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Head Restraints

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Introduction

As defined by section 12 of the *Motor Vehicle Safety Act*, a Technical Standards Document (TSD) is a document that reproduces an enactment of a foreign government (e.g. a Federal Motor Vehicle Safety Standard issued by the United States National Highway Traffic Safety Administration). According to the Act, the *Motor Vehicle Safety Regulations* may alter or override some provisions contained in a TSD or specify additional requirements; consequently, it is advisable to read a TSD in conjunction with the Act and its counterpart Regulation. As a guide, where the corresponding Regulation contains additional requirements, footnotes indicate the amending subsection number.

TSDs are revised from time to time in order to incorporate amendments made to the reference document, at which time a Notice of Revision is published in the *Canada Gazette*, Part I. All TSDs are assigned a revision number, with “Revision 0” designating the original version.

Identification of Changes

In order to facilitate the incorporation of a TSD, certain non-technical changes may be made to the foreign enactment. These may include the deletion of words, phrases, figures, or sections that do not apply under the Act or Regulations, the conversion of imperial to metric units, the deletion of superseded dates, and minor changes of an editorial nature. Additions are underlined, and provisions that do not apply are ~~stroked through~~. Where an entire section has been deleted, it is replaced by: “[CONTENT DELETED]”. Changes are also made where there is a reporting requirement or reference in the foreign enactment that does not apply in Canada. For example, the name and address of the United States Department of Transportation are replaced by those of the Department of Transport.

Effective Date and Mandatory Compliance Date

The effective date of a TSD is the date of publication of its incorporating regulation or of the notice of revision in the *Canada Gazette*, and the date as of which voluntary compliance is permitted. The mandatory compliance date is the date upon which compliance with the requirements of the TSD is obligatory. If the effective date and mandatory compliance date are different, manufacturers may follow the requirements that were in force before the effective date, or those of this TSD, until the mandatory compliance date.

In the case of an initial TSD, or when a TSD is revised and incorporated by reference by an amendment to the Regulations, the mandatory compliance date is as specified in the Regulations, and it may be the same as the effective date. When a TSD is revised with no corresponding changes to the incorporating Regulations, the mandatory compliance date is six months after the effective date.

Official Version of Technical Standards Documents

The PDF version is a replica of the TSD as published by the Department and is to be used for the purposes of legal interpretation and application.

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S1. Purpose and scope

This Technical Standards Document (TSD) standard specifies requirements for head restraints to reduce the frequency and severity of neck injury in rear-end and other collisions.

S2. Application and incorporation by reference

S2.1 Application

[CONTENT DELETED] For applicability, see Schedule III and subsection 202(1) of Schedule IV to the *Motor Vehicle Safety Regulations*.

S2.2 Incorporation by reference

[CONTENT DELETED]

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. (*Distance de retrait*)

~~*Head restraint means a device that limits rearward displacement of a seated occupant's head relative to the occupant's torso. (*Appuie-tête*)~~

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). (*Dispositif de mesure de la position de l'appuie-tête (DMPA)*)

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. (*Hauteur*)

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. (*Destiné à l'usage des occupants*)

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. (*Appuie-tête arrière*)

* Please see subsection 2(1) of the *Motor Vehicle Safety Regulations* for the applicable definition.

Top of the head restraint means the point on the head restraint with the greatest height.
(*Sommet de l'appuie-tête*)

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 vehicle 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 Chapter V, Title 49, part 572 of the most recent edition of the *Code of Federal Regulations*, hereafter referred to as 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 ± 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 head restraint and seat using a 25 mm cylinder. The following option is only available to head restraints that can move with respect to the seat.

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 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 $37 \pm 0.7 \text{ Nm}$.

(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, and at any position of backset 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 a 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° for the dummy in all outboard designated seating positions;

- (b) *Head injury criteria (HIC)*. Limit the maximum HIC₁₅ value to 500. HIC₁₅ 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 (HIC₁₅) 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:

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

S4.3.2 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° 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° 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 as follows. The positions of seat adjustment specified in S5 and S5.1 are conditions to be met concurrently and are not a sequential list of adjustments. Any adjustable lumbar support is 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 Chapter V, Title 49, part 571, section 208 of the most recent edition of the *Code of*

Federal Regulations, hereafter referred to as 49 CFR, part 572, section 208§ 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 TSD standard are conducted with the ambient temperature between 18°C. and 28°C.

