



Overall Seat Hardness and Seat Hardness Distribution Test Procedure

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This document provides test methods for evaluating performance characteristics of motor vehicle seating related to occupant support, penetration, and comfort. It provides a means of comparing and assessing comfort-related performance of complete prototype or competitive benchmark vehicle seat systems.

1.2 Applicability. These test procedures apply to complete seat systems (production seats or prototypes built at the intended manufacturing quality). Testing must be performed on complete seat backs and complete seat cushions. Tests performed on subsystems or individual components will not be considered valid. For convenience and simplicity, many terms associated with H-Point devices use human body parts in their name. However, they should not be construed as measures that indicate interaction with any or all occupants concerning accommodation, human capabilities, or comfort. H-Point devices do not represent the size or posture of any category of occupant (see SAE J2896).

1.3 Remarks. The tools and procedures for determining seat coordinate positions used in this document are based on the SAE J826; H-Point Machine (Manikin).

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

SAE J826 SAE J2896

2.2 GM Standards/Specifications.

GMW16710 GMW16712 GMW16719

2.3 Additional References.

- Best Fit Method
- Hardness Distribution Test

3 Resources

3.1 Facilities. Tests must be performed in a climate controlled area capable of maintaining a constant temperature of $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and a relative humidity of $50\% \pm 5\%$.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Load/Deflection Measuring System. A system capable of applying forces up to 1500 N at a constant rate and measuring the resulting indenter position is required. Optionally, a system that is capable of performing tests on the seat, while the seat is mounted in the vehicle, may be used, provided the vehicle suspension effects are removed.

3.2.2 Seat Fixture. Fixture capable of simulating the position of the seat within the vehicle and capable of mounting the seat in positions required for testing of seat cushion and seat back.

3.2.3 Indenters. For overall seat cushion measurements, the SAE J826 buttock form, as seen in Figure 1, shall be used with a fixed joint. If overall seat back measurements are desired, the SAE J826 back form shall be used with a fixed joint.

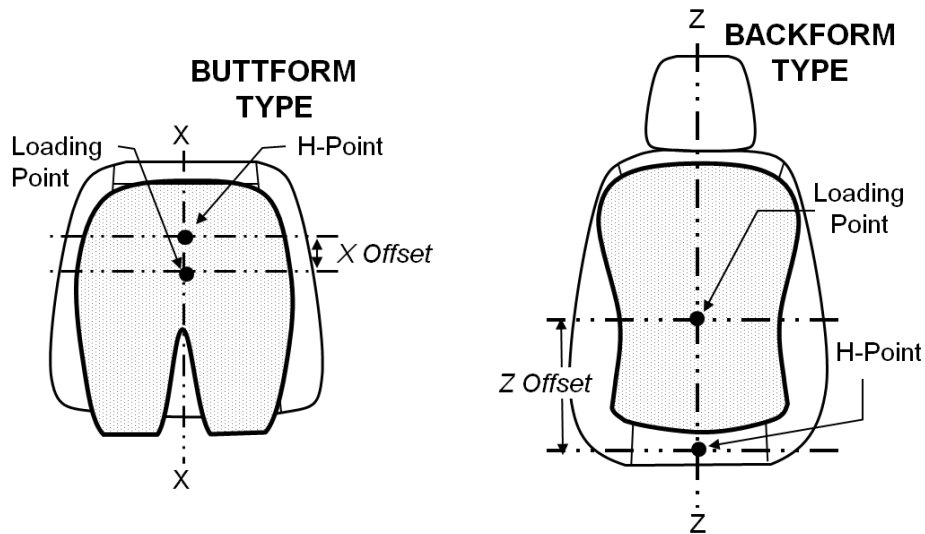


Figure 1: SAE J826 Buttock and Back Pans for Overall Cushion/Seat Back Measurements

- a. For the Hardness Distribution Test, the SAE J2896 indenter, as shown in Figure 2, is to be used.

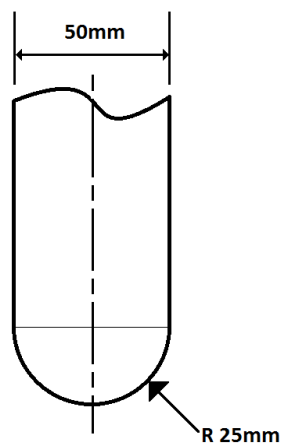


Figure 2: Indenter for Hardness Distribution Test

- b. For the Oval Type Indenter, the SAE J2896 Seatback and Seat Cushion Pressing Plate, as shown in Figure 3, shall be used.

