13. POST TEST REQUIREMENTS

A. Store all recorded data on hard storage such as magnetic tape or floppy diskettes.

B. Obtain necessary post test photographs as described in section 8 and as required to illustrate test results.

C. Process the test data to obtain the following:

(1) Acceleration vs. Time

(2) Time Zero Switch vs. Time

(3) Impact Velocity

(4) Determine if the deceleration of the head form exceeded 80g continuously for more than 3 ms.

(5) Determine if the interior compartment doors meet the inertia load requirements of FMVSS 201 S.3.3.1.

(6) Determine if sun visor mountings have a radius less than 0.125 inch.

(7) Determine if the armrests meet the requirements of FMVSS 201 S3.5.1 and/or S3.5.2.

NOTE: (1) THROUGH (4) MUST BE OBTAINED FOR EACH IMPACT.

The contractor shall re-verify all instrumentation and check data sheets and photographs.

14. REPORTS

14.1 MONTHLY STATUS REPORTS

The contractor shall submit a Monthly Test Status Report and a Vehicle Status Report to the COTR. The Vehicle Status Report shall be submitted until all vehicles or items of equipment are disposed of. Samples of the required Monthly Status Reports are contained in the report forms section.

14.2 APPARENT NONCOMPLIANCE

Any indication of a test failure shall be communicated by telephone to the COTR within 24 hours with written notification mailed within 48 hours (Saturdays and Sundays excluded). A Notice of Test Failure (see report forms section) with a copy of the particular compliance test data sheet(s) and preliminary data plot(s) shall be included.

In the event of a test failure, a post test calibration check of critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COTR's discretion and shall be performed without additional costs to the OVSC.

14.3 FINAL TEST REPORTS

14.3.1 COPIES

In the case of a test failure, **SEVEN** copies of the Final Test Report shall be submitted to the COTR for acceptance within three weeks of test completion. The Final Test Report format to be used by all contractors can be found in the "Report Section".

Where there has been no indication of a test failure, **FOUR** copies of each Final Test Report shall be submitted to the COTR within three weeks of test completion. Payment of contractor's invoices for completed compliance tests may be withheld until the Final Test Report is accepted by the COTR. Contractors are requested to NOT submit invoices before the COTR is provided copies of the Final Test Report.

Contractors are required to submit the first Final Test Report in draft form within two weeks after the compliance test is conducted. The contractor and the COTR will then be able to discuss the details of both test conduct and report content early in the compliance test program.

Contractors are required to PROOF READ all Final Test Reports before submittal to the COTR. The OVSC will not act as a report quality control office for contractors. Reports containing a significant number of errors will be returned to the contractor for correction, and a "hold" will be placed on invoice payment for the particular test.

14. REPORTS....Continued

14.3.2 REQUIREMENTS

The Final Test Report, associated documentation (including photographs) are relied upon as the chronicle of the compliance test. The Final Test Report will be released to the public domain after review and acceptance by the COTR. For these reasons, each final report must be a complete document capable of standing by itself.

The contractor should use **detailed** descriptions of all compliance test events. Any events that are not directly associated with the standard but are of technical interest should also be included. The contractor should include as much **detail** as possible in the report.

Instructions for the preparation of the first three pages of the final test report are provided below for the purpose of standardization.

14.3.3 FIRST THREE PAGES

A. FRONT COVER —

A heavy paperback cover (or transparency) shall be provided for the protection of the final report. The information required on the cover is as follows:

(1) Final Report Number such as 201-ABC-9X-001 where

201 is the FMVSS tested
ABC are the initials for the laboratory
9X is the Fiscal Year of the test program (or 0X after 1999)
001 is the Group Number (001 for the 1st test, 002 for the 2nd test, etc.)

(2) Final Report Title And Subtitle such as

SAFETY COMPLIANCE TESTING FOR FMVSS 201
Occupant Protection in Interior Impact
* *
World Motors Corporation
199X XYZ 4-door sedan
NHTSA No. CX0401

(3) Contractor's Name and Address such as

COMPLIANCE TESTING LABORATORIES, INC.
4335 West Dearborn Street
Detroit, Michigan 48090

14. REPORTS....Continued

NOTE: DOT SYMBOL WILL BE PLACED BETWEEN ITEMS (3) AND (4)

(4) Date of Final Report completion

(5) The words "FINAL REPORT"

(6) The sponsoring agency's name and address as follows

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Safety Assurance
Office of Vehicle Safety Compliance
400 Seventh Street, SW
Room 6115 (NSA-30)
Washington, DC 20590

14. REPORTS....Continued

B. FIRST PAGE AFTER FRONT COVER —

A disclaimer statement and an acceptance signature block for the COTR shall be provided as follows

This publication is distributed by the U. S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Prepared By: ___________________________

Approved By: ___________________________

Approval Date: __________________________

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: ___________________________

Acceptance Date: ________________________

14. REPORTS....Continued

C. SECOND PAGE AFTER FRONT COVER —

A completed Technical Report Documentation Page (Form DOT F1700.7) shall be completed for those items that are applicable with the other spaces left blank. Sample data for the applicable block numbers of the title page follows.

Block 1 — REPORT NUMBER

201-ABC-9X-001

Block 2 — GOVERNMENT ACCESSION NUMBER

Leave blank

Block 3 — RECIPIENT'S CATALOG NUMBER

Leave blank

Block 4 — TITLE AND SUBTITLE

Final Report of FMVSS 201 Compliance Testing of 199X World XYZ
4-door Sedan, NHTSA No. CX0401

Block 5 — REPORT DATE

March 1, 199X

Block 6 — PERFORMING ORGANIZATION CODE

ABC

Block 7 — AUTHOR(S)

John Smith, Project Manager
Bill Doe, Project Engineer

Block 8 — PERFORMING ORGANIZATION REPORT NUMBER

ABC-DOT-XXX-001

Block 9 — PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories
405 Main Street
Detroit, MI 48070

14. REPORTS....Continued

Block 10 — WORK UNIT NUMBER

Leave blank

Block 11 — CONTRACT OR GRANT NUMBER

DTNH22-9X-D-12345

Block 12 — SPONSORING AGENCY NAME AND ADDRESS

US Department of Transportation
National Highway Traffic Safety Administration
Safety Assurance
Office of Vehicle Safety Compliance (NSA-30)
400 Seventh Street, SW, Room 6115
Washington, DC 20590

Block 13 — TYPE OF REPORT AND PERIOD COVERED

Final Test Report
Feb. 15 to Mar. 15, 199X

Block 14 — SPONSORING AGENCY CODE

NSA-30

Block 15 — SUPPLEMENTARY NOTES

Leave blank

Block 16 — ABSTRACT

Compliance tests were conducted on the subject 199X World XYZ 4-Door sedan in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-201-XX for the determination of FMVSS 201 compliance. Test failures identified were as follows:

None

NOTE: Above wording must be shown with appropriate changes made for a particular compliance test. Any questions should be resolved with the COTR.