S5.1 [Untitled]

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 ± 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 ± 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 μm , 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 ± 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. If 125 mm or more of the cylinder can completely pass through the gap, the gap is not in compliance.

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 ± 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 ± 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° 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 ± 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 ± 1 N at the rate of 250 ± 50 N/minute. Determine the reference position after 5.5 ± 0.5 seconds at this load.

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

- (d) Reduce the load at the rate of 250 ± 50 N/minute until the load is completely removed. Maintain this condition for two minutes ± 5 seconds.

- (e) Increase the load at the rate of 250 ± 50 N/minute to 50 ± 1 N and, after 5.5 ± 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. This fixation is applied to the member(s) that first transmit(s) the seat back loading from the occupant to the head restraint.
- (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 ± 7.5 Nm about the H-point by applying a force to the seat back through the back pan at the rate of 187 ± 37 Nm/minute. The initial location on the back pan of the moment generating force vector has a height of 290 ± 13 mm. Apply the force vector normal to the torso reference line and maintain it within 2° 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 ± 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 aligning the centerline of the head form perpendicular to the displaced torso reference line, on the seat centerline, and at a height 65 ± 3 mm below the top of the head restraint. Apply a posterior initial load that will produce a 37 ± 0.7 Nm moment about the H-point. After maintaining this moment for 5.5 ± 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 ± 37 Nm/minute until a 373 ± 7.5 Nm moment about the H-point is produced. Maintain the load level producing that moment for 5.5 ± 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 ± 37 Nm/minute until it is completely removed. Maintain this condition for two minutes ± 0.5 seconds.
 - (8) Increase the load at the rate of 187 ± 37 Nm/minute until a 37 ± 0.7 Nm moment about the H-point is produced. After maintaining the load level producing that moment for 5.5 ± 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 ± 50 N/minute to at least 890 N and maintain this load level for 5.5 ± 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, and at any position of backset.

S5.3.1 Mount the vehicle on a dynamic test platform at the vehicle altitude set forth in S13.3 of ~~§571.208~~ 49 CFR, part 571, section 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. The following seat adjustments specify conditions to be met concurrently and are not a sequential list of adjustments. At each outboard designated seating position, 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 of this section. If the seat back is adjustable, it is set at an 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. 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 49 CFR, part 571, section 208 §571.208 of this part. The stabilized test temperature of the test dummy is at any temperature level between 20.5°C and 22.2°C (69°F and 72°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 1/2 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 49 CFR, part 571, section 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 1/2 degree. The test dummy remains within the limits specified in S10.4.2.1 of 49 CFR, part 571, section 208 §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 49 CFR, part 572, section 208 §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 49 CFR, part 571, section 208 §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 49 CFR, part 571, section 208 §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 49 CFR, part 571, section 208 §571.208 of this part, except that for rear outboard designated seating positions the feet of the test dummy are placed flat on the floor plan 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 ± 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_{15} 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 [Untitled]

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° 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

[CONTENT DELETED]

S7. Vehicles manufactured on or after September 1, 2010, and before September 1, 2011

[CONTENT DELETED]

Table 1 — Sled Pulse Corridor Reference Point Locations

Reference Point	Time (ms)	Acceleration (m/s ²)
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

