

## DEPARTMENT OF TRANSPORTATION

## National Highway Traffic Safety Administration

## 49 CFR Parts 571 and 585

[Docket No. NHTSA–2007–27986]

RIN 2127–AJ96

## Federal Motor Vehicle Safety Standards; Head Restraints

**AGENCY:** National Highway Traffic Safety Administration (NHTSA), DOT.

**ACTION:** Final rule; response to petitions for reconsideration.

**SUMMARY:** This document completes the agency's response to petitions for reconsideration of the December 2004 final rule upgrading our head restraints standard. We are partially granting and partially denying the petitions.

We are making two changes related to the backset requirement. First, to address concerns about variability in measurements, we are specifying that backset is determined by taking the arithmetic average of three measurements, rather than using a single measurement. Second, we are slightly relaxing the backset requirement by specifying that the 55 mm backset limit applies with the seat back at the vehicle manufacturer's specified design angle rather than at 25 degrees. This decision reflects consideration of interrelated issues and data concerning the 55 mm backset limit, consumer comfort, and seat back angle.

In addition, we are making a number of other amendments. We are making changes related to non-use positions of rear seat head restraints, requirements for gaps between the head restraint and seat back, and the backset and height retention (lock) tests, as well as a number of changes in other areas. For the front seat requirements, we are providing one additional year of leadtime and also establishing a one-year phase-in with an 80 percent requirement. The agency previously delayed the compliance date for voluntarily installed rear outboard head restraints by two years. In this document, we are also establishing a one-year 80 percent phase-in for those requirements. Finally, we respond to a petition for rulemaking concerning requirements included in the upgraded head restraints rule.

Today's amendments will not affect the costs of the December 2004 final rule. However, the agency estimates that the change in seat back angle to provide greater flexibility with respect to backset

will result in a 20 percent reduction in the number of whiplash injuries prevented by upgraded front seat head restraints, compared to the benefits estimated in the December 2004 final rule. Whiplash injuries are Abbreviated Injury Scale (AIS) 1 injuries.

The agency has separately been leading efforts to develop a Global Technical Regulation (GTR) on head restraints, under the United Nations Economic Commission for Europe 1998 Global Agreement. Some issues raised by petitioners for reconsideration, including ones related to backset and testing of dynamic systems, are also being discussed in the context of the GTR. While it is necessary for us to issue today's decision in order to respond to the outstanding petitions for reconsideration, we note that if agreement is achieved on the GTR, we will consider making changes in these and other areas.

**DATES:** *Effective Date:* This rule is effective July 3, 2007.

*Petitions:* Petitions for reconsideration must be received by June 18, 2007.

**ADDRESSES:** Petitions for reconsideration should refer to the docket number and be submitted to: Administrator, Room 5220, National Highway Traffic Safety Administration, 400 Seventh Street, SW., Washington, DC 20590. Please see the Privacy Act heading under Regulatory Notices.

**FOR FURTHER INFORMATION CONTACT:** For non-legal issues, you may contact Louis Molino of the Office of Rulemaking, Office of Crashworthiness Standards, Light Duty Vehicle Division, NVS–112, (Phone: 202–366–2264; Fax: 202–366–4329; E-mail: [Louis.Molino@dot.gov](mailto:Louis.Molino@dot.gov)).

For legal issues, you may contact Edward Glancy of the Office of Chief Counsel, NCC–112, (Phone: 202–366–2992; Fax 202–366–3820).

You may send mail to both of these officials at the National Highway Traffic Safety Administration, 400 7th Street, SW., Washington, DC 20590.

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**I. Background**

On December 14, 2004, NHTSA published in the **Federal Register** (69 FR 74848) a final rule<sup>1</sup> upgrading NHTSA's head restraint standard in order to reduce whiplash injuries in rear collisions. For front seat head restraints, the final rule provided that the upgraded standard becomes mandatory for all vehicles manufactured on or after September 1, 2008. For head restraints voluntarily installed in rear outboard designated seating positions, the requirements become mandatory on September 1, 2010.<sup>2</sup> In this section, we discuss the highlights of the December 2004 rule, and the safety concerns and other considerations that led the agency to adopt it.

**A. Current Head Restraints**

Vehicle manufacturers currently use three types of head restraints to meet the requirements of FMVSS No. 202. The first type is the "integral head restraint," which is non-adjustable and is built into the seat. It typically consists of a seat back that extends high enough to meet the height requirement of the standard. The second type is the "adjustable" head restraint, which consists of a separate cushion that is attached to the seat back, typically by two sliding metal shafts. Adjustable head restraints

<sup>1</sup> Docket No. NHTSA–2004–19807.

<sup>2</sup> The September 1, 2010 date was established in a final rule; partial response to petitions for reconsideration published in the **Federal Register** (46 FR 12145) on March 9, 2006.

typically adjust vertically to accommodate different occupant seating heights. Some also provide adjustments to allow the head restraint to be moved closer to the occupant's head. The third type is the active head restraint system, which deploys in the event of a collision to minimize the potential for whiplash. During the normal vehicle operation, the active head restraint system is retracted.

### *B. The Safety Concern—Whiplash Injuries*

Whiplash injuries are a set of common symptoms that occur in motor vehicle crashes and involve the soft tissues of the head, neck and spine. Symptoms of pain in the head, neck, shoulders, and arms may be present along with damage to muscles, ligaments and vertebrae, but in many cases lesions are not evident. The onset of symptoms may be delayed and may only last a few hours; however, in some cases, effects of the injury may last for years or even be permanent. The relatively short-term symptoms are associated with muscle and ligament trauma, while the long-term ones are associated with nerve damage.

Based on National Automotive Sampling System (NASS) data, we estimate that between 1988 and 1996, 805,581 whiplash injuries<sup>3</sup> occurred annually in crashes involving passenger cars and LTVs (light trucks, multipurpose passenger vehicles, and vans). Of these whiplash injuries, 272,464 occurred as a result of rear impacts. For rear impact crashes, the average cost of whiplash injuries in 2002 dollars is \$9,994 (which includes \$6,843 in economic costs and \$3,151 in quality of life impacts, but not property damage), resulting in a total annual cost of approximately \$2.7 billion.

### *C. Understanding Whiplash*

Although whiplash injuries can occur in any kind of crash, an occupant's chances of sustaining this type of injury are greatest in rear-end collisions. When a vehicle is struck from behind, typically several things occur in quick succession to an occupant of that vehicle. First, from the occupant's frame of reference, the back of the seat moves forward into his or her torso, straightening the spine and forcing the head to rise vertically. Second, as the seat pushes the occupant's body forward, the unrestrained head tends to lag behind. This causes the neck to change shape, first taking on an S-shape and then bending backward. Third, the forces on the neck accelerate the head,

which catches up with—and, depending on the seat back stiffness and if the occupant is using a shoulder belt, passes—the restrained torso. This motion of the head and neck, which is like the lash of a whip, gives the resulting neck injuries their popular name.

### *D. Previous Regulatory Approach*

As discussed in the NPRM preceding the December 2004 final rule, a historical examination of head restraint standards in this country indicates that the focus has been the prevention of neck hyperextension (the rearward movement of the head and neck over a large range of motion relative to the torso), as opposed to controlling lesser amounts of head and neck movement in a crash.

The predecessor to FMVSS No. 202 was General Services Administration (GSA) Standard 515/22, which applied to vehicles purchased by the U.S. Government and went into effect on October 1, 1967. GSA 515/22 required that the top of the head restraint achieve a height 700 mm (27.5 inches (in)) above the H-point.<sup>4</sup> Also in 1967, research using staged 48 kilometer per hour (kph) (30 mile per hour, mph) crashes concluded that a head restraint 711 mm (28 in) above the H-point was adequate to prevent neck hyperextension of a 95th percentile male. FVMSS No. 202, which became effective on January 1, 1969, required that head restraints be at least 700 mm (27.5 in) above the seating reference point or limit the relative angle between the head and the torso to 45 degrees or less during a dynamic test.

### *E. Current Knowledge*

There are many hypotheses as to the mechanisms of whiplash injuries. Despite a lack of consensus with respect to whiplash injury biomechanics, there is research indicating that reduced backset, i.e., the horizontal distance between the rear of the occupant's head and the head restraint, will result in reduced risk of whiplash injury. For example, one study of Volvo vehicles reported that, when vehicle occupants involved in rear crashes had their heads against the head restraint (an equivalent to 0 mm backset) during impact, no whiplash injury occurred.<sup>5</sup> By contrast,

another study showed significant increase in injury and duration of symptoms when an occupant's head was more than 100 mm away from the head restraint at the time of the rear impact.<sup>6</sup>

In addition, the persistence of whiplash injuries in the current fleet of vehicles indicates that the existing height requirement is not sufficient to prevent excessive movement of the head and neck relative to the torso for some people. Specifically, the head restraints do not effectively limit rearward movement of the head of a person at least as tall as the average occupant. Research indicates that taller head restraints would better prevent whiplash injuries because at heights of 750 to 800 mm, the head restraint can more effectively limit the movement of the head and neck.

In a recent report from the Insurance Institute for Highway Safety (IIHS), Farmer, Wells, and Lund examined automobile insurance claims to determine the rates of neck injuries in rear end crashes for vehicles with the improved geometric fit of head restraints (reduced backset and increased head restraint height).<sup>7</sup> Their data indicate that these improved head restraints are reducing the risk of whiplash injury. Specifically, there was an 18 percent reduction in injury claims. Similarly, NHTSA computer generated models have shown that the reduction of the backset and an increase in the height of the head restraint reduces the level of neck loading and relative head-to-torso motion that may be related to the incidence of whiplash injuries.<sup>8</sup>

With respect to impact speeds, research and injury rate data indicate that whiplash may occur as a result of head and neck movements insufficient to cause hyperextension. Staged low speed impacts indicate that mild whiplash symptoms can occur without a person's head exceeding the normal range of motion. This means that our previous focus on preventing neck hyperextension is insufficient to adequately protect all rear impact victims from risks of whiplash injuries. Instead, to effectively prevent whiplash, the head restraint must control smaller

<sup>4</sup> The H-point is defined by a test machine placed in the vehicle seat (Society of Automotive Engineers (SAE) J826, July 1995). From the side, the H-point represents the pivot point between the torso and upper leg portions of the test machine. It can be thought of, roughly, as the hip joint of a 50th percentile male occupant viewed laterally.

<sup>5</sup> Jakobsson et al., *Analysis of Head and Neck Responses in Rear End Impacts—A New Human-Like Model*. Volvo Car Corporation Safety Report (1994).

<sup>6</sup> Olsson et al., *An In-depth Study of Neck Injuries in Rear-end Collisions*. International IRCOBI Conference, pp 269–280 (1990).

<sup>7</sup> Farmer, Charles, Wells, JoAnn, Lund, Adrian, "Effects of Head Restraint and Seat Redesign on Neck Injury Risk in Rear-End Crashes," Insurance Institute For Highway Safety, October 2002.

<sup>8</sup> "Effect of Head Restraint Position on Neck Injury in Rear Impact," World Congress of Whiplash-Associated Disorders (1999), Vancouver, British Columbia.

<sup>3</sup> Non-contact Abbreviated Injury Scale (AIS) 1 neck.

amounts of rapid head and neck movement relative to the torso.

In sum, in light of recent evidence that whiplash may be caused by smaller amounts of head and neck movements relative to the torso, and that reduced backset and increased height of head restraints help to better control these head and neck movements, we concluded that head restraints should be higher and positioned closer to the occupant's head in order to be more effective in preventing whiplash.

Further, information about consumer practices regarding the positioning of adjustable head restraints indicates that there is a need to improve consumer awareness and knowledge of the importance of properly adjusted head restraints. Specifically, in 1995, NHTSA surveyed 282 vehicles to examine how well head restraints were adjusted and if the restraints should have been adjusted higher. Approximately 50 percent of adjustable head restraints were left in the lowest adjustable position. Three quarters of these could have been raised to decrease whiplash potential by bringing the head restraint higher in relation to the center of gravity of the occupant's head. The information was included in a report<sup>9</sup> for which the agency requested public comment. 61 FR 66992; December 19, 1996.

#### *F. January 2001 Notice of Proposed Rulemaking*

Using the new information gained about the effectiveness of head restraints, on January 4, 2001, NHTSA published in the **Federal Register** (66 FR 968) a notice of proposed rulemaking (NPRM) to improve the effectiveness of head restraints. The agency proposed new height and backset requirements, and other requirements, described below. NHTSA also proposed that head restraints be required in the rear outboard seating positions.

In the proposed FMVSS No. 202a, manufacturers were given the option of meeting either of two sets of requirements. The first set was a comprehensive group of dimension and strength requirements, compliance with which is measured statically. The second set was made of requirements that would have to be met in a dynamic test.<sup>10</sup>

<sup>9</sup> The report was included in Docket No. 96-22, Notice 1. It is noted that this NHTSA docket pre-dates the DOT DMS system.

<sup>10</sup> The previous version of FMVSS No. 202 also features two sets of requirements; one applies to statically tested head restraints and the other to dynamically tested head restraints.

#### **1. Proposed Requirements for Head Restraints Tested Statically**

To ensure that head restraints would be properly used in a position high enough to limit hyperextension, the NPRM proposed the following height requirements. The top of the front integral head restraint would have to reach the height of at least 800 mm above the H-point. The top of the front adjustable head restraint would have to reach the height of at least 800 mm above the H-point, and could not be adjusted below 750 mm. The top of the rear mandatory head restraint could be adjusted below 750 mm above the H-point. The NPRM also proposed that adjustable head restraints must lock in their adjustment positions. NHTSA proposed to retain existing requirements for head restraint width.<sup>11</sup> To control even smaller amounts of rapid head and neck movement relative to the torso than the amount of relative motion resulting in neck hyperextension, the NPRM proposed also to limit the amount of backset to 50 mm (2 in) for both front and rear outboard head restraints. In addition, the NPRM also proposed maximum gap requirements for head restraint openings within the perimeter of the restraint, and for height adjustable head restraints, between the seat and head restraint.

The agency also proposed to prohibit head restraints in the front seats from being removable solely by hand, i.e., without use of tools. Comments were requested on applying such a requirement to rear seat head restraints. Rear seat head restraints could be folded or retracted to "non-use" positions if they give the occupant an "unambiguous physical cue" that the restraint is not properly positioned by altering the normal torso angle of the seat occupant or automatically returning to a "use" position when the seat is occupied.

In addition, the NPRM proposed that these statically-tested head restraints would have to meet a new energy absorption requirement, compliance with which would be measured using a free-motion impactor. Additionally, the agency proposed placing a minimum on the radius of curvature for the front surface of the vehicle seat and head restraint. The NPRM proposed modifications to the existing strength versus displacement test procedure to require simultaneous loading of the back pan<sup>12</sup> and the head restraint, and

<sup>11</sup> 254 mm (10 in) for restraints on bench-type seats, and 171 mm (6.75 in) for restraints on individual seats.

<sup>12</sup> The back pan is the portion of the SAE J826 manikin (July 1995) that comes in contact with the seat back. Its shape is intended to simulate the

to remove the allowance for seat back failure.

#### **2. Proposed Requirements for Head Restraints Tested Dynamically**

The NPRM proposed a dynamic test alternative and said that the purpose was to ensure that the final rule does not discourage or preclude continuing development and implementation of active head restraints and other advanced seat back/head restraint systems designed to minimize rear impact injuries. Specifically, the NPRM proposed that head restraints tested dynamically would have to meet a Head Injury Criterion (HIC) limit of 150 with a 15 millisecond (ms) window. In addition, NHTSA proposed a head-to-torso rotation limit of 20 degrees when testing with a 95th percentile male dummy in front outboard seats, and of 12 degrees when testing with a 50th percentile male dummy in all outboard seats.<sup>13</sup> Further, the NPRM proposed that the head restraints must have the same lateral width specified for statically tested restraints.

#### *G. December 2004 Final Rule*

On December 14, 2004, after considering the public comments and other available information, NHTSA published in the **Federal Register** (69 FR 74848) a final rule upgrading Federal Motor Vehicle Safety Standard No. 202, *Head Restraints* (FMVSS No. 202). The new upgraded version of the standard was designated as FMVSS No. 202a.

##### **1. In General**

To provide better whiplash protection for a wider range of occupants, the rule required that front outboard head restraints meet more stringent height requirements. Fixed front head restraints must be not less than 800 mm. In their lowest adjustment position, adjustable head restraints must not be lower than 750 mm, and in their highest position, they must be at least 800 mm. To reduce the distance that a vehicle occupant's head can be whipped backward in a rear end crash, this rule established new requirements limiting backset in front seats and limiting the size of gaps and openings in the restraints. The rule also established new strength and position retention requirements. Finally, it significantly amended the dynamic compliance test option currently in the standard to

shape of an occupant's back and thus allow for a realistic load distribution.

<sup>13</sup> Changes to the dynamic test procedures were also proposed, including a new sled pulse corridor. Also, the entire vehicle would be mounted on the test sled, not merely the seat.

encourage continued development and use of “active” head restraint systems because the test is designed to allow a manufacturer the flexibility necessary to offer innovative active head restraint designs while still ensuring a minimal level of head restraint performance.

In developing the final rule, the agency decided not to require head restraints for rear seating positions. However, in order to ensure that head restraints voluntarily installed in rear outboard seating positions do not pose a risk of exacerbating whiplash injuries, the final rule required that, if provided, those head restraints meet certain height, strength, position retention, and energy absorption requirements, but no backset limit. The head restraint regulation of the United Nations/Economic Commission for Europe (UN/ECE) also does not mandate rear seat head restraints, but manufacturers can voluntarily choose to have rear head restraints type approved per the regulation.

The agency explained that in the future stages of its efforts to improve occupant protection in rear impacts, it intends to evaluate the performance of head restraints and seat backs as a single system to protect occupants, just as they work in the real world, instead of evaluating their performance separately as individual components. Accordingly, in making our decisions about the upgraded requirements for head restraints, we sought, e.g., through upgrading our dynamic test procedure option, to make those requirements consistent with the ultimate goal of adopting a method of comprehensively evaluating the seating system.

NHTSA also sought to harmonize the FMVSS requirements for head restraints with the head restraint regulation of the UN/ECE, except to the extent needed to provide increased safety for vehicle occupants or to facilitate enforcement.<sup>14</sup> In some instances, a desire to achieve increased safety in a cost effective manner made it necessary for us to go beyond or take an approach different from that in the ECE regulation.

The agency estimated that approximately 272,464 whiplash injuries occur annually, and that the final rule would result in approximately 16,831 fewer whiplash injuries, 15,272 involving front seat occupants and 1,559 involving rear seat occupants. The estimated average cost in 2002 dollars,

per vehicle, of meeting the rule was estimated to be \$4.51 for front seats, and \$1.13 for rear seats currently equipped with head restraints, for a combined cost of \$5.42. The cost per year was estimated to be \$70.1 million for front head restraints and \$14.1 million for optional rear head restraints, for a combined annual cost of \$84.2 million. The final rule was considered to be economically significant because the agency estimated that it would result in economic benefits in excess of \$100 million.

## 2. Details of the December 2004 Final Rule

Under the final rule, the top of the front outboard integral head restraint must reach the height of at least 800 mm above the H-point, instead of the 700 mm above the seating reference point (SgRP)<sup>15</sup> previously required. The top of the front outboard adjustable head restraint must be adjustable to at least 800 mm above the H-point, and cannot be adjusted below 750 mm.

If a manufacturer chooses to install head restraints in rear outboard seating positions, these head restraints must meet certain height, strength, position retention, and energy absorption requirements. The rear outboard head restraint is defined as a rear seat back, or any independently adjustable seat component attached to or adjacent to the rear seat back, that has a height equal to or greater than 700 mm, in any position of backset and height adjustment, as measured with the J826 manikin. Accordingly, any rear outboard seat back or any independently adjustable component attached or adjacent to that seat back that exceeds 700 mm above the H-point, must meet the above requirements.

In recognition of the manufacturing and measurement variability concerns highlighted by the industry commenters, the agency increased the maximum allowable backset for front head restraints from the proposed 50 mm to 55 mm. Backset adjustment to less than 55 mm was permitted. However, the backset may not be adjustable to greater than 55 mm when the top of the front head restraint is positioned between 750 and 800 mm, inclusive, above the H-point. There is no backset limit for optional rear head restraints. The agency specified use of a Head Restraint Measurement Device

(HRMD), consisting of a head form developed by the Insurance Corporation of British Columbia (ICBC) attached to the Society of Automotive Engineers (SAE) J826 manikin (rev. Jul 95), for measuring backset compliance.

The minimum width requirement for front outboard head restraints in vehicles without a front center seating position, and for optional rear head restraints is 170 mm. The minimum width requirement for front outboard head restraints in vehicles with a center seating position between the outboard positions is 254 mm. For integral head restraints, there is a limit of 60 mm on the maximum gap between the head restraint and the top of the seat. The gap limit for adjustable head restraints in their lowest position of adjustment and any position of backset adjustment is similarly 60 mm. For all head restraints, gaps within the restraint are also limited to not more than 60 mm.

Under the final rule, an adjustment retention mechanism that locks into place is mandatory for all adjustable head restraints. Retention of the head restraint in its vertical position is tested using a loading cylinder measuring 165 mm in diameter and 152 mm in length. The rearward (with respect to the seat direction) position retention testing is conducted using a loading sphere, with the seat back braced. Under both tests, the head restraint must return to within 13 mm of the initial reference point, an increase from the proposed 10 mm return requirement.

The energy absorption test procedure is conducted using a linear impactor, rather than the proposed free-motion impactor or the pendulum impactor used in ECE 17.

The dynamic compliance option utilizes a Hybrid III 50th percentile adult male test dummy only, as the 95th percentile Hybrid III dummy is not yet available for compliance purposes. The head-to-torso rotation is limited to 12 degrees, and the maximum HIC<sub>15</sub> was limited to 500 instead of 150 in the NPRM. These performance limits must be met with the head restraint midway between the lowest and the highest position of adjustment rather than at the lowest position as proposed.

Between the effective date of the final rule and September 1, 2008, manufacturers were permitted to comply with FMVSS No. 202 by meeting: (1) All the requirements of the current FMVSS No. 202, (2) the specified requirements of ECE 17, or (3) all the requirements of FMVSS No. 202a. NHTSA has found that ECE 17 is functionally equivalent to the existing FMVSS No. 202, so it permitted

<sup>14</sup> The regulation, adopted by the UN/ECE's Working Party 29, World Forum for Harmonization of Vehicle Regulations, is ECE 17, Uniform Provisions concerning the Approval of Vehicles with regard to the Seats, their Anchorages, and any Head Restraints (<http://www.unece.org/trans/main/wp29/wp29regs/r017r4e.pdf>).

<sup>15</sup> The term “seating reference point” is fully defined in 49 CFR 571.3. It represents a unique design H-point. The H-point is the mechanically hinged hip point of an SAE J826 (July 1995) three-dimensional manikin (SAE J826 manikin), which simulates the actual pivot center of the human torso and thigh.

compliance with ECE 17 during the interim.

## II. Petitions for Reconsideration

We received seven petitions for reconsideration. Four were from auto manufacturers or an auto manufacturer trade association: the Alliance of Automobile Manufacturers (Alliance), Ford, DaimlerChrysler, and BMW. Two were from seat manufacturers: Johnson Controls and Keiper. The seventh petition was submitted by Syson-Hill and Associates, an engineering services firm. We note that we also received a petition from Kongsberg Automotive. However, since this was not submitted within the required timeframe for petitions for reconsideration, our regulations provide that it is treated as a petition submitted under 49 CFR part 552, rather than a petition for reconsideration. We address this petition for rulemaking in a separate section at the end of this notice.

In this section, we provide a brief summary of the issues raised by the petitions. The summary is representative and does not necessarily identify each petitioner which raised a particular issue.

### A. Backset Requirement

Several petitioners asked the agency to reconsider the 55 mm backset requirement. The Alliance stated that it believes there are potential safety disbenefits from the requirement. It argued that the 55 mm backset requirement measured at 25 degree torso angle is too aggressive and will create significant dissatisfaction. The Alliance stated that while it agrees less backset is better, a better balance between customer comfort and safety benefits must be achieved. It requested a maximum 70 mm requirement with "a 10 mm audit allowance to 80 mm."

DaimlerChrysler stated that it firmly believes that the backset requirement for front seats is overly restrictive and should be relaxed. That company stated that its experience suggests that designs meeting this requirement will encounter very strong consumer resistance. DaimlerChrysler stated that it designed the head restraints for a new vehicle to meet the backset requirements included in the NPRM, i.e., 50 mm at a torso angle of 25 degrees. It stated that consumer reaction from some customers, especially short-statured drivers, was very negative, and that some have removed or reversed the head restraint.

Daimler Chrysler asked the agency to reconsider the 25 degree torso angle as well as the 55 mm limit. That company stated that there are several vehicle

concepts, including light trucks, in which an angle of 25 degrees is much greater than the design and not realistic, thus leading to a much larger backset measured in the specified procedure as compared to a real world situation. DaimlerChrysler recommended that the agency specify the "design torso angle" rather than 25 degrees.

Johnson Controls stated that it believes a 90 mm backset requirement would best accomplish the goals of safety and passenger comfort while recognizing the practical effects of design and measurement variation inherent in the backset measurement technology.

### B. Backset Measurement Method

Ford argued that the backset measurement method and device specified in the final rule have not been sufficiently evaluated to adequately account for total process variability. It stated that test data analysis shows that the actual variability far exceeds the amount specified in the final rule, and that the rule is therefore not reasonable or practicable.

### C. Dynamic Option

The Alliance stated that it believes the dynamic test alternative included in the final rule is premature and not adequately supported and developed for use at this time. It requested that the agency investigate other alternatives and, in the meantime, retain the existing dynamic test in FMVSS No. 202.

### D. Rear Seat Non-Use Positions

Petitioners for reconsideration asked the agency to make several changes in the requirements for rear seat non-use positions. The Alliance and Ford petitioned the agency to allow head restraint designs that manually retract (without having to rotate) to non-use positions and that must be manually repositioned to in-use positions. The Alliance, BMW and DaimlerChrysler requested that the manually stowed non-use position compliance option originally in the NPRM be reinstated except that the required torso angle change should be no more than 5 degrees. GM recommended several options for visual cues to indicate that a rear seat head restraint is in a non-use position.

### E. Effective Date

The Alliance stated that while the date set forth in the final rule appears to provide more than three years leadtime, it was concerned that that leadtime will be subsumed during the period petitions for reconsideration are before the agency. It argued that

additional leadtime could be needed depending on when the agency resolved issues raised in the petitions. The Alliance also requested that in order to permit manufacturers to implement the required changes with the start of a new model cycle rather than at the end of the current model design, NHTSA should modify the compliance date to require 80 percent compliance with FMVSS No. 202a for the first year and 100 percent beginning the second year, with carry-forward credits.

### F. Other Issues

The petitioners for reconsideration raised a number of other issues, including ones related to the height requirement, gaps between the head restraint and the seat back, the backset and height retention (lock) tests, the energy absorption test and seat back bracing, head restraint clearance, the width of head restraints for certain seats, the option to comply with ECE 17, temperature and humidity, and owner's manual requirements.

## III. Development of Global Technical Regulation on Head Restraints

For the past couple years, NHTSA has been leading efforts to develop a Global Technical Regulation (GTR) on head restraints. During the November 2004 meeting of WP.29 and the Executive Committee of the 1998 Global Agreement, NHTSA formalized its sponsorship of the regulation on Head Restraints as identified in the Program of Work of the 1998 Global Agreement. In a notice published in the **Federal Register** (69 FR 60460) on October 8, 2004, NHTSA sought comments on a proposal that formalizes the U.S. sponsorship of a GTR on head restraints. The agency did not receive any comments.