14. REPORTS....Continued

Block 17 — KEY WORDS

Compliance Testing
Safety Engineering
FMVSS 201

Block 18 — DISTRIBUTION STATEMENT

Copies of this report are available from –
NHTSA Technical Information Services (TIS)
Room 5108 (NAD-40)
400 Seventh St., SW
Washington, DC 20590
Telephone No.: 202-366-4946

Block 19 — SECURITY CLASSIFICATION OF REPORT

Unclassified

Block 20 — SECURITY CLASSIFICATION OF PAGE

Unclassified

Block 21 — NUMBER OF PAGES

Add appropriate number

Block 22 — PRICE

Leave blank

14. REPORTS....Continued

14.3.4 TABLE OF CONTENTS

Final test report Table of Contents shall include the following:

Section 1 — Purpose of Compliance Test

Section 2 — Compliance Test Data Summary

Section 3 — Compliance Test Data

Section 4 — Noncompliance Data (if applicable)

Section 5 — Photographs

15. DATA SHEETS

TEST VEHICLE RECEIVING INSPECTION DATA SHEET

VEHICLE YEAR/MAKE/MODEL/STYLE: ____

NHTSA NO.: ____________ VIN: ____________________________________

DATE OF MANUFACTURE: ________________ (SEE CERTIFICATION LABEL)

COLOR: ____________________ ODOMETER READING: ________________

LABORATORY: _________________________ TEST DATE: ____________________

NUMBER OF SEATING POSITIONS:

FRONT: _____ REAR: ____

INSTRUMENT PANEL:

NOTE UNUSUAL FEATURES: ____

____

TYPE OF FRONT SEATS:

BENCH: _____ BUCKET: _____ SPLIT BACKS: _____

TYPE OF HEAD RESTRAINTS:

FIXED: _____ ADJUSTABLE: _____

VEHICLE EQUIPPED WITH ARMRESTS?

NO: _____ YES: _____ NUMBER: _____

LOCATION: ____

VEHICLE EQUIPPED WITH SUN VISORS?

NO: _____ YES: _____

VEHICLE EQUIPPED WITH INTERIOR DOOR LATCHES?

NO: _____ YES: _____ NUMBER: _____

LOCATION: ____

15. DATA SHEETS....Continued

REMARKS:

RECORDED BY: ____________________________ DATE: ________________

APPROVED BY: ____________________________

15. DATA SHEETS....Continued

HEAD FORM IMPACT TEST RESULTS
INSTRUMENT PANEL

VEHICLE YEAR/MAKE/MODEL/STYLE: ______________________________

VEHICLE NHTSA NO.: ____________ VIN: ______________________

DATE OF MANUFACTURE: ________________ (SEE CERTIFICATION LABEL)

LABORATORY: ______________________ TEST DATE: ____________

IMPACT LOCATION AND NUMBER				VELOCITY (mph)	PEAK ACCELERATION (3 ms Clip) Gs
NUMBER	X	Y	ANGLE		

REFERENCE POINT: ____

REMARKS:

RECORDED BY: ______________________ DATE: ______________

APPROVED BY: ______________________

15. DATA SHEETS....Continued

HEAD FORM IMPACT TEST RESULTS
SEAT BACKS

VEHICLE YEAR/MAKE/MODEL/STYLE: ______________________________

VEHICLE NHTSA NO.: __________ VIN: ______________________

DATE OF MANUFACTURE: ____________ (SEE CERTIFICATION LABEL)

LABORATORY: __________________ TEST DATE: ______________

IMPACT LOCATION AND NUMBER				VELOCITY (mph)	PEAK ACCELERATION (3 ms Clip) Gs
NUMBER	X	Y	ANGLE		

REFERENCE POINT: ____

RECORDED BY: ____________________ DATE: ______________

APPROVED BY: ____________________

15. DATA SHEETS....Continued

SUNVISOR AND ARMREST EVALUATION

VEHICLE YEAR/MAKE/MODEL/STYLE: ____

VEHICLE NHTSA NO.: _________________ VIN: __________________________________

DATE OF MANUFACTURE: ____________________ (SEE CERTIFICATION LABEL)

LABORATORY: _____________________________ TEST DATE: _____________________

SUN VISOR INFORMATION:

1. Are sun visors constructed of or covered with energy absorbing material?

   YES (PASS): _____ NO (FAIL): _____

2. Are any edges statically contactable by a spherical 6.5 inch diameter head form of radius less than 0.125 inch?

   YES (FAIL): _____ NO (PASS): _____

ARMREST INFORMATION:

A. FIXED ARMREST

1. Is it constructed of energy absorbing material with the capability of laterally deflecting 2 inches without contacting any underlying rigid material?

   YES: _____ NO: ______

2. Is it constructed of energy absorbing material that deflects or collapses within 1.25 inches of the rigid test panel surface without contacting underlying rigid material between 0.50 and 1.25 inches from the panel which has a vertical height of less than 1 inch?

   YES: _____ NO: _______

3. Does it provide adequate pelvic area impact protection?

   YES: _____ NO: ______

4. Does it meet at least one of the criteria No. 1 to 3?

   YES (PASS): _____ NO (FAIL): ______

15. DATA SHEETS....Continued

B. FOLDING ARMREST

Is it made of or covered with energy absorbing material? Or does it meet at least one of the criteria No. 1 to 3?

YES (PASS): _____ NO (FAIL): _______

REMARKS:

RECORDED BY: ____________________________ DATE: __________________

APPROVED BY: ____________________________

15. DATA SHEETS....Continued

DOOR LATCH EVALUATION

VEHICLE YEAR/MAKE/MODEL/STYLE: ____

VEHICLE NHTSA NO.: _______________ VIN: __________________________________

DATE OF MANUFACTURE: ____________________ (SEE CERTIFICATION LABEL)

LABORATORY: _______________________________TEST DATE: _____________________

LATCH ENGAGEMENT INTERFERENCE

DESCRIPTION OF LATCH LOCATION	NO LOAD	10G HORIZONTAL TRANSVERSE	10G VERTICAL	30G HORIZONTAL LONGITUDINAL

(MINUS VALUES INDICATE DISENGAGEMENT)

RECORDED BY: ____________________________ DATE: _____________________

APPROVED BY: ____________________________

15. DATA SHEETS....CONTINUED

SUMMARY OF RESULTS

VEHICLE YEAR/MAKE/MODEL/STYLE: ____

VEHICLE NHTSA NO.: ________________ VIN: ________________________________

DATE OF MANUFACTURE: ___________________ (SEE CERTIFICATION LABEL)

LABORATORY: ___________________________ TEST DATE: ____________________

	NUMBER OF IMPACTS	PASS/FAIL
INSTRUMENT PANEL	_________________	_____________
SEAT BACK	_________________	_____________
SUN VISORS	_________________	_____________
ARMRESTS	_________________	_____________
INTERIOR COMPARTMENT DOORS	_________________	_____________

REMARKS:

RECORDED BY: ______________________________ DATE: _______________

APPROVED BY: ______________________________

16. FORMS

LABORATORY NOTICE OF TEST FAILURE TO OVSC

FMVSS NO.: 201 TEST DATE: ____________________

LABORATORY: ____________________

CONTRACT NO.: ____________________ DELV. ORDER NO.: ____________________

LABORATORY PROJECT ENGINEER'S NAME: ____________________

TEST SPECIMEN DESCRIPTION: ____________________

VEHICLE NHTSA NO.: ________ VIN: ____________________

MFR: ____________________

TEST FAILURE DESCRIPTION: ____________________

____

____

____

FMVSS REQUIREMENT, PARAGRAPH S___ : ____________________

____

____

____

NOTIFICATION TO NHTSA (COTR): ____________________

DATE: ____________________ BY: ____________________

REMARKS:

16. FORMS....Continued

MONTHLY TEST STATUS REPORT
FMVSS 201
DATE OF REPORT: ____________

NO.	VEHICLE NHTSA NO., MAKE & MODEL	COMPLIANCE TEST DATE	PASS/ FAIL	DATE REPORT SUBMITTED	DATE INVOICE SUBMITTED	INVOICE PAYMENT DATE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

16. FORMS....Continued

MONTHLY VEHICLE STATUS REPORT
FMVSS 201
DATE OF REPORT: _____________

NO.	VEH. NHTSA NO., MAKE & MODEL	DATE OF DELIVERY	ODOMETER READING	TEST COMPLETE DATE	VEHICLE SHIPMENT DATE	ODOMETER READING
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

APPENDIX A
MOTOR VEHICLE SAFETY STANDARD NO. 201
Occupant Protection in Interior Impact-Passenger Cars

S1. PURPOSE AND SCOPE

This standard specifies requirements to afford impact protection for occupants.