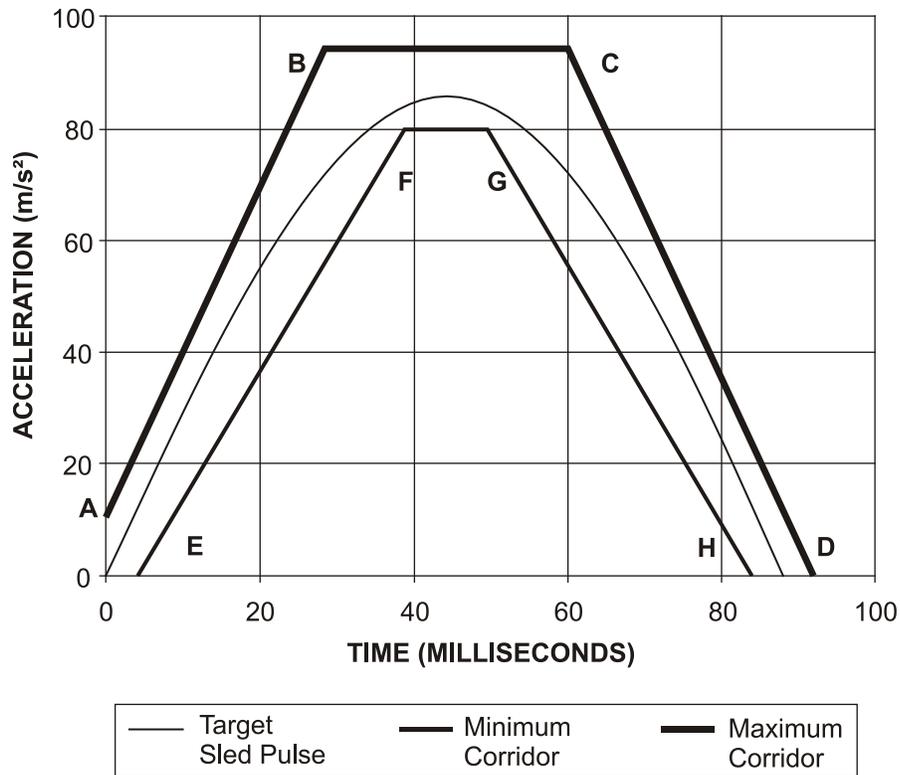
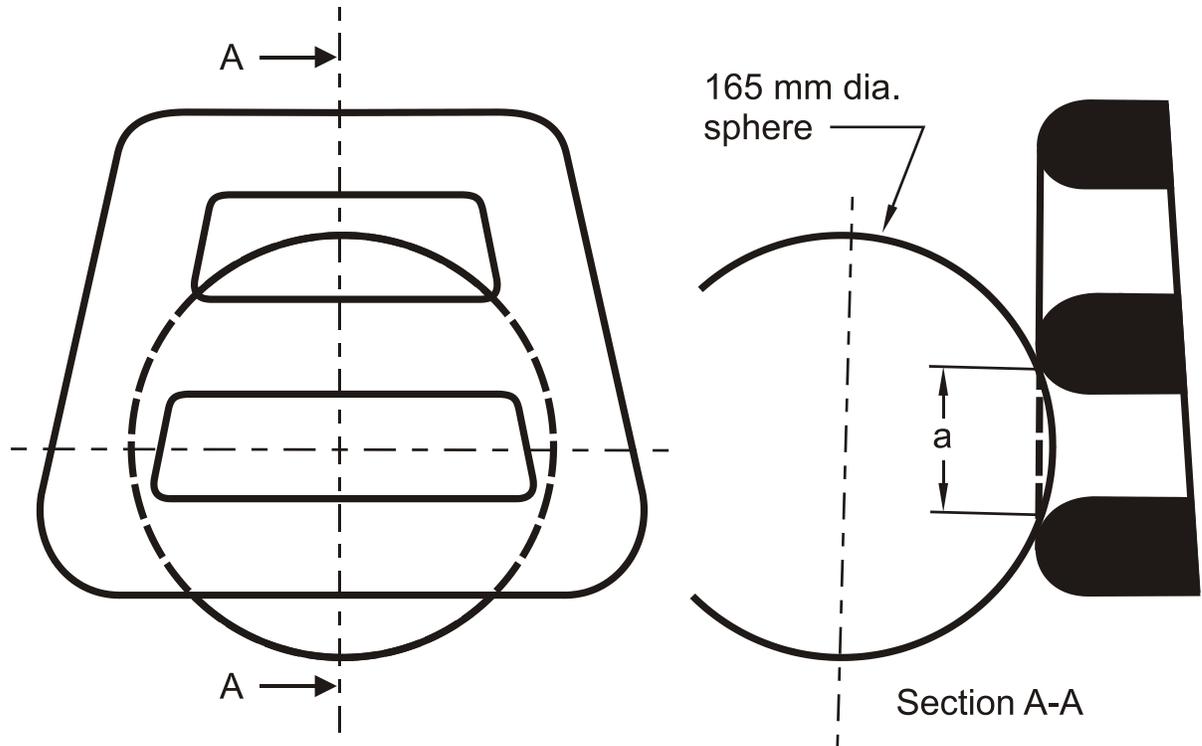


