58-89-MRD-201

HR-3-13

FINAL REGULATORY EVALUATION:
EXTENSION OF HEAD RESTRAINT REQUIREMENTS TO LIGHT TRUCKS, BUSES, AND MULTIPURPOSE PASSENGER VEHICLES WITH GROSS VEHICLE WEIGHT RATING OF 10,000 POUNDS OR LESS
(FMVSS 202)

OFFICE OF REGULATORY ANALYSIS
PLANS AND POLICY
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

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I. INTRODUCTION AND BACKGROUND

Since January 1, 1969, passenger cars (but not light trucks* or other vehicles) have been required by Federal Motor Vehicle Safety Standard (FMVSS) No. 202 to provide head restraints that meet specified requirements for each outboard front designated seated position. The standard requires that either of two conditions be met:

1) During a forward acceleration of at least 8g on the seat supporting structure, the rearward angular displacement of the head reference line shall be limited to 45^{o} from the torso reference line; or

2) The head restraint must measure 27.5 inches above the seating reference point, with the head restraint in its fully extended position. The width of the head restraint, at a point 2.5 inches from the top of the head restraint or at 25 inches above the seating reference point, must be not less than 10 inches for use with bench seats and 6.75 inches for use with individual seats. The head restraint must withstand an increasing rearward load until there is a failure of the seat or seat back, or until a load of 200 pounds is applied.

Test procedures are specified in FMVSS 202.

*Throughout the analysis, "light trucks" is used as an abbreviation for trucks, buses and multipurpose passenger vehicles of 10,000 pounds Gross Vehicle Weight Rating (GVWR) or less.

Two generic types of head restraints have been utilized to meet the requirements of FMVSS 202:

> <u>Integral head restraints</u> -- This system consists of a seatback high enough to meet the 27.5 inch height requirement. Some integral head restraints are a "see-through" design.
>
> <u>Adjustable head restraints</u> -- This system consists of a separate head restraint pad that is attached to the seat back by sliding metal shafts. The occupant may adjust the restraint to the top, bottom, or intermediate positions.

At the time of issuance of FMVSS 202, personal transportation was the major use of only about one-half of pickup trucks. As Table I-1 shows, the major use of pickup trucks has been changing over time. Light truck use is an important factor for this analysis because the agency believes that light trucks used for agricultural or construction purposes are probably not involved in rear impacts as often as light trucks used for personal transportation. While the Truck Inventory and Use Survey data are not yet available for 1987, the recent introduction and great acceptance of compact light trucks (52.6 percent of the light truck market in 1985) and the record breaking sales of light trucks in 1985, 1986, and 1987, have probably brought the use of light trucks more in line with passenger cars. Probably over seventy percent of light trucks are now being used for personal transportation. At the time of issuance of FMVSS 202, light truck sales were not as large of a fraction of the under 10,000 pound GVWR vehicle market as they are currently (in 1970, light trucks comprised 15.7 percent of the combined passenger car and light truck market, compared to 28.7 percent in 1985). These changing trends in light truck use and sales have resulted in the agency deeming it appropriate to take a second look at whether some of the safety standards originally applicable only to passenger cars should be extended to other vehicles.

TABLE I-1

THE MAJOR USE OF PICKUP TRUCKS

	1967	1977	1982
Personal Transportation	51.1%	64.6%	65.7%
Agriculture	25.9	17.4	11.8
Construction	7.6	5.6	10.1
Others	15.4	12.4	12.4

Source: Truck Inventory and Use Survey, Bureau of the Census

At the time FMVSS 202 was issued, the agency believed that occupants of light trucks would not be as vulnerable to whiplash injuries as passenger car occupants. As data provided in this analysis will show, light truck occupants are still not as vulnerable to whiplash injuries as passenger car occupants for two reasons:

First, light trucks are not involved in rear impacts as often as passenger cars. Table I-2 shows data indicating that in North Carolina, rear impact involvements per registered vehicle are 25 percent less for light trucks than for passenger cars. This percentage difference is probably greater than the national average, since the agriculture and construction use of pickup trucks in North Carolina is 27 percent versus about 22 percent for the national average.

Second, as data provided later in this analysis will show, given that a vehicle is involved in a rear impact, front seat occupants 15 years and older have a much higher whiplash injury rate in passenger cars than in light trucks. Reasons for this difference are discussed in the analysis; for example, some pickup truck occupants receive head injuries from striking the rear window glass rather than receiving a whiplash injury. However, even after adjusting for several differences that can be quantified, light truck occupants still have lower injury rates, given a rear impact, than passenger car occupants.

The question that this analysis tries to shed some light upon is: given that light trucks are involved in fewer rear impact crashes and given that light truck occupants are not injured as frequently as passenger car occupants in those crashes, is it reasonable and practicable to attempt to reduce the injuries that do occur?

TABLE I-2

(1984 plus 1985 North Carolina Data)
Vehicles in Rear Impacts per Registered Vehicle

Vehicle Type	Number Involved	Registered Vehicles	Involv. per 1,000 R. V.
Small Car	22,048	3,006,554	7.3
Medium Car	9,577	1,455,584	6.6
Large Car	12,781	1,962,594	6.5
Small Van	83	27,676	3.0
Standard Van	1,207	213,024	5.7
Small Pickup	2,366	406,328	5.8
Standard Pickup	3,736	745,414	5.0
Multipurpose Veh.	669	155,076	4.3
Total Pass. Car	44,406	6,424,732	6.9
Total Light Truck	8,061	1,547,518	5.2
Total	52,467	7,972,250	6.6

Source: "Relative Risk to Car and Light Truck Occupants", Partyka, Sikora, Surti, and Van Dyke, SAE 871093. p. 11.

A. The Petitions

On September 29, 1986, Dale T. Fanzo petitioned the agency to extend FMVSS 202 to require head restraints "on vehicles other than passenger cars". Mr. Fanzo suffered a whiplash injury resulting in damage to ligaments in his neck and other injuries while in a compact van. This analysis considers extending the head restraint requirements to light trucks.

On August 7, 1987, Mark E. Goodson, P.E. of Goodson Engineering, Inc. petitioned for "... light trucks, notably pickup trucks, to have safety features so as to minimize compression of the head and spine due to striking the rear glass". Mr. Goodson suggested that laminated glass should be used in the rear window in place of tempered glass and that the laminated glass could be mounted in a rubberlike compound that would allow the entire piece of glass to be deflected rearward in the event that the head strikes the rear window. In addition, the laminated glass would undergo plastic deformation, thereby absorbing some of the kinetic energy. Mr. Goodson states that "Headrests are an obvious alternative, but they have two problems: they do not always work well because the glass is so close, and they limit visibility somewhat. A better solution might be to use both FMVSS 202 headrests and the proposed changes in glazing materials and glazing support systems". Mr. Goodson states that he is not so concerned with the specific implementation of his proposals, but the spirit and intent of the petition is to lessen the severity of injuries that occur when a small truck is rear ended.