The proposal was formally presented by the U.S. and adopted by the Executive Committee and referred to the Working Party of Experts (GRSP) at the March 2005 Session of WP.29. In February 2005, the GRSP formed an informal working group, chaired by the US, to develop a GTR. The working group has met eight times with the following contracting parties and representatives participating: Netherlands, France, Canada, Japan, Germany, Spain, Korea, the UK, USA, the EC, the European Association of Automotive Suppliers (CLEPA) and the International Organization of Motor Vehicle Manufacturers (OICA).

In developing and drafting the new GTR, the working group is combining elements from UNECE Regulations Nos. 17, 25, and newly upgraded FMVSS No. 202, as well as considering proposals for

requirements not contained in the previously mentioned regulations. The working group is exchanging data and has started drafting the regulatory text.

The major outstanding issues are:

- *Applicability*: Applying the GTR to vehicles up to 4,500 kg or limiting it to 3,500 kg.
- *Backset*: There is general consensus that it should be regulated, but the maximum backset limit is still being discussed.
- *Measuring procedures for height and backset*: There is continued discussion on using the H-point or R point as the point of reference.
- *Dynamic Test*: The issue of how to evaluate dynamic systems continues to be under discussion.

The working group has submitted four Progress Reports on the status of this GTR. They can be found in Docket No. NHTSA-2004-14395.

We note that the work on the GTR has been proceeding at the same time that NHTSA has been evaluating the petitions for reconsideration. Some of the issues that are the subject of the petitions for reconsideration have also been raised in the context of the GTR. In this document, we are addressing those issues in the context of the petitions for reconsideration of the recently upgraded FMVSS No. 202. If the development of the GTR continues to proceed successfully and it is ultimately adopted, and if the U.S. has voted for its adoption, NHTSA would issue an NPRM based on the GTR for a new FMVSS.

#### IV. March 2006 Partial Response to Petitions

On March 9, 2006, NHTSA published in the **Federal Register** (71 FR 12145) a final rule; partial response to the petitions for reconsideration.<sup>16</sup> In that document, the agency delayed the date on which manufacturers must comply with the requirements applicable to head restraints voluntarily installed in rear outboard designated seating positions from September 1, 2008 until September 1, 2010. The agency stated that the remaining issues raised by petitioners for reconsideration would be addressed in a separate document.

#### V. Overview of Decision

This document addresses the remaining issues raised by petitioners for reconsideration of the December 2004 final rule upgrading the agency's head restraint standard. We are partially granting and partially denying the petitions. The more significant changes

that we are making in response to the petitions include:

- *Leadtime*: For the front seat requirements, we have decided to provide one additional year of leadtime and also establish a one-year phase-in with an 80 percent requirement. The agency previously extended the compliance date for the rear seat requirements by two years. We are also establishing a one-year phase-in with an 80 percent requirement for the rear seat requirements.
- *Backset*: We are making two changes related to the backset requirement. First, we are specifying in FMVSS No. 202a that backset is determined by taking the arithmetic average of three measurements, rather than using a single measurement. Two studies, one by NHTSA and one by Transport Canada, have indicated that taking an average of several measurements reduces variability. Second, we are slightly relaxing the backset requirement by specifying that the 55 mm backset limit applies with the seat back at the vehicle manufacturer's specified design angle rather than at 25 degrees. This decision reflects consideration of interrelated issues and data concerning the 55 mm backset limit, comfort, and seat back angle.
- *Rear Seat Non-Use Positions*: To provide greater flexibility in this area, we are adding (as included in the NPRM) an option for a 10-degree change in the torso reference angle criteria.
- *Gaps Between Head Restraint and Seat Back*: We are adding a manufacturer option under which the gap requirement may be met by either the existing FMVSS No. 202a procedure using a sphere or one based on the ECE 17 measurement methodology.
- *Backset and Height Retention (Lock) Tests*: We are specifying that instead of returning to the reference loads of 37 Nm and 50 N after application of the peak load during these tests, that the load be reduced to zero and then increased to the reference loads.

As discussed in the sections which follow, we are making a number of other changes as well.

Finally, as indicated above, the agency has separately been leading efforts to develop a GTR on head restraints. Some issues raised by petitioners for reconsideration, including ones related to backset and the dynamic test, are also being discussed in the context of the GTR. While it is necessary for us to issue today's decision in order to respond to the outstanding petitions for reconsideration, we note that if

agreement is achieved on the GTR, we will consider making changes in these and other areas.

#### VI. Response to Petitions

##### A. Backset Requirement

##### 1. Petitions

Several petitioners, including automobile manufacturers and seat manufacturers, requested reconsideration of the 55 mm backset requirement.

Under the final rule, backset is measured using an HRMD consisting of a head form developed by ICBC attached to the SAE J826 manikin (rev. Jul 95). The head form includes a probe that slides rearward until contact is made with the head restraint. The resulting measurement reflects the horizontal distance between the back of the head of a seated 50th percentile adult male occupant and the front of the head restraint.

Under the final rule, backset must not exceed 55 mm for front seats, with the seat back positioned at an angle that gives the J826 manikin a torso reference line angle of 25 degrees. We will refer to the torso reference line angle and seat back angle interchangeably.

In addressing the petitioners' requests concerning the backset requirement, we will consider together issues related to the 55 mm value, test procedure variability, specification of the HRMD, and seat back angle, as they are closely interrelated.

The Alliance stated that it believes that the 55 mm backset requirement measured at 25 degree torso angle is too aggressive and will create significant customer dissatisfaction. It stated that while it agrees that reducing backset is desirable, a better balance between customer comfort and safety benefits should be achieved. That organization stated that 5th percentile female stature occupants do not sit at 25 degree torso angles, but prefer about 18 degrees and some as little as 14 to improve their ability to see the road ahead.

The Alliance stated that this is corroborated by the 2001 UMTRI response to the NPRM, which indicates a mean seat back (torso angle) of 22 degrees with a 3.2 degree standard deviation. The petitioner argued that this more upright back angle greatly reduces the backset to the point it interferes with the head of some of these occupants, if not just their hair.

(NHTSA notes that backset is reduced with more upright seat back angles because the angle of an occupant's head relative to the occupant's torso changes as the occupant's seat back angle is changed. As an occupant's seat back

<sup>16</sup> Docket No. NHTSA-2006-23848.

angle is reduced, making the seat back more vertical, the occupant's head is tilted increasingly further back with respect to their torso. Conversely, as the back angle is increased, the occupant's head is tilted further forward.)

The Alliance stated that negative consumer reactions to a recent new vehicle introduction with a 50 mm backset head restraint at 25 degree torso angle included removal and reversal of the head restraint. That organization indicated that increasing the torso angle a couple degrees did not satisfy customers. The Alliance also stated that drivers' increasing the seat back angle to relieve the close proximity of the head restraint to their heads may result in positioning the seat back at an angle greater than the one that provides optimal vision of the vehicle controls and displays, headroom, and lumbar comfort.

The Alliance stated that while the 50 mm backset requirement was relaxed to 55 mm in the final rule by NHTSA to account for a 5 mm measurement variability range of the HRMD, it does not account for a 2 degree design tolerance for seat back torso angle or an H-point tolerance of 12 mm. The Alliance stated that it believes a maximum of 70 mm should be adopted with a 10 mm audit allowance, making the limit effectively 80 mm. According to the Alliance, this would still make it necessary for manufacturers to design front head restraints within the IIHS Acceptable or Good rating for geometry.

DaimlerChrysler stated that it firmly believes the backset requirement for front seats is overly restrictive and should be relaxed. That company stated that its experience suggests that designs meeting this requirement will encounter very strong consumer resistance. It made a number of the same arguments as the Alliance, in some cases in more detail.

DaimlerChrysler indicated that it recently introduced a new vehicle in the U.S. market that was designed just after the issuance of the NPRM for the head restraint rule. That company stated that it ambitiously designed the head restraints for this new vehicle to meet the backset requirements of the NPRM, i.e., 50 mm at a torso angle of 25 degrees. DaimlerChrysler stated that the reaction from some customers has been very negative, with more than two percent of customers rating them unacceptable in a recent survey of owners. That company stated that given this response, it embarked on a high priority redesign effort to change the backset to 65 mm at a 25 degree torso angle.

According to DaimlerChrysler, it appears that a high percentage of 5th percentile female drivers object to the head restraints. It stated that some of these drivers are removing the head restraint and others are reversing the head restraint. DaimlerChrysler also stated that merely reclining the seat further has not been an acceptable solution for some drivers (especially those of short stature), and could also degrade visibility of controls, displays and rearward visibility.

DaimlerChrysler also stated that studies by the IIHS conclude that women are at greater risk of neck injury than men. That company argued that a new head restraint standard should protect those at the greatest risk, where the benefits are greatest, and where discomfort issues have the greatest consequences. DaimlerChrysler argued that referencing the backset requirement from a 25 degree torso angle, an angle more consistent with the angles typically used by larger stature (i.e., taller) occupants than those used by smaller stature occupants biases the requirement in favor of the larger stature occupants at the expense or discomfort of smaller stature occupants.

DaimlerChrysler stated that the UMTRI submission in response to the NPRM showed mean seat back angles to be 22.5 degrees with a standard deviation of 3.5 degrees. According to DaimlerChrysler, the mean angle minus 2 standard deviations approximates the 5% female occupant and the mean angle plus 2 standard deviations approximates the 95% male occupant. It stated that this shows, on average, a 14 degree range in seat back angle between these upper and lower size occupants for automotive design. DaimlerChrysler stated that with NHTSA's assumed 3 mm change in backset per degree change in seat back angle, most of the 55 mm backset is lost for the 5% female without any accommodation for hair clearance. DaimlerChrysler suggested that the regulation specify the backset at the seat back design angle.

DaimlerChrysler provided other arguments in support of specifying backset at the seat back design angle. It argued that there are several vehicle concepts (e.g., light trucks, minivans, SUV's and full size vans) in which an angle of 25 degrees is not realistic, thus leading to a much larger backset in NHTSA's procedure as compared to the real world situation. That company stated that SAE J-1100 July 2002 recommends a 22 degree nominal torso design angle. It urged the agency to use the "design torso angle."

In a later submission, DaimlerChrysler indicated that nominal seat back angles

for high vehicles, e.g., light trucks, are approximately 20 degrees, whereas for other vehicles, e.g., sedans they are approximately 23 to 25 degrees. It indicated that a 1 degree increase of seat back angle yields 3 to 4 mm increase of backset.

On the issue of the 55 mm backset limit and variability, DaimlerChrysler stated that while the final rule made some accommodation for measurement variance for the HRMD, the net effect of the 55 mm backset limit is less than a 50 mm backset design. It argued that the 5 mm increase that NHTSA included in the final rule does not account for seat back (torso angle) tolerances that are  $\pm 2$  degrees, and H-point tolerances of  $\pm 12$  mm. In a later submission, DaimlerChrysler argued that a "worst case" sum of backset tolerances is 29 mm. This includes 5 mm for seat upholstery, 10 mm for torso angle of the manikin, 10 mm for head rest rod to seat back angle, and 4 mm for seat reference point. DaimlerChrysler indicated that it would be necessary to design to a 26 mm backset limit to allow for these worst case tolerances.

DaimlerChrysler stated that all of its arguments point to the need for greater backset, and an audit allowance of at least a 10 mm beyond the intended nominal requirement. It requested a nominal backset requirement of 70 mm, with an additional 10 mm allowance for compliance.

DaimlerChrysler characterized NHTSA's philosophy in the head restraint rulemaking as being "if a little backset is good, less is better," and argued such an approach cannot be justified below 70 mm of backset. That company stated that it agreed that, all things being equal, "the less the backset, the better," but a balance between "customer acceptance" and "a better theoretical design" should be achieved. DaimlerChrysler argued that until the mechanism and threshold for whiplash is completely understood, overly ambitious targets should be avoided until they can be backed by better fundamental knowledge of the causation and prevention of rear impact induced neck injuries and customer acceptance.

Ford stated that it believes the backset measurement method and device have not been sufficiently evaluated to account adequately for total process variability. It stated that its test data analysis found significantly greater operator/gauge variability than that suggested by the agency in its rule.

Ford argued that the capability of the HRMD and related measurement process has not been sufficiently established. That company stated that the final rule preamble stated that



“maximum allowable backset requirement is based on the  $\pm 5$  mm tolerance of the measuring device” and that the tolerance “represents the variability associated with measuring backset with the ICBC measuring device.” Ford argued that this statement does not define in acceptable statistical terms the accuracy of the measuring device and that sufficient data are not provided to permit an assessment of the accuracy of the measuring device.

Ford argued that, as a threshold matter, the accuracy of the measuring device must be determined. It asserted that accuracy characterizes the level of deviation of the measurement device output from known “accurate” values, and that accuracy evaluation is performed utilizing calibration procedures using established certified specimens that are traceable to nationally recognized standards typically maintained by the National Institute of Standards & Technology. Ford claimed that without such traceability it is impossible to evaluate ICBC’s claim that “that the HRMD yields a level of accuracy of  $\pm 5$  mm when used by competent, well-trained operators.”

Ford stated that RONA Kinetics, the developer and manufacturer of the HRMD,<sup>17</sup> calibrates all new HRMDs, but there are no studies to indicate how well that calibration is maintained over time in various test labs. According to Ford, there is no calibration procedure that test labs can use to check calibration retention. It argued that because the true accuracy of HRMDs is not known, seat manufacturers and agency contractors cannot reliably verify compliance with the backset requirement of 55 mm. Ford argued that the agency should develop the accuracy requirements for the HRMD, verify that the proposed HRMDs satisfy these minimum requirements, and develop calibration standards and the necessary equipment to permit periodic calibration of the test device at the point of use.

Ford stated that once accuracy and calibration are established, repeatability and reproducibility as well as other major variability factors should be assessed with a study. According to that company, a comprehensive study should be conducted to assess the statistical distribution of the backset measurement on a sufficient sample of seat designs representative of the United States light vehicle fleet and these measurements should be compared to

the actual backset. Ford stated that these variables include, but are not limited to, different HRMD machines, different J826 manikins, different operators, different laboratories, differing temperatures and humidity, as well as the variability of the parameters set forth in the agency’s compliance test procedure.

Ford stated that in the absence of these data, it undertook a preliminary study to assess the accuracy of the HRMD. According to Ford, this study did not attempt to evaluate all major sources of potential variability. The preliminary study evaluated three different seats designed to meet the IIHS good rating, and used three trained operators using their own HRMD and associated J826 manikins.

Ford stated that of five combinations it evaluated, only one combination across three paired operators/gauges had a range of 10mm. The remaining combination ranges were between 19 mm and 21 mm. Ford stated that if it assumed that the  $\pm 5$  mm “tolerance” represents a range of 10 mm, these results double what the agency stated manufacturers should expect when measurements are taken by trained HRMD operators.

Ford also stated that this study excluded certain significant potential variables, including the impact of various laboratories, temperature and humidity variances, and manufacturing variability. Ford argued that its study identifies the need for the agency to perform the necessary work to determine the actual capability of the HRMD, and that the agency needs to consider and address other potential sources of variability and develop a reasonable and practicable backset requirement.

Ford also submitted data which it argued indicated that multiple variabilities mean that head restraint designs must use a backset less than 30 mm to assure statistical significance.

Ford later submitted the results of two studies addressing comfort and backset. That company stated that the studies show that it is not possible to design a seat that is both statistically compliant with the 55 mm requirement and comfortable for a vast majority of drivers. That company argued that the data show that the design target must be less than 19 mm to be compliant statistically with the 55 mm requirement. It also stated that the minimum backset required to satisfy 85 percent of drivers is 69 to 87 mm, depending on the vehicle model. Ford argued that for head restraints that do not adjust in the fore/aft direction, the FMVSS 202a backset requirement

would have to be at least 98 mm in order to satisfy about 85 percent of drivers. Ford stated that fore/aft adjustable head restraints could be a solution to the comfort problem if FMVSS 202a permitted the 55 mm backset requirement at the most forward position of the head restraint.

Johnson Controls stated that it believes a 90 mm backset requirement would best accomplish the goals of safety and passenger comfort while recognizing the practical effects of design and measurement variation inherent in the backset measurement methodology. It stated that an UMTRI study concluded that backset below 70 mm would not accommodate a substantial number of occupants. Johnson Controls also argued that the potential for variation in measurement technique and the variation inherent in the design tolerances associated with the determination of backset require a substantially lower nominal backset than the 55 mm limit in the standard. That petitioner noted that the agency added 5 mm in light of variability associated with the measuring device, but argued that while this is one facet of variation, sources of variation include repeatability, reproducibility, trim, foam and structure tolerances that are inherent in the designs used.

## 2. Agency Response

In responding to the petitions concerning the backset requirement, we begin by noting that the agency addressed issues related to backset at considerable length in the final rule preamble. As discussed in that document, in selecting the 55 mm limit, we attempted to balance comfort, safety and measurement variability concerns.

While all of these concerns are important, we note that in order to address the problem of whiplash, it is necessary to reduce the backset of many current head restraints. As discussed in the final rule, the available scientific data show that whiplash may be caused by relatively small amounts of head and neck movements relative to the torso.

Based on the available scientific data, NHTSA estimated that the final rule, once fully implemented, would prevent 15,272 front seat whiplash injuries annually. By contrast, we estimate that if the 55 mm backset limit were relaxed to 70 mm, the number of prevented injuries would be reduced by almost half, to 7,743. In the final rule preamble, we noted that no commenter disputed scientific data indicating that the closer the head restraint is to the occupant’s head at the time of impact, the better the protection the head restraint offers.

<sup>17</sup> We note that some commenters refer to the ICBC device as HRMD, whereas the agency refers to the combined ICBC device and J826 manikin as the HRMD.



On reconsideration, for reasons discussed below, we have decided to make two changes related to the backset requirement. First, we are specifying in FMVSS No. 202a that backset is determined by taking the arithmetic average of three measurements, rather than using a single measurement. Two studies, one by NHTSA and one by Transport Canada, have indicated that taking an average of several measurements reduces variability. Second, we are slightly relaxing the backset requirement by specifying that the 55 mm backset limit applies with the seat back at the vehicle manufacturer's specified design angle rather than at 25 degrees. This decision reflects consideration of interrelated issues and data concerning the 55 mm backset limit, comfort, and seat back angle.

In explaining our decision in this area, we will begin with a discussion of issues related to suitability of the HRMD. We will then address issues related to comfort, seat back angle, and the 55 mm backset limit.

#### a. Suitability of the HRMD and Measurement Variability

In the final rule preamble, we addressed issues related to specifying use of the HRMD for measuring backset and test variability. As discussed earlier, the agency relaxed the backset requirement from the proposed 50 mm by 5 mm, to 55 mm, to account for the variability associated with measuring backset with the HRMD.

The HRMD consists of a SAE J826 three-dimensional manikin with a head form designed by ICBC attached. The SAE J826 manikin is sometimes referred to as an "OSCAR" device. The ICBC head form includes a probe that slides rearward until contact is made with the head restraint, thereby measuring backset.

In commenting on the NPRM, most vehicle manufacturers and seat suppliers had opposed the use of the HRMD. Generally, they questioned the accuracy and repeatability of head restraint geometry measurements made using that device. Further, the HRMD was deemed too sensitive to foam, trim, actual H-point, temperature, and humidity variations. Several commenters argued that the HRMD was not appropriate for compliance testing because repeated testing on the same seat assembly yielded different results. For example, Ford noted that the 2000 Ford Taurus and 2000 Mercury Sable received different ratings despite the fact that they are manufactured on the same platform and have identical front seats.

On the other hand, Transport Canada had reported that a study commissioned by several Canadian insurance companies, conducted by RONA Kinetics and Associates, Ltd., entitled "Head Restraint Field Study," concluded that the HRMD is repeatable and an effective predictor of head restraint position. Transport Canada has used the HRMD for years and finds it to be a convenient and accurate tool.

In addressing accuracy concerns, ICBC said that the HRMD yields a level of accuracy of  $\pm 5$  mm when used by competent, well-trained operators. ICBC stated further that manufacturers have historically had to accommodate similar tolerance levels with other compliance testing based on the H-point machine.

In addressing Ford's comments on different measurement results for virtually identical vehicles, ICBC stated that the two seats, while identical in theory, had different upholstery materials (leather and cloth) and also had different stitching patterns. As a result, the deviation between two seat measurements was 5 mm, which ICBC noted was enough to warrant awarding two different vehicle head restraint ratings.

ICBC commented that it developed the HRMD because there were no similar tools available to produce accurate and repeatable measurements. It claimed the HRMD is more biofidelic than other similar or proposed devices, because it has an articulating neck joint that approximates the C7-T1 joint (i.e., the location on the spine between the most inferior cervical vertebra and the most superior thoracic vertebra). This allows the operator to approximate human posture at any seat back angle. The ICBC noted that there are 35 HRMD devices now in use, arguing this makes it a well-accepted compliance tool, and that the device is readily available from ICBC. Further, the HRMD represents a small cost for demonstrating compliance.

In adopting the HRMD for the final rule, the agency stated ICBC claimed the device has an accuracy of  $\pm 5$  mm. The agency stated that because ICBC has a significant amount of experience in using the HRMD, its assertion that the overall level of repeatability of its device is within a  $\pm 5$  mm, when used correctly, was persuasive.

The agency also concluded that ICBC adequately explained the discrepancy between the measurement results for Ford Taurus and Mercury Sable. Different upholstery and stitching patterns can result in different measurements. If these differences are significant, the difference in both height and backset may be significant.

We also stated we had found that while measuring head restraint geometries with the HRMD for use in a cost study, the backset measurements varied by a total of 10 mm when NHTSA's Vehicle Research and Test Center (VRTC) repeated the measurement of a single vehicle seat three times. This was consistent with the ICBC statements showing  $\pm 5$  mm accuracy.

In petitioning for reconsideration, petitioners raised many of the same issues concerning the HRMD and variability as had been raised in the comments. However, additional data was submitted, including the results of the preliminary study conducted by Ford. In addition, many of these same issues have been raised in the context of the negotiations for a GTR, and new data have been presented in that context. While this document considers the issues for purposes of the FMVSS No. 202 final rule, we have taken into account the GTR data since it is available relevant information.

After carefully considering the petitions and other available information, we continue to believe that the HRMD is a suitable test device.

First, in response to Ford's argument that the HRMD has not been shown to be an "accurate" measuring device, we disagree. As indicated earlier, the HRMD consists of an SAE J826 manikin with a head form designed by ICBC attached.

The SAE J826 manikin has long been incorporated in NHTSA's safety standards for purposes of determining H-point location. See S10.4.2.1 and S10.4.2.2 of FMVSS No. 208 and S7.2.1 of FMVSS No. 214. Moreover, the definitions section of 49 CFR Part 571 defines H-point by referencing SAE J826.

As to the head form designed by ICBC, we note that, in conjunction with the ongoing development of a head restraint GTR, Transport Canada recently conducted a study<sup>18</sup> to verify whether the HRMD is an adequate tool to measure backset. Among other things, the study sought to verify specifications and dimensional tolerances of the HRMD headform and measuring probes.

Transport Canada reported that the head form is manufactured to have a mass of  $3150 \pm 50$  grams, and all linear dimensions of the head form are within  $\pm 0.25$  mm of the drawing specifications for the head form size "J" provided in ISO DIS 6220—Headforms for use in the testing of protective helmets. It also reported that both height and backset

<sup>18</sup> GTR HR-7-5 (<http://www.unece.org/trans/main/wp29/wp29wgs/wp29grsp/head07.html>).

probes are within  $\pm 2$  mm of the RONA Kinetics drawing specifications, and that conformity with the drawing specifications is accomplished with a specially designed jig.

Transport Canada noted that the ICBC HRMD is not patented and imitations exist. It indicated, however, that the ICBC HRMD bears the ICBC/RONA Kinetics nameplate guaranteeing its authenticity and construction accuracy. FMVSS 202a specifies use of the ICBC head form.

The HRMD is a purely mechanical device. Also, unlike a crash test dummy, it is not subjected to crash test forces. Given these considerations, we believe that calibration should rarely be needed. We note, however, that the International Insurance Whiplash Prevention Group (IIWPG), of which ICBC is a member, has identified that variability between OSCAR units can be an issue when using the ICBC HRMD. To address this issue, IIWPG has developed a "Gloria jig" to calibrate the combination together as one single unit. We note that proper use of test equipment is an issue that NHTSA considers in all of its compliance testing. We believe that the issue of calibration of HRMD's is an issue for the agency to consider in the context of possible inclusion in the Laboratory Test Procedures or Compliance Test Procedure (CTP) for FMVSS No. 202a.

As to specifications for temperature and humidity, we do not believe these factors would have any significant effect on the HRMD since it is purely mechanical measuring tool. The issue of temperature and humidity related to seats is addressed later in this document.

As part of evaluating the petitions for reconsideration, NHTSA conducted an additional study of height and backset measurement variability. Transport Canada has also conducted such a study, a portion of which was discussed earlier. Studies have also been conducted by Ford, the European Automobile Manufacturers Association, and Japan.

To accompany this response to petitions, NHTSA has prepared a Technical Analysis Relevant to Petitions for Reconsideration of FMVSS 202a which, among other things, presents the results of the NHTSA study, and also provides analysis of the other studies.<sup>19</sup> A copy of this Technical Analysis will be placed in the docket.

The goal of the NHTSA study was to understand the expected variation in

backset measurement when using multiple laboratories. The NHTSA study concluded, among other things, that taking the average of three backset measurements at each of three labs reduced the average measurement range between labs by about half (from 8.5 mm to 4.5 mm). The backset measurement variability across labs fit between the estimates made from the Japanese and Ford data. Using an average of three measurements in each backset position of adjustment, at a 2 standard deviation (s.d.) (97.7 percent) level of certainty, the expected variability was 5.64 mm; at a 3 s.d. (99.9 percent) level of certainty, the expected variability was 8.47 mm.

The Transport Canada study, which used eight vehicles, sought to verify whether the ICBC HRMD is an adequate tool to measure backset. It concluded that the HRMD provides repeatable and reproducible results. It also found that increasing the number of measurements always reduced the backset measurement variability. Using an average of three measurements in each backset position of adjustment, at a 2 s.d. (97.7 percent) level of certainty, the expected variability was 2.6 mm; at a 3 s.d. (99.9 percent) level of certainty, the expected variability was 3.9 mm. We reassessed the Canadian data using the same statistical techniques used in our own study and found the 2 s.d. and 3 s.d. values to be 2.84 mm and 4.26 mm, respectively.<sup>20</sup> This was slightly higher than Transport Canada reported, but still about half the variability the agency study found.

Given that both the NHTSA and Transport Canada studies indicated that increasing the number of measurements reduce backset measurement variability, we have decided to specify in FMVSS No. 202a that backset is determined by taking the arithmetic average of three measurements, rather than using a single measurement. This will help address some of the concerns about variability cited by petitioners. We also believe that these studies, as well as the information discussed in the final rule preamble, confirm that the HRMD is an adequate and appropriate tool to measure backset, providing repeatable and reproducible results.

**b. Comfort, the 55 mm Backset Limit, and Seat Back Angle**

As indicated above, petitioners for reconsideration argued that the 55 mm

backset requirement measured at 25 degree torso angle is too aggressive and will create significant customer dissatisfaction. We will address together issues related to the 55 mm limit and the 25 degree torso angle given the interrelationship between them, e.g., reducing the torso degree at which backset is measured by one degree, from 25 degrees to 24 degrees, while maintaining the same backset limit, would result in head restraint designs with approximately 3 to 4 mm of additional backset.

Numerous commenters on the NPRM stated that occupants may be intolerant of head restraints very close to the back of their head. Further, because of differences in the occupant size, posture and seat angle preference, the same head restraint can yield different amounts of backset clearance and thus comfort for different individuals.

In addressing the comments in the final rule preamble, we stated that since ICBC reported that 49 of 164 vehicles from model year 2001 met the proposed 50 mm backset limit, it appears that occupant discomfort in front seats is not an insurmountable obstacle. We concluded that the available information does not substantiate the industry concerns associated with discomfort from front seat back adjustment to a more upright position.

