

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

LABORATORY TEST PROCEDURE

FOR

FMVSS 201U

Occupant Protection in Interior Impact
Upper Interior Head Impact Protection



Safety Assurance
Office of Vehicle Safety Compliance
Room 6115, NSA-30
400 Seventh Street, SW
Washington, DC 20590

**OVSC LABORATORY TEST PROCEDURE NO. 201U
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1. PURPOSE AND APPLICATION

The Office of Vehicle Safety Compliance (OVSC) provides contractor laboratories with Laboratory Test Procedures as guidelines for obtaining compliance test data. The data are used to determine if a specific vehicle or item of motor vehicle equipment meets the minimum performance requirements of the subject Federal Motor Vehicle Safety Standard (FMVSS). The purpose of the OVSC Laboratory Test Procedures is to present a uniform testing and data recording format, and provide suggestions for the use of specific equipment and procedures. If any contractor views any part of an OVSC Laboratory Test Procedure to be in conflict with a Federal Motor Vehicle Safety Standard (FMVSS) or observes deficiencies in a Laboratory Test Procedure, the contractor is required to advise the Contracting Officer's Technical Representative (COTR) and resolve the discrepancy prior to the start of compliance testing.

Every contractor is required to submit a detailed test procedure to the COTR before initiating the compliance test program. The procedure must include a step-by-step description of the methodology to be used. The contractor's test procedure shall contain a complete listing of test equipment with make and model number and a detailed check-off sheet. The list of test equipment shall include instrument accuracy and calibration dates. All equipment shall be calibrated in accordance with the manufacturer's instructions. There shall be no contradictions between the Laboratory Test Procedure and the contractor's in-house test procedure. Written approval of the in-house test procedures shall be obtained from the COTR before initiating the compliance test program. The OVSC Laboratory Test Procedures are not intended to limit or restrain a contractor from developing or utilizing any testing techniques or equipment which will assist in procuring the required compliance test data. These Laboratory Test Procedures do not constitute an endorsement or recommendation for use of any product or method. However, the application of any such testing technique or equipment is subject to prior approval of the COTR.

NOTE: The OVSC Laboratory Test Procedures, prepared for the limited purpose of use by independent laboratories under contract to conduct compliance tests for the OVSC, are not rules, regulations or NHTSA interpretations regarding the meaning of a FMVSS. The Laboratory Test Procedures are not intended to limit the requirements of the applicable FMVSS(s). In some cases, the OVSC Laboratory Test Procedures do not include all of the various FMVSS minimum performance requirements. Recognizing applicable test tolerances, the Laboratory Test Procedures may specify test conditions that are less severe than the minimum requirements of the standard. In addition, the Laboratory Test Procedures 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 standard itself and within the scope of the contract. Laboratory Test Procedures 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 necessarily guaranteed if the manufacturer limits its certification tests to those described in the OVSC Laboratory Test Procedures.

2. GENERAL REQUIREMENTS

FMVSS 201, Occupant Protection in Interior Impact - Upper Interior Head Impact Protection, requires passenger cars, and trucks, buses and multipurpose passenger vehicle's (LTV's) with a Gross Vehicle Weight Rating (GVWR) of 4,536 kilograms or less, except that the requirements of S6 do not apply to buses with a GVWR of 3,860 kilograms or more, to provide protection when an occupant's head strikes upper interior components, including pillars, side rails, headers, and the roof during a crash.

Each vehicle manufactured on or after September 1, 1998, subject to the phase-in requirements below, shall comply with the upper interior requirements of FMVSS 201 at the target locations specified when impacted by the Free Motion Headform (FMH) at any speed up to and including 24 kph.

PHASE-IN REQUIREMENTS - SCHEDULE #1

PERCENTAGE COMPLYING	VEHICLE MODEL YEAR	PERIOD OF PRODUCTION
10%	1999	September 1, 1998 to August 31, 1999
25%	2000	September 1, 1999 to August 31, 2000
40%	2001	September 1, 2000 to August 31, 2001
70%	2002	September 1, 2001 to August 31, 2002
100%	2003	September 1, 2002 and after

ALTERNATIVE PHASE-IN REQUIREMENTS - SCHEDULE #2

PERCENTAGE COMPLYING	VEHICLE MODEL YEAR	PERIOD OF PRODUCTION
7%	1999	September 1, 1998 to August 31, 1999
31%	2000	September 1, 1999 to August 31, 2000
40%	2001	September 1, 2000 to August 31, 2001
70%	2002	September 1, 2001 to August 31, 2002
100%	2003	September 1, 2002 and after

2. GENERAL REQUIREMENTS....Continued

The phase-in percentage requirements are based on (S6.1.1, S6.1.2, S6.1.5):

- A. The average annual production of passenger cars and LTV's with a GVWR of 4,536 kg or less, excluding buses with a GVWR 3,860 kg, manufactured for sale in the United States based on three production years.

OR, at the manufacturer's option

- B. The annual production of passenger cars and LTV's with a GVWR of 4,536 kg or less, excluding buses with a GVWR 3,860 kg, manufactured for sale in the United States for the current production year.

ALTERNATIVE PHASE-IN REQUIREMENTS - SCHEDULE #3

A manufacturer may, at its option, comply with the following:

- A. Passenger cars and LTV's with a GVWR of 4,536 kg or less, excluding buses with a GVWR 3,860 kg, manufactured before September 1, 1999, are not required to comply with the upper interior requirements of FMVSS 201.

Then –

- B. Passenger cars and LTV's with a GVWR of 4,536 kg or less, excluding buses with a GVWR 3,860 kg, manufactured on or after September 1, 1999, shall comply with the upper interior requirements of FMVSS 201.

ALTERNATIVE PHASE-IN REQUIREMENTS FOR FINAL STAGE MANUFACTURERS OR ALTERERS - SCHEDULE #4

A final stage manufacturer or alterer may, at its option, comply with the following:

- A. Passenger cars and LTV's with a GVWR of 4,536 kg or less, excluding buses with a GVWR 3,860 kg, manufactured on or after September 1, 1998 and before September 1, 2002 are not required to comply with the upper interior requirements of FMVSS 201.