B. The Passenger Car Evaluation

"An Evaluation of Head Restraints, Federal Motor Vehicle Safety Standard 202", by Charles Kahane, NHTSA, February 1982, estimated the effectiveness of head restraints (in reducing the overall risk of injury in rear impacts, not just neck injuries) at 17 percent for integral head restraints and 10 percent for adjustable head restraints. An estimated 64,000 injuries would be reduced annually in passenger cars with the 1979 fleet mix of integral and adjustable head restraints. The following paragraphs provide relevant highlights from the 1982 Evaluation.

The main reason that adjustable head restraints were less effective than integral head restraints was that 75 percent of the adjustable head restraints were left in the "down" position. As a result, the in-use median height of adjustable head restraints, in the position in which they were set by occupants, was less than 26 inches. By contrast, the median height of integral head restraints was over 28 inches. Since the median height of pre-standard seatbacks was about 22 inches, adjustable head restraints in effect provided only two-thirds as much additional height as integral head restraints provide. Although the agency has not collected any data on the height of adjustable head restraints in the down position since the 1982 evaluation, it appears that manufacturers have voluntarily raised seat back heights in cars with adjustable head restraints. This would improve the effectiveness of adjustable head restraints. Whether this also occurred in light trucks is unknown, thus the analysis continues to use the 10 percent effectiveness for adjustable head restraints and the 17 percent effectiveness for integral head restraints.

A number of studies have shown that female occupants are more vulnerable to neck injury than males. The most evident explanation is that females, on the average, have considerably narrower necks than males and, especially, a smaller muscle mass. Yet, their necks must support heads of roughly the same volume as males'.

The lifetime cost of head restraints, including fuel consumption, was estimated to average $32.35 (1981 dollars), with 28 percent of the head restraints being integral and 72 percent adjustable. These average costs provided in the 1982 evaluation are no longer subscribed to. In the 1982 evaluation, integral head restraints were estimated to cost much less than adjustable head restraints. However, only one integral head restraint was torn down for cost estimating purposes and either that cost estimate was in error or that head restraint system was not representative of other integral head restraint systems. Subsequent to the publication of the 1982 evaluation, a number of other integral head restraints were torn down for cost estimating purposes, resulting in cost estimates that are closer to the adjustable head restraint costs. Chapter IV presents the agency's current assessment of head restraint costs.

II. THE NOTICE OF PROPOSED RULEMAKING -- AND THE COMMENTS

The Notice of Proposed Rulemaking (NPRM) (53 FR 50047), published on December 13, 1988, proposed the extension of FMVSS 202 to trucks, buses, and MPV's with a GVWR of 10,000 pounds or less, and the driver's seat of school buses with a GVWR of 10,000 pounds or less. No commenter opposed the proposal, although some commenters raised concerns about particular issues, such as leadtime.

The NPRM also asked for comments on several issues:

1) Should light trucks of a certain size or weight be exempt from the head restraint standard? No commenter favored this proposal, and the agency is not going to exempt any light trucks in the final rule.

2) Should rear seats have head restraints? The American Insurance Association favored extending the requirements to rear seats. Chrysler Corporation stated that rear seat head restraints were not justified and cited visibility problems with rear seat head restraints. The agency has decided not to extend the requirements to rear seats, because of the small number of whiplash injuries to rear seat occupants in light trucks. These were estimated in the "Preliminary Regulatory Evaluation, Proposed Extension of Head Restraints to Light Trucks, Buses, and Multipurpose Passenger Vehicles with Gross Vehicle Weight Rating of 10,000 Pounds or Less, FMVSS 202," April 1988 (herein referred to as the PRE), as being only 81 rear seat occupant whiplash injuries per year in light trucks, based on 1982-1985 data.

3) Should medium and heavy trucks be required to have head restraints? No commenter favored this proposal. The agency has decided not to extend the requirements to heavy trucks, because of the smaller percentage of occupants injured in these trucks than in light trucks or passenger cars (whiplash injury rate of 2.5 percent for front seat occupants in rear-impacted vehicles for medium to heavy trucks versus 4.6 percent for light trucks and 14.8 percent for passenger cars). In addition, the effectiveness of head restraints in medium and heavy trucks has not been established.

4) Is visibility limited by a significant degree by front seat head restraints? The agency gave its opinion in the NPRM and PRE that front seat head restraints have a negligible effect on accident causation and that the tradeoff between the reduction of whiplash injuries and the potential loss of visibility was acceptable. Chrysler concurred with the agency that front seat head restraints do not reduce visibility to any measurable degree. Chrysler stated that the anatomy of the neck is such that the driver looks around the head restraint when looking to the rear (unless the head restraint is unusually wide) and that the passenger side front seat head restraint is usually in line with the B-pillar, and thus does not reduce visibility.

5) Could the rear window in a pickup truck serve as a substitute for a head restraint? No commenter agreed that this was a workable or appropriate proposal, and the agency is not going to adopt this as an alternative way of meeting the standard for pickup trucks. See the PRE for extensive discussions on this issue.

6) Could the rear window in a pickup truck be made safer either by using laminated glass, glass-plastic glazing, or by other means? The PRE provided some discussion about the safety aspects of different types of glass. Motor Voters commented that they favored glass-plastic glazing as a way to reduce ejections. General Motors provided a discussion of the issue saying "Several injury mechanisms are possible from head contact with the backlight, including lacerative injuries, penetration through the backlight, internal head injuries from the contact pulse with the backlight, head rotation into the mounting frame, etc. Perhaps the best overall compromise, if the backlight were intended to operate as a head restraint mechanism, would be to use either the encapsulated or urethane mounting method and an energy absorbing glazing." General Motors stated that head restraints would obviate the need for additional rear window requirements, since occupant head contact with the rear window would not be expected. However, this was exactly the scenario that brought about the Goodson petition, the head sliding off or missing the head restraint and being injured by the rear window. General Motors also stated that there could be a significant cost penalty associated with a glazing system that would reduce injuries, but gave no further cost breakdown.

At this time, the agency is not going to require improvements to the glazing of the rear window in pickup trucks. More information needs to be obtained regarding potential costs and benefits. On the benefits side, it is difficult to determine how many injuries would still occur due to contacting the rear window once head restraints become standard equipment. The agency is still researching glass-plastic glazing, and this is one of the potential future applications to be considered.

Another comment to the docket supported by the American Insurance Association, Motor Voters, and the Insurance Institute for Highway Safety, asked that integral head restraints be required, instead of allowing the choice between integral and adjustable head restraints. Motor Voters argued that there should be a passivity component to FMVSS 202 that would only allow integral head restraints since they are used more often, and thus have higher overall effectiveness. The agency did not propose this requirement in the NPRM, and thus, it is outside of the scope of this rulemaking proceeding. However, the agency will continue to monitor injuries in rear-impacted vehicles to determine if further rulemaking is necessary.

Other comments regarding the benefit analysis, leadtime, and the percent of the fleet to currently have head restraints will be discussed in their appropriate sections.