UMTRI had commented that a 50 mm backset causes interference with the "preferred" head position of 13 percent of drivers. Generally, these tend to be smaller occupants, who prefer a more upright seat back angle. We stated that the "preferred" backset position, as articulated by UMTRI, may merely refer to a position that the drivers are most accustomed to. We noted that the term does not necessarily mean that the position is the only acceptable one or even the safest one for a given occupant. We also noted that the driving population as a whole is accustomed to a backset position that is, while comfortable, not optimal to prevent whiplash injuries.

We stated that we believed that no significant deviation from the proposed backset limit of 50 mm was necessary to provide an overwhelming majority of front seat occupants with an acceptable backset position. We also stated that any potential discomfort can be reduced by a slight increase in seat back angle. We stated that we believe that most front seat occupants can increase the seat back angle slightly without compromising their ability to reach the steering wheel comfortably or see the road ahead. We stated that for every additional degree of inclination,

<sup>19</sup> "Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule."

<sup>20</sup> The difference between the Transport Canada analysis and the NHTSA analysis is that Transport Canada reported the average of the s.d. of operator measurements from the 8 seats measured, while NHTSA reported the square root of the pooled variance of operator measurements from the 8 seats.

approximately 3 mm of additional backset clearance would be obtained.

We also noted that our own measurements of 14 vehicles showed that the front seat head restraints in the MY 1999 Toyota Camry, Chevy C1500, Chevy S10, Saab 9–5, and Chevy Malibu had backsets within 50 mm. This supported comments by ICBC and IIHS that many vehicles already have a 50 mm backset. We also stated that we believe the seat manufacturers can provide a front seating system design, such as a different head restraint shape, that would allow for better comfort.

As to seat back angle, NHTSA explained in the final rule preamble that the seat back angle of 25 degrees was chosen because it is on the edge of the range of normally selected seat back angles and would most likely be selected by larger occupants. ICBC, which developed the HRMD, designed it to be used at 25 degrees. The 25-degree angle is also consistent with the methods used by IIHS and the Research Council for Automobile Repairs (RCAR) for measurement of height and backset.

We noted that the 25-degree seat back angle in comparison to steeper angles represents a more stringent requirement for backset measurements because it maximizes the distance between the head and head restraint. However, a 25-degree angle is less stringent for measuring head restraint height. We stated that if we decided to adopt the manufacturer's design seat back angle, typically around 23 degrees,<sup>21</sup> we would be requiring taller head restraints. We also stated that we were adopting a single measurement angle for both height and backset in order to reduce unnecessary complexity in measurements and increase accuracy of testing results. Finally, we noted that using the same angle for the measurement of backset and height for every seat, rather than the manufacturer's design seat back angle, will allow comparison of height and backset measurement from seat to seat.

As indicated above, in petitioning for reconsideration, DaimlerChrysler argued that there are several vehicle concepts (e.g., light trucks, minivans, SUV's and full size vans) in which a seat back angle of 25 degrees is not realistic, thus leading to a much larger backset using NHTSA's procedure as compared to the real world situation. That company stated that SAE J-1100 July 2002 recommends a 22 degree nominal torso design angle. It urged the agency to use the "design torso angle."

Also, the Alliance stated that 5th percentile female stature occupants do not sit at 25 degree torso angles, but prefer about 18 degrees and some as little as 14. It argued that this more upright back angle greatly reduces the backset to the point it interferes with the head of some of these occupants, not just the hair.

i. *Seat Back Angle.* After considering the petitions for reconsideration, we believe a small amount of additional flexibility is appropriate. While we believe the available information shows that no major change is needed, we are persuaded that additional flexibility is needed to account for vehicles with very upright design angles. As indicated above, in petitioning for reconsideration, DaimlerChrysler argued that there are several vehicle concepts (e.g., light trucks, minivans, SUV's and full size vans) in which a seat back angle of 25 degrees is not realistic.

Additional flexibility in this area could be provided either by adjusting the backset limit or the specified seat back angle. This is because the angle at which the seat back is set for backset measurement affects the amount of measured backset.

To the extent the agency reduces the seat back angle that is used for backset measurement, the backset limit is easier to meet. In the preamble to the final rule, we assumed a 3 mm reduction per degree of backset. Based on subsequent information provided by Ford and DaimlerChrysler, we believe a range of 3 mm to 4 mm may be more accurate. However, the exact value is vehicle-specific and influenced by such factors as the shape of the head restraint.

While we considered either adjusting the backset limit or the specified seat back angle, or a combination of the two approaches, we decided that the best way to provide appropriate additional flexibility is to specify design seat back angle instead of the 25 degree angle. This approach maximizes flexibility for vehicles with very upright design angles while minimizing the potential lost benefits.

As discussed in Supplement to the Final Regulatory Impact Analysis, the impact on benefits of changing the backset limit to 60 mm or changing seat back angle to design angle is similar (about a 20 percent loss in benefits). However, for vehicles with seat back angles significantly steeper than 25 degrees, e.g., 20 degrees, specifying seat back angle provides significantly greater flexibility.

As a practical matter, this approach provides some additional backset flexibility for most seats, since NHTSA estimates that the sales weighted

average front seat design seat back angle is 23.5 degrees.<sup>22</sup> Specifying that such a seat be tested at the design seat back angle instead of 25 degrees is roughly equivalent to increasing the backset limit by 4.5 to 6 mm. Therefore, this will also help address possible concerns related to comfort.

We note, in considering specifying design angle instead of 25 degrees, that our analysis of UMTRI data does not show a good correlation between design seat back angle and selected angle. However, the UMTRI data was limited to 17 vehicles with design angles ranging from 22 to 26 degrees, with a majority of vehicles having design angles of 24 and 25 degrees. Because the data represent such a limited number of different design angles, it has limited value in assessing the correlation between average selected seat back angle and design angle for a spectrum of design angles. We have not seen data to contradict our belief that a reasonable way of identifying the seats that are most likely to be used at very steep angles is to rely on the manufacturer design seat back angle.

We also note that while the HRMD was designed to be used at 25 degrees, the device has an articulation to allow for adjustment of the head for varying torso angles. The device can therefore be used at different seat back angles. It is relatively rare that a seat can be adjusted to have a seat back angle of exactly 25 degrees. Thus, even prior to the change to specify seat back angle, the standard specified testing in the adjustment position closest to 25 degrees. For these reasons, we believe there is no problem in testing vehicles at the design seat back angle. We also note that specifying testing at design seat back angle will slightly affect the height requirement.

ii. *55 mm Backset Limit and Comfort.* As we respond to issues concerning the backset limit and comfort, we will take account of the additional flexibility provided by specifying design seat back angle. As indicated above, the sales weighted average design seat back angle is 23.5 degrees. Specifying that such a seat be tested at the design seat back angle instead of 25 degrees is approximately equivalent to increasing the backset limit by 6 mm.

In petitioning for reconsideration, DaimlerChrysler cited consumer complaints about the head restraints of a vehicle it said were designed to meet the 50 mm backset requirement proposed in the NPRM. The petition submitted by the Alliance also cited this

<sup>21</sup> SAE J1100—Motor Vehicle Dimensions. All 1999–2000 make and model data submitted to NHTSA. The data ranged from 18 to 28 degrees.

<sup>22</sup> "Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule."

experience. We note that DaimlerChrysler had also cited this experience in commenting on the NPRM, but provided additional information in the context of its petition for reconsideration. We also note that some of the information submitted by DaimlerChrysler about this issue is subject to a claim of confidentiality.

In discussions with DaimlerChrysler, we were advised that the design backset target for the vehicle in question was 47 mm. This was intended to provide a margin of compliance, although not one sufficient for purposes of certification. In light of DaimlerChrysler's petition, NHTSA measured the backset on two versions of this vehicle. Since the measurements on one of these vehicles was made with the seat backs a few degrees steeper than the 25 degrees specified in the standard, the measurements were normalized by adding 4 mm<sup>23</sup> to the backset for each degree less than 25 degrees. The average backset was 28 mm in the lowest position of adjustment and 18 mm in the highest position of adjustment.

We subsequently learned from DaimlerChrysler that the 47 mm target was based on SgRP instead of H-point. However, under the final rule, backset measurement is based on H-point. This change is significant. As discussed in the final rule preamble, the SgRP is a theoretical design point in the vehicle, usually representing the most rearward normal riding or driving H-point. It does not necessarily represent the actual vehicle build, e.g., it may be 15 or 20 mm forward, rearward, above or below the actual vehicle H-point. The HRMD defines the H-point of the specific seat being measured and thus is representative of the actual backset experienced by an occupant of that seat. Since DaimlerChrysler's 47 mm target was based on SgRP instead of H-point, it is not surprising that the backset measured according to the final rule is very different.

Given that the as-built backset, measured using the HRMD in accordance with the final rule, is on the order of half of the value cited in the petition, we believe the complaints about this vehicle are not germane to the 55 mm requirement included in the final rule.

As part of evaluating the petitions for reconsideration concerning the backset, we looked at more recent data from IIHS concerning the backset of model year 2004 vehicles. That organization

measured the backset of vehicles representing approximately 100 make/models, or about half of the vehicle fleet, using the same procedure as that of the final rule. Some make/models were measured multiple times using different available seat trim levels. Nearly half of the vehicles (47.1 percent) had a backset of 55 mm or less.

Moreover, more than 30 percent had a backset of 45 mm or less, and 25 percent had a backset of 40 mm or less.

We also reviewed our Office of Defect Investigation database for consumer complaints about head restraints. The search was restricted to 2000 and later model year vehicles. Two hundred and five complaints were found. These were categorized as various types of complaints. The vast majority of the complaints (59%) pertained to the lack of head restraint in the rear seating positions of vehicles. Most of these were for pickups with two seat rows. Only two complaints (1%) specifically mention a lack of sufficient backset. The vehicles with these complaints were a 2003 Toyota Camry and a 2004 Honda Pilot.

Extrapolating the IIHS data to the entire vehicle fleet, we find that nearly half of current head restraints have a backset of 55 mm or less (tested at a seat back angle of 25 degrees). Yet there is an absence of any significant number of consumer complaints. Therefore, we do not accept Ford's study claiming that the minimum backset required to satisfy 85 percent of drivers is 69 to 89 mm (with an even higher value needed for a regulatory requirement due to issues related to variability). Ford did not submit many details of how its comfort study was performed. However, it is evident that the study was not a blind study in that the participants were aware of what was being evaluated. This could have had a strong influence on the results as well as the wording of the questions asked of each participant. In any event, no evidence has been presented that a substantial number of drivers are dissatisfied with the backset of the head restraints in half of all vehicles.

We have also considered petitioners' arguments related to the "design target" needed to ensure compliance with a 55 mm backset limit. We recognize that manufacturers routinely design their vehicles with a compliance margin to meet regulatory requirements. Such margins are intended to address both measurement variability (the factor which led NHTSA to increase the backset limit by 5 mm in the final rule as compared to the NPRM) and build variability. However, we do not accept DaimlerChrysler's claim that companies

must design to 26 mm in order to ensure compliance with a 55 mm limit, or Ford's claims that companies must design to 19 mm.

DaimlerChrysler estimated the design tolerance by providing theoretical ranges for various aspects of the seat design and estimating their effect on overall backset. These estimates were then summed to provide an overall estimate. One problem with this estimate is that it is based on theoretical design tolerances as opposed to measurements of actual seats. Thus, there is no way to know what confidence level of variance they represent.

Another problem with this estimate is the adding or stacking of these tolerances. Stacking of tolerances tends to provide an overestimate of the overall tolerance rather than a statistically valid estimate. A more appropriate technique would be to use a pooled variance technique such as the agency used in its estimates of backset measurement variability.<sup>24</sup> Finally, DaimlerChrysler provided no information or arguments about the extent to which it is possible for manufacturers to improve these tolerances.<sup>25</sup>

We also believe there are several problems with Ford's estimate of a target backset value. Ford estimated the mean shift to be in the range of -3.2 mm to -27.9 mm and from these estimates stated that with additional process controls a shift of  $\pm 15$  mm was possible. However, the mean shift estimates how close the as-built seat is to design. It is not an estimate of random build variance.

We believe that one of the causes for this difference is the reliance of designing seats around the theoretical SgRP, which can deviate substantially from the actual H-point. We saw this in the results of the backset measured for the DaimlerChrysler vehicle which had a design backset of 47 mm based on the SgRP location, but when measured as built had a backset of about half of that value. However, manufacturers can deal with this issue by designing their vehicles and seats in light of the actual H-point for purposes of FMVSS No. 202a. Thus, we do not accept a mean shift estimate of  $\pm 15$  mm as being necessary for purposes of meeting the backset requirement. Supporting this conclusion is data submitted by Ford

<sup>24</sup> "Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule."

<sup>25</sup> DaimlerChrysler did submit confidential information to indicate the cost associated with reducing the seat design tolerance. However, there was insufficient information provided to evaluate the cost estimates.

<sup>23</sup> For every degree the seat back was more upright than 25 degrees, the measured backset was increased by 4 mm to approximate the backset measurement with the seat back set to 25 degrees.

reporting capability of achieving a shift of as little as 3.2 mm.

In addition to the estimate of mean shift in backset, Ford provided estimates of variability around the mean for three vehicles. It also submitted data it described as seat-to-seat variability for a Lincoln Town Car.

The s.d. for build variability ranged from 5.4 mm to 7.2 mm. Using a pooled variance method, the Ford data gives an s.d. of 6.6 mm. However, the Ford data also included measurement variability.

Using data submitted by Japan, NHTSA has made an estimate of seat build variability separate from measurement variability. (This analysis is included in the Technical Analysis<sup>26</sup> noted earlier.) The technique used in the agency's analysis separates the effects of the variability associated with the technician, technician repeated measures, the seat build, and any interaction between these covariates. The s.d. for build variability of the three seats ranged from 2.7 mm to 7.3 mm, with a combined s.d. of 3.75 mm.

The s.d. of lab-to-lab measurement variability in NHTSA's study was estimated to be 2.82 mm. Transport Canada's study and NHTSA's analysis of data submitted by Japan show much smaller measurement variability.

We can estimate the combined build and measurement variability by summing the squares of the s.d. values and taking the square root. Thus, the combined s.d. is about 4.7 mm =  $[(2.82)^2 + (3.75)^2]^{0.5}$ . The 2 s.d. estimate of the combined measurement and build variability is 9.4 mm. Subtracting this value from the 55 mm backset limit, we arrive at a value of 45.6 mm. This is far larger than the estimates of 26 mm and 19 mm suggested by DaimlerChrysler and Ford as "design targets."

We note that NHTSA does not make estimates of the "design targets" that manufacturers may need to adopt in order to ensure that all of their vehicles comply with a particular requirement. It is up to each manufacturer to determine what is necessary to certify using due care that each of its vehicles comply with all applicable safety standards.

The above analysis is provided to help show why we do not believe the estimates provided by DaimlerChrysler and Ford are necessarily representative of what is achievable. Apart from accounting for measurement variability, the design target a manufacturer may need to adopt in order to ensure that all of its vehicles will comply with a particular requirement is primarily

dependent on the manufacturer's choices concerning design and manufacturing tolerances, and its quality control measures.

We also note, in the context of addressing variability, that some manufacturers have argued that the agency should adjust the backset limit in light of an additional type of variability, that is associated with using the same seat structure for multiple designs related to options or trim levels. An example of this is the differences in measured backset for the 2000 Ford Taurus and 2000 Mercury Sable, noted earlier. We believe this is an issue that manufacturers can address in the design process of each seating option or trim level, i.e., ensuring that each such design will enable the vehicle to meet the backset limit.

As indicated above, the agency stated in the preamble to the final rule that one method a driver could use to achieve additional head restraint clearance would be to increase seat back angle slightly. Although DaimlerChrysler and the Alliance stated in their petitions that this solution had been unacceptable for some, no supporting information was provided. Moreover, as indicated above, that experience was in the context of a seat with a backset far under the specified amount of the final rule. Based on seat geometry, movement of a seat back one recliner click would have a minimal effect on the vertical eye location of a driver, and a particularly small effect for a seat in a more upright position.

On the issue of whether the backset limit should be increased because women are at greater risk of neck injury than men, we note that the data indicate that reduced backset reduces the risk of neck injury. This suggests that reduced backset is even more important for women than men.

We recognize the importance of acceptable comfort for all occupants, including those of short stature. However, we believe that the available data do not support the view that the 55 mm requirement will create any significant problems for a well designed and well built seat. As indicated above, nearly half of the current vehicles measured by IIHS had a backset of 55 mm or less, more than 30 percent had a backset of 45 mm or less, and 25 percent had a backset of 40 mm or less. Moreover, these calculations were made using a seat back angle of 25 degrees, and the change to design seat back angle will provide additional flexibility to typical vehicles. Thus, a large number of vehicles in the current fleet show that the new requirement can be met without causing significant comfort issues.

Finally, as discussed further in the Supplemental Final Regulatory Evaluation (SFRE), increasing the backset limit along the lines suggested by the petitioners would substantially reduce the benefits of the final rule.

For these reasons, as well as the ones discussed in the final rule preamble, we decline to increase the 55 mm backset limit.

iii. *55 mm Backset Limit, H point and SgRP*. In December 2006, the Alliance recommended for FMVSS No. 202a<sup>27</sup> that the backset limit be kept "at no less than 55 mm at the design torso angle using a measurement procedure about the "R" point (SgRP) derived from ECE R17 in place of a backset requirement of 80 mm at the design torso angle using the "H" point (HRMD) measurement method." This recommended alternative would thus replace the one it presented in its petition for reconsideration. The Alliance stated that this would preserve the benefits the agency estimated in the FRIA.

We note that while the Alliance's recommendation is an alternative method of addressing concerns it raised in its petition for reconsideration about the backset limit, it represents a very different approach. In order to ensure that the agency can fully consider particular requests, petitioners for reconsideration should be specific in their petition about the relief they desire. We also note that while petitioners for reconsideration did not request that the agency use SgRP for measuring backset, the issue was raised in connection with measuring head restraint height.

As to the issue of using H-point or SgRP, the agency addressed this subject in the preambles to the NPRM and final rule. Use of H-point measures the actual vehicle as manufactured and hence the actual protection provided to vehicle occupants. By contrast, the SgRP is a theoretical design point in the vehicle and does not necessarily represent the actual vehicle build. Therefore, we continue to believe that use of H-point is a better approach and decline to change to SgRP.

## B. Rear Seat Non-Use Positions

### 1. Petitions

In the head restraint final rule, NHTSA permitted rear head restraints to have non-use positions in limited circumstances. The agency decided to permit such positions to address concerns about rear visibility. However, the agency also wanted to reduce the

<sup>26</sup> "Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule."

<sup>27</sup> The Alliance also made this recommendation for the GTR that is under development.

risk of injuries stemming from misused head restraints.

In light of these considerations, the agency adopted the following requirement: (1) A head restraint in a non-use position must automatically return to a normal "use position" when the seat is occupied by a 5th percentile female dummy whose midsagittal plane is aligned within 15 mm of the head restraint centerline; or (2) the head restraint must be capable of manually rotating at least 60 degrees forward or rearward in a vehicle vertical longitudinal plane between the "use position" and the non-use position. In explaining its decision to allow the latter of these two options, the agency stated that if the head restraint is capable of rotating forward or rearward by at least 60 degrees to achieve a non-use position, it would clearly be in a non-use position, thereby informing the occupant that the head restraint is available, but out of place.

The agency did not adopt a proposed provision that would have required that the non-use positions cause a 10-degree change of the torso angle of the J826 manikin. This proposed requirement was based on the premise that the non-use position should give the occupant an obvious physical cue when the head restraint is not properly positioned. Given its decisions not to mandate rear head restraints and to allow head restraints to be removable without the use of tools, the agency concluded that it would be incongruous to mandate a possibly complex seat mechanism to ensure that non-use positions provide a physical cue to the occupant in the form of a 10-degree change to the torso reference angle.

Petitioners for reconsideration asked the agency to make several changes in the requirements for rear seat non-use positions. The Alliance and Ford petitioned the agency to allow head restraint designs that manually retract (without having to rotate) to non-use positions and that must be manually repositioned to in-use positions.

The Alliance stated that since publication of the NPRM, many new vehicles have been designed such that the rear seats retract into the floor. The head restraints on these seats can be lowered to a position nearly flush with the top of the seat back, allowing the seat to be stowed without head restraint removal. It argued that the folding head restraints permitted by the final rule would take up too much space below the floor. It also argued that removable head restraints allowed by the final rule are not preferred by customers and are less likely to be available when needed. Ford stated that strong customer

demand for vehicle functionality requires rear seats with folding or otherwise stowable seats.

The Alliance argued that disallowing retractable head restraints may overly restrict otherwise acceptable head restraints and is contrary to the interests of occupant safety. Ford stated that the restriction is not reasonable, necessary or practicable. The Alliance requested that the agency allow non-use positions of less than 700 mm, and in-use adjustment positions between 700 mm and 750 mm.

GM recommended several options for visual cues to indicate that a rear seat head restraint is in a non-use position. These included a permanent label similar to that already present in some Volvo models, and indicators that deploy only when the head restraint is in the lowest position.

The Alliance, BMW and DaimlerChrysler requested that the manually stowed non-use position compliance option originally in the NPRM be reinstated except that the required torso angle change should be no more than 5 degrees. DaimlerChrysler stated that the agency's efforts to minimize adjustability misuse may have the unintended consequence of threatening the very installation of rear seat head restraints. It argued that a 5 degree torso angle change would be clearly uncomfortable for an adult and would satisfy the agency's concern about misuse.

BMW stated that it believed that NHTSA did not intend to inadvertently prohibit designs that meet the agency's proposed 10-degree change in the torso reference angle criteria, and it believes this added option can provide occupants with an obvious physical cue that the head restraint is not properly positioned. That company stated that, based on the NPRM, it had designed seats to meet the 10-degree change in torso reference angle option. However, BMW recommended that the agency adopt a 5-degree change in torso reference angle option.

## 2. Agency Response

After considering the petitions, we have decided to add an option for a 10-degree change in the torso reference angle criteria. Head restraints that meet this option will give the occupant an obvious physical cue when the head restraint is not properly positioned. We are not adopting a 5-degree change in the torso reference angle criteria since, for reasons discussed below, we believe this option would not provide an obvious physical cue. We are also not adopting the other changes requested by petitioners for reasons discussed below.

In the December 2004 final rule, the agency did not adopt the proposed 10-degree torso angle change option for rear seat non-use positions in light of concerns raised by commenters that it was overly burdensome. We adopted instead the option for head restraints that fold forward or rearward by 60 degrees. We concluded that although such designs would not necessarily provide a physical cue, they would provide a clear visual cue that the head restraint is not in a proper use position.

However, based on our review of the petitions for reconsideration, we believe that it would be useful to include the 10-degree torso angle change option as well. As indicated above, BMW stated that it has designed head restraints to meet this option.

Given the requests of petitioners, we carefully considered whether a 5-degree torso angle change option would provide an appropriate physical cue. To explore this question, the agency developed a human factors study to determine if an occupant would be likely to reposition their head restraint as a function of the torso angle change the head restraint produced in the non-use position.<sup>28</sup>

The baseline seat for this study was the second row captain's chair of a 2005 MY Dodge Grand Caravan. In its OEM configuration, the seat created a nominal 5 degree torso angle change between its non-use and in-use positions. The head restraint was then modified by introducing two forward offsets that generated either a 10 or 15 degree torso angle change. One other condition that was used was a label attached to the head restraint in the 5-degree condition. The label was modified from a label used by Volvo.

Of the participants who adjusted the head restraint, 88% adjusted it immediately after sitting down. The 5-degree condition and label condition were unsuccessful in motivating participants to adjust the head restraint. For the 5-degree condition, only 3 out of 20 participants (15 percent) adjusted the head restraint. None of the participants (0 out of 20) adjusted the head restraint as a result of the label. The 10-degree condition had a nearly 80% success rate, 19 out of 24. Only four participants were run in the 15-degree condition since the percentage of participants who adjusted the head restraint in the 10-degree condition was high. The 15-degree condition had a 100% rate of adjustment.

<sup>28</sup> DOT HS 809 957, "Rear Seat Stowable Head Restraint Non-Use Position Torso Angle Study," November 2005.

In light of the results of this human factors study, which demonstrated the effectiveness of a 10 degree torso angle change and the ineffectiveness of a 5 degree torso angle change, we decline to adopt petitioners' request for a 5-degree torso angle change option.

We also decline to adopt the other changes recommended in this area by petitioners. As to the issue of permitting manually retractable head restraints, we continue to believe that head restraints should not have non-use positions unless either there is an automatic return to a normal use position feature or there is a clear physical or visual signal to occupants that the head restraint is not in a position intended for use. This is necessary to help prevent unintentional misuse. A head restraint that simply retracts to a lower position intended to be a non-use position looks the same to an occupant as a head restraint that has a position of adjustment below the required 750 mm height. There would be no physical or visual cue leading the user to adjust the head restraint to the in use position.

While we appreciate concerns that current designs for rear seats that retract into the floor may not come within one of the available options, petitioners have not shown that these options could not be met by other designs, including ones with more novel packaging. We note that the agency extended the compliance date for the rear seat requirements to September 1, 2010. This provides additional leadtime for design changes. As discussed elsewhere in this document, we are also providing a one-year 80 percent phase-in for the rear seat requirements.

As to the Alliance's request that the agency allow in-use adjustment positions between 700 mm and 750 mm, we note that the final rule specified that the lowest in-use position must be at least 750 mm. The rationale for this minimum height requirement was provided in the NPRM and final rule. Of particular note, the 750 mm requirement ensures that the head restraint will provide benefits to a higher percentage of rear seat occupants.

No new information was provided to support a change in this requirement. Issues related to visibility and folding seat storage are addressed by allowing for removal and non-use positions. The gap requirements assure that short-statured occupants will have head restraint protection even when the head restraint is at the 750 mm position. We therefore decline to make this requested change.

As to the request for other options for visual cues to indicate that a rear seat head restraint is in a non-use position,

including labels, no information has been provided to show that such cues would be effective. As noted above, in our human factors study, none of the participants (0 out of 20) adjusted their head restraints as a result of a label. Accordingly, we are not adopting such additional options.

Finally, we note that in December 2006, the Alliance asked the agency to include all of the non-use alternatives within the current GTR draft text, including a 450 mm  $\times$  55 mm  $H_{LE} \times S$  "Discomfort metric." The request concerning "discomfort metric" was not included in the Alliance's petition. It is, however, relevant to the concerns the Alliance raised about rear non-use positions and has similarities to the change in torso reference angle approach. The specific values for the "discomfort metric" are still under discussion in the context of developing the draft GTR. Before adopting such an approach, we would want to more carefully analyze it. Accordingly, we are not adopting a "discomfort metric" at this time.

### C. Dynamic Option

The agency included an upgraded optional dynamic test requirement in the head restraint final rule which, if chosen, allows a manufacturer to forgo certification to the majority of static test requirements (S4.3 and S5.3). While the dynamic option is intended to facilitate the continued development and use of "active" head restraint systems, it is available for any head restraint system.

Under the dynamic option, the entire vehicle is exposed to a half-sine deceleration pulse with a target of 8.8 g peak and 88 ms duration. The 50th percentile male Hybrid III dummy in each seat must have a maximum head-to-torso rotation of less than 12 degrees and a HIC15 of less than 500.

While the head restraint standard previously included an optional dynamic test alternative, the agency adopted the upgraded alternative for several reasons. First, the agency wanted the dynamic test alternative to be consistent with the standard's upgraded static test requirements, including the height requirement. The existing performance limit (45 degree head rotation) was such that very short head restraints could comply with the regulation.

Also, the previous dynamic alternative specified use of a 95th percentile adult male dummy. However, the agency had not adopted a specific 95th percentile adult male dummy for regulatory purposes. The agency specified use of the 50th percentile

adult Hybrid III dummy to improve objectivity and enforceability.

