify strengthening FMVSS 207 to prevent such tragedies.

In three of these cases, five adults and one child died of burns from fires in vehicles with fuel tanks mounted behind the rear axle. There was evidence that seat failure contributed to their inability to get out of the car. In four cases, restrained front seated adults were ejected after the seatbacks failed. Among adults, there were five other fatalities, ten with quadriplegic injuries, five with paraplegic injuries, and five with severe brain injuries. Although these cases span two decades, they are a small fraction of the total cases where people were seriously to fatally injured as a consequence of seat failure in rear impacts.

The Insurance Institute for Highway Safety has conducted research and testing on the subject that was reported nearly ten years ago.[5] IIHS research shows that head restraints can be designed to provide a high level of protection to the head and neck in rear impacts countering the argument that collapsing seats help to prevent whiplash. IIHS has developed a test procedure and a modified dummy to assess head restraint performance. Of course, a head restraint is irrelevant if the seatback fails.

One factor that might be considered in this matter is that safety belts mounted on a seatback can provide superior occupant restraint, and such mounting requires significantly stronger seat

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[4] It should be noted that we have observed that seats with seat mounted belts have generally been strengthened only on the side with the belt, so that care must be taken to ensure that such asymmetric strength designs are not allowed.

[5] "Rear crash protection in cars: Seat/head restraints in two of every three models are marginal or poor," IIHS News | April 5, 2007.

structures. As mentioned above, however, we have observed that some manufacturers of seat mounted belts have strengthened only the side of the seat on which the belt is mounted providing an even less safe seat performance in a rear impact. Note that with such a failure, the occupant would come out of his or her shoulder belt as the seat forces the occupant away from the belt mounting side of the seat.

Newer, high strength steels are commonly used in modern motor vehicles. They could be used in seat design to provide an adequate level of strength with no weight penalty. The question of the cost of such improvements is an open one. However, some manufacturers are already making vehicles with strong seatbacks, demonstrating that they are not excessively expensive. Mercedes is on record in NHTSA's 1974 rulemaking that dynamic testing be required to test seat back strength in FMVSS 207.

Beyond strengthening the requirements of FMVSS 207 and 202, NHTSA could and should add a rear impact rating for seatback and head restraint performance to NCAP which could be effective in encouraging most new vehicle manufacturers to make vehicles safer in rear impacts while NHTSA goes through the Cantor requested rulemaking.

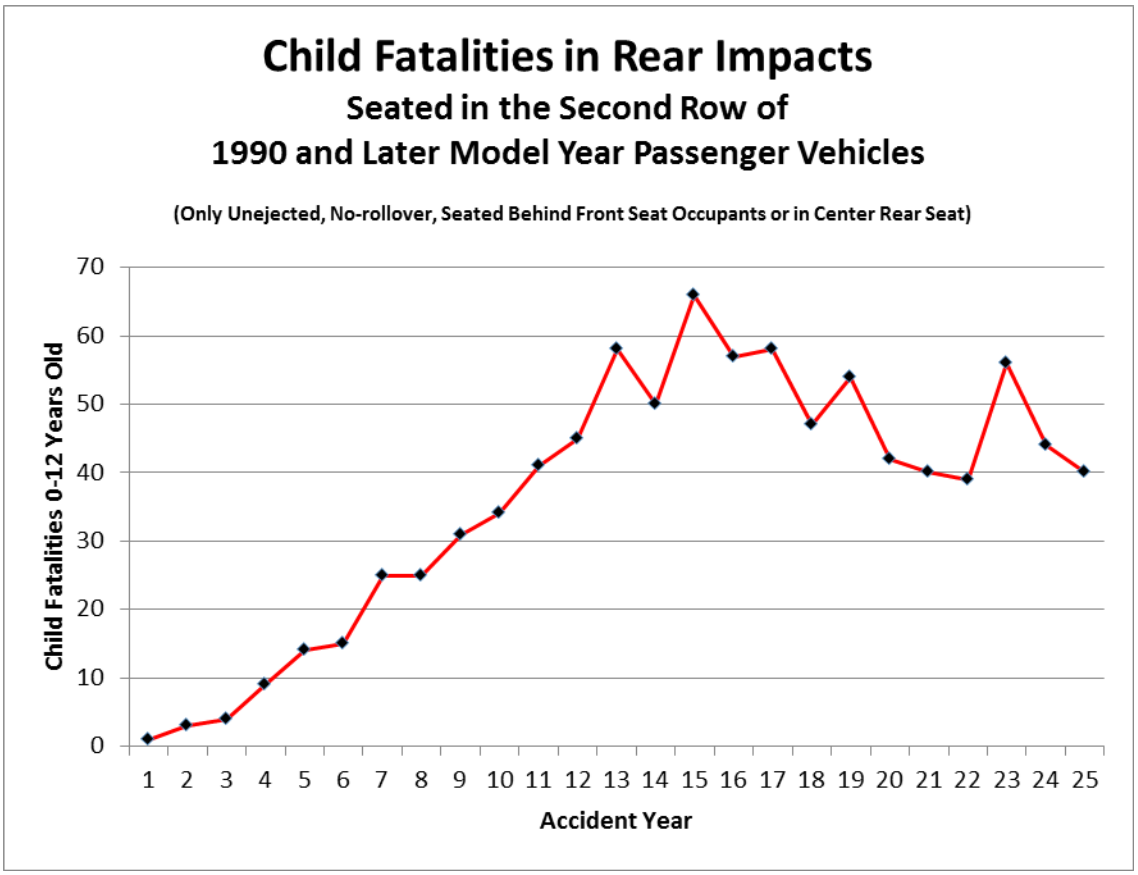
As was the case with rollovers, NHTSA has for decades sat on major evidence that people – particularly children – are being injured and dying unnecessarily in rear impacts: the last major crashworthiness and occupant protection frontier. It did finally address the question of fires in rear impacts reasonably effectively. It should now finish the job and not be distracted by the ephemeral potential through voluntary guidelines for major advances in crash avoidance.