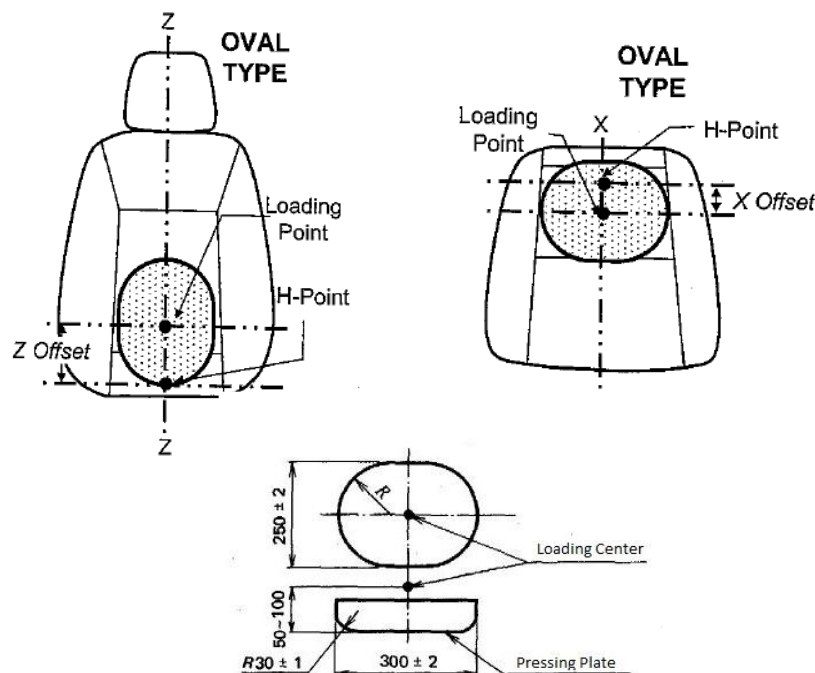


Figure 3: SAE J2896 Oval Type Pressing Plate (all dimensions in millimeters)

3.3 Test Vehicle/Test Piece. A complete seat created at the intended level of manufacturing quality shall be used.

3.4 Test Time.

Calendar time:	1.5 days
Test hours:	8 hours
Coordination hours:	4 hours

3.5 Test Required Information. Torso angle, thigh angle, and Seating Reference Point (SgRP). For General Motors vehicles, the seat should be set into the audit position per GMW16710 and the design SgRP used. For competitive/Non-GM vehicles, the seat should be placed and the H-Point found using GMW16719. SgRP/H-Point will be referred to as the reference point in this procedure.

3.6 Personnel/Skills. Test requires an engineer or technician capable of mounting the seat and running test machinery.

4 Procedure

4.1 Preparation. The specimen should be conditioned, undeflected, and undistorted at $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and relative humidity of $50\% \pm 5\%$ for at least 4 h before being tested. The tests shall be performed 72 h or more after the manufacturing of the raw materials used in the test specimen (foam, elastic components other than metal, etc.)

4.2 Conditions.

4.2.1 Environmental Conditions. Test shall be run at $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and relative humidity of $50\% \pm 5\%$.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Seat Setup. The seats shall be placed into the same position used for finding H-Point. For General Motors vehicles, GMW16710 shall be used. For competitive/Non-GM vehicles, GMW16719 shall be used.

4.3.1.1 Any nonstandard adjustable features should be set to the specified positions. If no setting is specified, features should be set to full off or retracted position (e.g., lumbar support or thigh extender). **Note:** When setting the tilt on the seat, it should be set in the neutral position (middle position); if no tilt position is specified. When setting lumbar to full off (fully deflated) position on a passive lumbar system, it is necessary to push the air out of the air bladders by sitting in the seat with the valve open. This must occur before setting the seat in design position.

4.3.1.2 Measurements shall be referenced to the H-Point, thigh angle, and the torso angle. For General Motors vehicles, the nominal values shall be provided by GM. Loading direction is to be normal to thigh angle (cushion) and torso angle (back) as shown in Figure 4, Figure 5 and Figure 6.

