



FMVSS 202a Dynamic Testing for Head Restraints

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. The purpose of this test procedure is to determine if a head restraint/seat system meets the dynamic requirements of FMVSS 202a.

1.2 Applicability. Applies to each front outboard designated seating position and each applicable rear outboard designated seating position with a head restraint.

1.3 Remarks. In conducting dynamic testing for FMVSS 202a, head restraints are subjected to a simulated rear impact with the use of a 50th percentile Hybrid Three Dummy (HIII), as well as dimensional criteria for width. The intent of the head restraint is to minimize the rotation of the head relative to the torso. Occupant impact protection must be addressed during the design stages of vehicle development. It is expected that early in the design stage that dimensional layouts have been conducted and that analysis has been completed to ensure the success of the testing. This procedure describes the method for testing the seat outside of the vehicle, however, in some instances the vehicle or portions of it may be required. All values given in this test procedure were valid at the date of issue. For the actual values, refer to the latest editions of the standards mentioned in 2.1.

2 References

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

2.1 External Standards/Specifications.

49 CFR 571.202a	FMVSS 202a	SAE J826 (July 1995)
49 CFR 571.208	SAE J211	

Note: SAE J826 (July 1995) lists the specific date of; July 1995 as the standard to be used. This is a specific mannequin required for this test, subsequent releases have added and revised the mannequin.

2.2 GM Standards/Specifications.

GMW14957

2.3 Additional References.

None

3 Resources

3.1 Facilities. Lab facility certified by the International Organization for Standardization (ISO).

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 SAE J826 (July 1995) Three-Dimensional (3D) mannequin.

3.2.2 A sphere with diameter of (25 ± 0.25) mm.

3.2.3 Steel tape with accuracy of ± 0.75 mm and sufficient range for measuring the height of the head restraint.

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3.2.4 Carpenter's square.

3.2.5 Calipers with accuracy of ± 0.75 mm.

3.2.6 Head Restraint Measurement Device (HRMD). The SAE J826 (July 1995) three-dimensional mannequin with a head form attached.

3.2.7 Inclinator with accuracy of ± 0.2 mm degrees.

3.2.8 Sled facility and rigid buck that is capable of producing the velocity within the corridors as defined (see Appendix A, Figure A3 and Figure A4).

3.2.9 Suitable software to perform angular displacement by digitally analyzing the angular displacement of the head relative to the torso (see Appendix A, Figure A2).

3.2.10 HIII, 50th percentile male instrumented with target bracket rigidly attached to the clavicle. Targets are placed at center of head as well as targets placed on the bracket (see Appendix A, Figure A1).

3.2.11 Test stand and fixture setup to retain test vehicle and other test equipment needed to conduct head restraint test.

3.2.12 Test fixture to attach Type II Safety Belt to retain the HIII on rebound.

3.2.13 Angular accelerometers placed at positions T1 and in the head of the HIII.

3.3 Test Vehicle/Test Piece. Testing may be conducted on bed plate. Vehicle or buck may be required if head restraint attaches to the body or if the vehicle structure interacts with the deflecting seat.

3.4 Test Time.

Calendar time: 5 days

Test time: 8 h

Coordination time: 8 h

3.5 Test Required Information. Manufacturer's drawing showing seat dimensions, arrangement, and Seating Reference Point (SGRP).

3.6 Personnel/Skills. The following individuals are necessary to complete this test procedure:

3.6.1 General Motors Responsible Engineer.

3.6.2 Testing Organization Test Engineer.

3.6.3 Testing Organization Test Technician.

4 Procedure

4.1 Preparation. Test plate or vehicle buck and equipment to rigidly affix the seat.

4.1.1 Target Placement Detail. Three targets are placed on the HIII:

- Clavicle bracket places close to the neck with the targets placed as far apart as possible.
- Placement of target at chin is as far from away as possible from the center of gravity of the head.
- Center target is placed at the center of gravity of the head.

4.2 Conditions.

4.2.1 Environmental Conditions. Test to be conducted at ambient.

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 Determine H-Point for Testing Purposes.

4.3.1.1 Adjust the complete seat full down. If the seat cushion adjusts independently of the seat back, adjust the seat cushion full up. If cushion has independent tilt, then adjust tilt to full down. Adjust the track to mid position. If an adjustment does not exist midway between the forward most and rearmost positions, adjust the seat to the closest position rear of the geometrical midpoint. Adjust the head restraint to mid height. If an adjustment position does not exist at the geometric midpoint between the highest position and the lowest position, adjust the head restraint to the first position below and nearest to the midway position.

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4.3.1.2 Position the Three-Dimensional (3D) mechanical mannequin per SAE J826 (July 1995).

4.3.1.3 Adjust lumbar and bolster adjustment to the most non-supportive positions. Adjust the seat back to the closest position to produce a 25 degree torso back angle from vertical. If two positions are equidistant from 25 degrees, adjust the seat back to the position rearward of 25 degrees.

4.3.1.4 Measure the torso angle using the back angle quadrant of the mannequin.

4.3.1.5 Record this H-point, torso angle and the seat back angle on the data sheet (see Appendix A, Data Sheet A1).

4.3.2 Measurement of Width. Measure the width of the head restraint at a distance (65 ± 3) mm below the top of the head restraint and perpendicular to the torso reference line. The width must be 170 mm minimum (254 mm for front seats requiring the wider head restraints). Record this as the width on the data sheet (see Appendix A, Data Sheet A1).