III. BENEFITS

The benefit of adding head restraints to light trucks would primarily be the reduction of whiplash injuries. Whiplash is a noncontact injury to tissues in the neck: the muscles, ligaments or vertebrae. Whiplash occurs when crash forces cause the displacement or rotation of the head, relative to the torso, to the degree that the neck is extended, twisted or flexed beyond its normal range of motion. The most common form of whiplash in a rear impacted vehicle without head restraints involves the unsupported head moving backwards and downwards relative to the fixed torso, with resultant hyperextension of the neck. This is the principal injury mechanism that head restraints are designed to mitigate. In the case of pickup trucks, head restraints may also reduce some head injuries that result from striking the rear window or other portions of the rear of the cab.

Neck pain and stiffness is the most common whiplash symptom, but involvement of the cervical nerves and spine often leads to symptoms in the head, shoulder, arms, or upper back. The pain and disability associated with whiplash may last anywhere from several days to several years. Data indicate that whiplash victims miss an average of 4 days of work (National Crash Severity Study, June 1980). Whiplash differs from visible injury in that the symptoms may not appear until sometime after the accident.

A. Comparison of Light Trucks and Passenger Cars

Table III-1 presents national estimates of four years of data on people 15 years and older in rear impacted vehicles, in both front and rear seats. The age of 15 years was chosen because many children under this age would receive sufficient support from the normal height seatback and thus would not need head restraints. This slightly underestimates the total number of injuries because there would be a small number of younger children that are tall enough to benefit from head restraints in the front right seat. Data are presented on passenger cars, pickup trucks and vans, utility vehicles, and all light trucks (LT). When examining the front seat occupant data in Table III-3, pickup trucks are separated from vans to examine the effects of the rear window.

Table III-2 presents the actual sample sizes from which the national estimates were derived. The number of utility vehicle cases is fairly low, making their whiplash injury rates somewhat suspect. (Utility vehicles include on-off road vehicles like Jeeps, Blazers, etc.) However, there are sufficient data on pickup trucks and vans to have reasonable confidence in these estimates. The actual number of people in the front seat is 526 for pickup trucks and 171 for vans.

Table III-3 presents the front seat occupant injuries. A quick comparison with Table III-1 indicates that there were 1,920 injuries overall and only an estimated 81 rear seat whiplash injuries in pickups, vans and MPV's per year. For this reason, the agency is not considering requiring head restraints for the rear seats of light trucks. The front seat occupants in Table III-3 will be used to compare cars and light trucks, but the front seat outboard population will be used in benefit calculations.

TABLE III-1

People 15 years and older in rear-impacted vehicles
National estimates -- Annual Average of 1982-85 NASS with all unknowns distributed
Front and Rear Seat Occupants

Nontowed

Vehicle	Total People	Number of People Injured: Injured	All Neck	Whiplash	Percent of People Injured: Injured	All Neck	Whiplash
Car	1,480,454	294,983	193,623	180,911	19.9	13.1	12.2
P'up/Van	363,232	41,086	13,472	13,152	11.3	3.7	3.6
Utility	19,316	3,116	1,478	1,478	16.1	7.7	7.7
All LT	382,548	44,202	14,950	14,630	11.6	3.9	3.8

Towed

Vehicle	Total People	Number of People Injured: Injured	All Neck	Whiplash	Percent of People Injured: Injured	All Neck	Whiplash
Car	177,105	102,970	61,979	58,484	58.1	35.0	33.0
P'up/Van	12,546	8,058	2,950	2,771	64.2	23.5	22.1
Utility	2,143	1,453	499	474	67.8	23.3	22.1
All LT	14,689	9,511	3,449	3,245	64.7	23.5	22.1

Nontowed and Towed

Vehicle	Total People	Number of People Injured: Injured	All Neck	Whiplash	Percent of People Injured: Injured	All Neck	Whiplash
Car	1,657,559	397,953	255,602	239,395	24.0	15.4	14.4
P'up/Van	375,778	49,144	16,422	15,923	13.1	4.4	4.2
Utility	21,459	4,569	1,977	1,952	21.3	9.2	9.1
All LT	397,237	53,713	18,398	17,875	13.5	4.6	4.5

TABLE III-2

NASS SAMPLE SIZE
Actual Number of Cases

People 15 years and older in rear-impacted vehicles
Front and Rear Seat Occupants

Nontowed

Vehicle	Total People	Number of People Injured		
		Injured	All Neck	Whiplash
Car	2,433	869	626	606
P'up/Van	587	186	78	72
Utility	44	16	11	11
All LT	631	202	89	83

Towed

Vehicle	Total People	Number of People Injured		
		Injured	All Neck	Whiplash
Car	1,850	1,294	703	655
P'up/Van	145	111	43	38
Utility	17	12	5	5
All LT	162	123	48	43

Nontowed and Towed

Vehicle	Total People	Number of People Injured		
		Injured	All Neck	Whiplash
Car	4,283	2,163	1,329	1,261
P'up/Van	732	297	121	110
Utility	61	28	16	16
All LT	793	325	137	126

TABLE III-3

People 15 years and older in rear-impacted vehicles
National estimates -- Annual Average of 1982-85 NASS with all unknowns distributed
Front Seat Occupants

Nontowed

Vehicle	Total People	Number of People Injured: Injured	All Neck	Whiplash	Percent of People Injured: Injured	All Neck	Whiplash
Car	1,377,076	280,709	186,878	174,592	20.4	13.6	12.7
Pickup	261,964	35,172	10,584	10,333	13.4	4.0	3.9
Van	90,138	5,869	2,848	2,780	6.5	3.2	3.1
Utility	18,350	2,615	1,478	1,478	14.3	8.1	8.1
All LT	370,452	43,656	14,910	14,591	11.8	4.0	3.9

Towed

Vehicle	Total People	Number of People Injured: Injured	All Neck	Whiplash	Percent of People Injured: Injured	All Neck	Whiplash
Car	164,440	94,491	57,676	54,264	57.5	35.1	33.0
Pickup	7,334	4,984	2,059	2,039	68.0	28.1	27.8
Van	3,880	1,742	891	732	44.9	23.0	18.9
Utility	2,100	1,411	456	432	67.2	21.7	20.6
All LT	13,314	8,137	3,406	3,203	61.1	25.6	24.1

Nontowed and Towed

Vehicle	Total People	Number of People Injured: Injured	All Neck	Whiplash	Percent of People Injured: Injured	All Neck	Whiplash
Car	1,541,516	375,200	244,554	228,856	24.3	15.9	14.8
Pickup	269,298	40,156	12,643	12,372	14.9	4.7	4.6
Van	94,018	7,611	3,739	3,512	8.1	4.0	3.7
Utility	20,450	4,026	1,934	1,910	19.7	9.5	9.3
All LT	383,766	51,793	18,316	17,794	13.5	4.8	4.6
Note: Front seat Outboard occupants							
All LT:	373,253	51,030	18,316	17,794	13.7	4.9	4.8

The last group of data on Table III-3 indicates that the percent of people injured (all injuries) in rear-impacted vehicles is 1.8 times higher in passenger cars than in light trucks (24.3 percent for cars and 13.5 percent for all LT). The ratio is even greater for the whiplash type of injury (14.8 percent for cars and 4.6 percent for all LT, resulting in cars having a 3.2 times higher whiplash injury rate than light trucks).