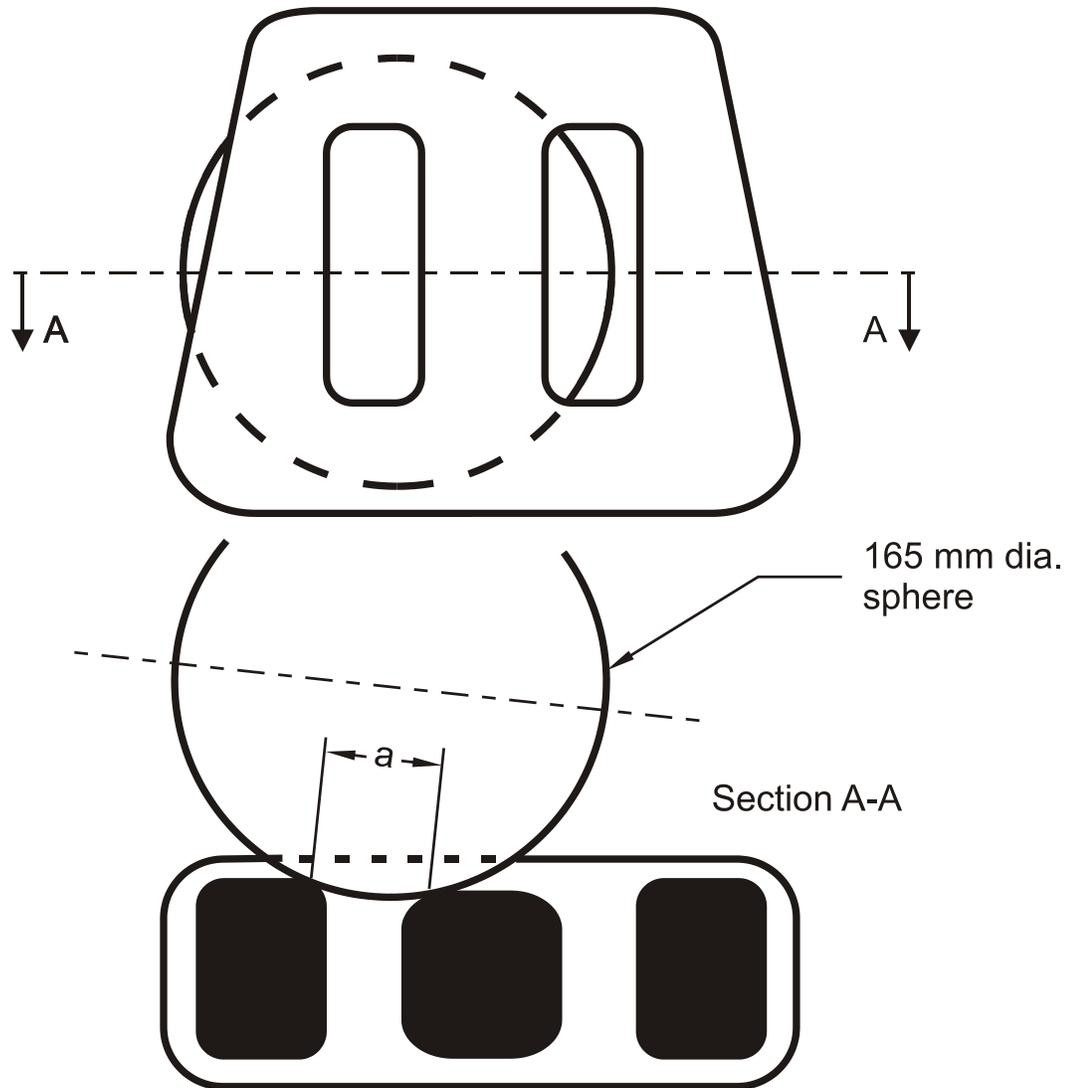
Figure 1 — Sled Pulse Acceleration Corridor

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 accelerations achieves 2.5 m/s^2 (0.25 G's).