S2. APPLICATION

This standard applies to passenger cars and to multipurpose passenger vehicles, trucks and buses with a GVWR of 10,000 pounds or less.

S3. REQUIREMENTS FOR PASSENGER CARS AND FOR TRUCKS, BUSES AND MULTIPURPOSE PASSENGER VEHICLES WITH A GVWR OF 10,000 POUNDS OR LESS MANUFACTURED ON OR AFTER SEPTEMBER 1, 1981.

S3.1 INSTRUMENT PANELS

Except as provided in S3.1.1, when that area of the instrument panel that is within the head impact area is impacted in accordance with S3.1.2 by a 15 pound, 6.5 inch diameter head form at —

(a) A relative velocity of 15 miles per hour for all vehicles except those specified in paragraph (b) of this section,

(b) A relative velocity of 12 miles per hour for vehicles that meet the occupant crash protection requirements of S5.1 of 49 CFR 571.208 by means of inflatable restraint systems and meet the requirements of S4.1.2.1(c)(2) of 49 CFR 571.208 by means of a Type 2 seat belt assembly at the right front designated seating position, the deceleration of the head form shall not exceed 80g continuously for more than 3 milliseconds. (56 F.R. 26036-June 6, 1991. Effective: June 6, 1991)

S3.1.1 The requirements of S3.1 do not apply to —

(a) Console assemblies;

(b) Areas less than 5 inches inboard from the juncture of the instrument panel attachment to the body side inner structure;

(c) Areas closer to the windshield juncture than those statically contactable by the head form with the windshield in place;

(d) Areas outboard of any point of tangency on the instrument panel of a 6.5 inch diameter head form tangent to and inboard of a vertical longitudinal plane tangent to the inboard edge of the steering wheel; or

APPENDIX A....Continued

(e) Areas below any point at which a vertical line is tangent to the rearmost surface of the panel.

S3.1.2 DEMONSTRATION PROCEDURES

Tests shall be performed as described in Society of Automotive Engineers (SAE) Recommended Practice J921, "Instrument Panel Laboratory Impact Test Procedure," June 1965, using the specified instrumentation or instrumentation that meets the performance requirements specified in SAE Recommended Practice J977, "Instrumentation for Laboratory Impact Tests," November 1966, except that —

(a) The origin of the line tangent to the instrument panel surface shall be a point on a transverse horizontal line through a point 5 inches horizontally forward of the Seating Reference Point (SRP) of the front outboard passenger Designated Seating Position (DSP), displaced vertically an amount equal to the rise which results from a 5 inch forward adjustment of the seat or 0.75 inches; and

(b) Direction of impact shall be either —

(1) In a vertical plane parallel to the vehicle longitudinal axis; or

(2) In a plane normal to the surface at the point of contact.

S3.2 SEAT BACKS

Except as provided in S3.2.1, when that area of the seat back that is within the head impact area is impacted in accordance with S3.2.2 by a 15 pound, 6.5 inch diameter head form at a relative velocity of 15 miles per hour, the deceleration of the head form shall not exceed 80g continuously for more than 3 milliseconds.

S3.2.1

The requirements of S3.2 do not apply to seats installed in school buses which comply with the requirements of FMVSS 222, "School Bus Passenger Seating and Occupant Protection" (49 CFR 571.222) or to rearmost, side-facing, back-to-back, folding auxiliary jump, and temporary seats.

S3.2.2 DEMONSTRATION PROCEDURES

Tests shall be performed as described in SAE Practice J921, "Instrument Panel Laboratory Impact Test Procedure," June 1965, using the specified instrumentation or instrumentation that meets the performance requirements specified in SAE Recommended Practice J977, "Instrumentation for Laboratory Impact Tests," November 1966, except that —

APPENDIX A....Continued

(a) The origin of the line tangent to the uppermost seat back frame component shall be a point on a transverse horizontal line through the seating reference point of the right rear designated seating position, with adjustable forward seats in their rearmost design driving position and reclinable forward seat backs in their nominal design driving position;

(b) The direction of impact shall be either —

(1) In a vertical plane parallel to the vehicle longitudinal axis; or

(2) In a plane normal to the surface at the point of contact;

(c) For seats without head restraints installed, tests shall be performed for each individual split or bucket seats back at points within 4.0 inches left and right of its centerline, and for each bench seat back between points 4.0 inches outboard of the centerline of each outboard designated seating position;

(d) For seats having head restraints installed, each test shall be conducted with the head restraint in place at its lowest adjusted position, at a point on the head restraint centerline; and

(e) For a seat that is installed in more than one body style, tests conducted at the fore and aft extremes identified by application of subparagraph (a) shall be deemed to have demonstrated all intermediate conditions.

S3.3 INTERIOR COMPARTMENT DOORS

Each interior compartment door assembly located in an instrument panel, console assembly, seat back, or side panel adjacent to a designated seating position shall remain closed when tested in accordance with either S3.31(a) and S3.3.1(b) or S3.3.1(a) and S3.3.1(c). Additionally, any interior compartment door located in an instrument panel or seat back shall remain closed when the instrument panel or seat back is tested in accordance with S3.1 and S3.2. All interior compartment door assemblies with a locking device must be tested with the locking device in an unlocked position.

S3.3.1 DEMONSTRATION PROCEDURES

(a) Subject the interior compartment door latch system to an inertia load of 10g in a horizontal transverse direction and an inertia load of 10g in a vertical direction in accordance with the procedure described in section 5 of SAE Recommended Practice J839b, Passenger Car Side Door Latch Systems, May 1965, or an approved equivalent.

APPENDIX A....Continued

(b) Impact the vehicle perpendicularly into a fixed collision barrier at a forward longitudinal velocity of 30 miles per hour.

(c) Subject the interior compartment door latch system to a horizontal inertia load of 30 g in a longitudinal direction in accordance with the procedure described in section 5 of SAE Recommended Practice J839b, Passenger Car Side Door Latch Systems, May 1965 or an approved equivalent.

S3.4 SUN VISORS

S3.4.1 A sun visor that is constructed of or covered with energy-absorbing material shall be provided for each front outboard designated seating position.

S3.4.2 Each sun visor mounting shall present no rigid material edge radius of less than 0.125 inch that is statically contactable by a spherical 6.5 inch diameter head form.

S3.5 ARMRESTS

S3.5.1 General

Each installed armrest shall conform to at least one of the following:

(a) It shall be constructed with energy absorbing material and shall deflect or collapse laterally at least 2 inches without permitting contact with any underlying rigid material.

(b) It shall be constructed with energy-absorbing material that deflects or collapses to within 1.25 inches of a rigid test panel surface without permitting contact with any rigid material. Any rigid material between 0.5 and 1.25 inches from the panel surface shall have a minimum vertical height of not less than 1 inch.

(c) Along not less than 2 continuous inches of its length, the armrest shall, when measured vertically in side elevation, provide at least 2 inches of coverage within the pelvic impact area.

S3.5.2 FOLDING ARMRESTS

Each armrest that folds into the seat back or between two seat backs shall either —

(a) Meet the requirement of S3.5.1; or

(b) Be constructed of or covered with energy absorbing material.