Data from two state files were examined to verify whether the phenomenon of higher injury rates in rear impacts for passenger car occupants was found. Data from both Pennsylvania (1983-85) and Indiana (1985) verified this finding. Pennsylvania data showed passenger car occupants 1.4 times more likely to be injured (all injuries) and 1.9 times more likely to report a whiplash injury. Indiana data showed passenger car occupants 1.6 times more likely to be injured (all injuries) and 2.1 times more likely to receive a whiplash injury.

The agency further examined the NASS accident files to try to determine the reasons for this difference.

One theory is that the rear window of a pickup truck acts as a head restraint. The front seat of passenger cars typically do not have a rear window in close proximity to the driver's head, even those with only two seats. Accident data indicate that there are 11,046 head injuries annually due to impact with rear windows of pickup trucks. Almost all of these injuries (96%) are minor AIS 1 injuries. When these injuries are added in with the 12,372 whiplash injuries in pickup trucks shown at the bottom of Table III-3, the pickup truck injury rate becomes 8.7 percent (12,372 + 11,046 = 23,418/269,298 = 8.7 percent). Adding these head injuries lowers the passenger car to pickup truck applicable injury ratio to 1.7 (14.8/8.7 = 1.7). However, it is obvious that the rear window is not the only factor that makes pickup truck whiplash rates so much lower than passenger car rates. Vans have a lower whiplash rate than pickup trucks, even before adding in head injuries to the rear window, despite the fact that they have no rear window that front seat occupants will strike. Still, the pickup truck rear window may be effective in reducing some whiplash injuries. The skull is hard and, in some low speed cases, it may be less injurious for an occupant to hit his/her head on a window than to risk a whiplash injury. In other cases, a whiplash injury may be reduced, but the occupant may still have a head injury.

A second theory evolves around findings that males have lower whiplash injury rates than females and that more males occupy the front seats of light trucks than do females. To corroborate this theory, NASS data was analyzed for males alone. This data indicated that 48.2 percent of the occupants in rear impacted passenger cars were males and 75.1 percent of the occupants in light trucks were males. In passenger cars, the new data agree with the older analyses that females have a higher whiplash injury rate than males (18.5 percent for females and 10.1 percent for males). This did not occur in light trucks. Both males and females had the same whiplash injury rate of 4.6 percent. Whether this is a real phenomenon or the result of a low number of females in the sample (about 30 whiplash cases) is not known. Comparing the injury rates of males alone results in a passenger car to light truck whiplash ratio of 2.2 (10.1/4.6 = 2.2). When male head injuries due to contact with the rear window in pickup trucks are included, the ratio becomes closer at 1.2 (10.1/8.3 = 1.2).

A third theory suggests that vehicle weight has an effect on the delta V that the light truck occupant incurs, compared to passenger car occupants. As a surrogate for vehicle weight, an analysis was performed comparing domestic light trucks to foreign light trucks, since foreign light trucks weigh less as a group. Foreign light trucks comprised only 9 percent of the sample. The overall injury rate in rear impacted vehicles was higher in foreign trucks (17.7 percent in foreign light trucks versus 12.9 percent in domestic light trucks). However, the whiplash injury percentages were slightly lower in foreign light trucks (3.9 percent in foreign light trucks and 4.5 percent in domestic light trucks). This difference is not significant, given the small foreign light truck sample and the fact that a higher percentage of foreign light trucks had head restraints than domestic light trucks in the 1982-1985 period. Whether vehicle weight is a factor in light truck whiplash injuries remains in doubt, because of the relatively small sample size of foreign light trucks. Another analysis of passenger cars towed away after a crash indicated that weight was not a factor in whiplash injury rates. The whiplash injury rate given a towed passenger car hit in the rear was 36 percent for cars up to 3,049 pounds, 42 percent for cars between 3,050 and 3,549 pounds, and 32 percent for cars over 3,550 pounds. If weight were an overriding factor, one would expect that the injury rate would decrease as car weight increased. This did not hold true for the 3,050 to 3,549 pound weight category.

Other potential factors that might explain the difference in whiplash injury rates between light trucks and passenger cars include vehicle configuration, vehicle height, and seat configuration.

Vehicle Configuration: A theory regarding vehicle configuration was discussed in the SAE paper 841658, by Nyquist, DuPont and Patrick, "Pick-up Truck Rear Window Tempered Glass as a Head Restraint -- Head and Neck Loads Relative to Injury Reference Criteria". Their observations of nine rear impact tests with a mini-pickup were that vehicle deformations in the seatback, cab rear wall, and cargo box forward wall as a result of occupant loading provided an effective safety feature.

Another theory is that light trucks typically have longer rear structures to haul cargo than passenger cars. Perhaps this longer structure crushes more and dissipates more energy providing "ride-down" benefits for the occupants.

Vehicle Height: The rear of pickup trucks and many vans are higher than the rear, or front, of most passenger cars. Thus, when a passenger car hits a light truck in the rear, perhaps the car's bumper goes under the truck's bumper, and the softer upper part of the car's front is engaged, resulting in a lower average acceleration of the truck than would occur if the bumpers and stiffer lower structures of both vehicles were engaged.

Seat Configuration: The seat of pickup trucks, without extended cabs, is fairly close to the back of the cab. One of the injury modes described in the passenger car evaluation is called "ramping". This occurs during the impact when the seat back tilts backwards allowing the occupant to ride up the seat towards the roof or towards the back seat. Ramping can result in whiplash injuries if the occupant rides up over the head restraint or in head or neck injuries from contacting the roof. With the seatback near the back of the cab, the seat cannot tilt back through large angles. However, vans do not have this same seating configuration, yet vans had a lower whiplash injury rate than pickup trucks.

In summary, the agency cannot determine at this time why light trucks have lower whiplash injury rates than passenger cars. This lower rate occurs despite the fact that almost all cars in the accident file had head restraints while probably only around 25 percent of the light trucks had head restraints. Several theories have been discussed. These include the back window in pickup trucks as being somewhat effective as a head restraint; male occupancy being more predominant in light trucks and males having a lower propensity to receive a whiplash injury; and vehicle configuration, weight, height, and seat configuration. Perhaps many of these factors are involved.

While the comparison of whiplash injury rates between passenger cars and light trucks is interesting to examine, the real issue of this rulemaking is to what degree head restraints will improve the safety of light truck occupants and what are the costs and benefits involved with requiring light trucks to be equipped with head restraints.

B. Estimated Benefits of Head Restraints for Light Trucks

As shown on Table III-3, there are an estimated 51,030 injuries to outboard front seat occupants 15 years of age or older in rear impacts of all types to light truck occupants annually. The Insurance Institute for Highway Safety (IIHS) commented that whiplash injuries are generally underreported, especially in police reports, because the symptoms are often not apparent at the scene of the crash. IIHS went on to quote a report based on telephone interviews and mail questionaires one to seven days after the crash which found twice the number of whiplash injuries than reported by the police. Since the estimated number of injuries (51,030) comes from the NASS file, and the NASS investigators interview crash victims between 2 and 7 days after the crash, it is believed that the NASS data would already include the underreported injury cases.

