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United States of America Request to List Regulations in The Compendium of Candidates Head Restraints

The United States of America requests that Federal Motor Vehicle Safety Standard (FMVSS) No. 202 – Head Restraints be listed in the Compendium of Candidates.

Background

There are an estimated 272,088 whiplash injuries per year occurring in police-reported and unreported rear impact crashes. Many of these rear impact crashes are at low speeds. It is the consensus of the biomedical community that, at least on a macroscopic level, whiplash injuries due to rear impact crashes occur as a result of the movement of the head and neck relative to the torso. Minimum height requirements are based on the premise that in the case of no head restraint, both the bending moment on the neck and the head rotational angle is maximized, resulting in cervical hyperextension (movement beyond the normal range of motion).

When FMVSS No. 202, "Head Restraints," was first promulgated in 1969 it was believed that a head restraint height of 700 mm was sufficient to prevent neck hyperextension for most occupants and, therefore, mitigate whiplash injuries. However, current research indicates that whiplash may occur as a result of head and neck movement insufficient to cause hyperextension. Height requirements beyond the current levels are intended to prevent whiplash injuries by further limiting the movement of the head and neck. It is also widely believed that reducing the gap between the occupant's head and the head restraint should reduce the movement of the head relative to the torso, and thus result in lower whiplash rates.

Description of Regulation

In December 2005, FMVSS No. 202 was upgraded. It now requires front seat head restraints in passenger cars, pickups, vans, and utility vehicles to be capable of achieving a height where the top of the head restraint is at least 800 mm above the H-point (which represents the normally seated 50th male hip point). The regulation has a lower limit on height; head restraints in all front outboard seats may not be less than 750 mm from the H-point. The regulation does not require rear outboard head restraints, but specifies that if head restraints are installed they must be at least 750 mm. It also requires in front seats only that the distance between the back of the head form representing the position of a 50th percentile head, in a normally seated position, and the head restraint (defined as backset) be no farther than 55 mm in any adjustment position. See Table 1 for a summary of requirements.

The upgraded regulation harmonizes many parts, but not all of FMVSS No. 202 with the Economic Commission for Europe Regulation No. 17 (ECE 17) – Uniform Provisions Concerning The Approval Of Vehicles With Regard To The Seats, Their Anchorages And Head Restraints (Head Rests). The width and gap measurements in FMVSS 202 for

adjustable restraints differ from those found in ECE 17. Further, there are additional requirements for backset and adjustment retention locks for front outboard seating positions. The upgraded regulation also contains an optimal dynamic test not found in ECE 17.

Benefits

In the United States of America the annual number of whiplash injuries was estimated to be approximately 272,464. 251,035 of these injuries involve occupants of front outboard seats, 21,429 injuries involve occupants of rear outboard seats. The average economic cost of each whiplash injury resulting from a rear impact collision is $9,994[1], which includes $6,843 in economic costs and $3,151 in quality of life impacts. The total annual cost of rear impact whiplash injuries is approximately $2.7 billion.

Based on a study conducted by Kahane in 1982, the agency estimates that current integral head restraints are 17 percent effective in reducing whiplash injury in rear impact crashes for adult occupants, while current adjustable head restraints are 10 percent effective in reducing whiplash injury in rear impact crashes for adult occupants.[2] The overall effectiveness of current head restraints for passenger cars is estimated to be 13.1 percent.

In the Federal Regulatory Impact Analysis, it was estimated that upgrading the head restraint requirements would yield the following benefits:

(a) For front seats, reducing the backset to 55 mm increases the head restraint effectiveness by 5.83 percent, resulting in 15,272 fewer whiplash injuries for front seat occupants each year.
(b) For rear seats, increasing the height of voluntarily installed rear head restraints increases the effectiveness of these head restraints by 17.45 percent, resulting in 1,559 fewer whiplash injuries for rear seat occupants each year.[3]
(c) The total annual reduction in rear impact whiplash injuries is thus estimated at (15,272 + 1,559) 16,831 or 6 percent of the annual number of whiplash injuries (272,464).

In sum, it was estimated that this rulemaking upgrade will further reduce the incidence of whiplash by an additional ≈6 percent (272,464 *0.0618 = 16,831). It is noted that with respect to whiplash injuries, a 6 percent reduction in the incidence of whiplash is a significant step forward because the current head restraints only prevent 13.1 percent of whiplash injuries occurring in rear impact crashes.

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[1] The cots is estimated in 2002 US dollars.

[2] Kahane, C., ''An Evaluation of Head Restraints, Federal Motor Vehicle Safety Standard 202.'' NHTSA, February 1982, DOT HS–806–108.

[3] In computing benefits, we based our estimates on the effectiveness of either increased height or reduced backset, but not both. We could not combine effectiveness of increased height and reduced backset because this, in some instances, would result in ''double-counted'' benefits. Since determining combined effectiveness is not possible, the agency notes that these estimates may underestimate the true effectiveness.