4.3.1.3 If a competitive seat is to be measured, use H-Point procedure from GMW16719 to set the seat in the correct position. For seat force vs. deflection testing of competitive seats, the load direction should be normal to the measured thigh angle and torso angle as seen in Figure 4, Figure 5 and Figure 6.

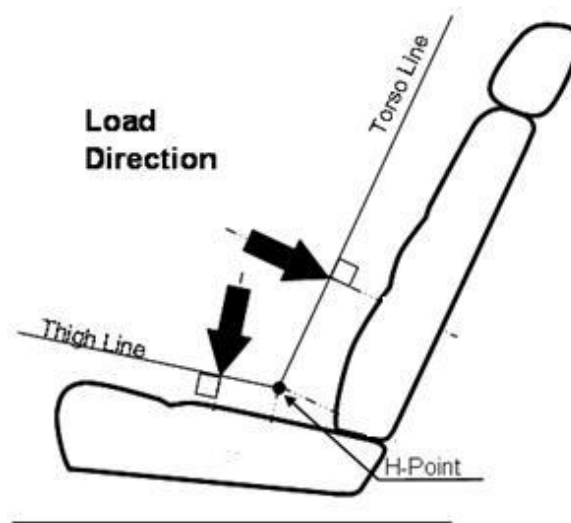


Figure 4: Load Directions



Figure 5: Seat Cushion Fixed, Indentation Normal to Thigh Line



Figure 6: Seat Back Fixed, Indentation Normal to Torso Line
Notice the Head Restraint Bars are Supported

4.3.1.4 Seats should be attached to a rigid fixture capable of securing the test sample in proper position and orientation under test conditions.

4.3.1.5 Place a piece of muslin cotton cloth over the seat area to be checked during all tests. The muslin cloth should be of sufficient size to prevent the machine from contacting the seat. The muslin should be a plain cotton fabric having a thread count and weight typical of a durable, mid-grade, general-purpose muslin that is available from most fabric stores. The muslin should have enough slack so that the cloth does not provide resistance to the indentation. If the muslin cloth is pulled too tight over the surface, the resistance of the cloth will affect the loading/unloading curve.

4.3.2 Overall Cushion Measurement. During the overall cushion measurement, the H-Point of the buttock shape is to be placed 50 mm forward of the reference point of the seat. This is done as it is not possible on many seats to match the H-Point of the buttock form and the reference point of the seat without the buttock shape coming into contact with the seat back. This contact with the seat back would skew the results of the loading test. The placement of the loading point is outlined in Figure 7.

To meet this requirement, the loading point will differ for each buttock form, as the mounting point may be different from one buttock form to the next. See Appendix A, A3, for details in measuring this X-Offset.

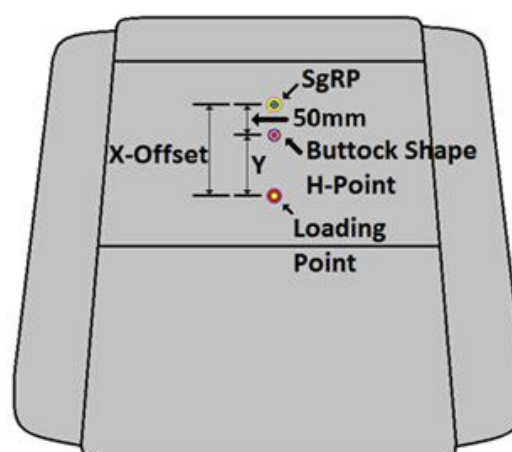


Figure 7: Overall Cushion Measurement Loading Point Location

The test to be performed is outlined as follows. Prior to the test, the force on the machine should be zeroed. No preload should be used. A conditioning cycle should be run prior to each test run. The conditioning cycle should reach a maximum load of 1100 N at a rate of 200 mm/minute and then removed with instantaneous changeover at a rate of 200 mm/minute. Upon termination of the conditioning cycle, there should be a 5 s dwell time prior to the test run. The test cycle's maximum loading force should be 1100 N at a rate of 200 mm/minute. Changeover time from loading to unloading should be instantaneous. Record the force-position data taken during the application and removal of the force on the test specimen. Allow the specimen to rest for 60 s before running subsequent trials. Typically, three total trials are collected. Data is to be collected from both the conditioning cycles and test cycles.