APPENDIX B
INSTRUMENT PANEL LABORATORY IMPACT TEST PROCEDURE
SAE J921, SAE RECOMMENDED PRACTICE

1.0 SCOPE

This SAE Recommended Practice defines simplified laboratory impact test procedure for evaluating characteristics of automotive instrument panels under simulated occupant impact conditions. Head mass, headform diameter, location and attitude of impact velocity, and head impact velocity are defined for this test.

2.0 INTRODUCTION

The evaluation of the injury potential of instrument panels is a complex problem involving human tolerance, car and occupant dynamics during an accident, and severity of injury to face and brain.

Simulation of this complex problem can be approached by complex tests in which linear accelerators or actual vehicle crashes are employed using anthropomorphic dummies or cadaver, as test subjects. These types of test, are presently too limited, cumbersome or expensive to serve as feasible methods for evaluating instrument panels. Therefore, the test procedure and related test equipment presented herein are designed to give valid, comparable, and reproducible data necessary for the evaluation of various types and configurations of instrument panels.

3.0 ITEMS TO BE MEASURED

The following items are defined for measurement:

3.1 Impact Velocity

The velocity of the headform at the moment of impact.

3.2 Rebound Velocity

The headform velocity at the moment that it severs contact with the test specimen.

3.3 Maximum Headform Displacement

The maximum amount of displacement of the leading surface of the headform after initial contact with the test specimen.

3.4 Acceleration-Time History of the Headform

The tangential acceleration-time curve of the axis of symmetry of the headform during the period of contact with the test specimen.

APPENDIX B....Continued

4.0 LOCATION AND ATTITUDE OF IMPACT

4.1 Using the vehicle package drawings and directing attention to the vertical longitudinal vehicle section in which evaluation is to be made, locate the passenger "H" point using SAE J826, with the front seat in the full forward position.

4.2 Draw a line from this point tangent to the instrument panel sheet metal and parallel to a vertical longitudinal plane of the car. The maximum length of this line shall be 33.0 inches. Construct a perpendicular to the line at the point of tangency. The intersection of the perpendicular with the panel assembly surface is the location of the point of impact, and the direction of impact shall be taken along this perpendicular.

4.3 If, due to configuration of the panel and body geometry, the impact point, as located by paragraph 4.2, should fall forward of the point of contact upon the main instrument panel sheet metal structures of 4.5 inches diameter circle laid tangent to the inner surface of the windshield and the instrument panel sheet metal, then the latter point shall be selected as the point of impact and the impact direction shall be determined by a normal at this point constructed on the H-point-tangent line as illustrated in Figure 1.

4.4 If there is some other point located along the H-point-tangent line such that an impact delivered to the panel at this point and normal to the aforesaid line would obviously be more severe than for the point determined by either paragraphs 4.2 or 4.3, then an impact test shall also be run at this point. The direction of impact shall be determined by a normal at this point erected on the tangent H-point line.

5.0 TEST EQUIPMENT AND INSTRUMENTATION

5.1 Recommended test equipment consists of a substantially constructed base, "A" frame, and adjustable anvil. (See Figures 2 and 3.) A pendulum of 15 pound effective weight is suspended in the "A" frame on self-aligning ball bearing mounts. The details of a pendulum design are included in the Appendix. A differently constructed pendulum giving comparable result, may be used, provided these results can be correlated with the recommended pendulum by the use of the standard test sample shown in Figure 4.

5.2 Pendulum headform shall be a 6.5 inch diameter hemisphere. The headform shall have sufficient offset, with respect to the pendulum arm, to preclude the contact of the arm with the instrument panel while impacting the headform.

5.3 Impact velocity may be obtained by simply dropping the pendulum or by use of an impelling device. The recommended impact velocity is 15 mph.

APPENDIX B....Continued

SELECTION OF POINT OF IMPACT

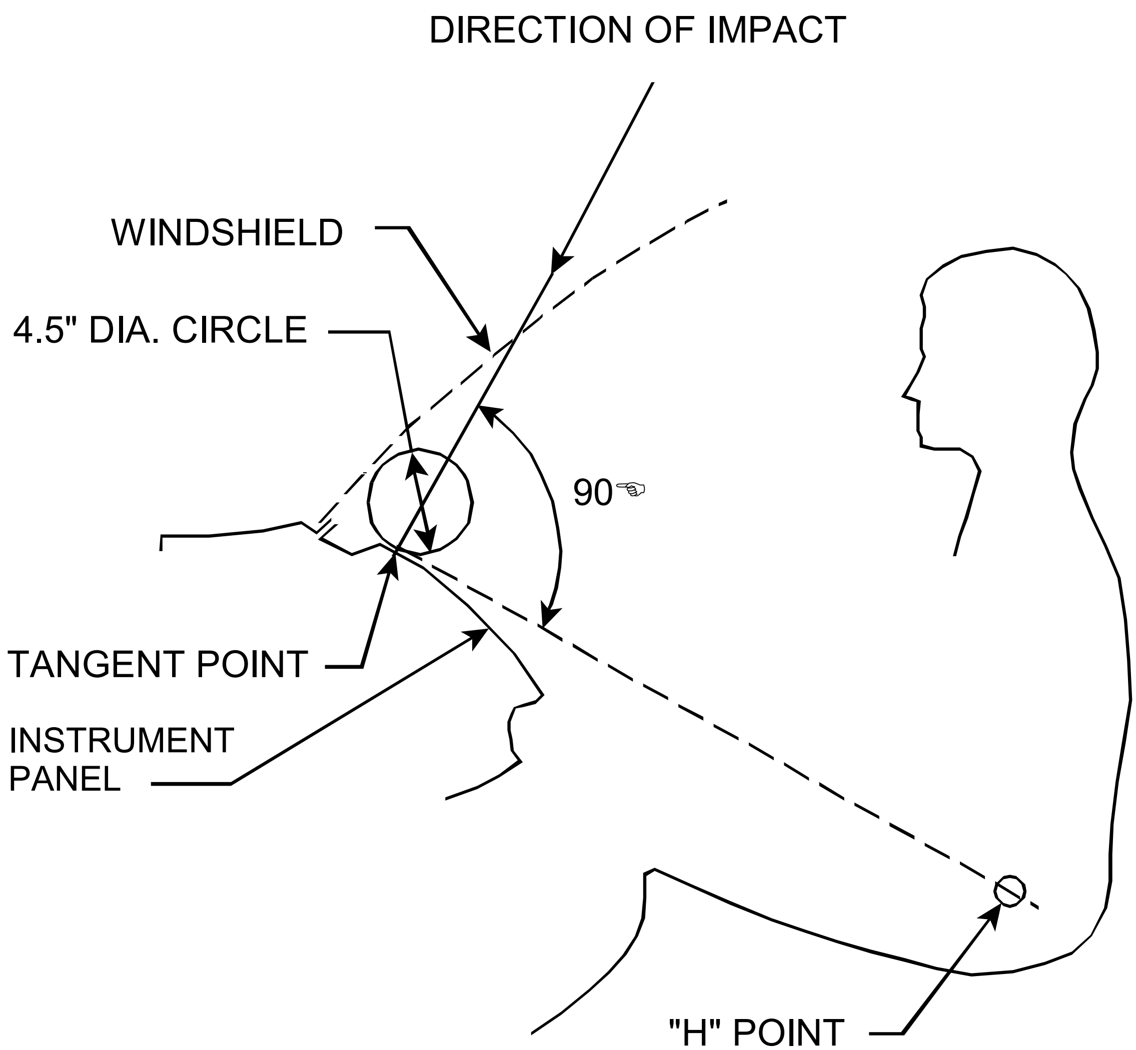


FIGURE 1

APPENDIX B....Continued

5.4 Recommended measuring instrumentation consists of two accelerometers, an optical transducer for velocity and amount of displacement, a system of amplifiers, and a light beam oscillograph. The specification of this equipment appears in the Appendix. Alternate instrumentation is permitted, provided test results can be correlated by the use of the standard test sample shown in Figure 4.

