PUBLIC INTEREST RESEARCH GROUP
2000 P STREET, N.W.
SUITE 711
WASHINGTON, D. C. 20036
(202) 833-9700

February 21, 1974

James B. Gregory, Administrator
National Highway Traffic Safety Administration
Department of Transportation
Washington, D.C. 20590

Dear Dr. Gregory:

The initial motor vehicle safety standards were intended to be only temporary. They were taken from existing motor vehicle standards (mostly those of the Society of Automotive Engineering and the General Services Administration) and many of them remain virtually unchanged from their initial form as issued in 1967 and 1968.

In particular, the standards for seat strength (MVSS 207, Seating Systems) and head restraints (MVSS 202) are essentially as they were when they were first effective. These two standards were intended to protect occupants (particularly in the front, outboard seating positions) from injury in low to moderate speed rear and frontal impacts. Recent studies of contemporary vehicles subjected to rear impacts (both experimentally and in accidents on public roads) have shown both the inadequacy of these standards and the failure of the head restraint standard in particular "to meet the need for motor vehicle safety."

The National Safety Council's accident statistics show that there are four million rear end vehicle impacts each year and it is estimated that the number of so-called "whiplash" type neck injuries in these crashes "may be considerably in excess of 1,000,000" each year. Yet the evidence from two studies of injuries from rear end impacts shows that the improvement in neck injury statistics is only 14 to 18 percent in cars equipped with head restraints as opposed to those which are not.

The attached petition asked that rule making be initiated to include a rear crash requirement in motor vehicle safety standard 208, Occupant Crash Protection. In keeping with the philosophy of standard 208 and of good public health policies, the petition asks that the standard be a passive one, eliminating the present designs in which head restraints must be adjusted to give optimum protection. Most important, the petition asks that compliance testing of the standard be done with anthropomorphic test devices (dummys) in actual vehicle impacts from a moving barrier.

The petition also asks the NHTSA to initiate two short term research projects to determine the feasibility of the proposed amendment. The first is to apply the proposed test procedure to a series of contemporary production vehicles to determine if the test procedures are practicable and the extent of non-compliance of such vehicles. The second is to modify several current production cars to determine the extent of modifications necessary to meet the new proposed standard.

A fuel tank integrity standard amendment which requires a rear impact to determine compliance has been proposed to become effective for 1977 model cars (or 1976 model cars if the Montoya amendment passes the Congress). Since compliance testing of the fuel tank standard and the proposed rear impact occupant protection standard are similar, the present proposal should be acted on immediately so that they can be phased in at the same time.

The NHTSA is already on notice as a result of previous lawsuits that the motor vehicle safety standards must meet the three legal requirements that they

> . . . shall be practicable, shall meet the need for motor vehicle safety, and shall be stated in objective terms. [emphasis added]

Action on this petition will preclude possible further challenges on these two inadequate seating standards.

Sincerely,

Carl E. Nash, Ph.D.

Before the

National Highway Traffic Safety Administration
Department of Transportation

PETITION TO AMEND MOTOR VEHICLE SAFETY STANDARD 208 TO INCLUDE PASSIVE OCCUPANT CRASH PROTECTION IN IMPACTS FROM THE REAR OF THE VEHICLE.

I. NATURE OF THE PETITION

This petition requests that the National Highway Traffic Safety Administration (NHTSA) issue a notice of proposed rule making to include a requirement for passive rear occupant crash protection in motor vehicle safety standard 208, Occupant Crash Protection.

II. JURISDICTION

This petition is filed pursuant to the authority of §§ 103, 119 of the National Traffic and Motor Vehicle Safety Act of 1966, 15 U.S.C. §§ 1392, 1407 and pursuant to the regulations promulgated thereunder governing the issuance of Federal Motor Vehicle Safety Standards (49 C.F.R. 553.31).

III. PETITIONER

Carl E. Nash is a member of the Public Interest Research Group, a group of professionals founded by Mr. Ralph Nader in 1970. Dr. Nash has worked on oversight of the National Highway Traffic Safety Administration and on issues of auto safety since 1971, and has participated in the informal rule making procedures of the NHTSA. The petitioner holds a Ph.D in theoretical physics from the University of North Carolina, Chapel Hill.