Then –

- B. Passenger cars and LTV's with a GVWR of 4,536 kg or less, excluding buses with a GVWR 3,860 kg, manufactured on or after September 1, 2002 shall comply with the upper interior requirements of FMVSS 201.

2. GENERAL REQUIREMENTS....Continued

PERFORMANCE REQUIREMENTS

The HIC(d) shall not exceed 1000 when calculated in accordance with the following formula:

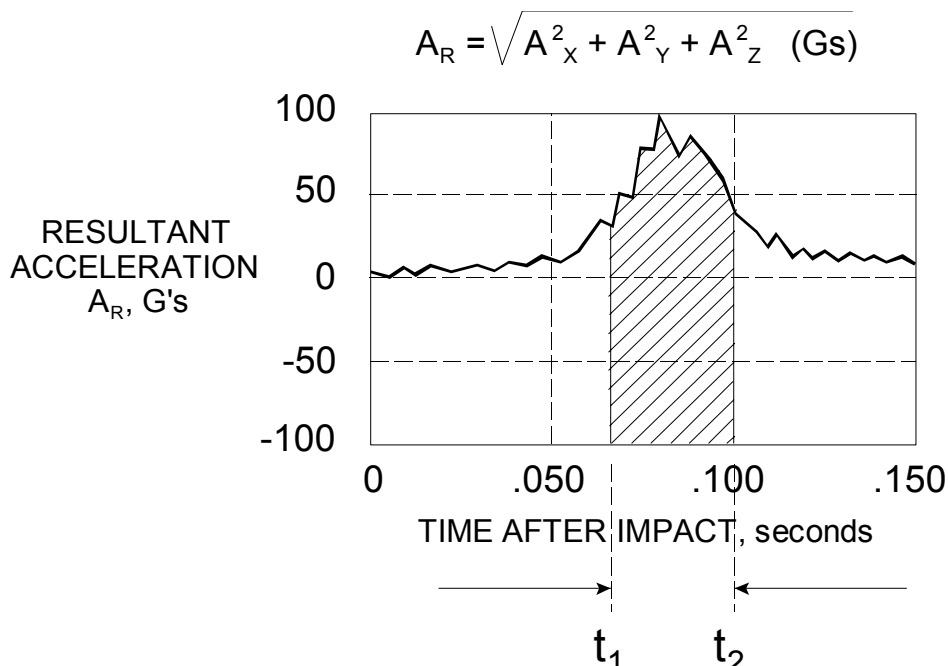
$$\text{HIC}(d) = 0.75446 (\text{Free Motion Headform HIC}) + 166.4$$

The Free Motion Headform HIC is calculated in accordance with the following formula:

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

where $A_R = [A_x^2 + A_y^2 + A_z^2]^{1/2}$ Resultant Acceleration magnitude in g units at the CG of the Free Motion Headform.

t_1 and t_2 are any two points in time during the impact event separated by not more than a 36 millisecond time.



FMVSS 201 REQUIREMENTS DO **NOT** APPLY TO (S6.3):

- A. Any target located on a convertible roof frame or a convertible roof linkage mechanism.
- B. Any target located rearward of a vertical plane 600 mm behind (relative to the vehicle orientation) the seating reference point of the rearmost designated seating position.

2. GENERAL REQUIREMENTS....Continued

- C. Any target located rearward of a vertical plane 600 mm behind (relative to the vehicle orientation) the seating reference point of the driver's seating position in an ambulance or a motor home.
- D. Any target in a walk-in van-type vehicle.

3. SECURITY

The contractor shall provide appropriate security measures to protect the OVSC test vehicles from unauthorized personnel during the entire compliance testing program. The contractor is financially responsible for any acts of theft and/or vandalism that occur during the storage of test vehicles. Any security problem shall be reported by telephone to the Industrial Property Manager (IPM), Office of Contracts and Procurement, within two working days after the incident. A letter containing specific details of the security problem will be sent to the IPM (with copy to the COTR) within 48 hours.

The contractor shall protect and segregate the data that evolves from compliance testing before and after each vehicle test. No information concerning the vehicle safety compliance testing program shall be released to anyone except the COTR, unless specifically authorized by the COTR or the COTR's Branch or Division Chief. The tested vehicles shall be protected from the elements and retained by the contractor for a minimum of 60 days so that NHTSA personnel can be given an inspection opportunity.

NOTE: No individuals, other than contractor personnel directly involved in the compliance testing program, shall be allowed to witness any vehicle compliance test unless specifically authorized by the COTR. It is the contractor's responsibility to secure the test site area during a test and to shield the test area from public view by the use of canvas or other blocking devices.

RULES FOR CONTRACTORS

- A. No vehicle manufacturer's representative(s) or anyone other than the contractor's personnel working on the NHTSA contract program along with NHTSA personnel shall be allowed to inspect NHTSA vehicles or witness vehicle preparation without prior permission. Such permission shall never be assumed.
- B. All communications with vehicle manufacturers shall be referred to the NHTSA. The contractor shall not release test data without the permission of the NHTSA.

4. GOOD HOUSEKEEPING

The contractor shall maintain the entire vehicle compliance testing area, test fixtures and instrumentation in a neat, clean and painted condition with test instruments arranged in an orderly manner consistent with good test laboratory housekeeping practices.

5. TEST SCHEDULING AND MONITORING

The contractor shall submit a test schedule to the COTR prior to testing. Tests shall be completed as required in the contract. Scheduling shall be adjusted to permit sample motor vehicles to be tested to other FMVSS as may be required by the OVSC. All testing shall be coordinated to allow monitoring by the COTR.

6. TEST DATA DISPOSITION

The contractor shall make all vehicle preliminary compliance test data available to the COTR on location within four hours after the test. Final test data, including digital printouts and computer generated plots, shall be furnished to the COTR within five working days. Additionally, the contractor shall analyze the preliminary test results as directed by the COTR.

All backup data sheets, strip charts, recordings, plots, technicians notes, etc., shall be either sent to the COTR or destroyed at the conclusion of each delivery order, purchase order, etc.