6.0 TEST PROCEDURE

6.1 All components shall be completely identified chemically and physically prior to testing.

6.2 All samples shall be maintained at a constant room temperature of 72ºF ± 5ºF for 12 hours prior to testing. The samples should be placed so that adequate ventilation is attained during this period. No physical or chemical abuse shall be exerted on these samples prior to, or during, this period.

6.3 Any substructures, braces, instruments, and so on, located between the instrument panel and firewall, which would influence the impact performance of the installed panel assembly, should be included in the specimen tested.

6.4 Full width instrument panels will be used and will be mounted to a rigid backup support, such that the leading edge and ends of the panel are rigidly affixed to the support.

6.5 The test shall be conducted with the panel inverted to duplicate more realistically the head to instrument panel impact. The attitude and point of impact of the panel shall be set up to coincide with the center of the headform at rest. The instrument panel including padding assembly shall just make contact with the impacting headform at rest.

6.6 Calibrate all instrumentation so that the maximum expected value for each function to be measured will be within 75 percent of the maximum desired deflection of the recording galvanometer or other instrumentation. This will prevent an unexpectedly high trace from going off the recorder graph or intermingling with other data traces. Pretest and post test calibration shall be performed and recorded to insure accurate data.

6.7 Adjust the drop height or the air cylinder accumulator, when used, to the pressure needed to obtain the required impact velocity. The pressure information should be obtained from a plotted pressure-velocity curve.

6.8 On completion of the required warmup period, perform the instrument verification tests as outlined in the operating instructions in the Appendix, when the suggested instrumentation is used.