4.3.3 Overall Back Measurement. When performing the overall back measurement, the location of the loading point is to be set so that the H-Point location of the back form matches the location of the reference point of the seat. As the location of the mounting fixture used on each individual back form may differ, it will be necessary to measure the Z-Offset between the H-Point of the back form and the location of the mounting/loading point as seen in Figure 8. For details regarding the measurement of the Z-Offset value, see Appendix A, A4.

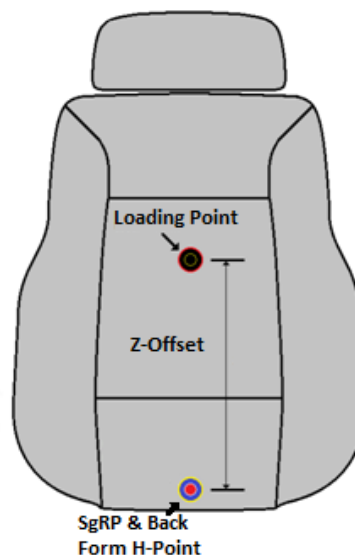


Figure 8: Overall Back Measurement Loading Point Location

The test is to be performed as specified by SAE J2896. This is outlined as follows. Prior to the test, the force on the machine should be zeroed. No preload shall be used. A conditioning cycle should be run prior to each test run. The conditioning cycle shall reach a maximum load of 550 N at a rate of 200 mm/minute and then removed with instantaneous changeover at a rate of 200 mm/minute. Upon termination of the conditioning cycle, there should be a 5 s dwell time prior to the test run. The test cycle's maximum loading force should be 550 N at a rate of 200 mm/minute. Changeover time from loading to unloading should be instantaneous. Record the force-position data taken during the application and removal of the force on the test specimen. Allow the specimen to rest for 60 s before running subsequent trials. Typically, three total trials are collected. Data is to be collected from both the conditioning cycles and test cycles.

4.3.4 Hardness Profile Test. The support provided by a seat system is determined by the shape of the seat surface, the support structure (frame), and the loading characteristics of these materials. This test measures the contour or hardness profile of motor vehicle seats. Measurements are to be performed with lumbar full off and lumbar full on.

Set maximum loading force to:

- a. Seat Cushion: 200 N (44.2 lbf)
- b. Seat Back: 100 N (22.1 lbf)

Set indenter speed to 200 mm/minute with an instantaneous changeover time.

At each cross section, spacing between consecutive points should be no greater than 25 mm, as seen in Figure 9.

Measurements should be taken at points along the cross sections locations presented in Table 1 and Table 2.

An example grid of indentation points on a seat cushion is seen in Figure 8. This is the minimum amount of points that should be tested with a default spacing of 25 mm between points. If greater resolution between points is needed, indentations may be performed at a lesser spacing at the discretion and need of the operator.

Note: Only one column 110 mm to the right or left of the centerline needs to be performed. In Figure 9, the column of points is shown on the right.

Table 1: Seat Cushion Sections

Section	Definition	Figure
Lateral Cross Section	0 mm forward of the reference point.	10
Lateral Cross Section	125 mm forward of the reference point.	10
Lateral Cross Section	250 mm forward of the reference point.	10
Centerline Cross Section	0 mm lateral of the reference point. (Plane parallel to the cushion and torso (back) line through SgRP)	11
Centerline Cross Section	± 110 mm on either side of the reference point. (Note that only the positive OR negative side of the centerline is necessary)	11

Table 2: Seat Back Sections

Section	Definition	Figure
Lateral Cross Section	35 mm above the reference point.	10
Lateral Cross Section	175 mm above the reference point.	10
Lateral Cross Section	350 mm above the reference point.	10
Centerline Cross Section	0 mm lateral of the reference point. (Plane parallel to the cushion and torso (back) line through SgRP)	11
Centerline Cross Section	± 110 mm on either side of the reference point. (Note that only the positive OR negative side of centerline is necessary)	11