7. GOVERNMENT FURNISHED PROPERTY (GFP)

ACCEPTANCE OF TEST VEHICLES

The contractor has the responsibility of accepting test vehicles from either new car dealers or vehicle transporters. In both instances, the contractor acts in the OVSC's behalf when signing an acceptance of test vehicles. If a vehicle is delivered by a dealer, the contractor must check to verify the following:

- A. All options listed on the "window sticker" are present on the test vehicle.
- B. Tires and wheel rims are the same as listed.
- C. There are no dents or other interior or exterior flaws.
- D. The vehicle has been properly prepared and is in running condition.
- E. The glove box contains an owner's manual, warranty document, consumer information, and extra set of keys.
- F. Proper fuel filler cap is supplied on the test vehicle.

7. **GOVERNMENT FURNISHED PROPERTY (GFP)....Continued**

If the test vehicle is delivered by a government contracted transporter, the contractor should check for damage which may have occurred during transit.

A "Vehicle Condition" form (shown on the next page) will be supplied to the contractor by the COTR when the test vehicle is transferred from the new car dealer or between test contracts. The upper half of the form describes the vehicle in detail, and the lower half provides space for a detailed description of the post test condition. Vehicle Condition forms must be returned to the COTR with the copies of the Final Test Report or the reports will NOT be accepted.

NOTIFICATION OF COTR

The COTR must be notified within 24 hours after a vehicle has been delivered.

7. GOVERNMENT FURNISHED PROPERTY (GFP)...Continued

REPORT OF VEHICLE CONDITION AT THE COMPLETION OF TESTING

CONTRACT NO.: DTNH22-_____ DATE: _____

FROM: _____

TO: _____

The following vehicle has been subjected to compliance testing for FMVSS No: _____

The vehicle was inspected upon arrival at the laboratory for the test and found to contain all of the equipment listed below. All variances have been reported within 2 working days of vehicle arrival, by letter, to the NHTSA Industrial Property Manager (NAD-30), with a copy to the OVSC COTR. The vehicle is again inspected, after the above test has been conducted, and all changes are noted below. The final condition of the vehicle is also noted in detail.

MODEL YEAR/MAKE/MODEL/BODY STYLE: _____

NHTSA NO.: _____ ; BODY COLOR: _____ ; VIN: _____

ODOMETER READINGS: ARRIVAL - _____ miles DATE - _____

COMPLETION - _____ miles DATE - _____

PURCHASE PRICE: \$ _____ DEALER'S NAME: _____

ENGINE DATA: _____ Cylinders ; _____ Liters ; _____ Cubic Inches

TRANSMISSION DATA: _____ Automatic _____ Manual _____ No. of Speeds

FINAL DRIVE DATA: _____ Rear Drive _____ Front Drive _____ 4 Wheel Drive

TIRE DATA: Size - _____ Mfr. - _____

CHECK APPROPRIATE BOXES FOR VEHICLE EQUIPMENT:

<input type="checkbox"/>	Air Conditioning	<input type="checkbox"/>	Traction Control	<input type="checkbox"/>	Clock
<input type="checkbox"/>	Tinted Glass	<input type="checkbox"/>	All Wheel Drive	<input type="checkbox"/>	Roof Rack
<input type="checkbox"/>	Power Steering	<input type="checkbox"/>	Speed Control	<input type="checkbox"/>	Console
<input type="checkbox"/>	Power Windows	<input type="checkbox"/>	Rear Window Defroster	<input type="checkbox"/>	Driver Air Bag
<input type="checkbox"/>	Power Door Locks	<input type="checkbox"/>	Sun Roof or T-Top	<input type="checkbox"/>	Passenger Air Bag
<input type="checkbox"/>	Power Seat(s)	<input type="checkbox"/>	Tachometer	<input type="checkbox"/>	Front Disc Brakes
<input type="checkbox"/>	Power Brakes	<input type="checkbox"/>	Tilt Steering Wheel	<input type="checkbox"/>	Rear Disc Brakes
<input type="checkbox"/>	Antilock Brake System	<input type="checkbox"/>	AM/FM/Cassette Radio	<input type="checkbox"/>	Other-

LIST OTHER PERTINENT OPTIONAL EQUIPMENT ON NEXT PAGE (REMARKS SECTION)

7. GOVERNMENT FURNISHED PROPERTY (GFP)....Continued

REMARKS:

Equipment that is no longer on the test vehicle as noted on previous page:

Explanation for equipment removal:

Test Vehicle Condition:

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

8. CALIBRATION OF TEST INSTRUMENTS

Before the contractor initiates the safety compliance test program, a test instrumentation calibration system will be implemented and maintained in accordance with established calibration practices. The calibration system shall be set up and maintained as follows:

- A. Standards for calibrating the measuring and test equipment will be stored and used under appropriate environmental conditions to assure their accuracy and stability.
- B. All measuring instruments and standards shall be calibrated by the contractor, or a commercial facility, against a higher order standard at periodic intervals NOT EXCEEDING 6 MONTHS FOR INSTRUMENTS AND 12 MONTHS FOR CALIBRATION STANDARDS. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment.

Accelerometers shall be calibrated every six months or after a vehicle fails to meet the FMVSS 201 performance requirements whichever occurs sooner.

- C. All measuring and test equipment and measuring standards will be labeled with the following information:
 - (1) Date of calibration
 - (2) Date of next scheduled calibration
 - (3) Name of the technician who calibrated the equipment
- D. A written calibration procedure shall be provided by the contractor including, as a minimum, the following information for all measurement and test equipment:
 - (1) Type of equipment, manufacturer, model number, etc.
 - (2) Measurement range
 - (3) Accuracy
 - (4) Calibration interval
 - (5) Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident)
 - (6) The actual procedures and forms used to perform the calibrations.

8. CALIBRATION OF TEST INSTRUMENTS....Continued

- E. Records of calibration for all test instrumentation shall be kept by the contractor in a manner that assures the maintenance of established calibration schedules. All such records shall be readily available for inspection when requested by the COTR. The calibration system will need the acceptance of the COTR before the test program commences.
- F. Test equipment shall receive a calibration adjustment immediately prior to a test and a calibration check after the test. This check shall be recorded by the test technician(s) and submitted with the final report.
- G. The headform(s) shall be calibrated before each vehicle test and the calibration checked after each vehicle test. A vehicle test consists of all upper interior component targets. The contractor is required to calibrate the FMH prior to testing the first target and subsequent to the completion of testing of all targets on the vehicle.