Sincerely,

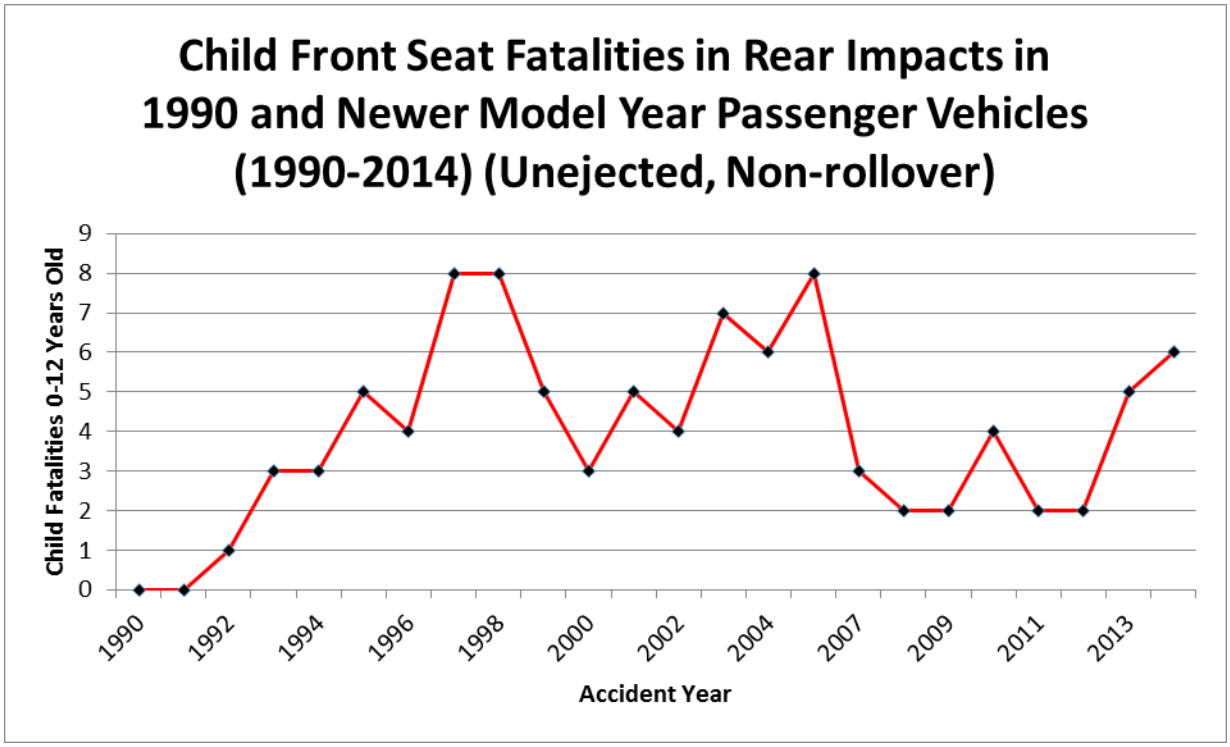
Clarence M. Ditlow
Executive Director

Attachment A – Child Rear Impact Study

Child Fatalities in Rear Impacts Seated in the Second Row of 1990 and Later Model Year Passenger Vehicles (FARS 1990-2014) (Unejected, Non-rollover, Seated Behind a Front Seat Occupant or in the Center Rear Seat)														
	AGE													
Accident Year	0	1	2	3	4	5	6	7	8	9	10	11	12	Total
1990											1			1
1991			1	1				1						3
1992	1		1	2										4
1993	1	2		3			1		1				1	9
1994	1	1	3		2			1	2			2	2	14
1995		3	2	2	1	1	2	1		1	1	1		15
1996	1	3		4	2	2	3	3		2	1	2	2	25
1997	1	1	4	3	4	2	1	3	1	1	2	1	1	25
1998	2	2	2	4	1	3	1	5	2	1	2	4	2	31
1999	3	4	4	4	2	3	3	1	3	4	1	1	1	34
2000	2	6	2	6	2	2	2	3		7	3	4	2	41
2001	6	8	5	5	2	2	4	3	2	2	2	3	1	45
2002	4	3	3	7	5	8	4	1	6	5	8	2	2	58
2003	14	7	2	5	4	3	2	1	3	3	1	4	1	50
2004	12	7	8	2	6	1	9	2	3	4	2	5	5	66
2005	10	4	5	6		6	4	6	5	7	2	1	1	57
2006	9	10	5	4	8	3	5	3	3	1	2	3	2	58
2007	8	7	5	1	3	4	3	3	2	4	1	2	4	47
2008	12	4	4	2	8	6	4	2	1	2	5	2	2	54
2009	6	2	4	4	6	3	5	2	1	4	1	1	3	42
2010	8	7	6	1	2	3	1	1	2	3	3	2	1	40
2011	2	5	6	2	5	5	1	3	1	2	4	3		39
2012	8	8	7	5	8	3	3	3	1	3	2	2	3	56
2013	4	4	1	3	6	7	4	3	4	4	1	2	1	44
2014	3	4	3	7	3	4	2	3	2	3	1	3	2	40
Total	118	102	83	83	80	71	64	54	45	63	46	50	39	898


Child Fatalities in Rear Impacts
Seated in the Second Row of
1990 and Later Model Year Passenger Vehicles