6.9 Identify the specimen and test run on the data sheet and the oscillogram recording sheet.

APPENDIX B....Continued

SAE PASSENGER COMPARTMENT TEST PENDULUM

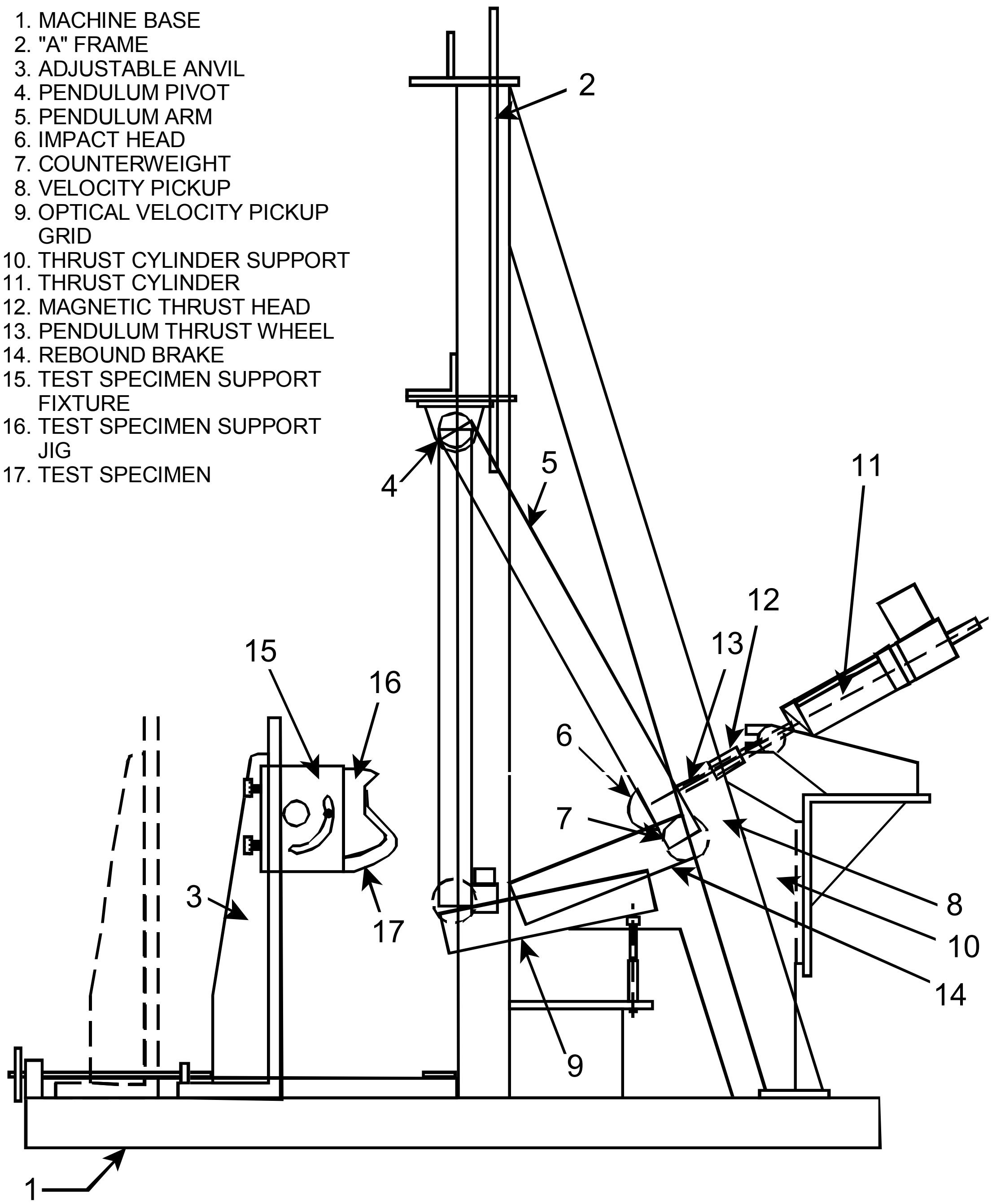


FIGURE 2

APPENDIX B....Continued

SAE PASSENGER COMPARTMENT TEST PENDULUM INSTRUMENTATION CONSOLE

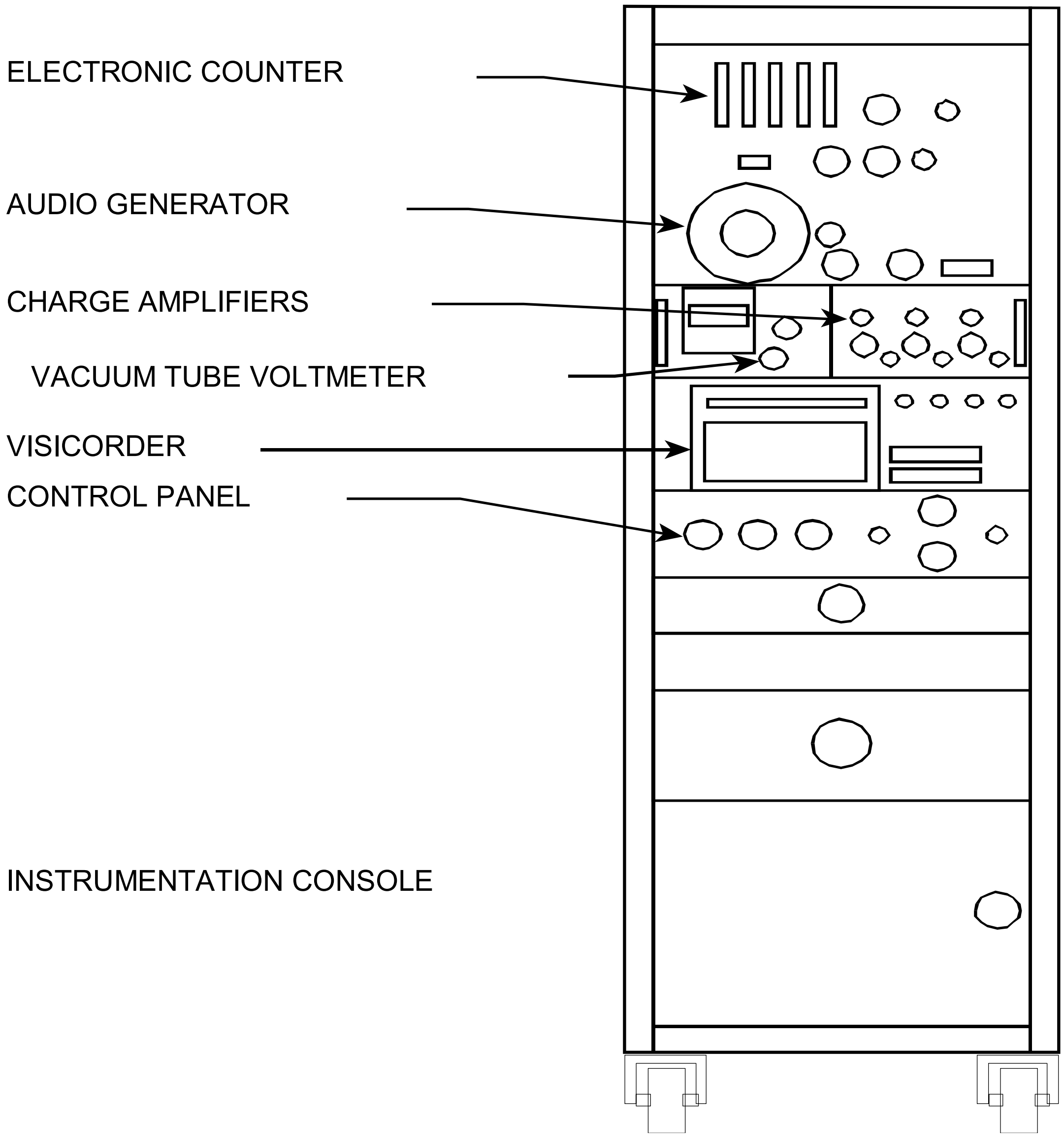


FIGURE 3

APPENDIX B....Continued

INSTRUMENT PANEL IMPACT TEST
MACHINE TEST SAMPLE

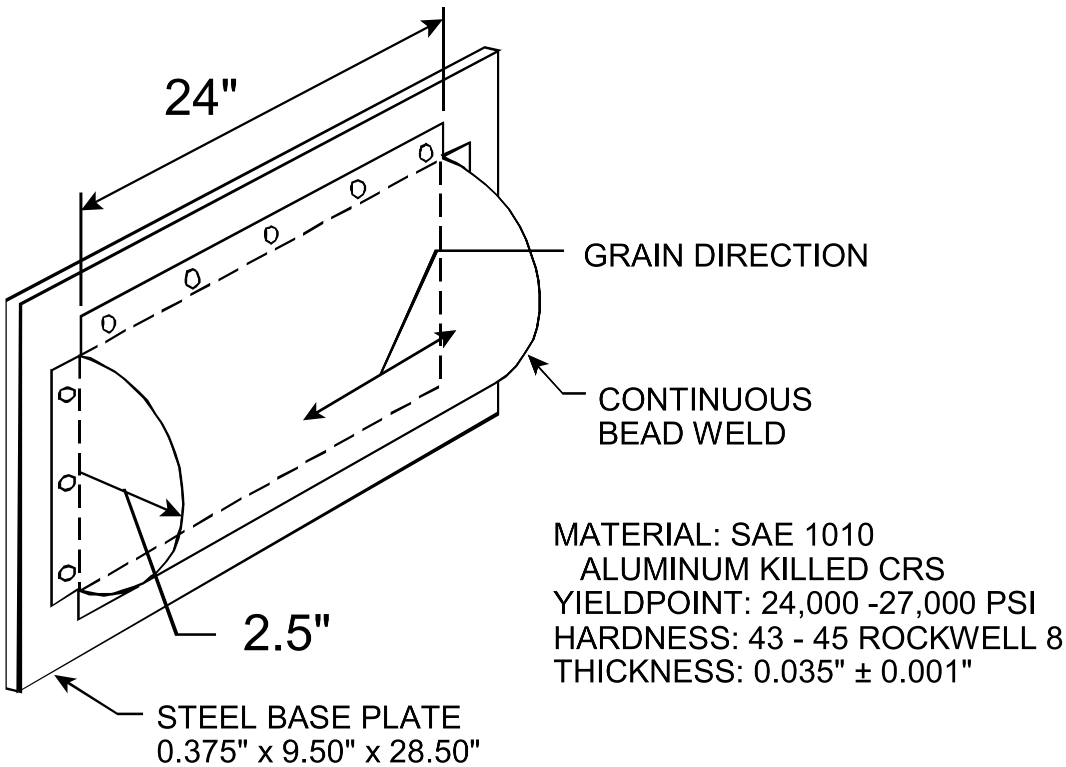


FIGURE 4

7.0 TEST EXECUTION

7.1 Release the safety and impact the sample.

7.2 Record the test data. post impact condition of the sample, and any unusual conditions on the data sheet.

7.3 Recheck all calibrations at the end of the tests or as test results warrant.

7.4 At completion of the tests or whenever the impactor is left unattended, lock it to prevent accidental firing or damage to the instruments.

8.0 DATA ANALYSIS

8.1 Record impact velocity, rebound velocity maximum headform penetration.

8.2 Calculate coefficient of restitution N by the formula

$$N = \text{Rebound Velocity}/\text{Impact Velocity}$$

APPENDIX B....Continued

8.3 Record acceleration-time history curve. Determine maximum headform deceleration.

8.4 Determine energy absorption or other acceleration-time values, for comparison purposes from the acceleration-time curves.

9.0 APPENDIX

9.1 Pendulum Design Specifications

9.1.1 The instrument panel laboratory impact test pendulum is designed on the basis that the center of percussion of the physical pendulum coincides with its impact point. Its effective mass can be varied to match test procedure requirements by adjusting the weights of the pendulum's various components.

9.1.2 For design purposes the pendulum is further defined as follows:

The moment of inertia of the pendulum arm is taken as that of a uniform beam rotated about one of its ends.

The moment of inertia of the pivot assembly is taken as that of a stepped cylinder rotated about its axis.

The moments of inertia of the remaining pendulum components are taken to be point masses rotated about the pivot axis with a radius from the pivot axis to the center of gravity of the component, specifically, $I_c = I_{cg} + (r^2 \times M_c)$. But, I_{cg} is a small value compared to the r^2M_c values and can be safely left out for design purposes.

The certification of the desired center of percussion is established by adjusting the counterweight to the correct period for the radius of the defined center of percussion.

The center of gravity of the pendulum assembly is determined by direct measurement. The radius from the pivot to the center of gravity of the pendulum, the defined center of percussion mass of the pendulum assembly are used to calculate the total moment of inertia and the effective weight of the pendulum assembly by the following formula:

$$I_T = L \times L_{egs} \times M_T$$

Final correlation of multiple pieces of test equipment is most simply insured by building the physical pendulum assembly to an accepted design.

APPENDIX B....Continued

9.1.3 Schematic, Legend, and Calculations

A schematic of the pendulum am assembly is shown in Figure 5.