When a HIC(d) greater than 1000 is recorded, the FMH must be calibrated as soon as possible and before the continuation of compliance testing.

The pretest and post test calibrations and calibration checks shall be submitted with the final report. A number of FMHs may be used to conduct the required target tests. Pretest and post test calibrations must be submitted for each headform used in the conduct of the vehicle test.

- H. The contractor may be directed by NHTSA to evaluate its data acquisition system.

Further guidance is provided in the International Standard ISO 10012-1, "Quality Assurance Requirements for Measuring Equipment" and American National Standard ANSI/NCSL Z540-1, "Calibration Laboratories and Measuring and Test Equipment - General Requirements."

NOTE: In the event of a failure to meet the standard's minimum performance requirements additional calibration checks of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration will be at the COTR's discretion and will be performed without additional cost.

9. PHOTOGRAPHIC DOCUMENTATION

Each impact test shall be documented on 16 mm color movie film at a minimum speed of 1,000 frames-per-second. Glare or lights on any glass surface must be minimized so that views of the FMH during the test are visible for film analysis.

A timing mark must be registered on the film edge a minimum of every 10 milliseconds and a time zero mark must be registered on the film in order to permit test analysis on a film analyzer. The Contractor shall report all camera locations along with camera speeds and focal length on the appropriate final report data sheets.

CAMERA(S) REQUIRED

One camera is required for each FMH impact test. The camera should be placed perpendicular, or as close as possible, to the plane of motion capturing the FMH free flight and impact with the target.

IMPACT EVENT MARKER

All high speed cameras shall have film markers to mark "time zero" for the FMH impact.

REFERENCE TARGETS

Dimensional reference targets (approximately 300 mm apart) shall be placed in the plane of motion of the FMH center of gravity (midsagittal plane). The targets orientation within the plane is not important noting that the targets must be visible in the film image throughout the impact event. The distance between the reference targets shall be recorded and included in the test report.

INFORMATIONAL PLACARDS

Vehicle identification placard(s) shall be positioned so that the placard will be visible in the camera's field-of-view. The following information will be shown:

- A. Vehicle's NHTSA Number
- B. The words "FMVSS 201U"
- C. Target Identification
- D. Test Date
- E. Name of contract laboratory
- F. Vehicle model year, make and model

9. PHOTOGRAPHIC DOCUMENTATION....Continued

FILM TITLE AND EDITING

The 16 mm impact test movie film shall include the following frames:

- A. “The following FMVSS 201U Upper Interior Impact Tests were conducted under contract with the National Highway Traffic Safety Administration by (name and location of test laboratory)”
- B. FMVSS 201U UPPER INTERIOR IMPACT TESTS
TEST VEHICLE MODEL YEAR, MAKE AND MODEL
NHTSA No. CXXXXX
DATE CONDUCTED
CONTRACT NO.: DTNH22-XX-X-XXXXX
- C. The ending frame shall state “THE END”

FILM EDITING

The film shall be edited in the following sequence:

- A. Title
- B. All high speed coverage in the following order:

A-Pillar Targets, B-Pillar Targets, Other Pillar Targets, Rearmost Pillar Targets, Front Header Targets, Side Rail Targets, Rear Header Targets, Upper Roof Target, Sliding Door Track Target, Roll-Bar Targets, Stiffener Target, and Brace Target.
- C. “THE END”

9.1 STILL PHOTOGRAPHS

Photographs shall be color, 8 x 10 inches or 8.5 x 11 inches, and legible. A tag, label or placard identifying the test vehicle model, NHTSA number, date, and pre or post test identification shall appear in each photograph and be legible. Each photograph shall be labeled as to subject matter. The test setup and equipment used in all tests shall be photographed for the record before and at prescribed time periods during testing listed in this test procedure. Any failure must be photographed at various angles to assure complete coverage. **NOTE:** Photographs of all areas of the test vehicle that may be of importance to the upper interior impact test shall be taken in excess and developed only if the need arises.

9. PHOTOGRAPHIC DOCUMENTATION....Continued

As a minimum, the following photographs shall be included in the compliance report:

- A. Left side view of vehicle
- B. Right side view of vehicle
- C. 3/4 frontal view from left side of vehicle
- D. 3/4 rear view from right side of vehicle
- E. Vehicle's certification label
- F. Vehicle's tire information label
- G. Actual instrumentation as setup for the impact test(s)
- H. For each component, the pretest condition of the component with the target location(s) marked
- I. For each target, the test setup documenting the target location and FMH impact angle
- J. For each target, a post test photograph(s) documenting the target location
- K. For each target, a post test photograph(s) documenting target circle contact within the FMH forehead impact zone
- L. For each component, the post test condition of the component.

9.3 REFERENCE PHOTOGRAPHIC TARGETS

The Free Motion Headform shall have targets on each side of the head with the center of the target at the CG of the head in the X and Z direction relative to the measuring directions of the accelerometers.

9.4 TARGET CIRCLE FOR IMPACT LOCATIONS

The areas of the vehicle to be impacted by the headform should be marked with a solid 12.7 mm diameter circle centered on the targets. Any transferable opaque medium that identifies contact with the forehead impact zone is acceptable. Prior to the initiation of the test program, the contractor must obtain COTR approval for the contact medium that will be used.

10. DEFINITIONS

A-PILLAR

Any pillar entirely forward of a transverse vertical plane passing through the seating reference point (SgRP) of the driver's seat.

AMBULANCE

A motor vehicle designed exclusively for the purpose of emergency medical care, as evidenced by the presence of a passenger compartment to accommodate emergency medical personnel, one or more patients on litters or cots, and equipment and supplies for emergency care at a location or during transport.

B-PILLAR

The forwardmost pillar on each side of the vehicle that is, in whole or part, rearward of a transverse vertical plane passing through the SgRP of the driver's seat, unless there is only one pillar rearward of that plane and it is also a rearmost pillar.