(Only Unejected, No-rollover, Seated Behind Front Seat Occupants or in Center Rear Seat)
Child Fatalities 0-12 Years Old
70
60
50
40
30
20
10
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Accident Year

Front Seat Child Fatalites in Rear Impacts in 1990 and Newer Model Year Passenger Vehicles (1990-2014 FARS) (Unejected, Non-rollover)														
	AGE													
Accident Year	0	1	2	3	4	5	6	7	8	9	10	11	12	Total
1990														0
1991														0
1992			1											1
1993				1						1	1			3
1994				1		1	1							3
1995	1					1			2				1	5
1996	1											2	1	4
1997	1	1			2					1	1	2		8
1998	2			1	2		1			1	1			8
1999							1	1	1		1		1	5
2000					1							1	1	3
2001	1						2				1		1	5
2002							1	1			1		1	4
2003								1	1		2	1	2	7
2004					1	2		1		1			1	6
2005							1			1	2	1	3	8
2007									2				1	3
2008									1	1				2
2009		1									1			2
2010					1						2		1	4
2011	1			1										2
2012								1					1	2
2013	1								1	1		2		5
2014						1		1			1	2	1	6
Total	8	2	1	4	7	5	7	6	8	7	14	11	16	96


Child Front Seat Fatalities in Rear Impacts in 1990 and Newer Model Year Passenger Vehicles (1990-2014) (Unejected, Non-rollover)
Child Fatalities 0-12 Years Old
0
1
2
3
4
5
6
7
8
9
1990
1992
1994
1996
1998
2000
2002
2004
2007
2009
2011
2013
Accident Year

Attachment D – Other Case Photos

Carillo

Mikolajczyk

Schertz