IV. STATEMENT OF THE PROBLEM

A major deficiency in the head restraint standard is that it requires a conscious effort on the part of the vehicle user to adjust the restraints. The standard requires restraints only for the front outboard seating positions, leaving other occupants in a car unprotected from neck injury in rear impacts. As a practical result, most vehicles are used with both of the head restraints in their lowest adjusted position, too low to protect any but the smallest vehicle occupants. A Rochester, New York study[1] found 73 percent of the head restraints in cars involved in rear end collisions in the study were adjusted to their lowest position. Observations in Los Angeles and Washington, D.C. by the Insurance Institute for Highway Safety[2] (IIHS) showed an even higher percentage of cars on the road with improperly adjusted head restraints. A Cornell Aeronautical Laboratory study found that only 17.7% of the adjustable head restraints in its study were adjusted off the lowest position.[3] In some cars, notably the French Peugeot, the head restraints can be pushed down so low that they effectively disappear altogether.

The Rochester study and the IIHS study both found that the reduction in neck injuries (usually referred to as "whipleash" injuries) were decreased by only 14 to 18 percent for all drivers and right front seat passengers. The IIHS study found no statistically significant improvement in the rate of neck injuries of males in seating positions having head restraints. Women in the Rochester and IIHS studies showed a reduction of 25 and 22 percent respectively. The difference between the rates of neck injuries between men and women is probably to their different average

stature. A significant proportion of women would be protected by head restraints in their lowest position in some cars.

Another reason for the inadequate protection given most men (and taller women) by most head restraints is that the standard requires only that head restraints protect heads whose center of gravity is 25 inches or less above the "h" point (the centerline of the hip joint). The SAE Recommended Practice, J 963, Anthropomorphic Test Device for Dynamic Testing,[4] puts the center of gravity of the head of a 50th percentile man at 26.5 inches above the "h" point. Thus, fully half of the male population would not be protected by a head restraint which only minimizes the standard (as many do).[5]

There is also no requirement for a positive locking mechanism to hold the adjustment of a head restraint. In 1972, Consumers Union pointed out:[6]

> Among the domestic models we have tested, only the General Motors cars...had positive latches which held the restraints in their raised position even under a severe blow. A gentle blow of the hand (or, of course, the head) or even a fairly gentle push knocked the restraints down all the way in the Ford and the Ambassador that we tested for this month (as well as other cars currently in our garage). If, in a rear-end impact, the head restraint slips too easily to its lowest position, it not only offers little whipleash protection; it may even act as a fulcrum to increase the likelihood of injury.

The weakness of seats and head restraints which meet or exceed the federal standards was recently demonstrated in crash tests sponsored by the Insurance Institute for Highway Safety.[7] These tests were carried out according to the procedures set out in the proposed fuel tank integrity standard (MVSS 301 as would become effective for 1977 model cars).[8] Under rear impacts by a

crash barrier moving at 30 mph, the six vehicles (two full size sedans and four sub-compact cars) revealed the following weaknesses:

--In all six cars, the front seat back broke or was bent into a fully reclining position allowing the test dummys to slide into the rear seat or window areas. In most of the cars, there was other damage to either the front or rear seats.

--In one of the cars (an Opel 1900) the head restraints pulled out of the seats and were found lying loose in the car. (This would not be considered a failure of MVSS 202.)

--In five of the six cars tested, at least one door was jammed so that it could not be opened. In two of these (the Ambassador and the Chevrolet Vega) all of the doors were jammed closed.

It should be obvious that there is a critical need for a comprehensive rear crash standard which will protect occupants from impact injury in both straight-on and angular rear crashes, and which will allow escape from the impacted vehicles.

On the average, because the speed differential between striking and struck vehicles in a rear end crash is not as great as in other types of crashes, such crashes are not as serious as head on or side impacts. However, there are about four million rear crashes each year in the U.S. which kill between 500 and 1000 people in the struck cars and may injure as many as a million people with whiplash or worse type injuries.

This petition is to request that the NHTSA promulgate an amendment to the occupant restraint standard, MVSS 208, to include protection from injury in rear impacts. In 1970, the NHTSA recognized the failure of the public to use safety belts provided in new cars. The agency proposed that passive methods be used to protect occupants of vehicles from injury in some crash modes (frontal impact, side impact, and rollover). A second innovation which was included in the regulation that was issued in March 1971 was compliance testing in which the measure of compliance comes from injury criteria experienced by human simulation dummys during crash testing.