BRACE

A fixed diagonal structural member in an open body vehicle used to brace the roll-bar and connect the roll-bar to the main vehicle body structure.

CONVERTIBLE

A vehicle whose A-pillars are not joined with the B-pillars (or rearmost pillars) by a fixed, rigid structural member.

CONVERTIBLE ROOF FRAME

The frame of a convertible roof.

CONVERTIBLE ROOF FRAME LINKAGE

Any anchorage, fastener, or device necessary to deploy a convertible roof frame.

DAYLIGHT OPENING (DLO)

For openings on the side of the vehicle, other than a door opening, the locus of all points where a horizontal line, perpendicular to the vehicle longitudinal centerline, is tangent to the periphery of the opening.

For openings on the front and rear of the vehicle, other than a door opening, daylight opening means the locus of all points where a horizontal line, parallel to the vehicle longitudinal centerline is tangent to the periphery of the opening.

10. DEFINITIONS...Continued

If a horizontal line is tangent to the periphery at more than one point at any location, the most inboard point is used to determine the daylight opening.

DESIGNATED SEATING POSITION (DSP)

Any plan view location capable of accommodating a person at least as large as a 5th percentile adult female, if the overall seat configuration and design and vehicle design is such that the position is likely to be used as a seating position while the vehicle is in motion, except for auxiliary seating accommodations such as temporary or folding jump seats. Any bench or split-bench seat in a passenger vehicle with a GVWR less than 10,000 lb, having greater than 127 cm of hip room (measured in accordance with SAE J1100(a)) shall have not less than three designated seating positions, unless the seat design or vehicle design is such that the center position cannot be used for seating.

DOOR OPENING

For door openings on the side of the vehicle, the locus of all points where a horizontal line, perpendicular to the vehicle longitudinal centerline, is tangent to the periphery of the side door opening.

For door openings on the back end of the vehicle, door opening means the locus of all points where a horizontal line, parallel to the vehicle longitudinal centerline, is tangent to the periphery of the back door opening.

If a horizontal line is tangent to the periphery at more than one point at any location, the most inboard point is the door opening.

FOREHEAD IMPACT ZONE

The part of the Free Motion Headform surface area determined in accordance with the procedure set forth in S8.10 and described in Section 11.4, Free Motion Headform Forehead Impact Zone. (49CFR571.201)

FREE MOTION HEADFORM (FMH)

A test device conforming to the specifications of Part 572, Subpart L (P572L). The P572L performance calibration procedure is included in Appendix A.

MIDSAGITTAL PLANE OF A DUMMY

A longitudinal vertical plane passing through the seating reference point (SgRP) of a designated seating position (DSP).

10. DEFINITIONS....Continued

MOTOR HOME

A motor vehicle with motive power designed to provide temporary residential accommodations, as evidenced by the presence of at least four of the following facilities: cooking; refrigeration or ice box; self-contained toilet; heating and/or air conditioning; a potable water supply including a faucet and a sink; and a separate 110-125 volt electrical power supply and/or an LP gas supply.

OTHER PILLAR

Any pillar that is not an A-pillar, a B-pillar, or a rearmost pillar.

PILLAR

Means any structure, excluding glazing and the vertical portion of door window frames, but including accompanying molding, attached components such as safety belt anchorages and coat hooks, that (1) supports either a roof or any other structure (such as a roll-bar) above the driver's head or (2) is located along a side edge of a window.

ROLL-BAR

A fixed overhead structural member, including its vertical support structure, that extends from the left to the right side of the passenger compartment of any open body vehicles and convertibles. It does not include a header.

SEAT BELT ANCHORAGE

Any component involved in transferring seat belt loads to the vehicle structure, including, but not limited to, the attachment hardware, but excluding webbing or straps, seat frames, seat pedestals, and the vehicle structure itself, whose failure causes separation of the belt from the vehicle structure.

SEATING REFERENCE POINT (SgRP)

Means the unique design H-point, as defined in SAE J1100 (June 1984), which:

- A. Establishes the rearmost normal design driving or riding position of each designated seating position, which includes consideration of all modes of adjustment, horizontal, vertical, and tilt, in a vehicle;
- B. Has X, Y, and Z coordinates, as defined in SAE J1100 (June 1984), established relative to the designed vehicle structure;
- C. Simulates the position of the pivot center of the human torso and thigh; and

10. DEFINITIONS....Continued

- D. Is the reference point employed to position the two-dimensional drafting template with the 95th percentile leg described in SAE J826 (May 1987), or, if the drafting template with the 95th percentile leg cannot be positioned in the seating position, is located with the seat in its most rearward adjustment position.

SLIDING DOOR TRACK

A track structure along the upper edge of a side door opening that secures the door in the closed position and guides the door when moving to and from the open position.

STIFFENER

A fixed overhead structural member that connects one roll-bar to another roll-bar or to a header of any open body vehicle or convertible.

UNLOADED VEHICLE WEIGHT (UVW)

The weight of a vehicle with maximum capacity of all fluids necessary for operation of the vehicle, but without cargo, occupants, or accessories that are ordinarily removed from the vehicle when they are not in use.

UPPER ROOF

The area of the vehicle interior that is determined in accordance with the procedure set forth in S8.15, Upper Roof.

WINDSHIELD TRIM

Molding of any material between the windshield glazing and the exterior roof surface, including material that covers a part of either the windshield glazing or exterior roof surface.

11. PRETEST REQUIREMENTS

11.1 TEST DATA LOSS

A. INVALID TEST DESCRIPTION

An invalid compliance test is one that does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

B. INVALID TEST NOTIFICATION

The contractor shall notify NHTSA of any test not meeting all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test, by telephone, within 24 hours of the test and send written notice to the COTR within 48 hours of the test completion.

C. RETEST NOTIFICATION

The Contracting Officer of NHTSA is the only NHTSA official authorized to notify the Contractor that a retest is required. The retest shall be completed within 2 weeks after receipt of notification by the Contracting Officer that a retest is required.