4.3.3 Position the HIII as specified in 49 CFR 571.208 and the mid-sagittal plan within 15 mm of the head restraint centerline.

4.3.3.1 Place the 50th percentile HIII onto the seat such that the lower torso is within 12 mm of the test H-point.

4.3.3.2 Push or pull on the dummy's knees to produce a pelvic angle of 22.5 degrees within a 2.5 degree tolerance band.

4.3.3.3 Ensure head is level to the platform within a half degree. If head is not within a half degree, readjust the dummy and ensure that the angle is still within the tolerance band.

4.3.3.4 Obtain X and Z data points for heel relative to front seat attachment fiducial point. Position feet relative to the vehicle coordinates with the feet perpendicular to the legs if on a fixture. Position the HIII per 49 CFR 571.208 if in vehicle. Measure distance between the outboard knee surfaces and ensure that there is 270 mm (10.6 in) between them. In the case where the feet must be placed less than 270 mm apart to fit under the seat between the tracks of the position directly in front of the occupant, the feet may be adjusted accordingly. Confirm the width and any adjustments necessary with the GM Validation Engineer or GM Design Release Engineer.

4.3.3.5 Position the arms and hands in contact with the seat back and cushion and the sides of the dummy.

4.3.3.6 Measure the rearmost center of the HIII head to the front surface of the head restraint and record on data sheet (see Appendix A, Data Sheet A1).

4.3.4 Safety Belt Adjustment. Prior to placing the Type 2 safety belt around the HIII, fully extend from the retractor and release three times to remove slack. If the seat belt D-ring anchorage is adjustable, place it in the position closest to the geometric mid position. If there is not a locking position at the exact mid position, adjust to the locking position closest to and higher than the geometric position.

4.3.5 Sled Pulse.

4.3.5.1 The target acceleration with time expressed in milliseconds is $= 86S/N(\pi t/88)m/s^2$, for $V = (17.3 \pm 0.6)$ km/h. Refer to Appendix A, Figure A3 for corridor of pulse. Additional velocity examples are attached (see Appendix A, Figure A4).

4.3.5.2 Sled acceleration should be filtered according to SAE J211.

4.3.6 Confirmation of Head Restraint Removability Designation. Upon completion of the sled test, and during the Design Review Based on Test Results (DRBTR), confirm the head restraint removability in accordance with GMW14957 and complete Table A1 in Appendix A.

5 Data

5.1 Calculations.

5.1.1 Digitized graphs and high speed video which show angular rotation of the head relative to the torso.

5.1.2 Angular rotation graphs from angular accelerometers (Gyro). Use a 600 Hz channel class filter.

5.1.3 Head Injury Criteria (HIC) results. Use a 1000 Hz channel class filter according to SAE J211.

5.1.4 Width measurement of the head restraint.

5.1.5 Data sheet with measurements (see Appendix A, Data Sheet A1).

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5.2 Interpretation of Results. The requirements of the safety standard are detailed as follows: Head Injury Criteria $HIC_{15} < 500$, maximum rearward angular displacement between the head and torso of the HIII 50th percentile ≤ 12 degrees, lateral width of the head restraint may not be < 170 mm as specified in 49 CFR 571.202a.

5.3 Test Documentation. The report shall contain pre-test pictures as well as post test pictures for all strength testing. Calculations and data shall be provided as detailed on the data sheet (see Appendix A, Data Sheet A1).

6 Safety

This Engineering Standard may involve safety requirements for hazardous materials, the method of operations and equipment. This standard does not propose to address all the safety issues associated with its use. It is the responsibility of the user of this standard to ensure compliance with all appropriate safety and health practices. This would include any specific training that may be required. The safety and health standards include site specific rules and procedures, company rules and procedures, and Government Standards. Contact shall be made with the appropriate site Safety and Health personnel for further direction and guidance in these matters.

7 Notes

7.1 Glossary.

Backset: The minimum horizontal distance between the rear of the head and the head restraint as measured by the head restraint measuring device (HRMD).

Designated Seating Positions: Any plan view location that is capable of accommodating a person at least as large as a 5th percentile female, or if the overall seat configuration and vehicle design is such that the position is likely to be used as a seating positions while the vehicle is in motion, with the exception of temporary or folding jump seats.

Head Restraint Measurement Device (HRMD): The SAE International SAE J826 (July 1995), three-dimensional mannequin with a head form attached, representing the head position of a seated 50th percentile male, with sliding scale of the head for purpose of measuring backset.

Head Restraint: A device that limits rearward angular displacement of a seated occupant's head relative to the occupant's torso.

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

H-Point: The mechanically hinged hip point of a mannequin which simulates the actual pivot center of the human torso and thigh described in SAE J826 (July 1995).

Outboard Designated Seating Position: A designated seating position where a longitudinal vertical plane tangent to the outboard side of the seat cushion is < 30 cm (12 in) from the innermost point on the inside surface of the vehicle at a height between the design H-point and the shoulder reference point and longitudinally between the front and rear edges of the seat cushion.

Top of the Head Restraint: The point on the head restraint with the greatest height.

7.2 Acronyms, Abbreviations, and Symbols.

3D	Three-Dimensional
DRBTR	Design Review Based on Test Result
Gyro	Angular Accelerometer
HIC	Head Injury Criteria
HIII	Hybrid Three Dummy
HRM	Head Restraint Measurement
HRMD	Head Restraint Measurement Device
ISO	International Organization for Standardization
SGRP	Seating Reference Point

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