Unfortunately, the rear crash mode was not included in the passive occupant restraint standard at that time. However, with the advent of more sophisticated anthropomorphic compliance test dummys (particularly in their neck design which is crucial in measuring response to rear impacts)[9] it should now be possible to include the rear crash mode in motor vehicle safety standard 208. The injury criteria which would be appropriate for rear impact protection would be head acceleration, chest acceleration and hyperextensive head rotation. In addition, because of the special nature of rear impacts, at least two criteria must be applied to the vehicles in testing compliance: that the seats remain attached to their mountings and are not seriously distorted during the crash, and that the doors remain operable to aid in escape in the event of fuel leakage or fire from the fuel tank.

There is no firm agreement or definitive research findings on the degree of neck flexion, head rotation, or head rotational acceleration that can occur without serious or permanent injury occurring. There is some evidence that women are more susceptible to whiplash type injuries than are men. This phenomenon is discussed in some detail in O'Neill.[10] Probably the best summary of the available research on injury in rear end impacts is contained in the introduction and literature review of the paper by States and Balcerak.[11] In this review, they note that the natural limits of neck extension are between 61 and 93° (the angle of allowed rearward rotation of the head due to the flexibility of the neck only). They further state:

> The majority of whiplash injuries appear to be caused by extension beyond the physiological range of neck motion...

Mertz and Patrick[12] concluded that neck extension should be limited to 80° after a series of sled tests of live human volunteers, cadavers, and dummys, but recommended that a sixty degree limitation would be preferable to avoid injury. In the present MVSS 202, one of the alternative test methods requires that rearward angular displacement (rotation) of the head be limited to 45° under an acceleration of eight times the acceleration of gravity.

Hilyard et. al.[13] have studied deployable head restraints (using a technology similar to that of the air bag, the second such study to come from the Highway Safety Research Institute in the last several years) and found that head extension could be limited to about ten degrees using these devices in crashes at 40 mph, even in a 30° oblique rear impact. However, compliance with the pro-

posed standard (45° neck extension in a 30 mph impact at oblique angles of up to 30°) should be possible with simpler, more conventional seat designs.

Because of the lack of agreement on allowable neck extension, and because the NHTSA is presently using the conservative figure of 45°, that figure is being proposed in the present standard. The discussion of head angular acceleration by Hilyard, et. al. indicates that not enough is known about this parameter to be able to set limits on it for injury protection. Presumably, the limitation on head (linear) acceleration and extension will automatically limit head angular acceleration.

The proposed amendment to MVSS 301, fuel system integrity, involves a rear, moving barrier impact at 30 mph. 1977 model vehicles will be required to meet this amendment. Real world impacts do not, however, always involve direct collisions into the rear of a vehicle. As with frontal collisions (and as recognized in MVSS 208) rear impacts are often at an angle and may impart angular momentum to the struck vehicle. For this reason, a rear crash protection standard should emulate the frontal crash standard and provide for impacts which vary up to 30° from an impact directed longitudinally into the vehicle.

The petitioner does not believe that the 30 mph speed specified in the fuel system integrity standard is sufficiently high to offer adequate protection in all types of rear impact collisions. This compromise is being proposed for this amendment in the interest of simplifying the compliance test procedures with the additional specification that angular impacts must also be included. Further upgrading of this amendment by increasing the moving barrier impact speed within two years for both the present

standard and the fuel tank integrity standard (MVSS 301) should be incorporated.

The following proposed amendment to motor vehicle safety standard 208 is intended to incorporate passive rear impact protection requirements for vehicle occupants into that standard with consideration given to the special problems encountered with such collisions. We are petitioning the NHTSA to issue this or a similar proposal as a Notice of Proposed Rule Making immediately.

In addition, the NHTSA should contract to have tests conducted according to the proposed rear crash requirements using the latest available anthropomorphic test dummys to determine the feasibility of the compliance tests. Also, the NHTSA should contract to have current or recent production vehicles modified so that they can meet these standards to determine the feasibility and cost of such modifications. Calspan Corporation, for example, has had a considerable amount of experience in making such modifications to production automobiles.

[1]States, John D., M.D., and John C. Balcerak, The Effectiveness of Head Restraints in Rear End Impacts, Rochester Applied Science Associates, Inc., New York, June 1973,(DOT HS-800-877).

[2]O'Neill, Brian, William Haddon, Jr., M.D., Albert B. Kelley and Wayne W. Sorenson, Ph.D., "Automobile Head Restraints: Frequency of Neck Injury Insurance Claims in Relation to the Presence of Head Restraints," The American Journal of Public Health, December, 1971.

[3]Morris, D.F. and J. Garrett, "Performance Evaluation of Automobile Head Restraints," Society of Automotive Engineers paper, January 1972.