9.1.3.1 Measured Values —

W_p = Weight of pivot assembly
W_b = Weight of beam
W_h = Weight of head assembly (including impact head, accelerometers, thrust wheel, etc.)
W_{vp} = Weight of optical velocity transducer assembly
W_{cw} = Weight of counterweight and brake assembly
W_T = $W_p + W_b + W_h + W_{vp} + W_{cw}$ = Total weight of pendulum assembly
L = Radius of center of percussion and center of gravity of the head assembly about pivot axis
R_p = Effective radius of the pivot assembly
L_b = Total length of the beam
L_{vp} = Radius of center of gravity of velocity transducer assembly about the pivot axis
L_{cw} = Radius of center of gravity of counterweight and brake assembly about pivot axis
L_{cgs} = Radius of center of gravity of pendulum assembly about pivot axis
L' = Length from pivot end of pendulum to center of percussion and center of gravity of head assembly
L_p' = Length from pivot end of pendulum to pivot axis
L_b' = L_b
L_{vp}' = Length from pivot end of pendulum to center of gravity of velocity transducer assembly
L_{cw}' = Length from pivot end of pendulum to center of gravity of counterweight and brake assembly
L_{cgs}' = Length from pivot end of pendulum to center of gravity of pendulum assembly
$L_{cgs\text{-}ew}$ =Length from pivot axis to cgs of pendulum without counterweight

9.1.3.2 Defined Values –

ω = Angular velocity, radians/sec
M_p = Mass of pivot assembly = W_p/g
M_b = Mass of beam = W_b/g
M_h = Mass of head assembly = W_h/g
M_{vp} = Mass of velocity transducer assembly = W_{vp}/g
M_{cw} = Mass of counterweight and brake assembly = W_{cw}/g

APPENDIX B....Continued

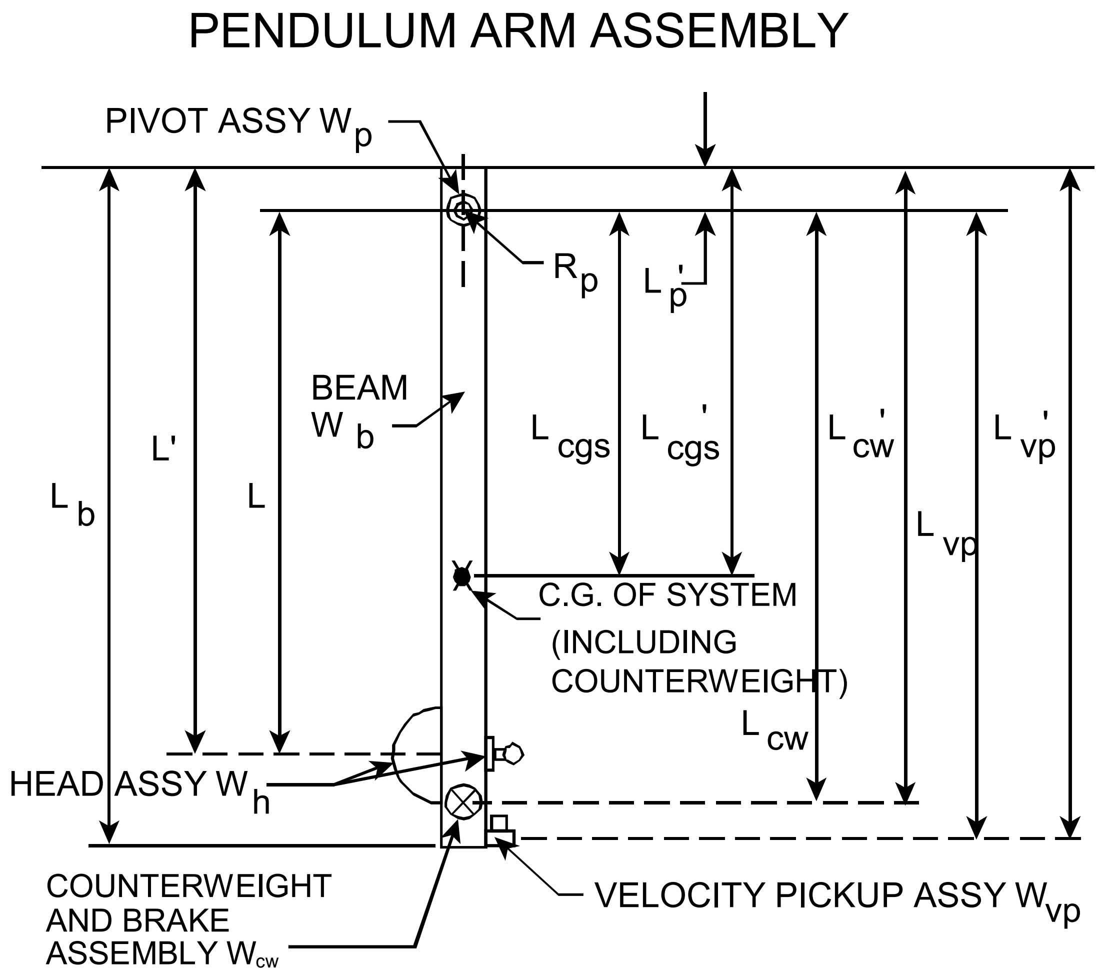


FIGURE 5

$M_T =$ $M_p + M_b + M_h + M_{vp} + M_{cw}$ = Total mass of pendulum assembly
$I_p =$ $1/2\ M_p R_p^2$ = Moment of inertia of pivot assembly
$I_b =$ $1/3\ M_b L_b^2$ = Moment of inertia of beam about pivot axis
$I_h =$ $M_h I_h^2$ = Moment of inertia of head assembly about pivot axis
$I_{vp} =$ $M_{vp} L_{vp}^2$ = Moment of inertia of velocity transducer assembly about pivot axis
$I_{cw} =$ $M_{cw} L_{cw}^2$ = Moment of inertia of counterweight and brake assembly about pivot axis
$I_T =$ $I_p + I_b + I_h + I_{vp} + I_{cw}$ = Defined total moment of inertia of pendulum assembly about pivot axis

9.1.3.3 Formulations

Figure 6 is a diagram of the physical pendulum.