D. WAIVER OF RETEST

NHTSA, in its sole discretion, reserves the right to waive the retest requirement. This provision shall not constitute a basis for dispute over the NHTSA's waiving or not waiving any requirement.

E. TEST VEHICLE

NHTSA shall furnish only one vehicle for each test ordered. The contractor shall furnish the test vehicle required for the retest. The retest vehicle shall be equipped as the original vehicle. The original vehicle used in the invalid test shall remain the property of NHTSA and the retest vehicle shall remain the property of the contractor. The contractor shall retain the retest vehicle for a period not exceeding 180 days if it fails the test. If the retest vehicle passes the test, the contractor may dispose of it upon notification from the COTR that the test report has been accepted.

F. TEST REPORT

No test report is required for any test that is determined to be invalid unless NHTSA specifically decides, in writing, to require the contractor to submit such report. The test data from the invalid test must be safeguarded until the data from

11. PRETEST REQUIREMENTS....Continued

the retest has been accepted by the COTR. The report and other required deliverables for the retest vehicle are required to be submitted to the COTR within 3 weeks after completion of the retest.

G. DEFAULT

The contractor is subject to the default and subsequent reprocurement costs for non-delivery of valid or conforming test (pursuant to the Termination For Default clause in the contract).

H. NHTSA'S RIGHTS

None of the requirements herein stated shall diminish or modify the rights of NHTSA to determine that any test submitted by the contractor does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

11.2 DETAILED TEST AND QUALITY CONTROL PROCEDURES REQUIRED

Prior to conducting any compliance test, contractors are required to submit a detailed in-house compliance test procedure to the COTR that includes:

- A. A step-by-step description of the methodology to be used.
- B. A written Quality Control (QC) Procedure that shall include calibrations, the data review process, report review, and the people assigned to performed QC on each task.
- C. A complete listing of test equipment that shall include instrument accuracy and calibration dates as required by Section 8, Calibration of Test Instruments.
- D. **DETAILED checkoff lists to be used during the test and during the data review. These lists shall include all test procedure requirements and FMVSS requirements pertaining to the safety standard for which testing is being performed. Each separate checkoff sheet shall identify the lab, test date, vehicle and test technicians. These check sheets shall be used to document that all requirements and procedures have been complied with. These sheets shall be submitted with the test report.**

There shall be no contradiction between the OVSC Laboratory Test Procedure and the contractor's in-house test procedure. The procedures shall cover all aspects of testing from vehicle receipt to submission of the final report. Written approval of the procedures shall be obtained from the COTR before initiating the compliance test program. After testing commences, written approval shall also be obtained from the COTR prior to any changes in the procedures.

11. PRETEST REQUIREMENTS....Continued

11.3 FREE MOTION HEADFORM (PART 572, SUBPART L)

The Free Motion Headform(s) used for testing must conform to the specifications of Part 572, Subpart L (P572L). The headform must conform in every respect both before and after being used in the vehicle test. A vehicle test consists of all upper interior targets. The P572L performance calibration test procedure is included in Appendix A.

11.4 FREE MOTION HEADFORM FOREHEAD IMPACT ZONE

The forehead impact zone of the headform is determined in accordance with the following procedure (S8.10):

- A. Position the headform so that the baseplate of the skull is horizontal. The midsagittal plane of the headform is designated as Plane S (Figure 1).
- B. From the center of the threaded hole on top of the headform, draw a 69 mm line forward toward the forehead, coincident with Plane S, along the contour of the outer skin of the headform. The front end of the line is designated as Point P.

From Point P, draw a 100 mm line forward toward the forehead, coincident with Plane S, along the contour of the outer skin of the headform. The front end of the line is designated as Point O.

- C. Draw a 125 mm line coincident with a horizontal plane along the contour of the outer skin of the forehead from left to right through Point O so that the line is bisected at Point O.

The end of the line on the left side of the headform is designated as Point a and the end of the right as Point b.

- D. Draw another 125 mm line, coincident with a vertical plane, along the contour of the outer skin of the forehead through Point P so that the line is bisected at Point P.

The end of the line on the left side of the headform is designated as Point c and the end on the right as Point d.

- E. Draw a line from Point a to Point c along the contour of the outer skin using a flexible steel tape.

Using the same method, draw a line from Point b to Point d.

- F. The forehead impact zone is the surface area on the FMH forehead bounded by lines a-O-b and c-P-d, and a-c and b-d.

11. PRETEST REQUIREMENTS....Continued

FREE MOTION HEADFORM (FMH) FOREHEAD IMPACT ZONE

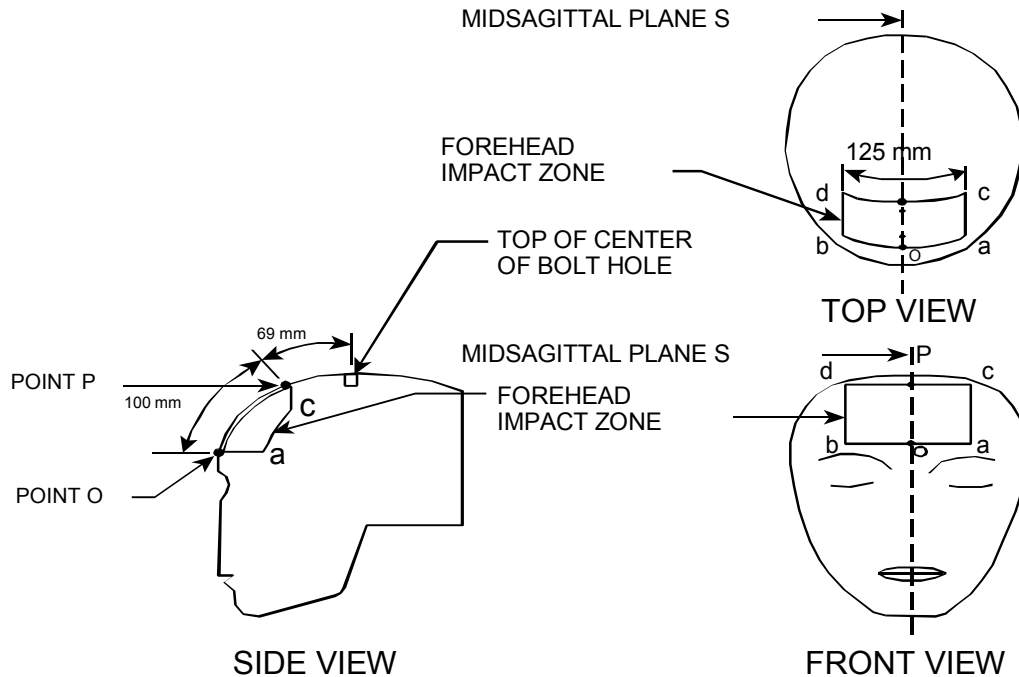


FIGURE 1

11.5 INSTRUMENTATION TO BE INSTALLED IN THE FREE MOTION HEADFORM

The contractor shall provide and install the following instrumentation in the Free Motion Headform.