### 1. Basic Test Requirement

In petitioning for reconsideration, the Alliance and DaimlerChrysler argued that the test was premature and not adequately supported. They stated that the 12 degree rotation limit has no biomechanical derivation. They questioned the basis for the injury risk curve provided in the preamble of the final rule, which shows whiplash risk associated with head translation rather than rotation. The Alliance and DaimlerChrysler asked the agency to retain the previous dynamic option that specifies a 95th percentile test dummy and a 45 degree head-to-torso rotation.

DaimlerChrysler argued that the agency had not provided any biomechanical data correlating risk of neck injury with head rotation. It claimed that head rotation has been found to be not a good estimator for neck injury. It also argued that the agency did not present a cost-benefit analysis to relate the benefit of reducing head rotation to 12 degrees. That company argued that there has been no quantifiable justification for changing the existing dynamic alternative.

DaimlerChrysler also stated that studies conducted by IIHS for its dynamic head restraint test has eliminated head rotation from consideration as an assessment parameter for whiplash injury. It stated that IIHS has elected to instead use neck tension and neck shear.

Ford argued that the head-to-torso rotation may not be functionally equivalent to the static requirements, and may be design/technology restrictive. It argued that the Volvo WHIPS seat has good field performance yet does not pass the 12 degree requirement. That company asked that the head-to-torso rotation limit be increased to 20 degrees. It argued that this would represent a 10 percent risk of whiplash injury. As an alternative, Ford suggested that the agency use neck moment as the injury criterion.

After considering the petitions for reconsideration, NHTSA has decided to retain the basic dynamic test alternative included in the final rule. We note that the agency previously addressed the general criticisms of this option in both the NPRM and final rule preambles. In the preamble of the December 14, 2004 final rule and in an associated technical report,<sup>29</sup> the agency showed the

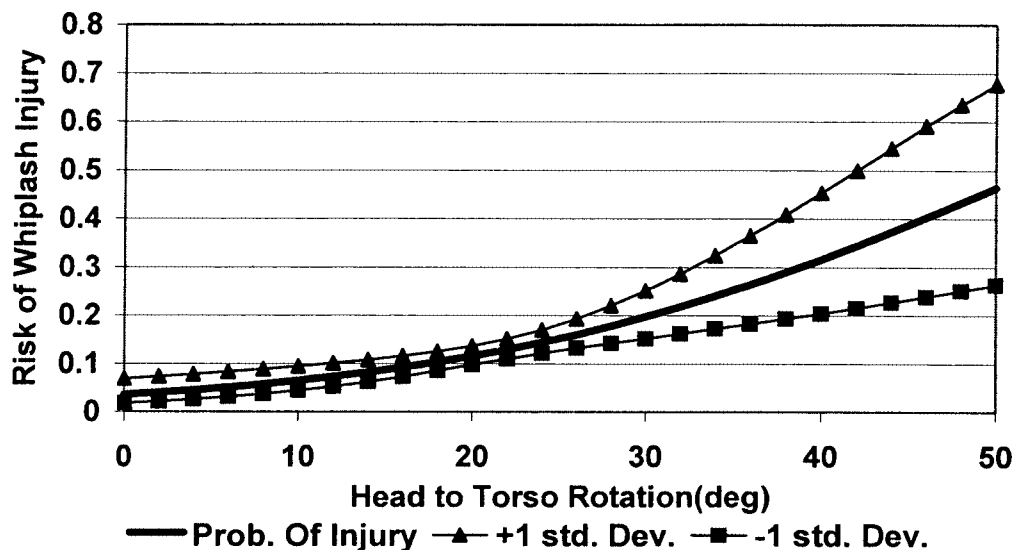
<sup>29</sup> Docket No. 2004-19807-05, NHTSA Technical Report, "Injury Criteria and Anthropomorphic Test Devices for Whiplash Injury Assessment. NHTSA has also published this study in the 2005 ESV



biomechanical basis for the development of the head-to-torso rotation limit.

Unfortunately, the agency incorrectly presented in the final rule preamble a graph of head displacement rather than

head rotation (69 FR at 74874). The graph should have been the following:



**Figure 1. Risk of Whiplash Injury versus Head to Torso Rotation on the Hybrid III 50<sup>th</sup> percentile male dummy**

This correct graph addresses some of the questions raised by the petitioners.

DaimlerChrysler cited a technical paper<sup>30</sup> for its claim that head rotation has been found to be not a good estimator for neck injury. Using statistical and optimization techniques on published biomechanical data, the authors of the paper concluded that neck tensile force alone was the best predictor of AIS 3+ neck injury. All the biomechanical data used for analysis were those where the subject was either uninjured (AIS=0) or the subject sustained AIS 3+ neck injuries. Thus, the resulting injury criterion, neck tension or  $N_{ij}$ , are meant for developing AIS 3+ neck injury criterion. There is no way of assessing the risk of AIS=1 neck injuries with these data, which is the AIS level for whiplash injuries. Therefore, we do not accept that company's argument concerning this paper.

As to Ford's request concerning neck moment, we note that lower neck moment was one of the criteria considered by the agency when developing the dynamic option proposal. However, we decided in favor of head-to-torso rotation for the following reasons.

We have decided in favor of head-to-torso rotation because, in the absence of generally accepted injury criteria specifically applicable to whiplash injuries, we believe that a head restraint's ability to prevent whiplash is primarily due to its ability to prevent the rearward translation and rotation of the occupant's head with respect to the torso. The sled tests showed that rearward head rotation seemed to correlate with head restraint position. Other biomechanics researchers have found a similar correlation and used head-to-torso rotations for the evaluation of whiplash injury. The agency is willing to reconsider the dynamic performance criteria if and when more advanced whiplash injury criteria become available. 69 FR 74875 (footnote omitted).

In adopting the upgraded dynamic test, it was our goal to provide a level of safety similar to that of the static requirements. However, given the differences in the basic nature of the test requirements, we do not believe it is possible to provide one-to-one correspondence between the two sets of tests. Thus, a particular vehicle may be able to pass one test but not the other.

For reasons discussed above and in the NPRM and final rule preambles, we do not believe it would be appropriate to simply retain the existing dynamic alternative test requirement. Among

other things, that requirement is not consistent with the upgraded static test requirements with respect to the need for higher and closer head restraints. Also, we believe there was a need to specify a specific test dummy to improve objectivity and enforceability.

As to DaimlerChrysler's argument that the agency has not presented cost-benefit analysis related to reducing head rotation to 12 degrees, the agency addressed, in connection with the December 2004 final rule, the costs and benefits of upgraded head restraints. This analysis was presented in the context of head restraints designed to meet the static requirements, the option which is relevant to nearly all current head restraints.

The dynamic alternative simply provides a means to facilitate the development and use of active head restraints, while ensuring the same level of protection as ones meeting the static requirements. For reasons discussed above, it was necessary to reduce the head rotation limit in order to accomplish this, and there were a variety of other reasons why it was necessary to upgrade the dynamic alternative. The agency is not requiring active head restraints, and we do not

conference. Kuppa, S., Saunders, J., Stammen, J., Mallory, A., "Kinematically Based Whiplash Injury Criterion," 19th ESV Conference, Paper No. 0211, 2005. (<http://www-nrd.nhtsa.dot.gov/pdf/nrd-01/esv/esv19/05-0211-O.pdf>)

<sup>30</sup> DaimlerChrysler cited: Nusholtz, G.S., Di Domenico, L., Shi, Y., Eagle, P., "Studies of Neck Injury Criteria Based on Existing Biomechanical Test Data," Accident Analysis and Prevention, May 2002. We note that the correct citation for this paper

is to Accident Analysis and Prevention, Vol. 35, pp. 777-786, 2003.

believe additional analysis concerning costs and benefits of the dynamic alternative is necessary.

As indicated in the discussion in the final rule preamble, data indicate that active head restraints can be designed to comply with the 12 degree head-to-torso rotation limit. Since the publication of the final rule, we have conducted dynamic tests using four different manufacturers' active head restraints. The results are shown in Table I. Three of the four seats had head-to-torso rotations of less than 7.7 degrees.<sup>31</sup> One seat exceeded the 12 degree limit (17.9 degrees). This data shows that, in general, active head restraints can perform very well in the dynamic option. However, this is a seating systems test that assesses the performance of multiple seat characteristics such as the seat back compliance and seat back recliner mechanism, in addition to the head restraint. So the mere presence of an active head restraint does not assure compliance. Also after publication of the final rule, it has been reported to the agency that a production Toyota Whiplash Injury Lessening (WIL) seat, optimized for rear impacts, but not an active head restraint, achieved a head-to-torso rotation of 6 degrees when tested to the dynamic compliance option.<sup>32</sup> The Toyota WIL seat shows non-active systems can be designed to pass the test.

TABLE I.—NHTSA TESTING OF MY2006 ACTIVE HEAD RESTRAINTS

Vehicle	Head-to-torso rotation (deg.)
Honda Civic .....	7.7
Nissan Altima .....	17.9
Saab 9-3 .....	4.1
Subaru Outback .....	4.1

We note that the Alliance requested that if the agency does not otherwise change the 12 degree limit, a 10 percent tolerance should be added for purposes of compliance.<sup>33</sup> This would, in effect, change the limit to 13.2 degrees. However, the Alliance did not present evidence that the 12 degree limit cannot be met by vehicles with active

restraints. We therefore decline to make this change.

We do not believe that the fact that the Volvo WHIPS seat does not pass the 12 degree limit is a reason to change the requirement. The primary reason for including the dynamic test option is to facilitate use of active restraint systems that require a certain range of motion to work effectively and which, when undeployed, might not meet the static test requirements.

The Volvo WHIPS seat does not present this type of active system. It incorporates features in the seat recliner mechanism to help optimize rear impact protection, but it does not "deploy" as such. We have been advised that the Volvo WHIPS seat meets the static test requirements.<sup>34</sup> Therefore, the dynamic test option is not needed to permit this type of system.

We also observe that Ford indicated that IIHS rated all of the 2005 Volvo models using the WHIPS seat as "Good." However, IIHS published a study in April of 2005, through the Highway Loss Data Institute (HLDI), which examined the rate of personal injury protection (PIP) claims in passenger cars struck in the rear for different vehicle classes (by vehicle weight), different types of head restraints (active, non-active), and different types of seats (WHIPS, and no WHIPS).<sup>35</sup> The results of the study indicate that for each vehicle class, active head restraints outperform non-active head restraints. In addition, within each vehicle class, the PIP rates of seats with active head restraints rated as "marginal" or "poor" by IIHS was lower than the PIP rates of seats without active head restraints rated as "good" by IIHS. The study indicated that Volvos equipped with WHIPS seats did not reduce relative PIP rates when compared to vehicles with similar size and weight.

## 2. Trigger Point

The Alliance stated in its petition that there is no provision in the dynamic option for a trigger point for a sensor driven deployable head restraint and that such a provision should be included. It stated that such a specification would be similar to one included in FMVSS No. 208 for the sled test option, and argued that such a provision should be included in the

head restraint standard to ensure objective testing.

In a meeting with NHTSA, BMW argued that for its dynamic head restraint design to be adequately tested, a trigger or deployment time needs to be part of the test procedure.<sup>36</sup> The BMW active head restraint uses a pyrotechnic design. Once the threshold acceleration is sensed, the pyrotechnic element fires and the head restraint moves about 40 mm to 60 mm forward, depending on the height adjustment, and rotates 9 degrees towards the occupants head.

BMW argued that the half-sine deceleration pulse is not representative of the pulse that its vehicle would sense in a rear impact. However, it believes the total  $\Delta V$  is acceptable. BMW provided a data plot of a rigid barrier striking one of its vehicles at 35 km/h in comparison to a sled pulse within the FMVSS 202a corridor. The slope of the acceleration was much higher for the barrier impact, although at approximately 80 ms they both have a 17 km/h  $\Delta V$ . BMW stated that its system would deploy in the rigid barrier impact, but might not in the sled test. It stated that if it were to adjust its algorithm to deploy in the test, it could get deployments in the field when it is unnecessary to protect the occupant.

After considering these requests, we decline to make the requested change. As discussed below, we believe that the specified sled pulse is representative of one experienced in a crash when the head restraint is needed to provide protection. Therefore, we believe the sensors should be designed to activate the head restraint in such a situation. We are concerned that if the agency specified a trigger point, i.e., specified that the head restraint be activated at a specific point in time as part of the test procedure, there would be no test of the sensors and no assurance that the head restraint would activate during the type of crash simulated by the sled pulse.

We do not consider the provisions of FMVSS No. 208 with respect to its sled test as indicative that a trigger point is needed for the head restraint sled test. The FMVSS No. 208 sled test was adopted as a special measure to help address the problem of aggressive air bags. The sled test was adopted to enable vehicle manufacturers to quickly depower all of their air bags.

There are no similar time issues related to active head restraints, and manufacturers have time to develop algorithms to ensure that such head restraints activate in a timely manner during the sled test, without activating

<sup>31</sup> Copies of the test reports will be placed in the docket.

<sup>32</sup> See the docket for this document.

<sup>33</sup> We note that when NHTSA includes tolerances in the safety standards, vehicles or equipment must meet the specified requirements at all points within the specified tolerances. Thus, tolerances within the safety standards do not provide compliance margins.

<sup>34</sup> In supplemental information submitted to the agency, Ford reported a 13 mm backset for the Volvo S80 (Docket No. NHTSA-2004-19807-25). This is consistent with agency backset measurements of the S40, which were well below the backset limit.

<sup>35</sup> Insurance Special Report—Head Restraints and Personal Injury Protection Losses, (2005). Highway Loss Data Institute (HLDI).

<sup>36</sup> Docket No. NHTSA-2004-19807-21.

in situations where deployment is unnecessary. We note that BMW has not presented evidence to the agency that this cannot be done with its system.

As to the issue of the representativeness of the crash pulse, we believe that the appropriateness of the  $\Delta V$  and average acceleration of the FMVSS No. 202a pulse is supported by a 2002 Swedish study by Krafft and others. This study examined rear impact crashes with crash recorders where crash pulse was a known (66 such crashes).<sup>37</sup> It examined the relationship between whiplash injury risk and parameters such as  $\Delta V$ , peak acceleration, average acceleration, and average windowed acceleration for 18 ms, 36 ms, and 80 ms. It found that average acceleration best correlated with whiplash injury risk.

For most occupants who had whiplash symptoms for longer than a month, the mean acceleration of the crash pulse was greater than 4.5g and above a  $\Delta V$  of 15 km/h. For this group, the average mean acceleration was 5.3 g and the average  $\Delta V$  was 20 km/h. The FMVSS No. 202a crash pulse has a 5.6 g average acceleration and 17.3 km/h  $\Delta V$ .

We are including in the Technical Analysis<sup>38</sup> noted earlier additional analysis concerning why we believe that the sled test pulse is appropriate.

### 3. Dynamic Angular Measurement

The Alliance, in reference to the procedure specified in S5.3.9 for calculating angular displacement, stated that Part 572 does not specify instrumentation for determining the angular position of either the head or the torso of the Subpart E dummy. It stated its understanding that agency tests have used magnetohydrodynamic (MHD) angular rate sensors mounted in the head and torso. The Alliance stated that if the agency plans to use these sensors for the FMVSS No. 202a dynamic tests, this instrumentation and its mounting (and any related changes to the dummy to offset the added mass of the MHD sensors) should be specified in Part 572 or in the FMVSS 202a test procedure, along with any algorithms that will be used to process the data.

We note that S5.3.9 does not specify specific instrumentation, but does specify that the instrumentation and

algorithm to be used is capable of determining the relative angular displacement to within one degree. While we have considered the Alliance's request, we have decided not to specify the specific instrumentation. A variety of types of instrumentation can be used to make the specified measurements, and we believe that there is no reason to be more specific.

We have made clarifying changes in the regulatory text to make it clear that the Hybrid III dummy is fitted with sensors to measure rotation between the head and torso, and that the dummy with the sensors is to still meet the specifications in 49 CFR Part 572 Subpart E.

### 4. Seat Back Angle

We note that the agency was not asked to change the 25 degree seat back angle specified for the dynamic test alternative, and are not making such a change. Concerns related to the static backset limit and comfort are not relevant to the dynamic test. Absent this consideration, we believe it is preferable to test seats in a consistent way with respect to seat back angle.

### 5. Technical Amendments

The Alliance pointed out an incorrect reference in S5.3.7.4. We are correcting that reference, from S5.3.7.4 to S5.3.7.5.

We note that maintaining the 25 degree seat back angle for the dynamic test and specifying design seat back angle for all other testing requires rearranging the regulatory text. S5.1 previously specified the seat back angle for all tests was 25 degrees. We have moved this specification to S5.3.4, which deals with the test setup for the dynamic test. S5.1 contains a specification that all tests, except the dynamic test (S5.3) and the backset for a specific type of head restraint not attached to the seat (S5.2.3), be performed at design position.

We are also making two technical clarifications related to seat setup. S5.3.4 previously contained specification for the seat cushion adjustment for the dynamic test. This has been brought forward to S5 because it is relevant to the static testing as well. Finally, S5.3.4 specified that seat cushion and seat back adjustment be made "without using any controls that move the entire seat." This prohibition is unnecessary and inconsistent with S5, which does not make this limitation.

### D. Clarification of Removability Requirement

The final rule provided that head restraints "must not be removable without a deliberate action distinct from

any act necessary for adjustment" (S4.5). Several petitioners requested clarification of this provision.

The Alliance stated that the rule is ambiguous for two adjustment/removal control scenarios. First, it stated that it believes that a button that would be pushed to an initial adjustment position to adjust head restraint height and which then must be pushed further to a more depressed position to permit removal of the head restraint would comply with the requirement of providing a "deliberate action distinct from any act necessary for adjustment." The Alliance requested confirmation that a single actuating device for adjustment and also for head restraint removal would comply with the standard when there are two distinctive positions for setting of the actuating device to perform the different operations of head restraint adjustment and head restraint removal.

Second, the Alliance stated that, in addition, its members are unsure whether the new limits on actions to remove head restraints would apply to current head restraints that have a control button that must be pushed to lower the head restraint, but not to raise it to a higher adjusted position. It stated that to adjust the head restraint higher, the head restraint is simply pulled upward. The Alliance stated that it believes that the combined action of pushing the same button used to adjust the head restraint down while pulling the head restraint up would constitute a "deliberate" action distinct from any act necessary for adjustment. It noted that the agency's CTP includes a statement that pushing the same button to adjust height and to remove the restraint is not permitted. The Alliance stated that it disagrees with this interpretation and stated that it is not consistent with ECE 17.

DaimlerChrysler and Johnson Controls also raised the same concern as the latter one made by the Alliance. DaimlerChrysler suggested that the language be reformulated to read: "The head restraint must not be removable without a deliberate action distinct from any act necessary for upward adjustment."

After considering the petitions for reconsideration, we have decided to adopt the language suggested by DaimlerChrysler. The purpose of this provision was to prevent head restraints from accidental removal when being adjusted. This is a potential problem when the head restraint is being adjusted in an upward direction but not a downward direction.

As to the Alliance's question concerning whether a head restraint

<sup>37</sup> Krafft, M., Kullgren, A., Ydenius, A., and Tingvall, C. (2002) Influence of Crash Pulse Characteristics on Whiplash Associated Disorders in Rear Impacts—Crash Recording in Real-Life Impacts, Traffic Injury Prevention, Vol. 3 (2), pp 141–149.

<sup>38</sup> "Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule."

design with a push button that would be pushed to an initial adjustment position to adjust head restraint height and which would be pushed further to a more depressed position to permit removal of the head restraint would comply with the requirement regarding providing a deliberate action distinct from any act necessary for adjustment, the answer is no. This assumes, consistent with the language we are adopting that was suggested by DaimlerChrysler, that the button would permit adjustment in the upward position.

As we understand the design at issue, the action required for adjustment and the action required for removal would be pushing the same button. The fact that the button would need to be pushed further for one scenario than the other would not be sufficient to make it a distinct deliberate action. However, pulling or twisting that same button would constitute a distinct action.

Further, we are aware of designs where the head restraint locks for both upward and downward movement and a single button is used to release the head restraint for adjustment in either direction. Under the new language that same button, activated in the same way, could not be used to release the head restraint for complete removal.

#### *E. Height Requirement*

Under the final rule, front seat head restraints must be able to achieve a height of at least 800 mm, and front seat and optionally provided rear seat head restraints must not be adjustable to positions lower than 750 mm. Height is defined as the distance from the H-point measured parallel to the torso reference line defined by the SAE J826 manikin.

As discussed earlier, the agency's decision to change seat back angle from 25 degrees to manufacturer design angle, as part of its response to petitions concerning the backset requirement, has a small impact on the height requirement. Under the final rule, the same specified seat back angle is used for measuring backset and height. In order to maintain this, we are specifying manufacturer design angle instead of 25 degrees for both requirements. This enables both measurements to be taken from the same manikin installation. In addition, we are not aware of any reason why different seat back angles would be used for the two requirements.

In the final rule preamble, we stated that there is a decrease in measured height of 2 to 3 mm for each degree the seat back is more upright. Because the fleet-weighted front seat back design angle is 23.5 degrees, the decrease in measured height will

typically be about 3 to 4.5 mm. This means that, on average, head restraints will need to be 3 to 4.5 mm taller for front seats as a result of this change. Most rear seat backs are not adjustable, so there is effectively no change in the averaged required height.

DaimlerChrysler petitioned the agency to add what it referred to as a "13 mm acceptance tolerance for audit purposes" to the height limit. This would mean reducing the height limit for front seat head restraints to 787 mm and rear seat head restraint to 737 mm.<sup>39</sup> That company indicated that such a provision would make the FMVSS No. 202a requirement more similar to ECE 17.

Johnson Controls requested that the current procedure for measurement of head restraint height, using SgRP, be retained. It stated that it believes it is inappropriate to utilize an H-point reference, which introduces more variation into the determination of head restraint height than exists today using SgRP.

Johnson Controls also addressed the issue of seat cushion adjustment. That petitioner stated that there is no reference in the final rule for seat cushion adjustment, but that this is covered in the CTP, i.e., highest adjustment position of the seat cushion. Johnson Controls stated that using the highest position of the cushion to determine compliance with head restraint height requirements utilizes a position occupied by smaller occupants to establish conformance with a height requirement intended to address larger occupants.

In a July 20, 2005, meeting with NHTSA, Ford requested that the agency use SgRP instead of H-point in measuring height.<sup>40</sup> The previous version of FMVSS No. 202 used SgRP, as does ECE 17.

The Alliance noted that the regulatory text in S5.2.1 states that the height should be measured using the scale incorporated in the SAE J826 manikin. It stated its belief that the agency's intent was to specify the headroom probe.

The Alliance also stated that it believes there is inconsistency between the seat back positions specified in S5.1 and those indicated in S5.2.1 and S5.2.3. S5.1 refers to an exception to the seat back angle specification that is then specified in S5.2.3.9 (backset

measurement). However, S5.2.1 (height measurement) also has an exception to the seat back angle.

As to the issue of measuring height from H-point or SgRP, the agency addressed this subject in the preambles to the NPRM and final rule. Use of H-point measures the actual vehicle as manufactured and hence the actual protection provided to vehicle occupants. By contrast, the SgRP is a theoretical design point in the vehicle and does not necessarily represent the actual vehicle build. Therefore, we continue to believe that use of H-point is a better approach and decline to change to SgRP.

As to seat cushion adjustment, it is the agency's goal to ensure that the specified height requirement is met with the cushion in the worst case position, i.e., regardless of how the cushion is adjusted, the height limit must be met. As to Johnson Controls' argument that this results in a requirement that utilizes a position occupied by smaller occupants to establish conformance with a height requirement intended to address larger occupants, we agree that it is not unreasonable to think that shorter occupants might be biased toward adjusting the entire seat with respect to the vehicle interior. However, we do not have any data showing that different size occupants routinely adjust seat cushion orientation in light of their own height or to believe that only small statured occupants would ride with seat cushions adjusted to yield a higher height with respect to the seat back.

We note that when the agency performed its study of backset measurement variability, discussed earlier, we also assessed height measurement variability. In general, the height variability is similar to that of backset, but we do not see a reduction in variance by taking the average of three measurements. We are including the results of that study in the Technical Analysis<sup>41</sup> discussed earlier.

While we have considered DaimlerChrysler's request that we reduce the specified height requirements by 13 mm, we decline to make that change. That company did not submit data demonstrating difficulties in the meeting the 800 mm height requirement for front seats or the 750 mm requirement for rear seats. As discussed earlier, manufacturers routinely design their vehicles with a compliance margin to meet regulatory requirements. Such margins are intended to address both measurement

<sup>39</sup> We note that when NHTSA includes tolerances in the safety standards, vehicles or equipment must meet the specified requirements at all points within the specified tolerances. Thus, tolerances within the safety standards are not "acceptance tolerances for audit purposes."

<sup>40</sup> Docket No. NHTSA-2004-19807-20.

<sup>41</sup> "Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule."

variability and build variability. We are not aware of any issues concerning undue measurement variability with respect to the height requirement. We also note that, unlike the backset limit, small differences in height do not raise comfort issues. We therefore decline to change the requirement.

The Alliance is correct that the scale referred to in S5.2.1 is more specifically the headroom probe. This is a more appropriate designation, and we are revising the language accordingly. We also note that the probe by itself cannot be used to directly measure height, but must be used in conjunction with, for example, a carpenter's square.

We also agree with the Alliance that there is inconsistency in S5.1, since it refers to an exception to the seat back angle used for measurement in S5.2.3 but not the exception stated in S5.2.1. We are therefore adding to S5.1 a reference to S5.2.1 indicating that this section also has an exception to the general seat back angle provision.

#### *F. Gaps Between Head Restraint and Seat Back*

DaimlerChrysler stated that it is concerned that the test method specified for the gap requirement could disallow the "shingled" or "saddle" design for head restraints. That company stated that it knows of no way to meet the 60 mm gap requirement in S4.2.4 for shingled or saddle type retractable head restraints, when using the spherical gap measurement procedure in S5.2.4 for gaps between the head restraint and seat. DaimlerChrysler stated that these designs currently are approved to ECE R17 where a linear gap measurement procedure is used. It petitioned that FMVSS No. 202a be harmonized with the ECE R17 procedure for this specific issue. The Alliance stated that further clarification is necessary for the gap measurement.

After considering the DaimlerChrysler and Alliance petitions, we have decided to specify that the gap requirement must be met when the gap is measured either by the existing current FMVSS No. 202a procedure using a sphere or one based on the ECE 17 measurement methodology. We are not aware of any data showing benefits to one methodology over the other.

Also, we are adding a new Figure 4 that we believe will help clarify the requirement when using the sphere.

#### *G. Backset and Height Retention (Lock) Tests*

FMVSS No. 202a includes test requirements to help ensure that a head restraint that locks in position will maintain this position when loaded

downward (S4.2.6 and S5.2.6) and rearward (S4.2.7 and S5.2.7).

For the height retention test, the seat back is initially braced to prevent it from moving. A 50 N downward force is applied with the round surface of a 165 mm diameter cylinder to establish an initial reference position. During the application of this load, the head restraint is required to not move more than 25 mm. This is necessary to prevent head restraints with very weak locks from displacing to their down position and passing the remainder of the test. The downward load is then increased to 500 N and is held for 5 seconds. The load is then reduced back to 50 N, and the position of the head form is checked to assure that it did not have a change from its reference position of more than 13 mm.

The backset retention test is somewhat more complicated than the height retention test because it is performed in the midst of the displacement test. First, the displaced torso reference angle is achieved by a 373 Nm moment applied through the back pan. This establishes the displaced torso reference line used to test for head restraint displacement beyond 102 mm. Then a 37 Nm moment is applied with the 165 mm spherical head form to establish an initial reference position for the locking test. During the establishment of this initial reference position the loading device is not permitted to move more than 25 mm. This is necessary to prevent head restraints with very weak locks from displacing to a physical stop and passing the remainder of the test in that position.