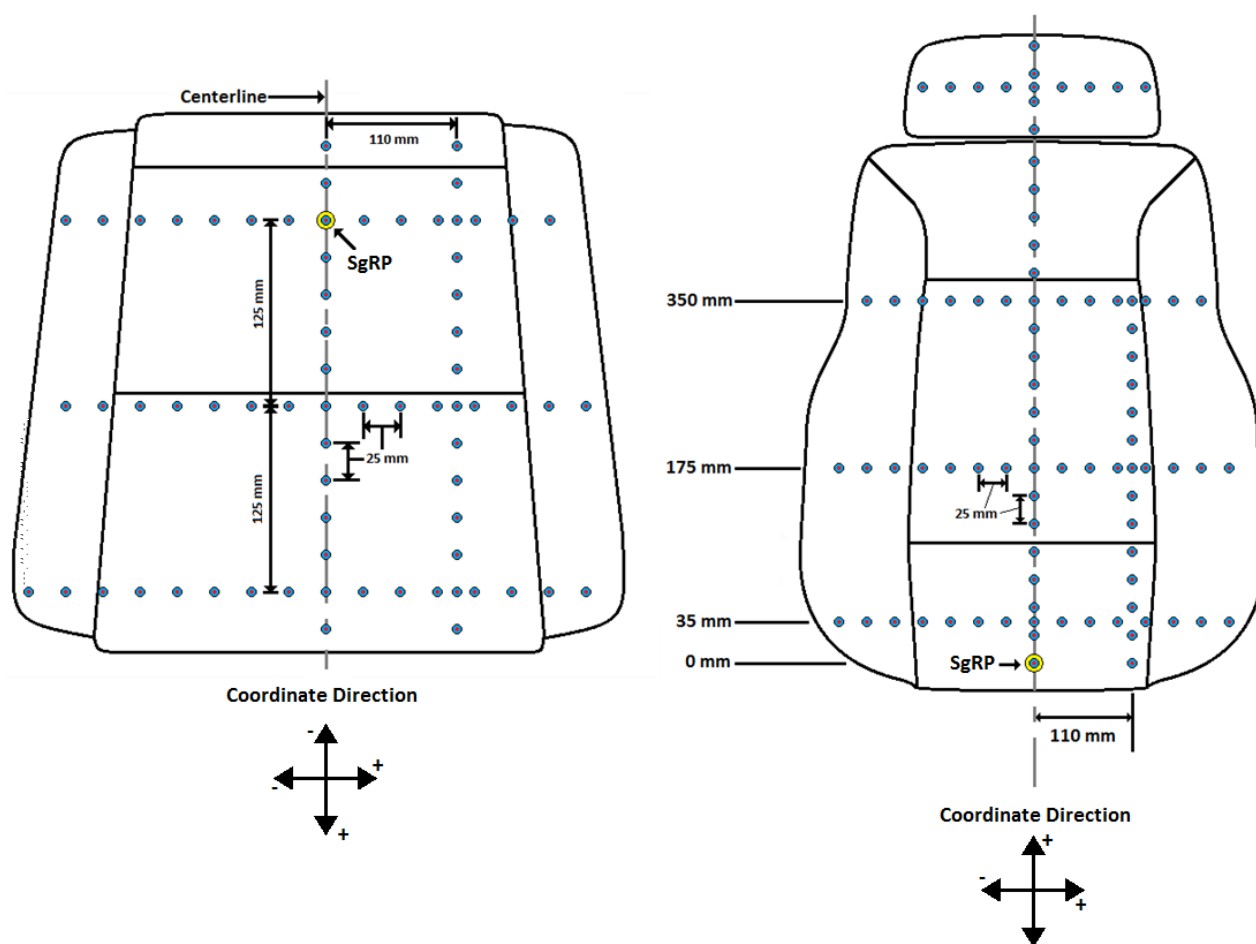


Figure 9: Seat Cushion and Seat Back with Grid of Indentation Points

In Figure 10a and Figure 10b, a detailed diagram of the spacing of columns and rows of indentation points with respect to H-Point is given.

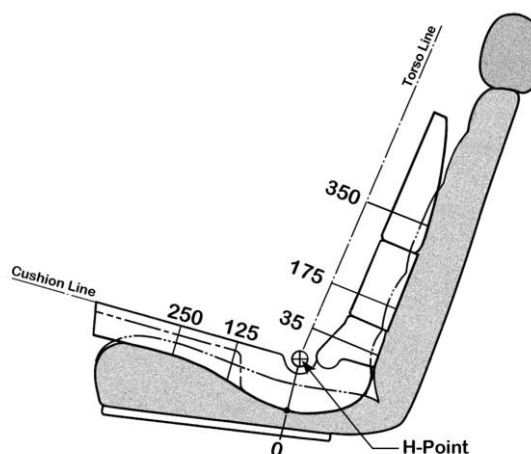


Figure 10a: Recommended Lateral Cross Sections Referenced from H-Point