[4]1970 SAE Handbook, Society of Automotive Engineers, New York, 1970, p. 948.

[5]The NHTSA standard requires that the top of the head restraint be 27.5 inches above the "h" point, but has performance requirements only for a point 25 inches above the "h" point.

[6]"Head Restraints and Bumpers: The State of the Art," Consumer Reports, February 1972, p. 96.

[7]Holt, H.E., Report of Six Moving Barrier Automobile Crash Tests, Insurance Institute for Highway Safety, Washington, D.C., November, 1973.

[8]38 Fed. Reg. 22417, August 20, 1973.

[9]Third generation anthropomorphic test devices have been received from General Motors under contract to the NHTSA and are expected from Sierra Engineering in the late spring.

[10]O'Neill, et. al., op. cit., p. 12.

[11]States, John D., M.D. and John C. Balcerak, op. cit., pp. 2-14.

[12]Mertz, H.J. and L.M. Patrick, "Strength and Response of the Human Neck," Proceedings of the Fifteenth Stapp Car Crash Conference, 1971.

[13]Hilyard, J.F., J.W. Melvin and J.H. McElhaney, Deployable Head Restraints, Highway Safety Research Institute, January 1973 (DOT HS 800-802). See also: J.W. Melvin and J.H. McElhaney, Deployable Head Restraints, Highway Safety Research Institute, June, 1971 (DOT HS-800 515).

PROPOSED AMENDMENT

49 C.F.R. 571.208 Occupant Crash Protection in Passenger Cars, Multipurpose Passenger Vehicles, Trucks, and Buses

SECTION S5 SHALL BE AMENDED BY ADDING A NEW SUBSECTION:

S5.4 Rear Moving Barrier Crash. When the vehicle is impacted from the rear by a barrier moving at any speed up to and including 30 mph in such a way that the barrier is moving parallel to the longitudinal centerline of the vehicle or is moving along a line which is at any angle up to 30° in either direction from the longitudinal centerline of the vehicle under the applicable conditions of S8, with anthropomorphic test devices at each designated seating position, it shall meet the injury and vehicle performance criteria of S6.

SECTION S6 SHALL BE AMENDED BY RETITLING IT AND ADDING NEW SUBSECTIONS:

S6 Injury and Vehicle Performance Criteria.

...

S6.5 Rearward flexion of the neck shall be limited so that the head shall not rotate rearward through an angle of more than 45°.

S6.6 No part of the seats or head restraints shall become disengaged from their mountings or attachments nor shall any part of the seat or head restraint be distorted so that any of the anthropomorphic test devices would leave their designated seating positions or have contact with other than laterally adjacent test devices.

S6.7 All doors provided for occupant egress shall be capable of being opened with no more than double the force required to open the doors in a similar, undamaged vehicle, and none of the doors provided for occupant egress shall open or become detached from their mountings as a result of the crash.

SECTION S8 SHALL BE AMENDED BY ADDING A NEW SUBSECTION:

S8.4 Rear moving barrier crash test conditions. The following conditions apply to the rear moving barrier crash test:

S8.4.1 The moving barrier, including the impact surface, supporting structure, and carriage, weighs 4,000 pounds.

S8.4.2 The impact surface of the barrier is a vertical, rigid, flat rectangle, 78 inches wide and 60 inches high, perpendicular to its direction of movement, with its lower edge horizontal and 5 inches above the ground surface.

S8.4.3 During the entire impact sequence the barrier undergoes no significant amount of dynamic or static deformation, and absorbs no significant portion of the energy resulting from the impact, except for energy that results in translational rebound movement of the barrier.

S8.4.5 The concrete surface upon which the vehicle is tested is level, rigid and of uniform construction, with a skid number of 75 when measured in accordance with American Society of Testing and Materials Method E-274-65T at 40 mph, omitting water delivery as specified in paragraph 7.1 of that method.

S8.4.6 The tested vehicle's parking brake is set and the transmission is in neutral.

S8.4.7 The barrier and test vehicle are positioned so that at impact--

(a) The vehicle is at rest in its normal attitude;

(b) The barrier is travelling in a direction along a line which is parallel to the longitudinal axis of the vehicle or at any angle up to 30° from the longitudinal axis of the vehicle at 30 mph; and

(c) A vertical plane through the geometric center of the barrier impact surface and perpendicular to that surface passes through a point on the centerline of the rear wheels of the tested vehicle and is half way between the wheels.