The moment is then increased to 373 Nm and maintained at that level for 5 seconds. It is during the application of this 373 Nm moment that the head form must not displace more than 102 mm beyond the displaced torso reference line. The moment is then reduced to the 37 Nm reference. The head form must return to within 13 mm of the initial reference position to verify that the locking mechanism is meeting the performance requirement.

We note that in the test procedure outlined above, the bracing of the seat back was introduced in the December 2004 final rule. We stated in the final rule preamble that if seat characteristics were not accounted for by bracing the seat "the horizontal displacement may be larger because of those characteristics." 69 FR at 74867. The return to position limit was also increased, relative to the NPRM, from 10 mm to 13 mm for the same reason.

Petitioners raised several issues concerning the backset and height

retention tests. In the sections which follow, we will address each issue and provide our response.

#### *1. Zero-Out Load*

Several petitioners, including the Alliance, DaimlerChrysler, Keiper, and Johnson Controls, asked that the agency make a slight modification to the test procedures described above. The modification involves the loading sequence. They recommended that instead of returning to the reference loads of 50 N or 37 Nm after application of the peak load, that the load be reduced to zero and then increased to the reference loads. They believe this will alleviate much of the permanent set associated with upholstery and foam in the head restraint that is not a true measure of structural displacement.

Keiper submitted test data from testing of a Mercedes Benz C-Class seat. Under the current procedure the backset retention displacement range was 15 to 18 mm, which is outside the 13 mm limit. However, after unloading the head restraint and reloading to the reference load, the displacement was 2 to 4 mm. Keiper did not indicate whether the seat back was braced. DaimlerChrysler submitted data that is subject to a claim of confidentiality.

In order to evaluate this issue, the agency conducted a series of tests on eight different make/models of vehicles. The agency performed height retention and backset retention tests according to the modified procedure suggested by the petitioners. In addition, as part of evaluating the appropriate procedure for these tests, the study included tests with the seat back braced and not braced. The details of the testing are included the Technical Analysis<sup>42</sup> noted earlier.

After considering the arguments and data submitted by manufacturers and the results of our testing, we have decided to grant the petitioners' requests in this area. Based on the testing performed to the modified test procedure, we conclude that completely removing the load on the head restraint before returning to the reference load improves the test results in a statistically significant way.

#### *2. Five Second Hold Time*

The Alliance petitioned the agency to specify a peak load hold time of 5 to 6 seconds and have the measurement taken during the hold period. The regulation currently states the hold time will be at least 5 seconds. The Alliance argued that the hold times for this and

<sup>42</sup> Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule."

other aspects of the loading procedure may affect the results.

After considering this issue, we believe that the request to modify the hold time for the maximum load values (S5.2.6(c), S5.2.7(a)(6) and S5.2.7(b)) from a minimum of 5 seconds to 5.5 ± 0.5 seconds has merit. We also believe that there should be a tolerance on the hold times for the initial application of the reference loads (S5.2.6.(b)(2) and S5.2.7(a)(5)) and on the times after which the displacement measurement should be made (S5.2.6(e) and S5.2.7(a)(8)). We are therefore making changes in the regulatory text to reflect these decisions.

### 3. Request for Elimination of Vertical Height Retention Test

Johnson Controls argued that the vertical height retention test is not justified and should be eliminated. It believes that the agency's justification for the 500 N load was derived from the force component of lateral (rearward) displacement. Johnson Controls stated that although its customers prescribe loads that a head restraint must resist vertically, these are to account for the loading a person might put on the head restraint as they enter or exit the vehicle and these loads are much less than 500 N.

In explaining the height retention force of 500 N in the preambles to the NPRM and final rule, we stated that it is representative of the peak loads likely to be encountered in moderate to severe rear impacts. We noted that the average upper neck shear forces in a Hybrid III 50th percentile male dummy in FMVSS No. 301 rear impacts was about 350 N. We surmised that this shear load was representative of the loading on the head restraint although we did not do an analysis to determine the direction of the loading.

Since the final rule was published, we have made a more thorough examination of head restraint loading based on the dummy neck loads measured in rear impact crash and sled tests. We have presented this analysis in a technical report.<sup>43</sup> The test type and dummy size that we have the most data for is the 50th percentile male dummy in a FMVSS No. 301 impact. For 23 cases, the average downward force was 539 N. We believe these and the other data presented in the technical report show the need for and appropriateness of the 500 N vertical load. We therefore

decline to adopt the request of Johnson Controls.

### 4. Pre-Load Displacement Limit

The Alliance stated there are some mechanical active head restraint designs that cannot meet the 25 mm pre-load displacement limit during the backset retention test (S4.2.7 and S5.2.7). It petitioned the agency to increase this limit to 35 mm or remove it completely. It argued that this requirement places a limitation on manufacturers' ability to provide active head restraints.

DaimlerChrysler stated that it has a rear seat head restraint design that rotates without locking, for occupant comfort. It called these "inclinable designs" and said that they displace during the preload and cannot meet the 25 mm limit on displacement during the preload of the height retention test (S4.2.6 and S5.2.6). It petitioned the agency to increase the preload limit for these types of head restraints to 50 mm.

As discussed below, we have decided to deny the requests of both petitioners. However, to help accommodate active head restraint systems, we are making a change in the test procedure to permit active systems to be fixed in their undeployed position during the position retention testing.

The Alliance stated that there are advanced active head restraints that, due to their mechanical nature, displace more than 25 mm during the preload of the backset retention test. Therefore, it requested a 35 mm limit.

We note that the agency anticipated that there may be advanced designs which, by their active nature, are unable to pass the static test requirements in their undeployed positions. This is why the dynamic compliance option was provided.

However, while the dynamic compliance option is specifically in place for active systems, it has never been our intention to exclude active systems from certifying through the static option. However, the agency has emphasized that such static compliance must be in the undeployed condition. See 69 FR 74854.

Based on our desire to not exclude the possibility of active systems being certified to the static option, we have decided to permit active systems to be fixed in their undeployed position during the retention tests. We are including a specific manufacturer option to this effect in FMVSS No. 202a.

We believe that the concern raised by the Alliance is brought about by the way active systems function and that the option to fix them in their undeployed position during the retention tests will resolve that concern. Therefore, we are

not changing the 25 mm limit to 35 mm as requested by that petitioner.

DaimlerChrysler requested an increase of the preload displacement limit in the height retention test from 25 mm to 50 mm because of a design that rotates for comfort. However, head restraint users will not know whether adjustment positions are for comfort or for improved whiplash protection. Moreover, regardless of whether a manufacturer intends a head restraint position to be for comfort or to provide improved whiplash protection, there are safety benefits for having the adjustment position selected by the user lock in place. The head restraint design, as described, appears to have non-locking positions. The agency included the preload displacement limit to address such systems. We are therefore not adopting the change recommended by DaimlerChrysler.

### 5. Seat Back Bracing

As discussed above, as part of the agency's additional testing and evaluation concerning the appropriate procedure for the height retention and backset retention tests, it included tests with the seat back braced and not braced.

The agency indicated in the preamble to the final rule that it intended to alter the position retention tests to allow the seat back frame to be braced. 69 FR at 74867. However, a provision to this effect was not included in the regulatory text.

We note that some concerns were expressed in the context of the development of a GTR that bracing the seat back during these tests does not provide a load path that would be seen in real world use.

As part of our additional testing, we studied the bracing of the seat back. The discussion below refers to testing that incorporates a zero load in the loading sequence. The testing showed that although there was a small reduction in the average displacement value for the braced condition when the loading was returned to the reference value, this difference was not statistically significant. However, we did find that bracing the seat back reduced the peak displacement by an average of about 18.5 mm and that this was significant at a 90% level of confidence. It was not our intention to reduce the stringency of this requirement by bracing the seat back.

As part of reevaluating the test procedure for these tests in response to petitions for reconsideration, we have decided that the seat backs should not be braced for these tests. We are also making this change as part of

<sup>43</sup> This analysis has been presented to the Informal Working Group on Head Restraints in connection with the ongoing development of a GTR and can be found at <http://www.uncece.org/trans/doc/2005/wp29grsp/HR-02-08e.pdf>.

maintaining consistency with changes we are making in the test procedure for the energy absorption test, which are discussed below. There is no need to change the regulatory text, given that the agency omitted adding a specification for bracing in the final rule.

#### *H. Energy Absorption Test and Seat Back Bracing*

Under the energy absorption test requirement (S4.2.5 and S5.2.5), a 6.8 kg mass strikes the head restraint at 24.1 km/h, and the deceleration of the impactor must not be more than 80g.

The Alliance stated that it was concerned that S5.2.5 of the regulatory text specifies that this test is to be performed with the seat back “rigidly fixed” without any further clarification of how it is fixed. It stated that the methodology as to how the seat back is fixed may affect the test results. It requested there be no seat back bracing.

The Alliance also stated that S4.2.5 and S5.2.5 do not specify a seat back angle for the test. It stated that it believes that it is the agency’s intent to perform the tests consistent with ECE 17, i.e., with the seat back at design position. It requested that this be explicitly stated in the regulation.

The agency has performed an evaluation of various energy absorption test methods. This evaluation is included in the Technical Analysis previously cited.<sup>44</sup>

In testing performed by the agency using a linear impactor, bracing the seat back resulted in a slightly more severe (about 10%) outcome. However, this difference was not statistically significant. Also, removal of the seat back bracing will simplify the test procedure. We have therefore decided to make the change requested by the Alliance.

We do not agree with the Alliance that FMVSS No. 202a was unclear about the seat back angle to be used in this test. Under the final rule, S5.1 stated that, except in S5.2.3, the seat back angle must be the position closest to 25 degrees.

However, given that we are changing from 25 degree seat back angle to design seat back angle for the backset and height requirements, we believe it is appropriate for purposes of consistency to also use design seat back angle for this test. Accordingly, we are granting the Alliance’s request to that effect.

#### *I. Head Restraint Clearance*

In order to accommodate vehicles with low rooflines, FMVSS No. 202a permits a lower minimum height for head restraints for front outboard-designated seating positions to allow a maximum of 25 mm of vertical clear space between the top of the front head restraint and the roofline. It similarly permits a lower minimum height for rear outboard seating positions equipped with optional head restraints to allow a maximum of 25 mm of vertical clear space between the top of the rear head restraint and the roofline or the backlight.

In petitioning for reconsideration, the Alliance expressed concern that the agency had not defined the term “roofline.” It stated its belief that the agency intended to measure clearance to the inside of the headliner, consistent with ECE 17 practice. The Alliance argued that without clearance to the inside of the headliner, the head restraints would damage the energy absorbing capability of the headliner. The Alliance requested that the agency replace the term “roofline” with “interior surface of the roof” to clarify that the intent is the same as ECE 17, or to define the term “roofline” as the interior surface of the roof of the vehicle.

The Alliance argued that for convertibles, the clearance to rear seat head restraint clearance needs to be 50 mm to allow for articulation of the folding top mechanism.

DaimlerChrysler made similar requests in its petition for reconsideration. However, in a June 8, 2005 with NHTSA, DaimlerChrysler requested that the rear seat clearance for convertibles be 10 mm during the folding phase of a convertible roof motion.<sup>45</sup> It showed a diagram of a vehicle design that had a 13 mm clearance during folding of the roof. This same design had 80 mm of clearance when the roof was in place.

After considering the petitions for reconsideration, we have decided to adopt changes along the lines suggested by the Alliance. As to the definition of roofline, it was always the agency’s intention to measure the roofline/backlight clearance from the interior surface of the vehicle rather than from the exterior surface. The latter would be unnecessarily complex and have no relevance to the head restraint dimensions. Accordingly, in the relevant portions of regulatory text we are replacing the term “roofline” with “interior surface of the vehicle at the

roofline,” and “backlight” with “interior surface of the backlight.”

On the issue of clearance for convertibles, we note that there are differences in the relief requested by the Alliance and the relief requested by DaimlerChrysler in its later request. The Alliance requested the agency to increase the allowed gap with the roof in place from 25 to 50 mm, and DaimlerChrysler requested that the agency provide 10 mm of clearance as the roof folds.

DaimlerChrysler presented a design with about 10 mm clearance when folding and 80 mm when in place. One might then conclude that, at a minimum, if the head restraint had essentially no clearance when the roof was folding, the in-place clearance would need to be 70 mm for this design.

The agency does not have independent data on convertible geometry. However, we believe that the argument that relief is needed appears reasonable. We have decided to grant the relief requested by the Alliance. We are not granting the later request made by DaimlerChrysler. That request would result in a greater reduction in stringency. We do not believe that a single design is sufficient to demonstrate a need for greater relief.

#### *J. Width of Head Restraints for Certain Seats*

Johnson Controls petitioned for reconsideration of the retention (from the earlier version of FMVSS No. 202) of the 254 mm width requirement for outboard designated seating positions for front rows with three designated seating positions. That company stated that it believes that the head restraint width requirement for these designated seating positions should be 170 mm, the same width as required by ECE 17 standard.

Johnson Controls argued that the distinction between bench and bucket seats that drove the difference in width requirements no longer exists. It also stated that the added width is not subject to any performance requirements.

The petitioner stated that, in support of retaining the requirement, the agency said that front outboard non-bench seats have a defined contour that better prescribe occupant seating position relative to the head restraint than bench seats, occupants seated on bench seats are freer than occupants of single seats to position themselves so that they are not directly in front of head restraint, and a bench head restraint needs to be wider to assure that the head restraint will be behind the occupant in event of a crash.

<sup>44</sup> “Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule.”

<sup>45</sup> Docket No. NHTSA–2004–19807–13



Johnson Controls argued that, based on a survey it conducted, less than 1.4 percent of front seats offered on the market today are bench seats where front outboard seating positions have no contour. It also argued that extra width is typically trim and foam which has no demonstrated ability to achieve goals of prevent neck hyperextension as well as smaller rotations of the neck.

After considering the request of Johnson Controls, we have decided to not make the change requested. We note that the agency addressed this issue in both the NPRM and final rule preambles.

As we discussed in the final rule preamble, the 254 mm width requirement at issue has been effect since January 1, 1969. We stated that we were not aware of any evidence showing that the present level of protection should be reduced. We stated that we decided to maintain wider head restraints for front bench-type seats because wider head restraints tend to better reduce relative head-to-torso motion in off-axis impacts.

After considering Johnson Controls' petition, our view remains the same. Johnson Controls did not provide evidence that wider head restraints do not provide benefits or that they do not better reduce relative head-to-torso motion in off-axis impacts.

DaimlerChrysler requested clarification concerning how this requirement applies to a three-passenger first row option with a walkway between the driver and the two-passenger seat to the driver's side. That company stated that it interprets the two-passenger seat to have two outboard seating positions by definition so that the width requirements for the head restraints is 170 mm and not the 254 mm requirement.

DaimlerChrysler's suggested interpretation is incorrect. S4.2.2 specifies that the lateral width of the head restraint for front outboard designated seating positions in a vehicle with a front center designated seating position must be not less than 254 mm. The term "outboard designated seating position" is defined at 49 CFR Part 571, and the inboard seating position on the two-passenger seat is not within that definition. Since the vehicle has a front center designated seating position, the two front outboard designated seating positions must have a width of not less than 254 mm.

#### *K. Option To Comply With ECE 17*

The Alliance stated that it appreciates the option in FMVSS No. 202 that permits compliance with ECE R17 until September 1, 2008 as an option. The

Alliance stated, however, that the agency has "no test procedures for its contractors to use in auditing compliance to an ECE regulation."

The Alliance recommended that NHTSA publish a policy statement that, for purposes of this option, the Technical Service organization type approval granted for the applicable system to the vehicle manufacturer who selects this option can be used for demonstrating compliance to FMVSS 202. It stated that, as an alternative, the agency would have to develop and publish an official and detailed Test Procedure for the ECE R17 requirements itemized in FMVSS No. 202.

We note that, given the relatively short duration of this option, NHTSA does not plan to develop a Laboratory Test Procedure for this option. We also decline to adopt the policy statement suggested by the Alliance.

Under the Safety Act, vehicle manufacturers are required to certify that their vehicles comply with all applicable Federal motor vehicle safety standards. They do not certify compliance with Laboratory Test Procedures.

NHTSA's Office of Vehicle Safety Compliance provides a CTP for the use of its contractor laboratories. The agency includes the following note at the beginning of these procedures:

The OVSC Test Procedures are prepared for the limited purpose of use by independent laboratories under contract to conduct compliance tests for the OVSC. The TPs are not rules, regulations or NHTSA interpretations regarding the FMVSS. The TPs are not intended to limit the requirements of the applicable FMVSS(s). In addition the TPs may be modified by the OVSC at any time without notice, and the COTR may direct or authorize contractors to deviate from these procedures, as long as the tests are performed in a manner consistent with the FMVSS itself and within the scope of the contract. TPs may not be relied upon to create any right or benefit in any person. Therefore, compliance of a vehicle or item of motor vehicle equipment is not guaranteed if the manufacturer limits its certification tests to those described in the TP.

A CTP does not need to be in place in order for a manufacturer to certify compliance with a particular standard or option within a standard. Also, a CTP does not need to be in place in order for the agency to enforce a particular standard or selected option within a standard. It is therefore unnecessary for the agency to adopt either of the alternatives suggested by the Alliance.

#### *L. Temperature and Humidity Specifications*

The Alliance stated that FMVSS No. 202a should have temperature and

humidity specifications in order to provide an objective test procedure. That organization stated that it could not find any humidity specifications, even though these environmental limits are included in most FMVSS test procedures.

The Alliance stated that the OVSC Laboratory Test Procedure specifies a temperature range of 19 to 26 degrees C, which the Alliance said is a much broader range than vehicle and seat manufacturer's test facilities experience. The Alliance stated that because the flexibility of seating foam and trim varies with temperature, it recommends adopting the same limits that have been used for many years for FMVSS No. 208 tests using the Hybrid III dummy. It argued that these temperature and humidity limits should be applied to dynamic tests, quasi-static force tests, and static measurements. The Alliance did not provide data concerning the extent to which seating foam may vary temperature or humidity.

In responding to the Alliance's request, we note that we do not believe that the quasi-static force tests and static measurements included in FMVSS No. 202a are comparable to the FMVSS No. 208 tests using the Hybrid III dummy. The agency includes certain environmental limits in FMVSS No. 208 related to the Hybrid III dummy because the test dummy itself is sensitive to environmental conditions. However, there is no reason to believe that the HRMD is sensitive to environmental conditions because it is a purely mechanical measuring tool. Moreover, we believe that head restraints should provide protection in the wide range of conditions experienced in the real world.

At the same time, we recognize that the inclusion of a temperature range improves the objectivity of the standard, particularly given the Alliance's argument that the flexibility of seating foam may vary with temperature. Without a specification, for example, it is not clear whether the agency might conduct tests at very low winter temperatures or very hot summer temperatures.

After considering this issue, we have decided to specify a temperature range of 18 to 28 degrees C (64.4 to 82.4 degrees F). This is representative of the interior temperatures at which vehicles are routinely operated. We note that the range is slightly wider than that included in the current version of the Laboratory Test Procedure. The Laboratory Test Procedure is not the same as the standard, and it is not uncommon for the agency to include narrower conditions in the Laboratory

Test Procedure than those specified in the standard.

We are not specifying conditions related to humidity. No information has been provided showing a need for such specifications, and vehicles are routinely operated at wide ranges of humidity.

Finally we are adding a test condition to the dynamic test which provides that the stability test temperature of the test dummy is at any temperature level between 69 degrees F and 72 degrees F, inclusive. This is the same condition as specified for FMVSS No. 208.

#### *M. Owner's Manual Requirements*

The Alliance petitioned the agency to modify requirements for the owner's manual. First, that organization raised concerns about a requirement in S4.7.1 that the owner's manual for each vehicle must emphasize that all occupants, including the driver, should not operate a vehicle or sit in a vehicle's seat until the head restraints are placed in their proper positions in order to minimize the risk of severe injury in the event of a crash. The Alliance argued that this requirement overstates the importance of head restraint adjustment.

The Alliance stated that while proper adjustment of head restraints is desirable to improve their effectiveness in reducing whiplash injuries—Abbreviate Injury Scale (AIS) 1 injuries—the agency has not presented data indicating that proper positioning minimizes the risk of severe injuries. That organization stated that severe injuries are generally considered to be injuries of AIS 3 or greater. It requested that the agency revise S4.7.1 to state that the owner's manual for each vehicle must emphasize the importance of properly adjusting head restraints to reduce the risk of injury.

In considering the Alliance's request in this area, we note that while the agency's benefits analysis only accounts for whiplash (AIS 1 neck) injury, we believe that there is a protective effect against high-order neck injuries in higher speed rear impacts. However, we agree that based on the frequency of injury the primary benefits of proper positioning head restraints are in AIS 1 injuries. We also believe that most consumers are not aware of the differences between different levels of AIS injuries or the terminology used to describe such injuries.

In light of the most frequent injuries addressed by proper positioning of head restraints—AIS 1 injuries—and the terminology ordinarily used to describe such injuries, we are removing the term "severe" from S4.7.1 and replacing it with the word "neck." We believe that

the addition of the word "neck" will help draw occupants' attention to the importance of proper adjustment of head restraints in much the same way as the word "severe," while avoiding inconsistent use of a term. We are not otherwise shortening the language, since we believe that it is important for all occupants, including the driver, to not operate a vehicle or sit in a vehicle's seat until the head restraints are placed in their proper positions in order to minimize the risk of neck injury.

The Alliance also expressed concerns about requirements related to instructions for head restraint adjustment. S4.7.2(d) requires each owner's manual to describe in an easily understandable format the adjustment of the head restraints and/or seat back to achieve appropriate head restraint position relative to the occupant's head. This discussion must include, at a minimum, accurate information on the following topics:

(1) A presentation and explanation of the main components of the vehicle's head restraints.

(2) The basic requirements for proper head restraint operation, including an explanation of the actions that may affect the proper functioning of the head restraints.

(3) The basic requirements for proper positioning of a head restraint in relation to an occupant's head position, including information regarding the proper positioning of the center of gravity of an occupant's head in relation to the head restraint.

The Alliance argued that the intent of item (2) is unclear. It stated that except for adjustment, and possibly removal and reinstallation, customers do not expect any "basic requirements" to "operate" head restraints. That organization also stated that adjustment, removal and reinstallation are covered elsewhere. The Alliance asked whether this provision is intended to address head restraints that fold or retract either automatically or manually.

In response, we note that although the issues of adjustment, removal and reinstallation are covered by other provisions, a head restraint may have other modes of operation. Folding and retracting are examples of these modes. This provision is intended to ensure that users have clear information on all the necessary requirements for proper operation.

The Alliance also argued that item (3) appears to be inconsistent with S4.7.2(d) because most customers do not understand the center of gravity of an occupant's head. That organization stated that it is not practicable to describe in an easily understandable

format the adjustment of the head restraint in relation to the center of gravity of the occupant's head. It suggested that (3) simply state the basic requirements for proper positioning of a head restraint.

We disagree with the Alliance that reference to the head restraint adjustment with respect to the head CG is inconsistent with easily understandable instructions. However, we believe it is appropriate to permit manufacturers the flexibility to provide instructions which reference other anatomical landmarks such as the tops of the ears, eyebrow, etc. We are therefore revising this provision to that effect.

#### *N. Nature of Standard*

Syson-Hille stated that while it seems reasonable to upgrade FMVSS 202, it believes that the agency is failing to appropriately address the whiplash issue. It argued that as long as seats continue to collapse in rear impacts, head restraints will continue to be ineffective. Syson-Hille stated that until the seat "systems" problem is addressed, neither the whiplash problem, nor the failure of seats to appropriately manage rear collision energy will be resolved. It stated that NHTSA should combine FMVSS No. 202 and No. 207 to form a seat "systems" test.

In response to this request, we note that we stated the following in the final rule preamble:

In the future stages of our efforts to improve occupant protection in rear impacts,<sup>46</sup> NHTSA intends to evaluate the performance of head restraints and seat backs as a single system to protect occupants, just as they work in the real world, instead of evaluating their performance separately as individual components. Accordingly, in making our decisions about the upgraded requirements for head restraints in this final rule, we sought, e.g., through upgrading our dynamic test procedure option, to make those requirements consistent with the ultimate goal of adopting a method of comprehensively evaluating the seating system.

Syson-Hille's request that we develop a seat systems test that considers the spectrum of rear impact severity is not within the scope of this rulemaking. We therefore decline to adopt its request. We note that the dynamic compliance option does provide a system test at an impact speed where whiplash injury is likely. In addition, as indicated in the paragraph from the final rule preamble cited above, the agency plans to

<sup>46</sup> As part of this effort, NHTSA issued a final rule upgrading the performance of vehicle fuel systems in rear impacts. (68 FR 67068, December 1, 2003).

continue its efforts to improve occupant protection in rear impacts, including considering methods of comprehensively evaluating the seating system. For now, for reasons discussed in this document, the NPRM and final rule preambles, and the agency's regulatory impact analyses, we believe the upgraded head restraint standard will make a significant contribution toward reducing whiplash injuries.

#### *O. Leadtime*

Under the final rule, the upgraded standard becomes mandatory for all vehicles manufactured on or after September 1, 2008. However, as indicated above, the agency previously extended the compliance date for the rear seat requirements to September 1, 2010.

The petitioners' request for additional leadtime was not limited to the rear seat. The Alliance stated that while the date set forth in the final rule appears to provide more than three years leadtime, it is concerned that that leadtime will be subsumed during the period petitions for reconsideration are before the agency.

The Alliance also stated that while it considered the final rule and potential issues for reconsideration, the agency published a test procedure previously unavailable. (This was apparently referring to the OVSC Laboratory Test Procedure or CTP.) The Alliance also claimed that other test procedures necessary to complete the final rule have not been made public, significantly limiting manufacturers' ability to assess the final rule and its impact on their respective vehicle fleets. The Alliance argued that test procedures are an integral part of the rulemaking process and must be available to the public during the entire rulemaking process beginning with the NPRM.

The Alliance stated that if the issues resolved in its petition were not resolved by September 2005, its members would no longer have adequate leadtime for some required changes. It stated that minor adjustments to backset can be made relatively quickly, but other changes are much more time-consuming. We note that one item the Alliance cited, development of mechanisms that allow conversion of passenger compartments to cargo areas, relates to rear seats. The Alliance also stated that developing and incorporating new active head restraint mechanisms requires a long leadtime.

The Alliance also stated that certain vehicle models that are past final design release will continue in production beyond September 1, 2008, but would require extensive changes to comply

with FMVSS No. 202a. It requested that in order to permit manufacturers to implement the required changes with the start of a new model cycle rather than at the end of the current model design, NHTSA should modify the compliance date to require 80 percent compliance with FMVSS No. 202a for the first year and 100 percent beginning the second year, with carry-forward credits.

Ford also expressed concern about the amount of time that it anticipated would be taken to address issues raised in the petitions for reconsideration. It stated that it cannot begin to make vehicle design changes necessary to comply with the rule, especially those involving retractable head restraints that raise significant safety issues, until these issues have all been resolved. Ford stated that it believes that the three year leadtime should not begin to run until all petitions have been resolved and all test requirements have been finalized. Like the Alliance, DaimlerChrysler requested an 80 percent/100 percent phase-in, with carry-forward credits.

In responding to the petitions for reconsideration concerning leadtime, we begin by noting two things. First, under 49 CFR 553.35, the filing of a petition for reconsideration does not stay the effectiveness of the rule unless the Administrator so provides. Accordingly, once a final rule is published in the **Federal Register**, manufacturers have the responsibility to take steps to comply with that rule as it is issued, including its compliance date, unless and until the agency changes the rule. The agency will not change the compliance date of a rule to account for situations where a manufacturer either simply assumes that its petition for reconsideration will be granted or decides not to take actions to comply with a standard until such time as the agency responds to its petition.