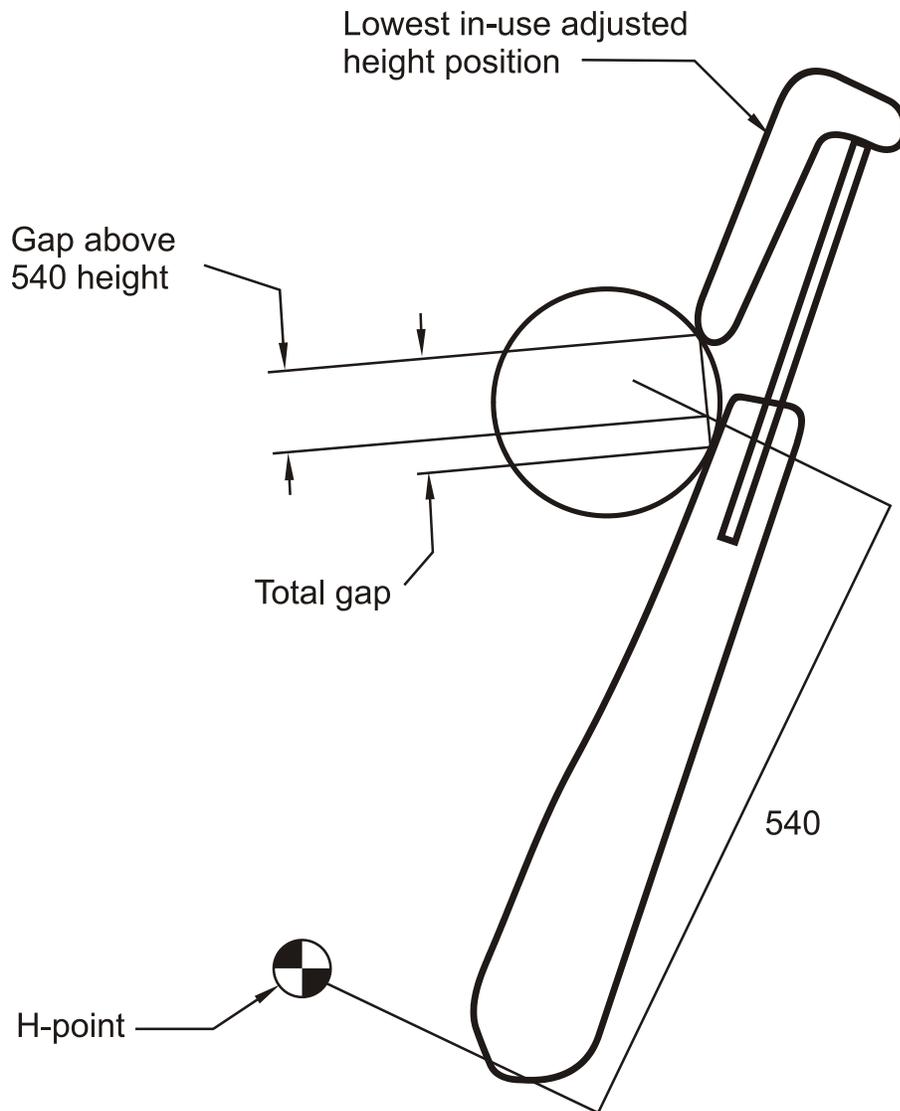
Note: Drawing not to scale

Figure 2 — Measurement of a Vertical Gap "a"



Note: Drawing not to scale

Figure 3 — Measurement of a Horizontal Gap "a"



- Notes:
1. Dimensions in mm
 2. Drawing not to scale

Figure 4 — Portion of Gap Above 540-mm Height