However, the NASS data does not include unreported accidents. A study by Westat, Inc. "National Accident Sampling System, Nonreported Accident Survey", November 1981, DOT HS 806-198, indicates that there are 0.27 unreported injuries per injury reported in NASS. A closer look into these injuries indicates that 5.2 percent of the unreported injuries were neck injuries as compared to 12.2 percent of the NASS injuries. One reason for this difference is that there are a higher number of single vehicle accidents among the unreported than the NASS reported and whiplash injuries would be rare in single vehicle accidents. Thus, an estimated 11.5 percent more injuries occur when including the unreported accidents [(5.2/12.2) x 0.27 = 0.115]. And the estimated number of injuries increases from 51,030 to 56,900 (51,030 x 1.115).

Based on comments to the docket and surveys of current light trucks, the agency estimates that by the 1992 model year 8.71 percent of the fleet will not voluntarily have head restraints (see Chapter IV). The agency believes that in the 1982-85 timeframe about 25 percent of the on-the-road light truck fleet was equipped with head restraints or high back seats. Based on the 1986 calendar year sales breakdown, it is estimated that about 60 percent of the head restraints on the road in the 1982-85 timeframe in light trucks were adjustable and 40 percent were integral head restraints.

The passenger car evaluation found that adjustable head restraints were 10 percent effective and the integral head restraints were 17 percent effective in reducing all rear impact injuries, not just head and neck injuries. It is assumed that the same effectiveness estimates would also apply to light trucks. Thus, the average effectiveness for the light trucks on the road in 1982-85 is estimated to be 12.8 percent (10 percent x 0.60 + 17 percent x 0.40 = 12.8 percent). However, since light trucks have lower injury rates than passenger cars and we can not identify the reasons why, there remains some doubt whether the effectiveness in passenger cars is directly transferable to light trucks. GM, in their docket comments, also questioned whether the effectiveness for light trucks would be the same as for passenger cars. The agency disagrees with GM that the agency does not have a reliable basis for assessing the effectiveness of head restraints in light trucks. Since the injury mechanism and types of injuries are similar for passenger cars and light trucks, the effectiveness estimates should be similar. While the rear window in some light trucks may reduce whiplash injuries, a head restraints could reduce some of the head injuries due to impacts with the rear window in pickup trucks and could reduce ejections through the rear window of pickup trucks by some extent simply by reducing the area through which occupants are ejected.

The first step in analyzing the benefits is to determine the number of injuries that would have occurred if none of the light trucks were equipped with head restraints. The following formula applies:

$I_{nr} = I_c/[1 - (A_c)(E_c)]$

Where : I_{nr} = Injuries when no vehicles have head restraints
I_c = Injuries with 1982-85 head restraint availability
A_c = 1982-85 head restraint availability
E_c = Effectiveness of head restraints given 1982-85 availability

Thus, I_{nr} = 56,900/[1 - (0.25)(0.128)] = 58,780 injuries if no vehicles had head restraints.

The number of injuries that could be reduced if head restraints were made standard equipment for all light trucks is shown below, dependent upon the type of head restraint utilized to meet the standard -- adjustable or integral. The agency does not know the future mix of adjustable and integral head restraints for light trucks that will not voluntarily be meeting the standard and will show the benefits assuming the remainder of the fleet is equipped with all adjustable head restraints or all integral head restraints. The benefits over the lifetime of the MY 1992 fleet of light trucks that would be required to have head restraints, and would not have done so voluntarily, are 510 - 870 injuries reduced. The injury reductions are over and above those that would be obtained by voluntary inclusion of head restraints up to and including MY 1992. The injury reductions could also be considered as the long term annual reductions once all light trucks in the fleet have head restraints as compared to voluntary inclusion of head restraints up to and including MY 1992.

o <u>Adjustable head restraints</u>: 58,780 injuries x 8.71 percent of the fleet x 10 percent effectiveness = 510 injuries reduced.

o <u>Integral head restraints</u>: 58,780 injuries x 8.71 percent of the fleet x 17 percent effectiveness = 870 injuries reduced.

IV. COST AND LEADTIME

A. Head Restraint Costs

The agency's cost estimates are based on data collected for the evaluation of FMVSS 202 Head Restraints in passengers cars, reported in NHTSA's final contract reports DOT HS-805-318 and DOT HS-806-769. These cost data have been updated to 1988 economics for the purpose of evaluating the extension of the head restraint standard to light trucks (See Table IV-1). Adjustable head restraint systems were studied on bench seats, standard bucket seats, and high back bucket seats. Integral head restraint systems were studied on bench seats, bucket seats, and see-through head restraint systems on bucket seats.

The Mustang integral head restraint cost and weight as reported in DOT HS-805-318 was considered to be grossly unrepresentative when compared with the head restraints studied in DOT HS 806-769. Therefore, it was not used for this analysis.

Several factors will influence the cost of head restraint systems, i.e., type of design selected (adjustable or integral), plushness, type of material (cloth/vinyl/leather), etc. For this reason, a range of costs and weights are presented of the potential consumer cost per vehicle, based on passenger car adaptation, for extending the standard to light trucks. As shown in Table IV-1, these costs and weights can vary from $22.00 to $49.00 and 6 to 14 pounds for adjustable head restraint systems per vehicle, and $22.00 to $40.00 and 5 to 7 pounds for integral head restraint systems per vehicle.

TABLE IV-1

Cost and Weight Variance of Vehicles Studied
with Adjustable Head Restraints
(Based on 1988 Economics)
(Ref. DOT HS-805-318)

	Consumer Cost Per Vehicle	Weight Per Vehicle (#)
1969 Rambler American	$22.14	6.15#
1969 Plymouth Valiant	48.18	13.98
1969 Dodge Polara	42.40	13.88
1969 Falcon	49.44	10.86
1969 LTD	37.86	10.74
1969 Thunderbird	31.63	8.57
1969 Chevrolet Nova	37.70	10.61
1969 Chevrolet Corvette	26.91	6.79
1969 Pontiac Firebird	34.81	9.74
1969 Cadillac Eldorado	35.88	10.99

Cost and Weight Variance of Vehicles Studied
with Integral Head Restraint Systems
(Based on 1988 Economics)
(Ref. DOT HS-805-769)

Bench Seat with Integral Head Restraint Systems	Consumer Cost Per Vehicle	Weight Per Vehicle (#)
1972 Dodge Monaco	$39.97	6.86#
1977 AMC Pacer	26.91	4.38
1980 Chevrolet Citation	21.53	6.79
Bucket Seat with Integral Head Restraint System		
1979 Chevrolet Monte Carlo	23.09	5.23
Bucket Seat with Integral See-through Head Restraint Systems		
1975 Saab	33.20	6.56
1978 Volvo	26.21	5.57

Comments to the docket from Ford and Chrysler indicated that both were planning on voluntarily installing head restraints on all of their light trucks by the proposed effective date. General Motors indicated they planned on voluntarily installing head restraints in their light trucks, but their schedule did not coincide with the proposed effective date. General Motors indicated that 80 percent of their new light truck sales would have head restraints as standard equipment for MY 1992 (the effective date), 90 percent by MY 1993, and 100 percent by MY 1994. Subsequently, the agency examined literature on the foreign manufacturers of light trucks (none of which commented on the proposal) trying to determine which models had head restraints as standard equipment for MY 1989. It appears that the Mazda pickup truck may be the only foreign light truck without head restraints as standard equipment. A telephone call was made to Mazda to determine whether Mazda had plans to make head restraints standard equipment for pickup trucks. Mazda has no concrete plans to make them standard equipment. However, pickup trucks with separate seats have head restraints as standard equipment, while the bench seats do not. It is estimated by NHTSA that about 7,000 Mazda pickup trucks come equipped with head restraints, based on literature indicating that separate seats come as standard equipment with automatic transmissions in one Mazda model and the breakdown of automatic versus manual transmissions.