Second, we disagree with the Alliance's apparent argument that CTPs are an integral part of the rulemaking process. They are not. As discussed earlier, vehicle manufacturers are required to certify that their vehicles comply with all applicable Federal motor vehicle safety standards. All necessary test procedures for certification are included in the standards themselves (sometimes by incorporation by reference or citation to other portions of the CFR).

In considering the petitioners' requests for additional leadtime, we note that the agency provided about three and one-half years leadtime in the final rule. Moreover, as a result of our earlier partial response to the petitions, we provided five and one-half years

leadtime for the rear seat requirements. We believe that these requirements, particularly the ones related to non-use positions, represent the most difficult technical challenges.

After considering the petitions, we have decided to provide some additional leadtime for the front seat requirements, primarily in light of the changes made in this final rule. The change in seat back angle, while generally providing greater flexibility with respect to the backset limit, has an impact on the height requirement. This could, in some cases, necessitate design changes. Also, while the various changes made in this document are relatively minor, manufacturers may need to re-test seats in order to ensure that their vehicles comply with the standards.

For the front seat requirements, we have decided to provide one additional year of leadtime and also establish a one-year phase-in with an 80 percent requirement. We are not providing for carry-forward credits. In addition to providing flexibility with respect to any minor design changes that may be needed as a result of the changes made by this final rule, the additional leadtime we are providing also accommodates the concerns identified by manufacturers concerning implementing changes with the start of a new model cycle rather than at the end of the current model design.

As indicated earlier, we previously delayed the compliance date for head restraints voluntarily installed in rear outboard designated seating positions from September 1, 2008 until September 1, 2010. As part of completing our response to the petitions, we have decided to also establish a one-year phase-in with an 80 percent requirement for these vehicles.

As indicated above, we believe that the rear seat requirements, particularly the ones related to non-use positions, represent the most difficult technical challenges. The one-year phase-in will provide additional flexibility in meeting these challenges. This 80 percent requirement applies to the production year beginning on September 1, 2010 and ending August 31, 2011. We note that since the rear seat requirements apply only to vehicles with voluntarily installed rear head restraints, the 80 percent figure is calculated solely with regard to vehicles with rear head restraints.

As with other phase-ins, we are establishing the usual reporting requirements.

### *P. Technical Amendments and Typographical Corrections*

In the section above on the dynamic optional test, specific technical amendments were described. We are also making several technical amendments as a result of our own review of the entire regulatory text. In Part 571.202 we are making the following revisions. We are adding the term GVWR to S2 and S4.1. In S4.1 we are changing the reference to S4.3 and S4.4 to S4.4 and S4.5. For Part 571.202a, in S5.2.7(a)(5) we are changing the reference to S5.2.7(4) to S5.2.7(a)(4).

Also, in a submission dated February 1, 2007, the Alliance requested a technical correction related to the agency's March 2006 rule delaying the date on which manufacturers must comply with the requirements applicable to head restraints voluntarily installed in rear outboard designated seating positions. While the Alliance believed the preamble was clear as to the agency's intent, it expressed concern that the changes made in the regulatory had the effect of delaying some but not all of the requirements for rear head restraints. To ensure clarity, we are making technical amendments to S2.1 and S4.1 to eliminate any doubt that all of the requirements for rear head restraints are delayed.

In addition, typographical errors have been corrected in Part 571.202a. These include elimination of extra spaces, adding an underline and punctuation correction. The following sections are affected: S2.2(a), S2.2(b), S4, S4.2.1(a)(2), S4.3.1, S5.2.5(a), S5.3.5, S5.3.7.1, S5.3.7.2, S5.3.7.3, S5.3.7.5, S5.4(a)(1), S5.4(a)(4).

## **VII. Kongsberg Petition for Rulemaking**

### *A. Summary of Petition*

On November 10, 2005, Kongsberg Automotive submitted a document to NHTSA that it characterized as a petition for reconsideration of the head restraint final rule. However, since this was not submitted within the required timeframe for petitions for reconsideration, our regulations provide that it is treated as a petition submitted under 49 CFR Part 552, rather than a petition for reconsideration.

The majority of arguments from Kongsberg concerning the final rule pertain to issues discussed extensively in our response to the timely petitions for reconsideration. However, in some cases, the relief sought is unique and not requested by others in petitions for reconsideration. After considering these requests carefully, the agency has decided to deny the Kongsberg rulemaking petition. Below we discuss

each of the issues raised by Kongsberg and the agency response.

### *B. Effective Backset*

#### **1. Petition**

The petitioner described the term "effective backset" as the combination of the backset measurement made in FMVSS No. 202a and the head restraint displacement measured during application of the initial reference moment on the head restraint during the backset retention test. The final rule limits on these two requirements are 55 mm for backset and 25 mm for the reference moment displacement. The petitioner requested that the agency replace the backset criterion of 55 mm with an "effective backset" limit of 80 mm. It stated that having separate requirements for backset and initial displacement in the retention test does not drive design changes towards optimization.

#### **2. Agency Response**

The agency has discussed in detail in this document and in the NPRM and final rule preambles and accompanying agency analyses the scientific basis for the backset limit and the expected benefits. We have also discussed the rationale for the backset retention test. Specifically, we have explained that the limit on displacement during the initial application of the reference moment of 37 Nm is necessary to prevent head restraints with very weak locks from displacing to a physical stop and passing the remainder of the test in that position.

In its request concerning an "effective backset" requirement, the petitioner recommends adding 25 mm to the backset value to account for this initial displacement under the reference load. Thus, depending on the initial displacement value, a head restraint could have a range of acceptable backset values between 55 mm (if the displacement was 25 mm) and 80 mm (if the displacement was 0 mm). The petitioner did not provide any data as to the expected benefits that might accrue from a change to an "effective backset" requirement or any alternative methodology for estimating these benefits. The petitioner implies this change would result in optimized designs, but does not support this contention.

In testing of seven different vehicle model seats to the backset retention test, the agency found the average initial displacement was approximately 15 mm when a head restraint was exposed to

the 37 Nm reference moment.<sup>47</sup>

Assuming an average displacement of 15 mm for the entire vehicle fleet, the requested effective backset approach would result in a 10 mm increase in backset limit or an equivalent backset of 65 mm. The agency's methodology for calculating benefits related to improved backset does not consider the initial displacement of the head restraint. Using the agency's methodology for estimating benefits, the recommended "effective backset" approach would result in a 36 percent loss of expected benefits estimated in the 2004 final rule. Moreover, it is possible that manufacturers might redesign head restraints to reduce the initial displacement in order to achieve more leeway for backset. This would reduce benefits even more.

Given the potential loss in benefits, the agency denies this request.

### *C. Backset Retention and Displacement*

#### **1. Petition**

Kongsberg expressed its agreement with the petitions for reconsideration that recommended that the moment be returned to zero before reapplication of the reference load in the backset retention test. However, it questioned the correlation between the 102 mm limit on displacement of the head restraint beyond the displaced torso reference line during application of the 373 Nm moment. It petitioned the agency to set a lower value for displacement that would "be correlated with a safety benefit." In addition, it disagreed with the 13 mm displacement allowance after the moment returns to the reference load. It referred to this displacement as the "permanent deformation" of the head restraint. It recommended that the "permanent deformation" be measured from the initial position of the head restraint rather than the position achieved at the reference load. It referred to this measurement as "effective backset retention" and recommended a limit of 25 mm.

#### **2. Agency Response**

We will begin by addressing the request to zero-out the applied moment during the testing. As discussed earlier in this document, the agency has agreed to make this change in response to petitions for reconsideration. Thus, the Kongsberg petition is moot on this point.

In reference to the Kongsberg request to set a lesser value for the current 102

<sup>47</sup> "Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule."

mm displacement limit beyond the displaced torso reference line, we make the following observations. This requirement was part of the standard when it originated in the late 1960s. In recent head restraint testing, even when the seat back was not braced, the average head restraint displacement was well below the required limit or close to actually being a negative displacement when using the displaced torso reference line as the zero displacement point.<sup>48</sup> Thus, we acknowledge that, in this relatively small sample, the 102 mm limit is not driving head restraint design. However, the agency has no research to indicate how reducing the limit would affect head restraint performance. Nor has the petitioner suggested a value that would “be correlated with a safety benefit.”

Finally, regarding the petitioner’s disagreement with the 13 mm allowance in the backset retention test as well as its recommendation that the “permanent deformation” be measured from the unloaded head restraint position and that the limit be 25 mm, the petitioner appears to place great emphasis on the compliance of the head restraint, i.e., how flexible it is under initial load, in addition to how well it maintains its position after the load is removed. The focus of the backset retention test in the final rule is restricted to an assessment of the head restraint ability to remained locked in its position of adjustment. This is addressed with the 13 mm limit on the change in reference positions. This was not intended as a restriction on “permanent deformation.” In addition, we did not intend to regulate the initial flexibility of the head restraint beyond the establishment of a 25 mm limit to assure there is no loophole for particularly weak locks.

Based on agency testing, we believe that a head restraint whose lock maintains its integrity will pass the 25 mm initial reference load displacement and 13 mm reference position change limits separately.<sup>49</sup> These same test data indicate that the average and standard deviation for backset retention displacement under the methodology recommended by Kongsberg is 26.1 mm  $\pm$  8.3 mm, when the seat back is not braced and the applied load is returned to zero. Thus, the average value is over the 25 mm limit recommended by the petitioner, and many head restraints

would need to be redesigned if the recommendation was adopted.

Kongsberg has not provided any data as to the expected benefits that would accrue by measuring the backset retention from the initial head restraint position rather than from the reference load position. Absent this analysis, the agency denies this part of the petition.

#### *D. Height Retention*

##### *1. Petition*

Kongsberg recommended that the agency adopt several changes to the height retention requirement. It expressed its agreement with petitions for reconsideration that recommended that the moment be returned to zero before reapplication of the reference load in the backset retention test. The height retention test is very similar to the backset retention test except that there is no limit on the head restraint displacement at peak load. The petitioner requested that the agency reevaluate the lack of a peak load limit and set a limit that provides safety benefit to taller occupants. The petitioner contends that the height retention requirement is not applied to non-adjustable head restraints and requested that it be expanded to all head restraints. Finally, it requested that the height retention limit be measured from the initial position rather than the reference position and that the limit be 25 mm instead of 13 mm. It called this an “effective height retention” limit.

##### *2. Agency Response*

First we will address the request to zero-out the applied moment during the testing. As discussed earlier in this document, the agency has agreed to make this change in response to petitions for reconsideration. Thus, the Kongsberg petition is moot on this issue.

In reference to the Kongsberg request for setting a peak load displacement limit, we make the following observations. The agency has no research data nor are we aware of any data that would enable us to determine if a limit on head restraint displacement under the peak downward load of 500 N is appropriate or what the limit should be. In the absence of such data being provided by the petitioner, we decline to act in this area.

In reference to the petitioner’s recommendation concerning application of the height retention test to all head restraints, we wish to clarify that the current regulatory text does not exclude any head restraint design from the provisions of the height retention test.

Finally, we address the request for an “effective height retention” limit. Based

on agency testing, we believe that a head restraint whose lock maintains its integrity will pass the 25 mm initial reference load displacement and 13 mm reference position change limits separately.<sup>50</sup> These same test data indicate that the average and standard deviation for height retention displacement under the methodology recommended by Kongsberg is 14.0 mm  $\pm$  3.2 mm, when the seat back is not braced and the applied load is returned to zero. Thus, we would expect most head restraints to meet the 25 mm limit recommended by the petitioner. Given these results, it is unclear what advantage would be achieved by changing the current requirement. Therefore the agency denies this part of the petition.

#### *E. Non-Use Position*

##### *1. Petition*

Kongsberg asked if the agency accepts the petitions for reconsideration of a 5 degree torso angle change option for non-use positions, that a warning label be required on the head restraint identifying the potential for neck injury and the need for a detailed explanation of the hazard in the owner’s manual.

##### *2. Agency Response*

As discussed earlier in this document, in response to petitions for reconsideration, the agency has reinstated (from the NPRM) a 10 degree torso angle change option for non-use positions. Our human factors study supported the need for the 10 degree torso angle change as opposed to the 5 degree change. In addition, the agency studied the effectiveness of warning labels on occupant behavior when paired with a 5 degree torso angle change. The results showed that the label was highly ineffective. Thus, we rejected the idea of adding a label as part of the non-use position requirement. Therefore we are denying the Kongsberg rulemaking petition asking for a label on the head restraint in addition to a torso change requirement. For these reasons, we are denying the portion of the Kongsberg rulemaking petition asking for a label on the head restraint in addition to a torso change requirement.

With respect to providing detailed explanations of neck injury hazards in the owner’s manual; Kongsberg has not suggested what might be added to the December 2004 final rule requirements. We believe the current requirement is sufficient and have made minor changes

<sup>48</sup> “Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule.”

<sup>49</sup> “Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule.”

<sup>50</sup> “Technical Analysis Relevant to Petitions for Reconsideration to the December 14, 2004 FMVSS 202a—Head Restraints Final Rule.”

in response to petitions for reconsideration, explained in this document.

#### *F. Definition of Rear Head Restraint*

##### 1. Petition

FMVSS No. 202a defines a rear seat head restraint in the following way:

"[A]t any rear outboard designated seating position, a rear seat back, or any independently adjustable seat component attached to or adjacent to a seat back, that has a height equal to or greater than 700 mm, in any position of backset and height adjustment, as measured in accordance with S5.1.1."

Kongsberg recommended that the agency modify the definition of a rear seat head restraint from one using a 700 mm height threshold to any head restraint that is an "independently adjustable seat component." Kongsberg stated that ECE requires a minimum height of 750 mm for any head restraint that is an "independently adjustable seat component." It argued that the FMVSS No. 202a requirement should match that of the ECE since it has not seen any justification for why the public expectation in Europe should differ from that in North America.

##### 2. Agency Response

First, we will address Kongsberg's claim that the ECE requires a minimum height for an "independently adjustable seat component." We are not aware of such a provision in ECE 17 relative to optionally provided rear seat head restraints.

Second, the agency provided an extensive justification for our definition for rear seat head restraints in the preamble of the 2004 final rule. Part of that justification was that the definition includes seats with cushion components on the top of the seat back, i.e., what the general public would consider a seat back. We also stated our belief that the definition had the required objectivity for an FMVSS.

The petitioner has not provided any new information that would persuade the agency to change its position on this issue. Therefore, this part of the petition for rulemaking is denied.

#### *G. Gaps*

##### 1. Petition

Kongsberg requested that the agency modify the requirement for a maximum 60 mm gap between the fully down head restraint and seat back measured with a 165 mm sphere pressed against the seat back to a 25 mm gap measured by a 25 mm diameter sphere passed through the space between the seat back and head restraint. In addition, it

requested that the agency limit the gap between the head restraint and seat back with the head restraint in the full up position.

##### 2. Agency Response

The agency received petitions for reconsideration on the issue of the maximum gap between the seat back and the fully down head restraint. Petitioners for reconsideration requested that this requirement be harmonized with the 25 mm gap in ECE 17. The petitioners indicated that the gap is to be measured perpendicular to the seat back angle. Our response to this petition for reconsideration is relevant here. Specifically, we modified the final rule to allow the use of either a 165 mm sphere pressed against the seat back with a 60 mm limit between the points of contact or a 25 mm diameter cylinder with its long axis perpendicular to the seat back angle and pushed into the gap between the head restraint and seat back.

Kongsberg has requested the use of a 25 mm sphere rather than a 25 mm cylinder. The agency has specified that a cylinder be used to be consistent with measuring the gap perpendicular to the seat back angle. Use of a sphere would be a less rigorous requirement since the gap could be oriented in any direction. Therefore, we are denying the rulemaking petition to use a 25 mm sphere to measure the gap.

On the issue of restricting the gap between the head restraint in the fully up position and the seat back, the agency addressed this issue in the 2004 final rule preamble. The agency concluded at that time that such a requirement was unnecessary because most misadjusted head restraints are adjusted too low and that such a restriction might limit the maximum height of head restraints above the 800 mm requirement and reduce protection for taller occupants. The petitioner has not provided any new information that would persuade the agency to change its position on this issue. Therefore, this part of the petition for rulemaking is denied.

#### *H. Removability of Head Restraints*

##### 1. Petition

Kongsberg recommended that if the agency allowed a single input to adjust and remove the head restraint, the input effort must be mutually exclusive. For example, if a button is pressed to adjust down, that button must be pulled to remove the head restraint. Thus, Kongsberg would define "distinct" as "mutually exclusive" and under no circumstances could the same push-

button be used for adjustment and removal. Referring to a petition for reconsideration the agency received on use of a single mechanism for downward adjustment and removal, Kongsberg stated that it does not believe the act to be distinct. It further stated that the agency must give consideration to the risk of injury when a head restraint is adjusted even slightly above the highest locking position.

##### 2. Agency Response

The agency received petitions for reconsideration on this issue. Our response to those petitions is relevant to Kongsberg petition for rulemaking. In response to petitions for reconsideration we decided to add the word "upward" to the restriction on removability such that it now states:

"The head restraint must not be removable without a deliberate action distinct from any act necessary for upward adjustment."

As discussed in this document, the revised requirement allows a push-button to release a head restraint for both downward adjustment and removal. This is a common design in many vehicles today. Although the push button action is the same for downward adjustment and removal, the actions are distinct because the head restraint is pushed down in one instance and pulled up in another. As indicated earlier in this document, the purpose of this provision is to prevent accidental removal of head restraints when being adjusted. This is a potential problem when the head restraint is being adjusted in an upward direction but not a downward direction.

The petitioner's recommendation for the removability requirement would be more restrictive than the revised regulatory text. It would justify this more stringent requirement based on concerns about misadjustment above the highest locking position and potential resulting injuries. However, it is not clear to the agency how much more likely this type of misadjustment is under the Kongsberg's recommendation as opposed to the current definition. Absent any further information documenting the relative risks of the two approaches, the agency has decided to deny this part of the petition for rulemaking.

#### **VIII. Rulemaking Analyses and Notices**

##### *A. Executive Order 12866 and DOT Regulatory Policies and Procedures*

NHTSA has considered the impacts of this rulemaking action under Executive Order 12866 and the Department of Transportation's regulatory policies and

procedures. This rulemaking document was not reviewed under E.O. 12866.

This rule amends the agency's December 2004 final rule upgrading the agency's head restraint standard, which was considered significant because of public interest and economically significant because the agency estimated yearly economic cost savings of approximately \$127 million. However, as explained below, today's amendments are not significant.

NHTSA is placing in the public docket a Supplemental Final Regulatory Evaluation describing the costs and benefits of this rulemaking action. Today's amendments will not affect the costs of the December 2004 final rule. However, as discussed in the SFRE and for the reasons discussed earlier in this document, the agency estimates that the change in seat back angle to provide greater flexibility with respect to backset will reduce front seat benefits by about 20 percent. We note that our estimate for rear seat benefits remains the same. This is because backset is not regulated for rear seat head restraints. In addition, our estimate of rear seat benefits is based on head restraint height. Although head restraint height is affected by seat back angle, since a large portion of rear seats are fixed or not adjustable, we are estimating no change in rear seat benefits.

Table II shows the SFRE benefits estimates with respect to the benefits of the December 2004 final rule and how those benefits are changed by today's rule:

TABLE II.—BENEFITS COMPARISON BETWEEN THE FINAL REGULATORY IMPACT ANALYSIS AND SUPPLEMENTAL FINAL REGULATORY EVALUATION

Whiplash injuries reduced	FRIA	SFRE
Front Seat .....	15,272	12,231
Rear Seat .....	1,559	1,559
Total .....	16,831	13,790

#### B. Regulatory Flexibility Act

NHTSA has considered the effects of this rulemaking action under the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*) The final rule will affect motor vehicle manufacturers, alterers, and seating manufacturers. NHTSA has determined that this action will not have a significant economic impact on a substantial number of small entities.

In the preamble to the December 2004 final rule upgrading the head restraint standard, NHTSA made a determination that that rule will not have a significant economic impact on a substantial

number of small entities. Today's amendments make relatively minor changes in that rule, generally for the purpose of providing greater flexibility. Since none of the amendments being made to the December 2004 final rule will significantly affect small entities, this rule will not have a significant economic impact on a substantial number of small entities.

#### C. National Environmental Policy Act

NHTSA has analyzed the final rule for the purposes of the National Environmental Policy Act. The agency has determined that implementation of this action will not have any significant impact on the quality of the human environment.

#### D. Executive Order 13132 (Federalism)

NHTSA has examined today's final rule pursuant to Executive Order 13132 (64 FR 43255, August 10, 1999) and concluded that no additional consultation with States, local governments or their representatives is mandated beyond the rulemaking process. The agency has concluded that the rule does not have federalism implications because the rule does not have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

Further, no consultation is needed to discuss the preemptive effect of today's rule. NHTSA rules can have preemptive effect in at least two ways. First, the National Traffic and Motor Vehicle Safety Act contains an express preemptive provision: "When a motor vehicle safety standard is in effect under this chapter, a State or a political subdivision of a State may prescribe or continue in effect a standard applicable to the same aspect of performance of a motor vehicle or motor vehicle equipment only if the standard is identical to the standard prescribed under this chapter." 49 U.S.C. 30103(b)(1). It is this statutory command that preempts State law, not today's rulemaking, so consultation would be inappropriate.

In addition to the express preemption noted above, the Supreme Court has also recognized that State requirements imposed on motor vehicle manufacturers, including sanctions imposed by State tort law, can stand as an obstacle to the accomplishment and execution of a NHTSA safety standard. When such a conflict is discerned, the Supremacy Clause of the Constitution makes these State requirements unenforceable. *See Geier v. American*

*Honda Motor Co.*, 529 U.S. 861 (2000). NHTSA has not outlined such potential State requirements in today's rulemaking, however, in part because such conflicts can arise in varied contexts, but it is conceivable that such a conflict may become clear through subsequent experience with today's standard and test regime. NHTSA may opine on such conflicts in the future, if warranted. *See id.* at 883–86.

#### E. Unfunded Mandates Reform Act

Section 202 of the Unfunded Mandates Reform Act of 1995 (UMRA) requires Federal agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of more than \$100 million in any one year (\$120,700,000 as adjusted for inflation with base year of 1995).

Because this final rule will not have a \$100 million effect, no Unfunded Mandates assessment has been prepared. A full assessment of the rule's costs and benefits is provided in the SFRE.

#### F. Executive Order 12988 (Civil Justice Reform)

With respect to the review of the promulgation of a new regulation, section 3(b) of Executive Order 12988, "Civil Justice Reform" (61 FR 4729, February 7, 1996) requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) Clearly specifies the preemptive effect; (2) clearly specifies the effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct, while promoting simplification and burden reduction; (4) clearly specifies the retroactive effect, if any; (5) adequately defines key terms; and (7) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. This document is consistent with that requirement.

Pursuant to this Order, NHTSA notes as follows. The preemptive effect of this rule is discussed above. NHTSA notes further that there is no requirement that individuals submit a petition for reconsideration or pursue other administrative proceeding before they may file suit in court.

#### G. Paperwork Reduction Act

The December 2004 final rule included the following "collections of information," as that term is defined in 5 CFR Part 1320 *Controlling Paperwork*



*Burdens on the Public:* the final rule required that vehicle manufacturers include in owners' manuals information about appropriate head restraint adjustment. Today's rule makes minor revisions to the owner's manual requirements. The revisions do not affect the nature of the information that must be provided or affect the burden hours. OMB has approved NHTSA's collection of owner's manual requirements under OMB clearance No. 2127-0541 *Consolidated Justification of Owner's Manual Requirements for Motor Vehicles and Motor Vehicle Equipment*. This clearance will expire on February 28, 2009. Given that the revisions will not affect the nature of the information that must be provided or the burden hours, the collection of information comes within that clearance.

*Two Years of Phase-in Reporting Requirements Beginning in 2010*—This final rule includes a phase-in period and reporting requirements for manufacturers of passenger cars, multipurpose passenger vehicles, trucks and buses with a GVWR of 4,536 kg or less, concerning the number of vehicles that meet requirements of Standard No. 202a. Two reports, one report for each of two consecutive years, will be required from each affected manufacturer. The reports will be due within 60 days after the end of the production year ending August 31, 2010, and within 60 days after the end of the production year ending August 31, 2011. Although OMB approval for these collections of information will not be sought until late 2008 (as part of the request for renewal of OMB clearance No. 2127-0541), NHTSA describes the anticipated collection of information as follows:

*Type of Request*—Revision of a Currently Approved Collection of Information.

*OMB Clearance No.*—2127-0541.

*Form Number*—This collection of information will not use any standard forms.

*Requested Expiration Date of Clearance*—At present, Clearance No. 2127-0541 is scheduled to expire on February 28, 2009. As a result of this final rule, NHTSA anticipates asking for another extension of this collection, though February 28, 2012.

*Summary of the Collection of Information*—NHTSA will ask for an extension of approval to collect the information already approved under OMB Clearance No. 2127-0541. In addition, NHTSA will ask for approval to adopt phase-in reporting requirements similar to those used in other phase-ins. For each year of the

phase-in period, manufacturers are required to provide to NHTSA, within 60 days after the August 31 end date of each "production year," information identifying the vehicles (by make, model, and vehicle identification number (VIN)) that have been certified as complying with certain head restraint requirements.

As discussed earlier, the implementation schedule for the new requirements is as follows:

- for the front seat requirements, 80 percent of each manufacturer's vehicles with a GVWR of 4,536 kg or less manufactured during the production year ending on August 31, 2010 (with the phase-in report due to NHTSA on October 31, 2010); and
- for the requirements for voluntarily installed rear head restraints, 80 percent of each manufacturer's vehicles with rear head restraints, manufactured during the production year ending on August 31, 2011 (with the phase-in report due to NHTSA on October 31, 2011).

#### *Description of the Need for the Information*

NHTSA needs this information to ensure that vehicle manufacturers are complying with the upgraded head restraint standard. NHTSA will use this information to determine whether a manufacturer has complied with the amended requirements of FMVSS No. 202a during the phase-in period.

#### *Description of the Likely Respondents (Including Estimated Number, and Proposed Frequency of Response to the Collection of Information)*

NHTSA estimates that 26 vehicle manufacturers will submit the required information.

#### *Estimate of the Total Annual Reporting and Recordkeeping Burden Resulting From this Collection of Information*

Anticipated Request for Clearance for February 28, 2009 through February 28, 2012—For each of 2010 and 2011, NHTSA anticipates requesting approval to collect an additional 26 hours per year to cover the phase-in reports from each of 26 manufacturers. Because NHTSA anticipates that the information will be collected and reported 100 percent through electronic means, it does not anticipate each manufacturer taking more than an hour to compile the information.

There would be 0 hours of recordkeeping burdens resulting from the collection of information.

NHTSA estimates that there are no additional cost burdens resulting from this additional collection of

information. There are no capital or start-up costs as a result of this collection.

#### *H. Executive Order 13045*

Executive Order 13045<sup>51</sup> applies to any rule that: (1) Is determined to be "economically significant" as defined under E.O. 12866, and (2) concerns an environmental, health or safety risk that NHTSA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, we must evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by us. This rule is not economically significant, and it will not have a disproportionate effect on children.

#### *I. National Technology Transfer and Advancement Act*

Section 12(d) of the National Technology Transfer and Advancement Act (NTTAA) requires NHTSA to evaluate and use existing voluntary consensus standards<sup>52</sup> in its regulatory activities unless doing so would be inconsistent with applicable law (e.g., the statutory provisions regarding NHTSA's vehicle safety authority) or otherwise impractical. In meeting that requirement, we are required to consult with voluntary, private sector, consensus standards bodies. Examples of organizations generally regarded as voluntary consensus standards bodies include the American Society for Testing and Materials (ASTM), the Society of Automotive Engineers (SAE), and the American National Standards Institute (ANSI). If NHTSA does not use available and potentially applicable voluntary consensus standards, we are required by the Act to provide Congress, through OMB, an explanation of the reasons for not using such standards.