Costs
An analysis was conducted on the US fleet to determine that costs to the manufacturer to implement the upgraded regulation. This analysis can be found in detail in Federal Regulatory Impact Analysis.

Average costs per vehicle are estimated to be:
$4.51 in front seats
$1.13 in rear seats for vehicles with rear head restraints
$5.42 per average vehicle
Total cost per year is estimated to be $84.2 million ($70.1 million for the front seat and $14.1 million for the rear seat).

Cost Effectiveness
The costs and benefits data was combined to estimate injuries prevented due to changes made to head restraint system to meet the upgraded requirements per dollar spent on implementing the changes to the vehicles.

The cost per equivalent life saved is estimated to be:
$2.39 million in front seats
$4.71 million in rear seats
$2.61 million total

Technical documentation supporting this regulation, including documentation concerning best available technology, relative benefits, and cost effectiveness can be found in the following documents:

- Final Regulatory Impact Analysis: FMVSS No. 202 Head Restraints for Passenger Vehicles
- Federal Motor Vehicle Safety Standards; Head Restraints; Final Rule

Table 1

Head Restraint Component	**US FMVSS 202**
A. Application 1. Vehicles	Front outboard and rear outboard (optional) seating positions in passenger cars, MPVs and trucks with a GVWR ≤ 4536 kg, with added exclusion for seating position adjacent to aisle on buses (more than 10 seats)
2. Requirements 1. Front outboard **a. Height**	
A. Fixed	Increased to 800 mm above H-point and measured with a SAE J826 manikin. Seat back angle set at 25 degrees. Seat cushion at highest position.
B. Adjustable	Must achieve a height of 800 mm and cannot be adjusted below 750 mm. Measured with a SAE J826 manikin. Seat back angle set at 25 degrees. Seat cushion in highest position.
2. Rear outboard	*Rear head restraint means a rear seat back, or any independently adjustable seat component attached to or adjacent to a seat back, that has a height equal or greater than 700 mm, in any position of backset and height adjustment.*
A. Fixed	If provided, minimum height of 750 mm above H-point. Measured with SAE J826 Manikin.
B. Adjustable	If provided, no adjustment below 750 mm from H-point. Measured with SAE J826 Manikin.
3. Rear Center	Not specified
b. Backset	
1. Front outboard positions	Backset limited to a maximum 55 mm as measured with HRMD. Head restraint (HR) in at any height adjustment between 750 and 800 mm, inclusive. Seat back angle set at 25 degrees. Seat cushion at highest position.
c. Width	
1. Front outboard	Minimum of 170 mm on single seats (outboard seats with no seat in between) and 254 mm on bench seats (outboard seats with seat in between).
2. Rear outboard	If provided, minimum of 170 mm for all seat types
d. Height of adjustable head restraint front surface	
	Not specified
e. Gaps	
1. All outboard positions	In all positions, gap between HR and seat back and within the HR is ≤ 60 mm. A 165 mm sphere is pressed against the gap with a load no more than 5 N
f. HR Adjustment Retention Devices (locks)	
1. Height	Must maintain height in highest position and at 800 mm and 750 mm for front and rear seats (if HR provided), respectively, while a downward force is applied. Seat back is rigidly constrained.
2. Backset	Under applied rearward moment, while adjusted to 800mm for front and 750mm for rear (if provided), HR must maintain any position of backset adjustment. Seat back is rigidly constrained.

Table 1
(continued)

Head Restraint Component	**US FMVSS 202**
g. Removability	
1. Front	Can be removed with deliberate action distinct from any act necessary for adjustment.
2. Rear	Can be removed with deliberate action distinct from any act necessary for adjustment.
h. Clearance	25 mm clear space allowed where rear HRs, when seat is occupied, interfere with *roofline or rear window*.
i. Non-use positions	
1. Front	Not allowed
2. Rear	Allowed, provided HR automatically returns to proper position when seat is occupied or the HR is rotated a minimum of 60° forward or rearward.
j. Radius of Curvature	Not specified
k. Energy Absorption	Front of HR impacted with head form at v=24.1 km/h. 3ms deceleration of head form must not exceed 80gs. Impactor is linear head form with mass of 6.8 kg.
l. Displacement Test Procedures	Seat back and HR loaded together. Moment of 373 Nm applied, displacement cannot exceed 102 mm same. Load increased to 890 N, seat back cannot fail. Use spherical form to apply load
m. Dynamic sled test (optional)	Corridor based on scaled version FMVSS 208 sled test. Target pulse falls in a corridor defined by 2-½ sine waves with amplitudes of 78 m/s^2 and 86 m/s^2. 50^{th} male dummy used in any seat, HR adjusted midway between lowest and highest position and any backset position. 12° max rotation.