Table IV-2 presents the estimated percent of the fleet that would not have head restraints voluntarily in place for model year 1992.

Table IV-2
Estimated Percent of the Fleet
That Will Not Voluntarily Have Head Restraints

		Number of Vehicles	Percent of the Fleet That Won't Voluntarily Have Head Restraints (Based on 1988 Sales of 4,921,920)
Model Year 1992			
GM sales for 1988 =	1,740,665		
	x 20%		
	348,133	348,133	7.07%
Mazda sales for 1988 =	93,287		
van	- 5,717		
with head restraint	- 7,000		
	80,570	80,570	1.64
Total		428,703	8.71%

Lifetime Fuel Penalty Cost

The lifetime fuel costs of carrying the extra weight of head restraints must also be considered. The lifetime fuel penalty costs shown in Table IV-3 (present value, 10% annual discount rate) are based on the historic relationship between weight and fuel economy, as well as DOE fuel price projections (see Tables IV-4 and IV-5) from anticipated 1992, (year of 100% implementation) out to year 2016. Increased fuel consumption is computed as follows:

$$\left[\left(\frac{W_2}{W_1}\right)^{.8} - 1\right] \left(\frac{\text{Lifetime VMT}}{\text{Fuel Economy, mpg}}\right)$$

W_2 = Vehicle weight after increase due to head restraint.
W_1 = Original vehicle weight

TABLE IV-3

Lifetime Fuel Penalty Cost Range
(Present Value, 10% Annual Discount Rate)

	Total Vehicle Average Weight Increase	Total Vehicle Lifetime Fuel Cost 1988 $
Adjustable Head Restraints	6 Lbs. to 14 Lbs.	$6.39 to $14.91
Integral Head Restraints	5 Lbs. to 7 Lbs.	$5.32 to $ 7.45

The MY 1987 projected weighted average curb weight of 3,797 pounds and a 21.6 mpg fuel economy level were used as constants thru year 2016. The 21.6 mpg level was reduced by 15 percent to 18.36 mpg to account for the difference between "real world" mpg and EPA's laboratory test results.

TABLE IV-4

WEIGHTED VEHICLE MILES TRAVELED
LIGHT TRUCKS

VEHICLE AGE (YEARS)	VEHICLE MILES TRAVELED	SURVIVAL PROBABILITY	WEIGHTED YEARLY TRAVEL (MILES)
1	14,200	1.000	14,200
2	14,800	.999	14,785
3	13,900	.988	13,735
4	12,200	.966	11,785
5	11,100	.946	10,500
6	9,900	.925	9,155
7	9,300	.897	8,340
8	8,800	.862	7,585
9	8,000	.825	6,600
10	7,600	.771	5,860
11	7,300	.710	5,185
12	6,900	.645	4,450
13	6,000	.573	3,440
14	6,000	.502	3,010
15	5,300	.441	2,335
16	5,000	.38	1,900
17	5,700	.32	1,825
18	5,100	.26	1,325
19	4,600	.20	920
20	4,200	.14	590
21	4,000	.08	320
22	3,700	.05	185
23	3,200	.03	95
24	2,500	.02	50
25	2,000	.01	20
		TOTAL	128,195

TABLE IV-5

ASSUMED FUEL PRICES USED FOR
LIFETIME FUEL PENALTY COSTS*

Year	Estimated Gasoline Cost (1988$) (cents/gallon)
1992	92.9
1993	98.3
1994	103.9
1995	109.3
1996	114.7
1997	120.3
1998	125.6
1999	128.9
2000	131.9
2001	137.4
2002	142.7
2003	147.5
2004	150.7
2005	153.6
2006	156.3
2007	158.9
2008	160.5
2009	161.4
2010	162.1
2011	162.8
2012	163.6
2013	164.1
2014	164.7
2015	165.2
2016	165.6

*Projections for individual years 1992 to 2000 are from the U.S. Department of Energy, Energy Information Administration (DOE/EIA) "1989 Annual Energy Outlook, Long Term Projections", Table A3, base case. DOE price projections for "dollars per million Btu" were converted into dollars per gallon based on 125,071 Btu's per gallon of gasoline (derived from DOE/EIA "Monthly Energy Review", November 1988, Tables A1 and A2). Real fuel prices after 2000, were calculated based on Implicit GNP Price Deflator and gasoline price deflator forecasts provided in the DRI forecast TREND 25YR0189, from "U.S. Long-Term Review (Winter 1988-89), pages A.3 and A.73. Estimates extended from 2013 to 2016 by NHTSA.

"Data Resources U.S. Long-Term Review" (Winter 1988-89) projects approximately 4.83 million light truck sales for 1992. Applying the percentage of the light truck fleet that will be affected from Table IV-2, and using the estimated costs range shown in Table IV-1, plus the lifetime fuel penalty costs shown in Table IV-3, the annual estimated impact cost range of the standard would be as follows:

- <u>Adjustable head restraints</u>: ($28.39 to $63.91/vehicle) x 4.83 million vehicles x 8.71 percent = $11.9 to $26.9 million.
- <u>Integral head restraints</u>: ($27.32 to $47.45/vehicle) x 4.83 million vehicles x 8.71 percent = $11.5 to $20.0 million.

Applying the costs and weights derived from passenger cars to the light truck fleet may overstate costs, because of styling features, especially for pickup trucks with bench seats. Due to the limited space between the rear of the seatback and the rear window, the plushness of the head restraints is restricted far more than on passenger cars. The thickness may be greatly reduced, requiring much less material, but still meeting the requirements of the standard. This could conceivably reduce the cost under that of a passenger car concept by approximately 1/3 the estimated material and labor content. A more conservative estimated weighted average (considering both adjustable and integral head restraint systems) for the light truck fleet based on the average cost derived from NHTSA's final contract reports DOT HS-805-318 and DOT HS-806-769, would be $29.45 ($22.00 per vehicle plus $7.45 lifetime fuel penalty cost to account for

7 additional pounds of weight per vehicle). This would place the annual estimated cost of the standard at $12.4 million. Since this standard can be met for under $100 million, this proposal is not considered a major rule.