The agency is not aware of any new voluntary consensus standards addressing the changes made to the December 2004 final rule as a result of this final rule.

#### *J. Privacy Act*

Anyone is able to search the electronic form of all comments received into any of our dockets by the

<sup>51</sup> 62 FR 19885, April 23, 1997.

<sup>52</sup> Voluntary consensus standards are technical standards developed or adopted by voluntary consensus standards bodies. Technical standards are defined by the NHTSA as "a performance-based or design specific technical specifications and related management systems practices. They pertain to products and processes, such as size, strength, or technical performance of a product, process or material."

name of the individual submitting the comment (or signing the comment, if submitted on behalf of an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (65 FR 19477 at 19478).

#### List of Subjects in 49 CFR Parts 571 and 585

Imports, Incorporation by Reference, Motor Vehicle Safety, Motor Vehicles, Reporting and recordkeeping requirements, and Tires.

■ In consideration of the foregoing, 49 CFR parts 571 and 585 are amended as follows:

#### PART 571—FEDERAL MOTOR VEHICLE SAFETY STANDARDS

■ 1. The authority citation for part 571 of title 49 continues to read as follows:

**Authority:** 49 U.S.C. 322, 30111, 30115, 30117, and 30166; delegation of authority at 49 CFR 1.50.

■ 2. Section 571.202 is amended by revising the section heading, S2, S4, and S4.1 to read as follows:

#### 571.202 Standard No. 202; Head restraints; Applicable at the manufacturers option until September 1, 2009.

\* \* \* \* \*

S2. *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks and buses with a GVWR of 4,536 kg or less, manufactured before September 1, 2009. Until September 1, 2009, manufacturers may comply with the standard in this § 571.202, with the European regulations referenced in S4.3 of this § 571.202, or with the standard in § 571.202a. For vehicles manufactured on or after September 1, 2009 and before September 1, 2010, manufacturers may comply with the standard in this § 571.202 or with the European regulations referenced in S4.3 of this § 571.202, instead of the standard in § 571.202a, only to the extent consistent with phase-in specified in § 571.202a.

\* \* \* \* \*

#### S4. Requirements.

S4.1 Each passenger car, and multipurpose passenger vehicle, truck and bus with a GVWR of 4,536 kg or less, must comply with, at the manufacturer's option, S4.2, S4.4 or S4.5 of this section.

\* \* \* \* \*

■ 3. Section 571.202a is revised to read as follows:

#### § 571.202a Standard No. 202a; Head restraints; Mandatory applicability begins on September 1, 2009.

S1. *Purpose and scope.* This standard specifies requirements for head restraints to reduce the frequency and severity of neck injury in rear-end and other collisions.

S2. *Application & incorporation by reference.*

S2.1 *Application.* This standard applies to passenger cars, and to multipurpose passenger vehicles, trucks and buses with a GVWR of 4,536 kg or less, manufactured on or after September 1, 2009. However, the standard's requirements for rear head restraints do not apply to vehicles manufactured before September 1, 2010, and, for vehicles manufactured between September 1, 2010 and August 31, 2011, the requirements for rear head restraints apply only to the extent provided in S7. Until September 1, 2009, manufacturers may comply with the standard in this § 571.202a, with the standard in § 571.202, or with the European regulations referenced in S4.3(a) of § 571.202. For vehicles manufactured on or after September 1, 2009 and before September 1, 2010, manufacturers may comply with the standard in § 571.202 or with the European regulations referenced in S4.3(a) of § 571.202, instead of the standard in this § 571.202a, only to the extent consistent with the phase-in specified in this § 571.202a.

S2.2 *Incorporation by reference.*

(a) Society of Automotive Engineers (SAE) Recommended Practice J211/1 rev. Mar 95, "Instrumentation for Impact Test—Part 1—Electronic Instrumentation," SAE J211/1 (rev. Mar 95) is incorporated by reference in S5.2.5(b), S5.3.8, S5.3.9, and 5.3.10 of this section. The Director of the Federal Register has approved the incorporation by reference of this material in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. A copy of SAE J211/1 (rev. Mar 95) may be obtained from SAE at the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096. A copy of SAE J211/1 (rev. Mar 95) may be inspected at NHTSA's Technical Information Services, 400 Seventh Street, SW., Plaza Level, Room 403, Washington, DC, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

(b) Society of Automotive Engineers (SAE) Standard J826 "Devices for Use in

Defining and Measuring Vehicle Seating Accommodation," SAE J826 (rev. Jul 95) is incorporated by reference in S3, S5, S5.1, S5.1.1, S5.2, S5.2.1, S5.2.2, and S5.2.7 of this section. The Director of the Federal Register has approved the incorporation by reference of this material in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. A copy of SAE J826 (rev. Jul 95) may be obtained from SAE at the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096. A copy of SAE J826 (rev. Jul 95) may be inspected at NHTSA's Technical Information Services, 400 Seventh Street, SW., Plaza Level, Room 403, Washington, DC or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html).

S3. Definitions.

*Backset* means the minimum horizontal distance between the rear of a representation of the head of a seated 50th percentile male occupant and the head restraint, as measured by the head restraint measurement device.

*Head restraint* means a device that limits rearward displacement of a seated occupant's head relative to the occupant's torso.

*Head restraint measurement device (HRMD)* means the Society of Automotive Engineers (SAE) (July 1995) J826 three-dimensional manikin with a head form attached, representing the head position of a seated 50th percentile male, with sliding scale at the back of the head for the purpose of measuring backset. The head form is designed by and available from the ICBC, 151 West Esplanade, North Vancouver, BC V7M 3H9, Canada ([www.icbc.com](http://www.icbc.com)).

*Height* means, when used in reference to a head restraint, the distance from the H-point, measured parallel to the torso reference line defined by the three dimensional SAE J826 (July 1995) manikin, to a plane normal to the torso reference line.

*Intended for occupant use* means, when used in reference to the adjustment of a seat, positions other than that intended solely for the purpose of allowing ease of ingress and egress of occupants and access to cargo storage areas of a vehicle.

*Rear head restraint* means, at any rear outboard designated seating position, a rear seat back, or any independently adjustable seat component attached to or adjacent to a seat back, that has a height equal to or greater than 700 mm, in any position of backset and height

adjustment, as measured in accordance with S5.1.1.

*Top of the head restraint* means the point on the head restraint with the greatest height.

**S4. Requirements.** Except as provided in S4.4, S4.2.1(a)(2) and S4.2.1(b)(2) of this section, each vehicle must comply with S4.1 of this section with the seat adjusted as intended for occupant use. Whenever a range of measurements is specified, the head restraint must meet the requirement at any position of adjustment within the specified range.

**S4.1 Performance levels.** In each vehicle other than a school bus, a head restraint that conforms to either S4.2 or S4.3 of this section must be provided at each front outboard designated seating position. In each equipped with rear outboard head restraints, the rear head restraint must conform to either S4.2 or S4.3 of this section. In each school bus, a head restraint that conforms to either S4.2 or S4.3 of this section must be provided for the driver's seating position. At each designated seating position incapable of seating a 50th percentile male Hybrid III test dummy specified in 49 CFR Part 572, Subpart E, the applicable head restraint must conform to S4.2 of this section.

**S4.2 Dimensional and static performance.** Each head restraint located in the front outboard designated seating position and each head restraint located in the rear outboard designated seating position must conform to paragraphs S4.2.1 through S4.2.7 of this section. Compliance is determined for the height requirements of S4.2.1 and the backset requirements of S4.2.3 of this section by taking the arithmetic average of three measurements.

**S4.2.1 Minimum height.**

(a) *Front outboard designated seating positions.* (1) Except as provided in S4.2.1(a)(2) of this section, when measured in accordance with S5.2.1(a)(1) of this section, the top of a head restraint located in a front outboard designated seating position must have a height not less than 800 mm in at least one position of adjustment.

(2) Exception. The requirements of S4.2.1(a)(1) do not apply if the interior surface of the vehicle at the roofline physically prevents a head restraint, located in the front outboard designated seating position, from attaining the required height. In those instances in which this head restraint cannot attain the required height, when measured in accordance with S5.2.1(a)(2), the maximum vertical distance between the top of the head restraint and the interior surface of the vehicle at the roofline must not exceed 50 mm for convertibles

and 25 mm for all other vehicles.

Notwithstanding this exception, when measured in accordance with S5.2.1(a)(2), the top of a head restraint located in a front outboard designated seating position must have a height not less than 700 mm in the lowest position of adjustment.

(b) *All outboard designated seating positions equipped with head restraints.*

(1) Except as provided in S4.2.1(b)(2) of this section, when measured in accordance with S5.2.1(b)(1) of this section, the top of a head restraint located in an outboard designated seating position must have a height not less than 750 mm in any position of adjustment.

(2) Exception. The requirements of S4.2.1(b)(1) do not apply if the interior surface of the vehicle at the roofline or the interior surface of the backlight physically prevent a head restraint, located in the rear outboard designated seating position, from attaining the required height. In those instances in which this head restraint cannot attain the required height, when measured in accordance with S5.2.1(b)(2), the maximum vertical distance between the top of the head restraint and the interior surface of the vehicle at the roofline or the interior surface of the backlight must not exceed 50 mm for convertibles and 25 mm for all other vehicles.

**S4.2.2 Width.** When measured in accordance with S5.2.2 of this section,  $65 \pm 3$  mm below the top of the head restraint, the lateral width of a head restraint must be not less than 170 mm, except the lateral width of the head restraint for front outboard designated seating positions in a vehicle with a front center designated seating position, must be not less than 254 mm.

**S4.2.3 Front Outboard Designated Seating Position Backset.** When measured in accordance with S5.2.3 of this section, the backset must not be more than 55 mm, when the seat is adjusted in accordance with S5.1. For adjustable restraints, the requirements of this section must be met with the top of the head restraint in any height position of adjustment between 750 mm and 800 mm, inclusive. If the top of the head restraint, in its lowest position of adjustment, is above 800 mm, the requirements of this section must be met at that position. If the head restraint position is independent of the seat back inclination position, the head restraint must not be adjusted such that backset is more than 55 mm when the seat back inclination is positioned closer to vertical than the position specified in S5.1.

**S4.2.4 Gaps.**

All head restraints must meet limits for gaps in the head restraint specified in S4.2.4.1. For gaps between the seat and head restraint, adjustable head restraints must meet either the limits specified in S4.2.4.1 or S4.2.4.2.

**S4.2.4.1 Gaps within the head restraint and between the head restraint and seat using a 165 mm sphere.** When measured in accordance with S5.2.4.1 of this section using the head form specified in that paragraph, there must not be any gap greater than 60 mm within or between the anterior surface of the head restraint and anterior surface of the seat, with the head restraint adjusted to its lowest height position and any backset position, except as allowed by S4.4.

**S4.2.4.2 Gaps between the adjustable head restraint and seat using a 25 mm cylinder.** When measured in accordance with S5.2.4.2 of this section using the 25 mm cylinder specified in that paragraph, there must not be any gap greater than 25 mm between the anterior surface of the head restraint and anterior surface of the seat, with the head restraint adjusted to its lowest height position and any backset position, except as allowed by S4.4.

**S4.2.5 Energy absorption.** When the anterior surface of the head restraint is impacted in accordance with S5.2.5 of this section by the head form specified in that paragraph at any velocity up to and including 24.1 km/h, the deceleration of the head form must not exceed  $785 \text{ m/s}^2$  (80 g) continuously for more than 3 milliseconds.

**S4.2.6 Height retention.** When tested in accordance with S5.2.6 of this section, the cylindrical test device specified in S5.2.6(b) must return to within 13 mm of its initial reference position after application of at least a 500 N load and subsequent reduction of the load to  $50 \text{ N} \pm 1 \text{ N}$ . During application of the initial 50 N reference load, as specified in S5.2.6(b)(2) of this section, the cylindrical test device must not move downward more than 25 mm.

**S4.2.7 Backset retention, displacement, and strength.**

(a) *Backset retention and displacement.* When tested in accordance with S5.2.7 of this section, the described head form must:

(1) Not be displaced more than 25 mm during the application of the initial reference moment of  $37 \pm 0.7 \text{ Nm}$ ;

(2) Not be displaced more than 102 mm perpendicularly and posterior of the displaced extended torso reference line during the application of a  $373 \pm 7.5 \text{ Nm}$  moment about the H-point; and

(3) Return to within 13 mm of its initial reference position after the application of a  $373 \pm 7.5 \text{ Nm}$  moment

about the H-point and reduction of the moment to  $37 \pm 0.7$  Nm.

(b) *Strength*. When the head restraint is tested in accordance with S5.2.7(b) of this section with the test device specified in that paragraph, the load applied to the head restraint must reach 890 N and remain at 890 N for a period of 5 seconds.

S4.3 *Dynamic performance and width*. At each forward-facing outboard designated seating position equipped with a head restraint, the head restraint adjusted midway between the lowest and the highest position of adjustment must conform to the following:

S4.3.1 *Injury criteria*. When tested in accordance with S5.3 of this section, during a forward acceleration of the dynamic test platform described in S5.3.1, the head restraint must:

(a) *Angular rotation*. Limit posterior angular rotation between the head and torso of the 50th percentile male Hybrid III test dummy specified in 49 CFR part 572, subpart E, fitted with sensors to measure rotation between the head and torso, to 12 degrees for the dummy in all outboard designated seating positions;

(b) *Head injury criteria*. Limit the maximum HIC<sub>15</sub> value to 500. HIC<sub>15</sub> is calculated as follows—

For any two points in time,  $t_1$  and  $t_2$ , during the event which are separated by not more than a 15 millisecond time interval and where  $t_1$  is less than  $t_2$ , the head injury criterion (HIC<sub>15</sub>) is determined using the resultant head acceleration at the center of gravity of the dummy head,  $a_r$ , expressed as a multiple of  $g$  (the acceleration of gravity) and is calculated using the expression:

$$HIC = \left[ \frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a_r dt \right]^{2.5} (t_2 - t_1)$$

4.3.2 *Width*. The head restraint must have the lateral width specified in S4.2.2 of this section.

S4.4 *Folding or retracting rear head restraints non-use positions*. A rear head restraint may be adjusted to a position at which its height does not comply with the requirements of S4.2.1 of this section. However, in any such position, the head restraint must meet either S4.4(a), (b) or (c) of this section.

(a) The head restraint must automatically return to a position in which its minimum height is not less than that specified in S4.2.1(b) of this section when a test dummy representing a 5th percentile female Hybrid III test dummy specified in 49 CFR part 572, subpart O is positioned according to S5.4(a); or

(b) The head restraint must, when tested in accordance with S5.4(b) of this section, be capable of manually rotating forward or rearward by not less than 60 degrees from any position of adjustment in which its minimum height is not less than that specified in S4.2.1(b) of this section.

(c) The head restraint must, when tested in accordance with S5.4(b) of this section, cause the torso reference line angle to be at least 10 degrees closer to vertical than when the head restraint is in any position of adjustment in which its height is not less than that specified in S4.2.1(b)(1) of this section.

S4.5 *Removability of head restraints*. The head restraint must not be removable without a deliberate action distinct from any act necessary for upward adjustment.

S4.6 *Compliance option selection*. Where manufacturer options are specified in this section, the manufacturer must select an option by the time it certifies the vehicle and may not thereafter select a different option for that vehicle. The manufacturer may select different compliance options for different designated seating positions to which the requirements of this section are applicable. Each manufacturer must, upon request from the National Highway Traffic Safety Administration, provide information regarding which of the compliance options it has selected for a particular vehicle or make/model.

S4.7 *Information in owner's manual*.

S4.7.1 The owner's manual for each vehicle must emphasize that all occupants, including the driver, should not operate a vehicle or sit in a vehicle's seat until the head restraints are placed in their proper positions in order to minimize the risk of neck injury in the event of a crash.

S4.7.2 The owner's manual for each vehicle must—

(a) Include an accurate description of the vehicle's head restraint system in an easily understandable format. The owner's manual must clearly identify which seats are equipped with head restraints;

(b) If the head restraints are removable, the owner's manual must provide instructions on how to remove the head restraint by a deliberate action distinct from any act necessary for upward adjustment, and how to reinstall head restraints;

(c) Warn that all head restraints must be reinstalled to properly protect vehicle occupants.

(d) Describe in an easily understandable format the adjustment of the head restraints and/or seat back to achieve appropriate head restraint position relative to the occupant's head.

This discussion must include, at a minimum, accurate information on the following topics:

(1) A presentation and explanation of the main components of the vehicle's head restraints.

(2) The basic requirements for proper head restraint operation, including an explanation of the actions that may affect the proper functioning of the head restraints.

(3) The basic requirements for proper positioning of a head restraint in relation to an occupant's head position, including information regarding the proper positioning of the center of gravity of an occupant's head or some other anatomical landmark in relation to the head restraint.

S5. *Procedures*. Demonstrate compliance with S4.2 through S4.4 of this section with any adjustable lumbar support adjusted to its most posterior nominal design position. If the seat cushion adjusts independently of the seat back, position the seat cushion such that the highest H-point position is achieved with respect to the seat back, as measured by SAE J826 (July 1995) manikin, with leg length specified in S10.4.2.1 of § 571.208 of this Part. If the specified position of the H-point can be achieved with a range of seat cushion inclination angles, adjust the seat inclination such that the most forward part of the seat cushion is at its lowest position with respect to the most rearward part. All tests specified by this standard are conducted with the ambient temperature between 18 degrees C. and 28 degrees C.

S5.1 Except as specified in S5.2.3 and S5.3 of this section, if the seat back is adjustable, it is set at an initial inclination position closest to the manufacturer's design seat back angle, as measured by SAE J826 manikin. If there is more than one inclination position closest to the design angle, set the seat back inclination to the position closest to and rearward of the design angle.

S5.1.1 *Procedure for determining presence of head restraints in rear outboard seats*. Measure the height of the top of a rear seat back or the top of any independently adjustable seat component attached to or adjacent to the rear seat back in its highest position of adjustment using the scale incorporated into the SAE J826 (July 1995) manikin or an equivalent scale, which is positioned laterally within 15 mm of the centerline of the rear seat back or any independently adjustable seat component attached to or adjacent to the rear seat back.

S5.2 *Dimensional and static performance procedures*. Demonstrate

compliance with S4.2 of this section in accordance with S5.2.1 through S5.2.7 of this section. Position the SAE J826 (July 1995) manikin according to the seating procedure found in SAE J826 (July 1995).

**S5.2.1 Procedure for height measurement.** Demonstrate compliance with S4.2.1 of this section in accordance with S5.2.1 (a) and (b) of this section, using the headroom probe scale incorporated into the SAE J826 (July 1995) manikin with the appropriate offset for the H-point position or an equivalent scale, which is positioned laterally within 15 mm of the head restraint centerline. If the head restraint position is independent of the seat back inclination position, compliance is determined at a seat back inclination position closest to the design seat back angle, and each seat back inclination position less than the design seat back angle.

(a)(1) For head restraints in front outboard designated seating positions, adjust the top of the head restraint to the highest position and measure the height.

(2) For head restraints located in the front outboard designated seating positions that are prevented by the interior surface of the vehicle at the roofline from meeting the required height as specified in S4.2.1(a)(1), measure the clearance between the top of the head restraint and the interior surface of the vehicle at the roofline, with the seat adjusted to its lowest vertical position intended for occupant use, by attempting to pass a 25 mm sphere between them. Adjust the top of the head restraint to the lowest position and measure the height.

(b)(1) For head restraints in all outboard designated seating positions equipped with head restraints, adjust the top of the head restraint to the lowest position other than allowed by S4.4 and measure the height.

(2) For head restraints located in rear outboard designated seating positions that are prevented by the interior surface of the vehicle at the roofline or the interior surface of the rear backlight from meeting the required height as specified in S4.2.1(b)(1), measure the clearance between the top of the head restraint or the seat back and the interior surface of the vehicle at the roofline or the interior surface of the rear backlight, with the seat adjusted to its lowest vertical position intended for occupant use, by attempting to pass a 25 mm sphere between them.

**S5.2.2 Procedure for width measurement.** Demonstrate compliance with S4.2.2 of this section using calipers to measure the maximum dimension perpendicular to the vehicle vertical

longitudinal plane of the intersection of the head restraint with a plane that is normal to the torso reference line of SAE J826 (July 1995) manikin and  $65 \pm 3$  mm below the top of the head restraint.

**S5.2.3 Procedure for backset measurement.** Demonstrate compliance with S4.2.3 of this section using the HRMD positioned laterally within 15 mm of the head restraint centerline. Adjust the front head restraint so that its top is at any height between and inclusive of 750 mm and 800 mm and its backset is in the maximum position other than allowed by S4.4. If the lowest position of adjustment is above 800 mm, adjust the head restraint to that position. If the head restraint position is independent of the seat back inclination position, compliance is determined at each seat back inclination position closest to and less than the design seat back angle.

**S5.2.4 Procedures for gap measurement.**

**S5.2.4.1** Procedure using a 165 mm sphere.

Demonstrate compliance with S4.2.4.1 of this section in accordance with the procedures of S5.2.4.1 (a) through (c) of this section, with the head restraint adjusted to its lowest height position and any backset position, except as allowed by S4.4.

(a) The area of measurement is anywhere on the anterior surface of the head restraint or seat with a height greater than 540 mm and within the following distances from the centerline of the seat—

(1) 127 mm for seats required to have 254 mm minimum head restraint width; and

(2) 85 mm for seats required to have a 170 mm head restraint width.

(b) Applying a load of no more than 5 N against the area of measurement specified in subparagraph (a), place a  $165 \pm 2$  mm diameter spherical head form against any gap such that at least two points of contact are made within the area. The surface roughness of the head form is less than  $1.6 \mu\text{m}$ , root mean square.

(c) Determine the gap dimension by measuring the vertical straight line distance between the inner edges of the two furthest contact points, as shown in Figures 2, 3 and 4.

**S5.2.4.2** Procedure using a 25 mm cylinder.

Demonstrate compliance with S4.2.4.2 of this section in accordance with the procedures of S5.2.4.2 (a) through (c) of this section, with the head restraint adjusted to its lowest height position and any backset position, except as allowed by S4.4.

(a) The area of measurement is between the anterior surface of the head restraint and seat with a height greater than 540 mm and within the following distances from the centerline of the seat—

(1) 127 mm for seats required to have 254 mm minimum head restraint width; and

(2) 85 mm for seats required to have a 170 mm head restraint width.

(b) Orient a  $25 \pm 1$  mm diameter cylinder such that its long axis is perpendicular to the seat back angle and in a vertical longitudinal vehicle plane. Applying a load of no more than 5 N along the axis of the cylinder, place the cylinder against any gap within the area of measurement specified in subparagraph (a). The surface roughness of the cylinder is less than  $1.6 \mu\text{m}$ , root mean square.

(c) Determine if at least 125 mm of the cylinder can completely pass through the gap.

**S5.2.5 Procedures for energy absorption.** Demonstrate compliance with S4.2.5 of this section in accordance with S5.2.5 (a) through (e) of this section, with adjustable head restraints in any height and backset position of adjustment.

(a) Use an impactor with a semispherical head form with a  $165 \pm 2$  mm diameter and a surface roughness of less than  $1.6 \mu\text{m}$ , root mean square. The head form and associated base have a combined mass of  $6.8 \pm 0.05$  kg.

(b) Instrument the impactor with an acceleration sensing device whose output is recorded in a data channel that conforms to the requirements for a 600 Hz channel class as specified in SAE Recommended Practice J211/1 (March 1995). The axis of the acceleration-sensing device coincides with the geometric center of the head form and the direction of impact.

(c) Propel the impactor toward the head restraint. At the time of launch, the longitudinal axis of the impactor is within 2 degrees of being horizontal and parallel to the vehicle longitudinal axis. The direction of travel is posteriorly.

(d) Constrain the movement of the head form so that it travels linearly along the path described in S5.2.5(c) of this section for not less than 25 mm before making contact with the head restraint.

(e) Impact the anterior surface of the seat or head restraint at any point with a height greater than 635 mm and within a distance of the head restraint vertical centerline of 70 mm.

**S5.2.6 Procedures for height retention.** Demonstrate compliance with S4.2.6 of this section in accordance with S5.2.6(a) through (e) of this section. For

head restraints that move with respect to the seat when occupant loading is applied to the seat back, S5.2.6(a) through (e) may be performed with the head restraint fixed in a position corresponding to the position when the seat is unoccupied.

(a) Adjust the adjustable head restraint so that its top is at any of the following height positions at any backset position—

(1) For front outboard designated seating positions—

- (i) The highest position; and
- (ii) Not less than, but closest to 800 mm; and

(2) For rear outboard designated seating positions equipped with head restraints—

- (i) The highest position; and
- (ii) Not less than, but closest to 750 mm.

(b)(1) Orient a cylindrical test device having a  $165 \pm 2$  mm diameter in plan view (perpendicular to the axis of revolution), and a 152 mm length in profile (through the axis of revolution) with a surface roughness of less than 1.6  $\mu\text{m}$ , root mean square, such that the axis of the revolution is horizontal and in the longitudinal vertical plane through the longitudinal centerline of the head restraint. Position the midpoint of the bottom surface of the cylinder in contact with the head restraint.

(2) Establish initial reference position by applying a vertical downward load of  $50 \pm 1$  N at the rate of  $250 \pm 50$  N/minute. Determine the reference position after  $5.5 \pm 0.5$  seconds at this load.

(c) Increase the load at the rate of  $250 \pm 50$  N/minute to at least 500 N and maintain this load for  $5.5 \pm 0.5$  seconds.

(d) Reduce the load at the rate of  $250 \pm 50$  N/minute until the load is completely removed. Maintain this condition for not more than two minutes.

(e) Increase the load at the rate of  $250 \pm 50$  N/minute to  $50 \pm 1$  N and, after  $5.5 \pm 0.5$  seconds at this load, determine the position of the cylindrical device with respect to its initial reference position.

**S5.2.7 Procedures for backset retention, displacement, and strength.** Demonstrate compliance with S4.2.7 of this section in accordance with S5.2.7(a) and (b) of this section. The load vectors that generate moment on the head restraint are initially contained in a vertical plane parallel to the vehicle longitudinal centerline.

(a) *Backset retention and displacement.* For head restraints that move with respect to the seat when occupant loading is applied to the seat back, S5.2.7(a)(1) through (8) may be performed with the head restraint fixed

in a position corresponding to the position when the seat is unoccupied.

(1) Adjust the head restraint so that its top is at a height closest to and not less than:

(i) 800 mm for front outboard designated seating positions (or the highest position of adjustment for head restraints subject to S4.2.1(a)(2)); and

(ii) 750 mm for rear outboard designated seating positions equipped with head restraints (or the highest position of adjustment for rear head restraints subject to S4.2.1(b)(2)).

(2) Adjust the head restraint to any backset position.

(3) In the seat, place a test device having the back pan dimensions and torso reference line (vertical center line), when viewed laterally, with the head room probe in the full back position, of the three dimensional SAE J826 (July 1995) manikin;

(4) Establish the displaced torso reference line by creating a posterior moment of  $373 \pm 7.5$  Nm about the H-point by applying a force to the seat back through the back pan at the rate of  $187 \pm 37$  Nm/minute. The initial location on the back pan of the moment generating force vector has a height of  $290 \text{ mm} \pm 13 \text{ mm}$ . Apply the force vector normal to the torso reference line and maintain it within 2 degrees of a vertical plane parallel to the vehicle longitudinal centerline. Constrain the back pan to rotate about the H-point. Rotate the force vector direction with the back pan.

(5) Maintain the position of the back pan as established in S5.2.7(a)(4) of this section. Using a  $165 \pm 2$  mm diameter spherical head form with a surface roughness of less than 1.6  $\mu\text{m}$ , root mean square, establish the head form initial reference position by applying, perpendicular to the displaced torso reference line, a posterior initial load at the seat centerline at a height  $65 \pm 3$  mm below the top of the head restraint that will produce a  $37 \pm 0.7$  Nm moment about the H-point. After maintaining this moment for  $5.5 \pm 0.5$  seconds, measure the posterior displacement of the head form during the application of the load.