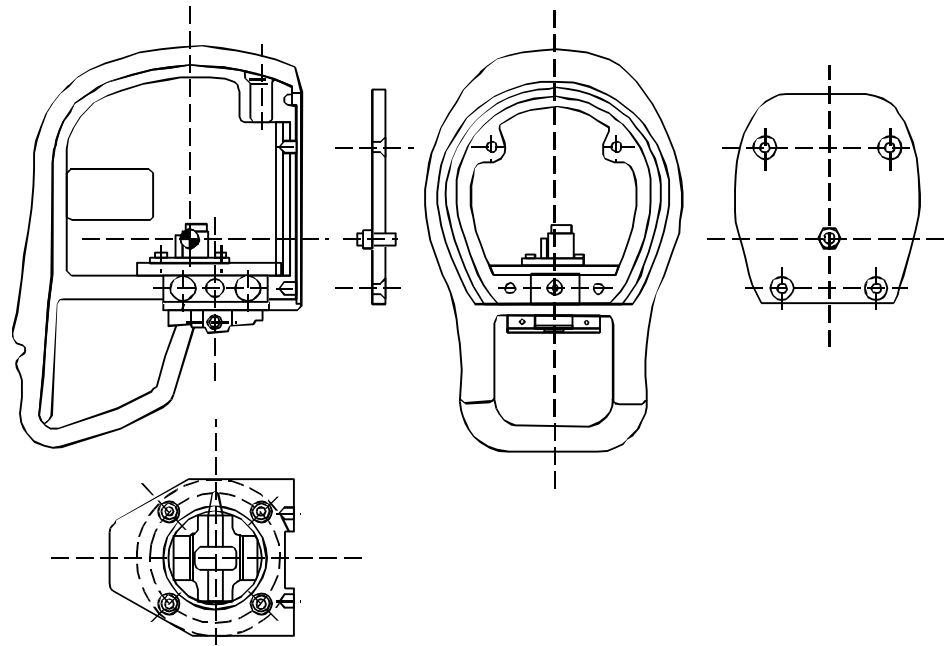
Three accelerometers shall be installed in the head cavity to measure orthogonal accelerations (A_x , A_y , and A_z) at the CG of the head assembly. The three accelerometers shall be mounted in an orthogonal array, and the intersection of the planes containing the sensitive axis of the 3 sensors will be the origin of the array. The figure below illustrates the instrumentation location in the FMH. Detailed information concerning the locations of the sensors can be found in Appendix A. The FMH shall be instrumented with Endevco 7264-2000 accelerometers with 1% transverse sensitivity.

The contractor shall furnish data recording equipment having a sufficient number of channels available for recording the necessary time histories. Each data channel will be comprised of a sensor, signal conditioner, data acquisition device, and all interconnecting cables, and must conform to the requirements of SAE Recommended Practice J211, MAR 95 with data Class 1000 for head acceleration data.

The contractor shall provide the necessary equipment to record and display the data. The data shall be included in the final test report and on the data tape/diskette.

11. PRETEST REQUIREMENTS....Continued

FREE MOTION HEADFORM (FMH) ASSEMBLY



An instrument calibration system capable of performing individual tests on all data channels used in acquiring the acceleration data shall conform to the appropriate section of SAE J211 dated March 1995.

A precision time system compatible with the test equipment shall be used to provide a time reference for all recorded data. A system/method that identifies the precise instant of headform contact will be incorporated with the time reference signal.

An instrumentation self-checking system that simultaneously monitors all data channels and displays, on a single indicator, will provide the GO/NO-GO status of the sensor system.

11.6 IMPACTOR AND IMPACT CONFIGURATION

The Contractor may use any means of propelling the headform as long as the impactor design is capable of impacting the targets specified with the FMH at $23.6 \text{ kph} \pm 0.3 \text{ kph}$ within the horizontal/vertical ranges required.

The impactor shall be able to launch the headform from any location inside the vehicle within specified approach angles. At the time of launch, the midsagittal plane of the headform is vertical and upright.

11. PRETEST REQUIREMENTS....Continued

The headform travels freely through the air, along a velocity vector perpendicular to the headform's skull cap plate, not less than 25 mm before making contact with the vehicle target (S8.13.2). The FMH shall travel in free flight at least 25 mm prior to impact.