Secondary Weight Effects

The issue of "secondary weight" effects, and cost implications thereof, has also been considered in this cost analysis. Secondary vehicle weight refers to weight increases in other parts of the vehicle to compensate for the additional "primary" weight (i.e., the head restraints alone). These secondary weight increases could conceivably include increases in vehicle structure (to maintain load-carrying ability) or an increase in average engine size (to maintain acceleration capability). The incremental weight increase appears to be too small (5-14 pounds) to require redesign of other vehicle subsystems. The cost analysis based on teardown of vehicles showed that not even the seats (to which the head restraints in passenger car were attached) were reinforced or changed. It would seem very unlikely, then, that other subsystems remote from head restraint systems were changed by the manufacturers. However, a sensitivity analysis shown in Table IV-6 and Table IV-7 is illustrative of what secondary weight propagation effects could be, using a theoretical weight factor of 0.7 pounds of secondary weight for each pound of primary weight added to the vehicle. An estimated price for secondary weight propagation of $0.49 variable cost per pound (1988 economics) times a 1.51 factor, or $0.74 per pound, for consumer price was used for this calculation.

Table IV-8 provides a summary of costs, without and with secondary weight effects, on a per vehicle basis. The costs with secondary weights are the sum of the costs without secondary weights and the costs from Tables IV-6 and IV-7.

Taking the estimated cost range shown in Table IV-8, including secondary weight costs and lifetime fuel penalty costs with secondary weights, the annual estimated impact cost range of the standard would be as follows:

- <u>Adjustable head restraints</u>: ($35.97 to $81.59/vehicle) x 4.83 million vehicles x 8.71 percent = $15.1 to $34.3 million.

- <u>Integral head restraints</u>: ($33.64 to $56.30/vehicle) x 4.83 million vehicles x 8.71 percent = $14.2 to $23.7 million.

TABLE IV-6

Estimated Consumer Price and Weight Effects of Using a .7 Factor for Secondary Weight Propagation (cost in 1988 economics)

	Total Vehicle Average Secondary Weight Increase #	Total Vehicle Secondary Weight Cost 1988 $
Adjustable Head Restraints	4.2 Lbs. to 9.8 Lbs.	$3.11 to $7.25
Integral Head Restraints	3.5 Lbs. to 4.9 Lbs.	$2.59 to $3.63

TABLE IV-7

Lifetime Fuel Penalty Cost Range Using a .7 Factor for Secondary Weight Propagation (cost in 1988 economics)

	Total Vehicle Average Secondary Weight Increase #	Total Vehicle Secondary Weight Cost 1988 $
Adjustable Head Restraints	4.2 Lbs. to 9.8 Lbs.	$4.47 to $10.43
Integral Head Restraints	3.5 Lbs. to 4.9 Lbs.	$3.73 to $5.22

Table IV-8
Total Vehicle Costs Range Including
Lifetime Fuel Penalty Cost
(On a Per Vehicle Basis)
(Present Value, 10% Annual Discount Rate)

(Without Secondary Weight)

	Total Vehicle Average Weight Increase	Total Vehicle with Lifetime Fuel Cost 1988 $
Adjustable Head Restraints	6 lbs. to 14 lbs.	$28.39 to $63.91
Integral Head Restraints	5 lbs. to 7 lbs.	$27.32 to $47.45

(With Secondary Weight)

	Total Vehicle Average Weight Increase	Total Vehicle with Lifetime Fuel Cost 1988 $
Adjustable Head Restraints	10.2 lbs. to 23.8 lbs.	$35.97 to $81.59
Integral Head Restraints	8.5 lbs. to 11.9 lbs.	$33.64 to $56.30

B. Leadtime

The proposed effective date was September 1, 1991. The agency believes this amount of leadtime is sufficient for the industry to equip all light trucks with head restraints as standard equipment.

Comments to the docket from Ford and Chrysler indicated that both were planning on voluntarily installing head restraints on all of their light trucks by the proposed effective date. General Motors indicated they planned on voluntarily installing head restraints in their light trucks, but their schedule did not coincide with the proposed effective date. General Motors indicated that 80 percent of their new light truck sales would have head restraints as standard equipment for MY 1992 (the effective date), 90 percent by MY 1993, and 100 percent by MY 1994. General Motors requested a phase-in effective date based on their scheduled voluntary compliance. No manufacturer showed that installation of head restraints is impracticable by the proposed effective date of the amendment. No comments were received from other manufacturers.

The agency does not typically have phase-in effective dates, except for the more major rulemakings when most vehicles in the fleet need to be changed. The agency does not favor a phase-in that will only affect a few manufacturers in the absence of compelling reasons.

General Motors indicated in their docket comments (Docket No. 88-24-NO1-009) that there would be another cost which would be dependent upon the effective date. These costs would accrue to those vehicles which would not voluntarily have head restraints installed for MY 1992, but would be redesigned for MY 1993 or MY 1994. GM argued that "The expenditure of additional resources to design, test, and install head restraints, in vehicles that will be discontinued in one or two years would not appear warrented unless NHTSA can demonstrate that such an expenditure will result in a significant societal benefit". GM did not estimate what this cost would be, nor has the agency, except to note that compliance testing costs are approximately $2,000 per head restraint design.

V. COST-EFFECTIVENESS

The range of costs estimated in Chapter IV for the MY 1992 fleet, when secondary weights are not included, are from $11.9 to $26.9 million annually for adjustable head restraints and from $11.5 to $20.0 million annually for integral head restraints. Light truck benefits over the lifetime of the MY 1992 fleet are estimated to be 510 injuries reduced for adjustable head restraints and 870 injuries reduced for integral head restraints. Thus, the cost per injury reduced range from $23,333 to $52,745 for adjustable head restraints and from $13,218 to $22,989 for integral head restraints.

When secondary weights are considered, costs for the MY 1992 fleet are estimated to range from $15.1 to $34.3 million for adjustable head restraints and from $14.2 to $23.7 million for integral head restraints. Thus, the cost per injury reduced range from $29,608 to $67,255 for adjustable head restraints and from $16,322 to $26,241 for integral head restraints.

Due to the limited space between the rear of the seat back and the rear window in a pickup truck, the plushness of head restraints is likely to be restricted. Based on this possibility, an alternative, lower cost estimate for MY 1992 has been made at $12.4 million for light trucks. Thus, the cost per injury reduced range from $24,313 for adjustable head restraints to $14,253 for integral head restraints.