(6) Increase the initial load at the rate of  $187 \pm 37$  Nm/minute until a  $373 \pm 7.5$  Nm moment about the H-point is produced. Maintain the load level producing that moment for  $5.5 \pm 0.5$  seconds and then measure the posterior displacement of the head form relative to the displaced torso reference line.

(7) Reduce the load at the rate of  $187 \pm 37$  Nm/minute until it is completely removed. Maintain this condition for not more than two minutes.

(8) Increase the load at the rate of  $187 \pm 37$  Nm/minute until a  $37 \pm 0.7$  Nm moment about the H-point is produced. After maintaining the load level producing that moment for  $5.5 \pm 0.5$  seconds, measure the posterior displacement of the head form position with respect to its initial reference position; and

(b) *Strength.* Increase the load specified in S5.2.7(a)(7) of this section at the rate of  $250 \pm 50$  N/minute to at least 890 N and maintain this load level for  $5.5 \pm 0.5$  seconds.

**S5.3 Procedures for dynamic performance.** Demonstrate compliance with S4.3 of this section in accordance with S5.3.1 through S5.3.9 of this section with a 50th percentile male Hybrid III test dummy specified in 49 CFR Part 572 Subpart E, fitted with sensors to measure head to torso rotation. The dummy with all sensors is to continue to meet all specifications in 49 CFR Part 572 Subpart E. The restraint is positioned midway between the lowest and the highest position of adjustment.

**S5.3.1** Mount the vehicle on a dynamic test platform at the vehicle altitude set forth in S13.3 of § 571.208 of this part, so that the longitudinal centerline of the vehicle is parallel to the direction of the test platform travel and so that movement between the base of the vehicle and the test platform is prevented. Instrument the platform with an accelerometer and data processing system. Position the accelerometer sensitive axis parallel to the direction of test platform travel.

**S5.3.2** Remove the tires, wheels, fluids, and all unsecured components. Remove or rigidly secure the engine, transmission, axles, exhaust, vehicle frame and any other vehicle component necessary to assure that all points on the acceleration vs. time plot measured by an accelerometer on the dynamic test platform fall within the corridor described in Figure 1 and Table 1.

**S5.3.3** Place any moveable windows in the fully open position.

**S5.3.4** *Seat Adjustment.* At each outboard designated seating position, if the seat back is adjustable, it is set at an initial inclination position closest to 25 degrees from the vertical, as measured by SAE J826 (July 1995) manikin. If there is more than one inclination position closest to 25 degrees from the vertical, set the seat back inclination to the position closest to and rearward of 25 degrees. Using any control that primarily moves the entire seat vertically, place the seat in the lowest position. Using any control that primarily moves the entire seat in the fore and aft directions, place the seat midway between the forwardmost and

rearmost position. If an adjustment position does not exist midway between the forwardmost and rearmost positions, the closest adjustment position to the rear of the midpoint is used. Adjust the seat cushion and seat back as required by S5 and S5.1 of this section. If the head restraint is adjustable, adjust the top of the head restraint to a position midway between the lowest position of adjustment and the highest position of adjustment. If an adjustment position midway between the lowest and the highest position does not exist, adjust the head restraint to a position below and nearest to midway between the lowest position of adjustment and the highest position of adjustment.

**S5.3.5 Seat Belt Adjustment.** Prior to placing the Type 2 seat belt around the test dummy, fully extend the webbing from the seat belt retractor(s) and release it three times to remove slack. If an adjustable seat belt D-ring anchorage exists, place it in the adjustment position closest to the mid-position. If an adjustment position does not exist midway between the highest and lowest position, the closest adjustment position above the midpoint is used.

**S5.3.6 Dress and adjust each test dummy as specified in S8.1.8.2 through S8.1.8.3 of § 571.208 of this Part.** The stabilized test temperature of the test dummy is at any temperature level between 69 degrees F and 72 degrees F, inclusive.

**S5.3.7 Test dummy positioning procedure.** Place a test dummy at each outboard designated seating position equipped with a head restraint.

**S5.3.7.1 Head.** The transverse instrumentation platform of the head is level within ½ degree. To level the head of the test dummy, the following sequence is followed. First, adjust the position of the H-point within the limits set forth in S10.4.2.1 of § 571.208 to level the transverse instrumentation platform of the head of the test dummy. If the transverse instrumentation platform of the head is still not level, then adjust the pelvic angle of the test dummy. If the transverse instrumentation platform of the head is still not level, then adjust the neck bracket of the dummy the minimum amount necessary from the non-adjusted "0" setting to ensure that the transverse instrumentation platform of the head is horizontal within ½ degree. The test dummy remains within the limits specified in S10.4.2.1 of § 571.208 after any adjustment of the neck bracket.

**S5.3.7.2 Upper arms and hands.** Position each test dummy as specified in S10.2 and S10.3 of § 571.208 of this Part.

**S5.3.7.3 Torso.** Position each test dummy as specified in S10.4.1.1, S10.4.1.2, and S10.4.2.1 of § 571.208 of this Part, except that the midsagittal plane of the dummy is aligned within 15 mm of the head restraint centerline. If the midsagittal plane of the dummy cannot be aligned within 15 mm of the head restraint centerline then align the midsagittal plane of the dummy as close as possible to the head restraint centerline.

**S5.3.7.4 Legs.** Position each test dummy as specified in S10.5 of § 571.208 of this Part, except that final adjustment to accommodate placement of the feet in accordance with S5.3.7.5 of this section is permitted.

**S5.3.7.5 Feet.** Position each test dummy as specified in S10.6 of § 571.208 of this Part, except that for rear outboard designated seating positions the feet of the test dummy are placed flat on the floorpan and beneath the front seat as far forward as possible without front seat interference. For rear outboard designated seating positions, if necessary, the distance between the knees can be changed in order to place the feet beneath the seat.

**S5.3.8 Accelerate the dynamic test platform to  $17.3 \pm 0.6$  km/h.** All of the points on the acceleration vs. time curve fall within the corridor described in Figure 1 and Table 1 when filtered to channel class 60, as specified in the SAE Recommended Practice J211/1 (March 1995). Measure the maximum posterior angular displacement.

**S5.3.9 Calculate the angular displacement from the output of instrumentation placed in the torso and head of the test dummy and an algorithm capable of determining the relative angular displacement to within one degree and conforming to the requirements of a 600 Hz channel class, as specified in SAE Recommended Practice J211/1, March 1995.** No data generated after 200 ms from the beginning of the forward acceleration are used in determining angular displacement of the head with respect to the torso.

**S5.3.10 Calculate the HIC<sub>15</sub> from the output of instrumentation placed in the head of the test dummy, using the equation in S4.3.1(b) of this section and conforming to the requirements for a 1000 Hz channel class as specified in SAE Recommended Practice J211/1 (March 1995).** No data generated after 200 ms from the beginning of the forward acceleration are used in determining HIC.

**S5.4 Procedures for folding or retracting head restraints for unoccupied rear outboard designated seating positions.**

(a) Demonstrate compliance with S4.4 (a) of this section, using a 5th percentile female Hybrid III test dummy specified in 49 CFR Part 572, Subpart O, in accordance with the following procedure—

(1) Position the test dummy in the seat such that the dummy's midsagittal plane is aligned within the 15 mm of the head restraint centerline and is parallel to a vertical plane parallel to the vehicle longitudinal centerline.

(2) Hold the dummy's thighs down and push rearward on the upper torso to maximize the dummy's pelvic angle.

(3) Place the legs as close as possible to 90 degrees to the thighs. Push rearward on the dummy's knees to force the pelvis into the seat so there is no gap between the pelvis and the seat back or until contact occurs between the back of the dummy's calves and the front of the seat cushion such that the angle between the dummy's thighs and legs begins to change.

(4) Note the position of the head restraint. Remove the dummy from the seat. If the head restraint returns to a retracted position upon removal of the dummy, manually place it in the noted position. Determine compliance with the height requirements of S4.2.1 of this section by using the test procedures of S5.2.1 of this section.

(b) Demonstrate compliance with S4.4 (b) of this section in accordance with the following procedure:

(1) Place the rear head restraint in any position meeting the requirements of S4.2 of this section;

(2) Strike a line on the head restraint. Measure the angle or range of angles of the head restraint reference line as projected onto a vertical longitudinal vehicle plane. Alternatively, measure the torso reference line angle with the SAE J826 (July 1995) manikin;

(3) Fold or retract the head restraint to a position in which its minimum height is less than that specified in S4.2.1 (b) of this section;

(4) Determine the minimum change in the head restraint reference line angle as projected onto a vertical longitudinal vehicle plane from the angle or range of angles measured in 5.4(b)(2). Alternatively, determine the change in the torso reference line angle with the SAE J826 (July 1995) manikin.

**S6 Vehicles manufactured on or after September 1, 2009, and before September 1, 2010 (Phase-in of § 571.202a).**

(a) For vehicles manufactured for sale in the United States on or after September 1, 2009, and before September 1, 2010, a percentage of the manufacturer's production, as specified in S6.1, shall meet the requirements



specified in this § 571.202a without regard to any option to comply with the standard in § 571.202 or with the European regulations referenced in S4.3(a) of § 571.202. So long as this percentage requirement is met, a vehicle may comply with the standard in this § 571.202a, with the standard in § 571.202, or with the European regulations referenced in S4.3(a) of § 571.202.

(b) Notwithstanding S6(a), vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with Part 567 of this chapter may comply with the standard in this § 571.202a, with the standard in § 571.202, or with the European regulations referenced in S4.3(a) of § 571.202.

**S6.1 Phase-in percentage.** For vehicles manufactured by a manufacturer on or after September 1, 2009, and before September 1, 2010, the amount of vehicles complying with S6(a) shall be not less than 80 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2009, the manufacturer's average annual production of vehicles manufactured on or after September 1, 2007, and before September 1, 2010, or

(b) The manufacturer's production on or after September 1, 2009, and before September 1, 2010.

**S6.2 Vehicles produced by more than one manufacturer.**

S6.2.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S6.1, a vehicle produced by more than one

manufacturer shall be attributed to a single manufacturer as follows, subject to S6.2.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

**S6.2.2** A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR Part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S6.2.1.

**S7. Vehicles manufactured on or after September 1, 2010, and before September 1, 2011 (Phase-in of rear seat requirements of § 571.202a).**

(a) For vehicles manufactured for sale in the United States on or after September 1, 2010, and before September 1, 2011 a percentage of the manufacturer's production of vehicles equipped with rear outboard head restraints, as specified in S7.1, shall meet the requirements specified in this § 571.202a for rear head restraints.

(b) Vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with Part 567 of this chapter are not subject to the requirement specified in S7(a).

**S7.1 Phase-in percentage.** For vehicles manufactured by a manufacturer on or after September 1, 2010, and before September 1, 2011, the amount of vehicles equipped with rear outboard head restraints complying

with S7(a) shall be not less than 80 percent of:

(a) If the manufacturer has manufactured vehicles for sale in the United States during both of the two production years prior to September 1, 2010, the manufacturer's average annual production of vehicles equipped with rear outboard head restraints manufactured on or after September 1, 2008, and before September 1, 2011, or

(b) The manufacturer's production of vehicles equipped with rear outboard head restraints on or after September 1, 2010, and before September 1, 2011.

**S7.2 Vehicles produced by more than one manufacturer.**

S7.2.1 For the purpose of calculating average annual production of vehicles for each manufacturer and the number of vehicles manufactured by each manufacturer under S6.1, a vehicle produced by more than one manufacturer shall be attributed to a single manufacturer as follows, subject to S7.2.2.

(a) A vehicle that is imported shall be attributed to the importer.

(b) A vehicle manufactured in the United States by more than one manufacturer, one of which also markets the vehicle, shall be attributed to the manufacturer that markets the vehicle.

**S7.2.2** A vehicle produced by more than one manufacturer shall be attributed to any one of the vehicle's manufacturers specified by an express written contract, reported to the National Highway Traffic Safety Administration under 49 CFR Part 585, between the manufacturer so specified and the manufacturer to which the vehicle would otherwise be attributed under S7.2.1.

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**Table 1 of 571.202a – Sled pulse corridor reference point locations.**

Reference Point	Time (ms)	Acceleration (m/s <sup>2</sup> )
A	0	10
B	28	94
C	60	94
D	92	0
E	4	0
F	38.5	80
G	49.5	80
H	84	0

**Figure 1 of §571.202a - Sled pulse acceleration corridor. The target acceleration with time expressed in milliseconds is  $a = 86 \sin(\pi t/88) \text{ m/s}^2$ , for  $V = 17.3 \pm 0.6 \text{ km/h}$ . The time zero for the test is defined by the point when the sled acceleration achieves  $2.5 \text{ m/s}^2$  (0.25 G's).**

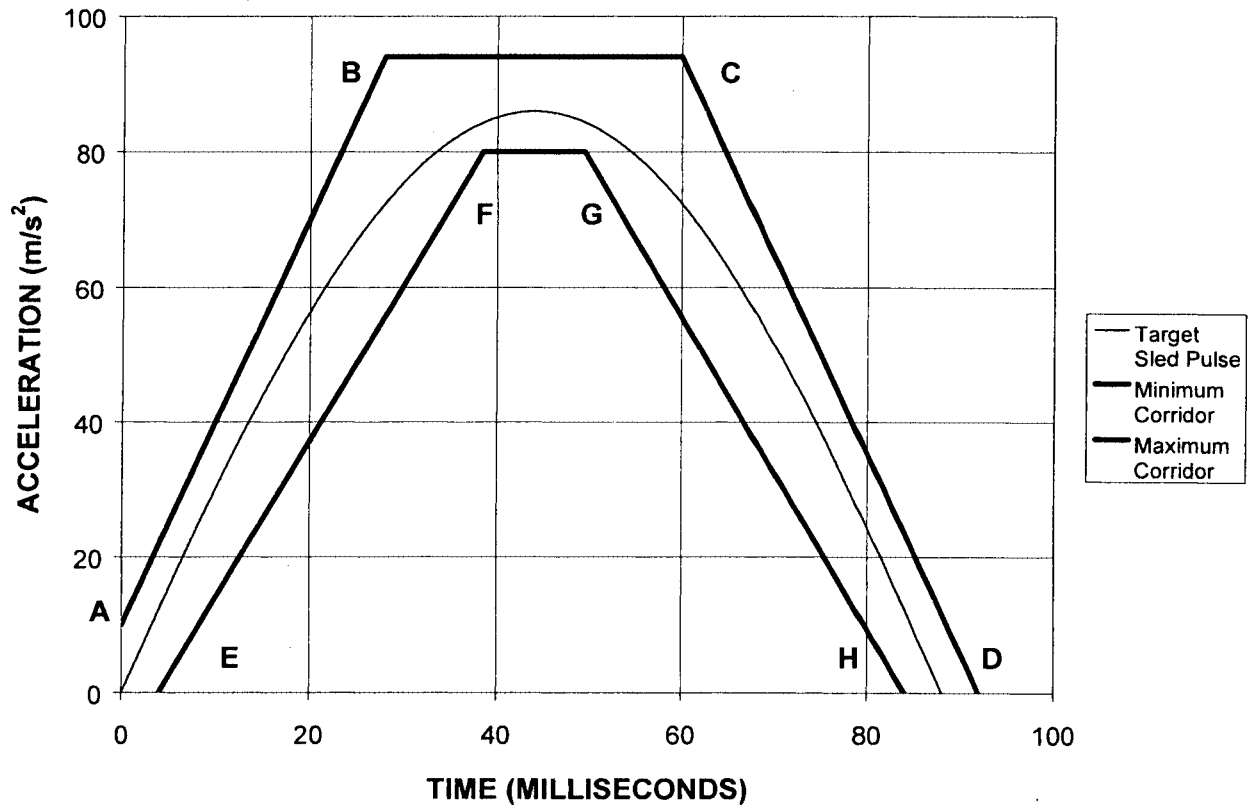


Figure 2 of §571.202a - Measurement of a vertical gap “a”.

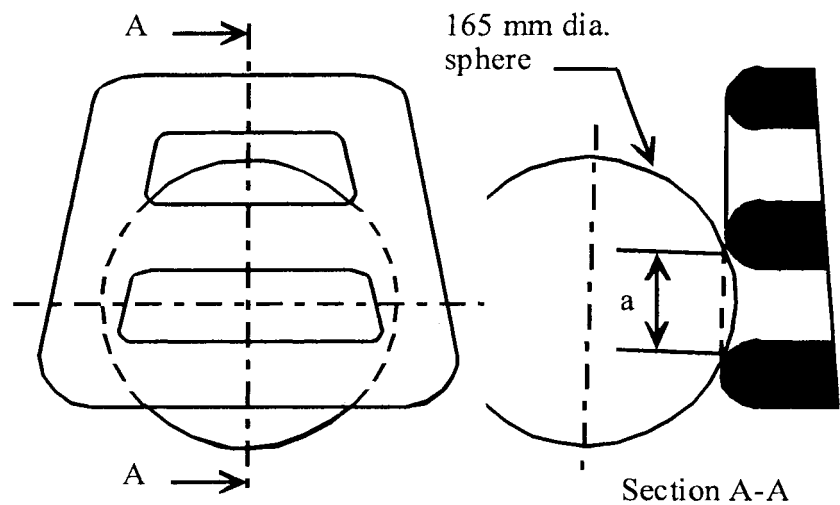
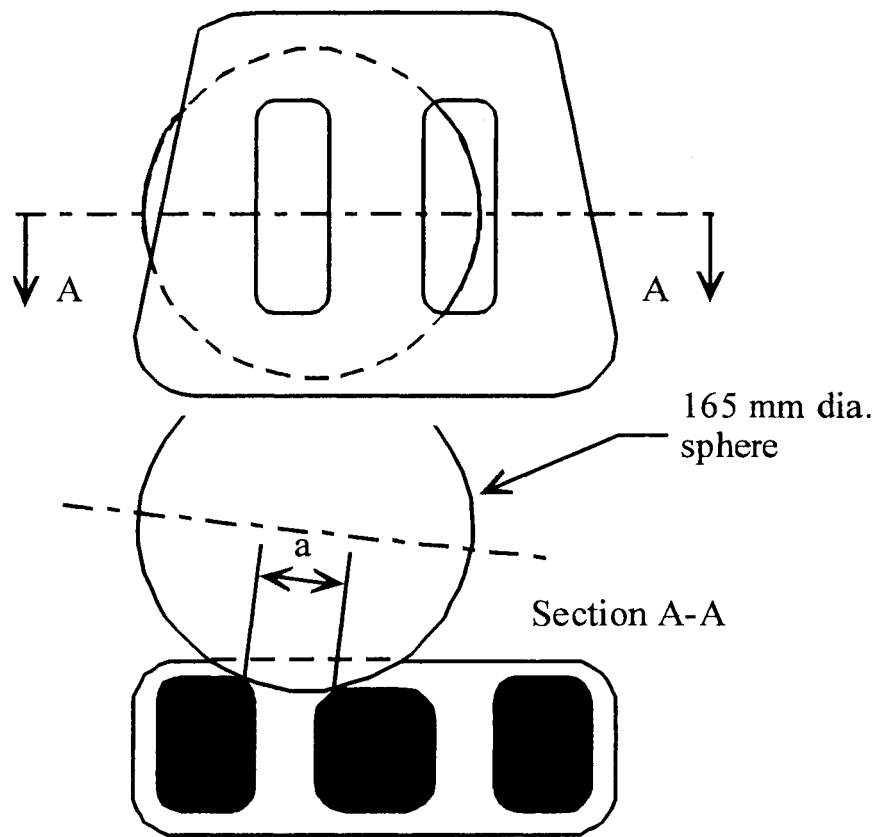
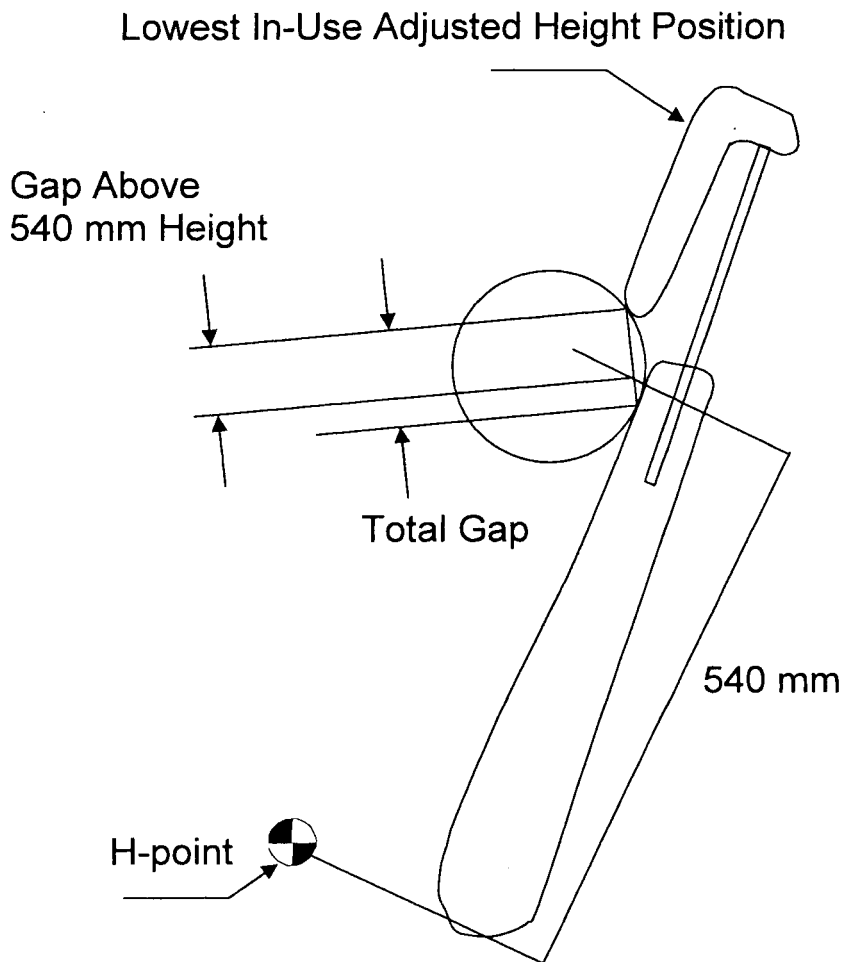


Figure 3 of §571.202a - Measurement of a horizontal gap “a”.



**Figure 4 of §571.202a – Portion of gap above 540 mm height.**

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**PART 585—PHASE-IN REPORTING REQUIREMENTS**

■ 4. The authority citation for Part 585 of Title 49 continues to read as follows:

**Authority:** 49 U.S.C. 322, 30111, 30115, 30117, and 30166; delegation of authority at 49 CFR 1.50.

■ 5. Amend Part 585 by adding Subpart J to read as follows:

**Subpart J—Head Restraints Phase-in Reporting Requirements**

Sec.

- 585.91 Scope.
- 585.92 Purpose.
- 585.93 Applicability.
- 585.94 Definitions.
- 585.95 Response to inquiries.
- 585.96 Reporting requirements.
- 585.97 Records.

**Subpart J—Head Restraints Phase-in Reporting Requirements****§ 585.91 Scope.**

This subpart establishes requirements for manufacturers of passenger cars, multipurpose passenger vehicles, trucks and buses with a GVWR of 4,536 kg or less to submit a report, and maintain records related to the report, concerning the number of vehicles that meet the requirements of Standard No. 202a.

**§ 585.92 Purpose.**

The purpose of these reporting requirements is to assist the National Highway Traffic Safety Administration in determining whether a manufacturer has complied with Standard No. 202a.

**§ 585.93 Applicability.**

This subpart applies to manufacturers of passenger cars, multipurpose passenger vehicles, trucks and buses

with a GVWR of 4,536 kg or less. However, it does not apply to manufacturers whose production consists exclusively of vehicles that are manufactured in two or more stages or that are altered (within the meaning of 49 CFR 567.7) after having previously been certified in accordance with Part 567 of this chapter.

**§ 585.94 Definitions.**

*Production year* means the 12-month period between September 1 of one year and August 31 of the following year, inclusive.

**§ 585.95 Response to inquiries.**

(a) *Production year ending August 31, 2010.* At any time during the production year, each manufacturer must, upon request from the Office of Vehicle Safety Compliance, provide information identifying the vehicles (by make, model and vehicle identification

number) that have been certified as complying with § 571.202a without regard to any option to comply with the standard in § 571.202 or with the European regulations referenced in S4.3(a) of § 571.202.

(b) *Production year ending August 31, 2011.* At any time during the production year, each manufacturer must, upon request from the Office of Vehicle Safety Compliance, provide information identifying the vehicles (by make, model and vehicle identification number) that have been certified as complying with the requirements specified in § 571.202a for rear head restraints.

#### **§ 585.96 Reporting Requirements.**

(a) *Production year ending August 31, 2010.*

(1) *General reporting requirements.* Within 60 days after the end of the production year ending August 31, 2010, each manufacturer must submit a report to the National Highway Traffic Safety Administration concerning its compliance with the head restraint requirements specified in § 571.202a, without regard to any option to comply with the standard in § 571.202 or with the European regulations referenced in S4.3(a) of § 571.202, for its passenger cars, trucks, buses and multipurpose passenger vehicles produced in that year. The report must provide the information specified in paragraph (2) of this section and in § 585.2 of this part.

(2) *Report content.*

(i) *Basis for phase-in production goals.* Each manufacturer must provide the number of passenger cars and multipurpose passenger vehicles, trucks and buses with a GVWR of 4,536 kg or

less manufactured for sale in the United States. The number must be either the manufacturer's average annual production of vehicles manufactured on or after September 1, 2007 and before September 1, 2010, or, at the manufacturer's option, the manufacturer's production on or after September 1, 2009 and before September 1, 2010. A new manufacturer that has not previously manufactured these vehicles for sale in the United States must report the number of such vehicles manufactured during the production period beginning on or after September 1, 2009 and before September 1, 2010.

(ii) *Production.* Each manufacturer must report for the production year ending August 31, 2010: The total number of passenger cars, multipurpose passenger vehicles, trucks, and buses with a gross vehicle weight rating of 4,536 kg or less that meet § 571.202a, without regard to any option to comply with the standard in § 571.202 or with the European regulations referenced in S4.3(a) of § 571.202.

(b) *Production year ending August 31, 2011.*

(1) *General reporting requirements.* Within 60 days after the end of the production year ending August 31, 2011, each manufacturer must submit a report to the National Highway Traffic Safety Administration concerning its compliance with the rear head restraint requirements specified in § 571.202a. The report must provide the information specified in paragraph (2) of this section and in § 585.2 of this part.

(2) *Report content.*

(i) *Basis for phase-in production goals.* Each manufacturer must provide

the number of passenger cars and multipurpose passenger vehicles, trucks and buses with a GVWR of 4,536 kg or less manufactured for sale in the United States with rear head restraints. The number must be either the manufacturer's average annual production of vehicles with rear head restraints manufactured on or after September 1, 2008 and before September 1, 2011, or, at the manufacturer's option, the manufacturer's production on or after September 1, 2010 and before September 1, 2011. A new manufacturer that has not previously manufactured these vehicles for sale in the United States must report the number of such vehicles manufactured during the production period on or after September 1, 2010 and before September 1, 2011.

(ii) *Production.* Each manufacturer must report for the production year ending August 31, 2011: The total number of passenger cars, multipurpose passenger vehicles, trucks, and buses with a gross vehicle weight rating of 4,536 kg or less that meet the rear head restraint requirements of § 571.202a.

#### **§ 585.97 Records.**

Each manufacturer must maintain records of the Vehicle Identification Number for each vehicle for which information is reported under § 585.96 until December 31, 2007.

Issued on: April 16, 2007.

**Nicole R. Nason,**

*Administrator.*

[FR Doc. 07-2011 Filed 5-3-07; 8:45 am]

**BILLING CODE 4910-59-P**