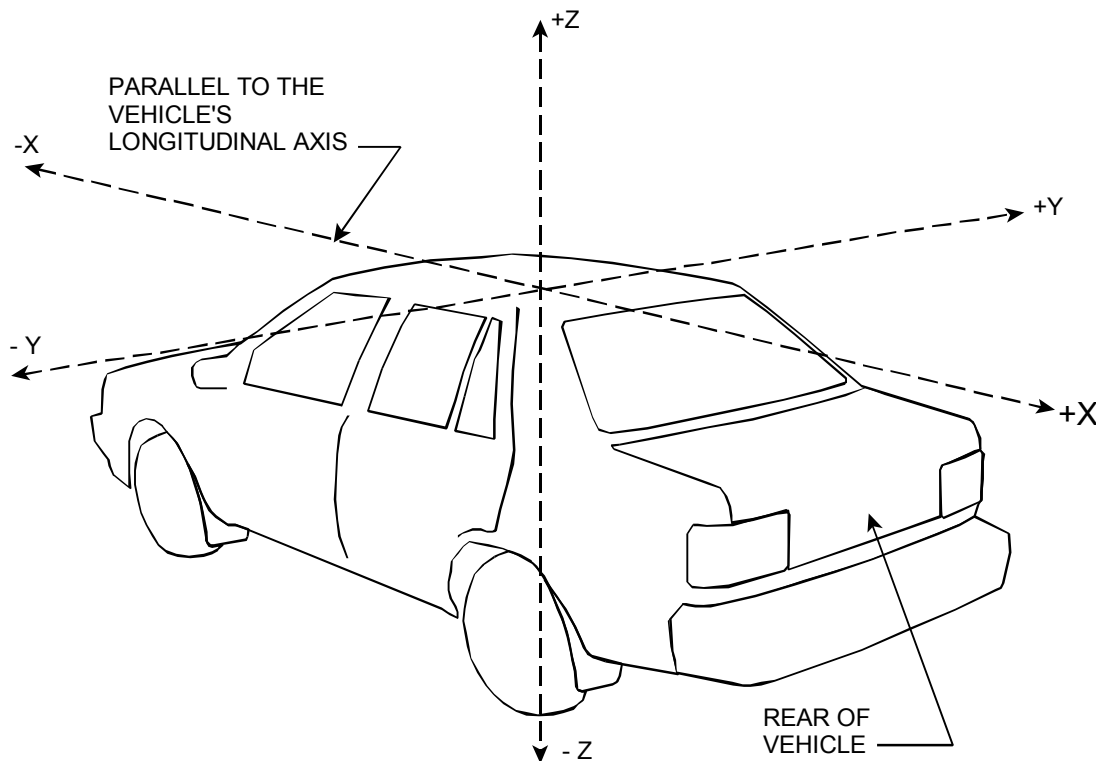
The forehead impact zone (some portion of) shall contact the target circle (some portion of) at the time of initial contact (S8.13.3).

NOTE: If the forehead impact zone fails to make initial contact with any part of the target circle, the OVSC considers that an incomplete test for the purpose of evaluating that target to the requirements of FMVSS 201.

11.7 ORTHOGONAL REFERENCE SYSTEM

An orthogonal reference system consisting of a longitudinal X-axis and a transverse Y-axis in the same horizontal plane and a vertical Z-axis through the intersection of X and Y defines the headform's horizontal direction of approach. Figure 2 illustrates the horizontal approach angle coordinate system. The X-Z plane is the vertical longitudinal zero plane and is parallel to the vehicle's longitudinal centerline. The X-Y plane is the horizontal zero plane parallel to the ground. The Y-Z plane is the vertical transverse zero plane that is perpendicular to the X-Y and X-Z planes. The X coordinate is negative forward of the Y-Z plane and positive to the rear. The Y coordinate is negative to the left of the X-Z plane and positive to the right. The Z coordinate is negative below the X-Y plane and positive above it.

FMH APPROACH ANGLE COORDINATE SYSTEM



11. PRETEST REQUIREMENTS....Continued

11.8 TEST TEMPERATURE CONDITIONS

The Contractor must verify that the FMH temperature is in the specified temperature range of 19°C to 26°C at any relative humidity between 10 percent to 70 percent. The FMH must be soaked in an ambient air environment in the specified range for a minimum of 4 hours prior to the test.

The ambient air temperature must be monitored and continuously recorded within 1 meter of the headform. The temperature sensors shall be accurate at least to within $\pm 0.1^\circ\text{C}$.

The contractor shall mark the ambient air temperature recording with the date, time and technician's name at the beginning of the 4 hour soak and when the test commences. Temperature recordings shall be furnished to the COTR with final test reports.

11.9 FMH IMPACT SPEED MEASUREMENT

The impact speed will be determined by integrating the Free Motion Headform X-axis acceleration. The contractor will process the acceleration versus time data recorded from the headform X-axis accelerometer to obtain the headform velocity data.

11.10 TEST DATA ACQUISITION AND REDUCTION

Analog data is prefiltered (Class 1000) and digitized at a minimum rate of 10,000 samples per second. The data is then placed into permanent storage on a magnetic disk or tape after application of appropriate calibration scale factors.

As the data is recalled for integration or plotting, the appropriate filter is applied. The filters are in accordance with SAE Recommended Practice J211 dated March 1995, "Instrumentation for Impact Tests." Velocity and displacement data is plotted after application of an SAE Class 180 filter.

Before plotting, the contractor's program manager or engineer shall determine the "time zero". When a velocity or displacement trace is to be plotted, integration for the appropriate acceleration signal is performed digitally.

11. PRETEST REQUIREMENTS....Continued

The filtering requirements for FMH data is Class 1000. As stated previously, the minimum sampling rate requirement is 10,000 samples per second per channel.

NOTE: The contractor must meet all the requirements in the NHTSA "Data Tape Reference Guide" which is available from the following organization:

U.S. Department of Transportation
 National Highway Traffic Safety Administration
 Office of Crashworthiness Research
 Safety Systems Engineering and Analysis Division
 Mail Code: NRD-11
 400 Seventh Street, SW
 Washington DC 20590
 Telephone: 202-366-4850

NHTSA's "Data Tape Reference Guide" is also available from the agency's web site www.nhtsa.dot.gov

ALGORITHMS USED TO CALCULATE THE HEAD INJURY CRITERION (HIC) AND TO DIGITALLY FILTER THE CLASS 1000 DATA

Information for the FORTRAN algorithms used to calculate the HIC and digitally filter the Class 1000 data collected from the FMH impact tests is available from the NHTSA Internet website. A listing of the variables required by the furnished algorithms shall also be supplied to the contractor.

For the various filter classes, the following cut-off frequencies shall be required:

CLASS	CUT-OFF FREQUENCY
60	100
180	300
600	1000
1000	1650

The most recent versions of the algorithms can be obtained from the agency's web site identified above. Any questions pertaining to the algorithms or requests for the algorithms should be directed to the organization identified above.

If a contractor is not presently certified as defined by the "Data Tape Reference Guide," the same organization should be contacted. A contractor is not considered qualified for test work described herein without this certification.