The agency requested comments from the public, insurance companies, and medical researchers regarding the average cost of whiplash injuries. The agency was also interested in tort judgments and/or settlements made regarding the value of pain and suffering associated with whiplash injuries, as well as work days lost and impairment as a result of whiplash injury. Whiplash injuries are not like the typical AIS 1 (minor cuts or bruises) or even AIS 2 (moderate injuries -- broken bones, etc.), because whiplash injuries often involve longer term pain and muscular stiffness. These symptoms, and perhaps rehabilitation therapy, many times last a year or longer. A comment on the issue led the agency to a study which is soon to be published by the All-Industry Research Advisory Council (AIRAC). Data from the study, based on a survey completed in the spring and summer of 1987 of 34 leading writers of auto insurance, were provided to the agency as follows:

o Nearly half (49.2 percent) of all injury claims paid by auto insurance companies involve a reported neck sprain or strain. It is the most common type of injury reported by persons involved in automobile accidents. Neck sprain and strain were the most severe injury in about 19 percent of all injury claims paid.

o Table V-1 provides data from the study. It shows that there were 8,687 cases where neck sprain or strain were the most serious injury. These are broken up into five types of coverage (definitions follow). Also shown are the average economic loss and the average payment by the insurance company. For three of the coverages the average economic loss is higher than the average payment by the insurance company. This occurs because in personal injury protection and medical payments, no payments are made for pain and suffering. In several of the coverages, not all of the wage loss is covered by insurance payments. In other cases, the liability limits are exceeded and the insurance payment does not cover all economic losses.

TABLE V-1

Average Payment Per Claim

When Neck Sprain or Strain was the Most Serious Injury

(1987 Dollars)

Coverage	Number of Claims	Average Economic Loss	Average Payment
BI Liability	4,502	$ 1,327	$ 2,979
Personal Inj. Prot.	2,226	1,422	1,173
Medical Payment	1,353	1,011	834
Uninsured Motorist	580	1,163	2,526
Underinsured Motorist	26	12,168	11,983
Total or Average	8,687	$ 1,324	$ 2,179

Definitions:

Bodily Injury Liability (BI) -- Pays for the insured driver's legal liability for bodily injury caused to someone else through the ownership, maintenance, or use of the vehicle, up to the policy limit specified. In other words, BI pays for injuries to other people when the insured vehicle's driver is legally at fault.

Personal Injury Protection (PIP) -- Pays benefits without regard to fault. Payments include reimbursement for medical expenses, wage losses, funeral expenses, and rehabilitation and replacement services necessitated by the injury. Sold in no-fault States and also in "add-on" States that place no limitation on the right to sue.

Medical Payment (MP) -- Pays the medical and funeral expenses of the insured, others riding in the vehicle and pedestrians struck by the vehicle without regard to fault. MP is typically sold with low benefit limits of $5,000 or less in State with traditional tort liability laws.
Uninsured Motorist (UM) -- Pays when the insured or others riding in the vehicle are injured by an uninsured motorist or hit and run driver.
Underinsured Motorist (UIM) -- Pays when the insured or others riding in the vehicle are injured by a motorist whose bodily injury coverage is inadequate to pay the full amount of damages legally owed, on a fault basis.

The type of State laws in effect in 1987 were:
Tort Liability State -- 26 States had this traditional coverage in which injury victims are expected to collect payment from the at-fault driver, and must be prepared to prove negligence. Some vehicle owners purchase medical payments coverage to provide non-fault medical and funeral benefits for occupants of the insured vehicle and pedestrians struck by the insured vehicle.
No-Fault State -- 14 States had laws that restrict the right to sue for minor auto injury claims, and which provide auto injury victims with substitute PIP benefits regardless of fault. These laws contain "tort thresholds", defined in terms of amount of medical expense, days of disability, or severity of injury, that determine when an injury qualifies for a liability claim or lawsuit against an at-fault driver.
Add-On State -- 11 States had laws that require auto insurers to offer PIP benefits, but which do not restrict the right to pursue a liability claim or lawsuit as well.

Pain and suffering payments can be estimated from the bodily injury liability and uninsured motorist coverages as the difference between economic loss and total payments. These are $1,652 for bodily injury liability and $1,363 for uninsured motorist coverages. A weighted average of these cases is $1,619. The average payment for economic loss is $1,324 over all coverages. Thus, the total payment including pain and suffering for an average insurance claim for neck sprain or strain would be $2,943.

VI. IMPACT ON SMALL BUSINESSES

The Regulatory Flexibility Act of 1980 (Public Law 96-354) requires agencies to evaluate potential effects of their final rules on small businesses, small organizations and small governmental jurisdictions.

There are a number of small businesses that could be affected by this final rule. These include motor home manufacturers, van converters, suppliers of seats, and suppliers of head restraint materials.

Motor home manufacturers: There are about 80 motor home manufacturers that are members of the Recreational Vehicle Industry Association (RVIA). Only 5 to 10 of these companies would not be considered small businesses.

Van converters: About 130 members of the RVIA are van converters; most of these have less than 500 employees and are small businesses. However, there are many more van converters in business that are not members of RVIA; the number is unknown. In 1986, there were 181,900 van conversion shipments. (Source: Automotive News 1987 Market Data Book, p. 50) Most of these van conversions are equipped with high back captain's chairs. Whether these seats currently meet FMVSS 202 is not known.

Historically, van converters ordered vans from an automobile manufacturer without seats and then installed their own seating packages. In 1988, Chevrolet imposed regulations controlling distribution of its van chassis and Suburbans to converters. Van conversion must go through authorized consignment pool companies. GMC followed Chevrolet by imposing requirements that all of its van chassis must be sold back to authorized GMC dealers, but did not cut off non-pool companies from conversion work. Ford and Dodge made no changes in their programs. Ford announced that with the FMVSS 208 requirement for dynamic testing of light trucks effective MY 1992, that it will not be able to supply seat-delete van chassis to converters. General Motors said it would be able to supply the seat-delete van chassis if the seats installed by converters were put in according to GM's prescribed envelope of dimensions. Chrysler Motors offered to provide data to converters so they could get independent testing done. (Source: Automotive News, February 6, 1989, Page 16) Thus, the van conversion market is changing rapidly, although not as a result of this rule. These changes are probably making it less likely that this rule will have a significant affect on small businesses, since the large manufacturers appear to be taking more control of the seats that might be used by van converters.

Suppliers of Seats

There are 13 members of the Recreation Vehicle Industry Association that are seat suppliers. This final rule could increase their dollar volume of business by potentially requiring higher seats to meet the requirements of FMVSS 202.

Suppliers of Head Restraint Materials

There are probably a number of small businesses that could potentially supply the metal or padding parts for adjustable head restraints for original, or more likely, multi-stage manufacturers. Again, this could be a potential increase in their business.

Currently, some businesses are selling aftermarket head rests and head restraints to light truck owners. With head restraints being required, this business would eventually dry up as new vehicles with head restraints entered the market. The agency does not know how many businesses are in this field or if they are small businesses. Since most manufacturers were going to install head restraints voluntarily, the aftermarket head restraint business would have been reduced even without this final rule. The final rule would bring about this reduction in business a little quicker.

Testing Costs

The estimated cost to test a head restraint to the FMVSS 202 requirements is estimated to be roughly $2,000. These testing costs would be passed on to consumers. Manufacturers can certify that their seats meet FMVSS 202 without testing, based on reasonable engineering procedures.

In summary, although there are a significant number of small businesses that will be affected by the installation of head restraints into light trucks, the agency does not believe that this final rule will have a substantial impact on them individually. Since most original equipment manufacturers were planning on installing head restraints voluntarily, the impact of this final rule has been minimized. With the exception of those companies that sell aftermarket head rests and head restraints, the final rule will be beneficial to small businesses by creating a demand for products that were not previously required.