DIAGRAM OF THE PHYSICAL PENDULUM

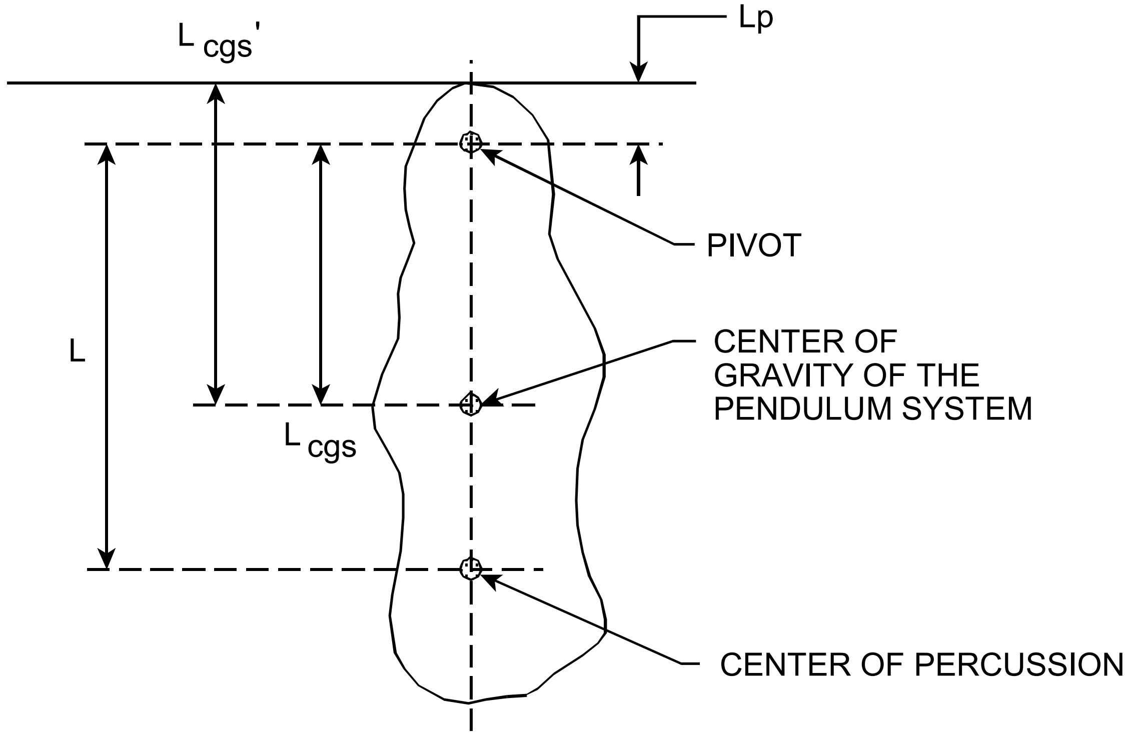


FIGURE 6
APPENDIX B....Continued

L_{cgs} = $[(M_pL_p' + 1/2\ M_bL_b + M_hL' + M_{vp}L_{vp}' + M_{cw}L_{cw}')/M_T - L_p]$, where –

L = $I_T / (M_TL_{cgs}')$ = Defined center of percussion

$$T \sqrt{\frac{Lx4\pi^2}{g}}$$

= Period of the pendulum for the defined center of percussion

$$KE \quad \frac{\omega^2}{2} I_T \quad \frac{\omega^2}{2} \frac{W_T\ L \times L_{cgs}}{g}$$

9.1.3.4 Calculations —

L = I_T / M_TL_{cgs}

APPENDIX B....Continued

$$L = \frac{I_p \quad I_b \quad I_h \quad I_{vp} \quad I_{cw}}{M_T \left[\left(\dfrac{M_p L_p \quad \frac{1}{2} M_b L_b \quad M_h \quad M_{vp} L_{vp} \quad M_{cw} L_{cw}}{M_T} \right) \quad L_p \right]}$$

Cancel out the value of g from the mass values then:

$$L = \frac{\frac{1}{2} M_p R_p^2 \quad \frac{1}{3} M_b L_b^2 \quad M_b L^2 \quad M_{vp} L_{vp}^2 \quad M_{cw} L_{cw}^2}{(M_p L_p \quad \frac{1}{2} M_b L_b \quad M_h \quad M_{vp} L_{vp} \quad M_{cw} L_{cw}) \quad L_p \quad {}_T}$$

$$L = \frac{\frac{1}{2} W_p R_p^2 \quad \frac{1}{3} W_b L_b^2 \quad W_b L^2 \quad W_{vp} L_{vp}^2 \quad W_{cw} L_{cw}^2}{(W_p L_p \quad \frac{1}{2} W_b L_b \quad W_h \quad W_{vp} L_{vp} \quad W_{cw} L_{cw}) \quad L_p \, (W_p \quad W_b \quad W_h \quad W_{vp} \quad W_{cw})}$$

To determine the correct weight, W_{cw}, and position of the counterweight, L_{cw}, the following equation must be solved:

$$M_{cw} \times L_{cw}^2 = I_T - I_p - I_b - I_h - I_{vp}$$

$$M_{cw} \times L_{cw} = (I_T / L) - [(L_{cgs\text{-}cw})(M_p + M_b + M_h + M_{vp})]$$

Precise adjustment of the center of percussion can be obtained by adjusting the counterweight mass or position to obtain the correct period.

9.2 Instrumentation Specifications —

The instrumentation necessary to measure the required parameters consists of an acceleration measuring system, a velocity measuring system, a penetration measuring system, and an optional rate of change of acceleration (jerk) measuring system. These systems include readout.

9.2.1 The Accelerometer Transducer

The specifications of the system for measuring acceleration are:

Transducer minimum full scale acceleration of 1500g.

APPENDIX B....Continued

Transducer minimum undamped natural frequency of 10 kc/sec.

Transducer low end frequency response down no more than 3 db at 1 cycle/sec.

Transducer damping over the undamped natural frequency range of 10 to 30 kc/sec between a maximum of 70 percent of critical damping and a minimum described by the formula:

%Cc = - 3.5 fn + 105, where –

%Cc =Percent of critical damping

fn = Undamped natural frequency, kc/sec

above fn = 30 kc/sec, %Cc may fall anywhere between 70% and 0 Cross-axis sensitivity in the plane normal to the sensitive axis no greater than 5% of the sensitivity along the sensitive axis.

Transducer to function properly in the temperature range of -20ºF to +165ºF.

Transducer sensitivity to the sound field due to the test such that a 100 db sound generated by the test will result in an equivalent acceleration signal no greater than 1g.

Transducer performance unaffected by humidity.

Transducer maximum weight 5 oz.

The overall accelerometer system provides:

A. The system reading of acceleration between 2 cycles/sec and 4.8 kc/sec within ± 5 percent of the actual acceleration.

B. The system noise output no greater than 1g plus 2 percent of the actual acceleration.

9.2.2 The Velocity Transducer —

The specifications of the system for measuring velocity are:

The transducer consists of a photoelectric pickup mounted on the impact pendulum and a companion stationary light source and grid equivalent to 50 impulses/inch travel of the head. The grid extends sufficiently in each direction from the point of impact so that the impact velocity, the velocity during impact, and the rebound velocity may be obtained.

APPENDIX B....Continued

Transducer temperature range for proper functioning -20ºF to +165ºF.

Transducer performance unaffected by humidity.

Pickup maximum weight 5 ounces.

The overall velocity measuring system consist, of the velocity transducer, a frequency meter without output, a smoothing filter, and readout to an oscillograph channel. The system reading is within ± 5 percent of the actual velocity when the reading is above 10 percent of the full scale range being used.

9.2.3 The Indentation Transducer —

The specifications of the system for measuring indentation are:

The signal from the velocity transducer is utilized as it indicates indentation in increments of 0.020 inch.

The pulse output of the frequency meter is actually used as it is invariant in shapes as the velocity.

In the overall indentation measuring system:

A. The frequency meter pulse output is fed to a divide-by-5-scaler to obtain a pulse for every five grid lines corresponding to 0.1 inch.

B. The output of the scaler and the frequency meter pulse output are mixed so that a train of pulses is obtained with every fifth pulse accented.

C. The mixer pulse output is recorded by an oscillograph channel.

9.2.4 Rate of Change of Acceleration (Optional) - -

The specifications for obtaining the rate of change of acceleration (jerk) are:

A. Either obtain the slope of the acceleration curve graphically from the oscillogram,

B. Or electronically differentiate the output of the accelerometer amplifier and record the result on a separate oscillograph channel. (This measurement is optional.)

APPENDIX B....Continued

9.2.5 Data Readout —

The readout means will be a light beam oscillograph with the following necessary specifications:

A minimum of six channels.

The recorded time signal within 0.1 percent of true time.

Chart speed at least 50 inches/second.

Minimum galvanometer undamped natural frequency of 8 kc/second.

9.2.6 Accelerometer System Calibration —

Primary system calibration will be done by using the Dynamic Mass Ratio method.

Electronic calibration of the system at the test site will be done by injecting a calibrating voltage in series with the accelerometer. If a charge amplifier is used, the calibrating voltage will be injected as recommended by the manufacturer.

An accelerometer deterioration check will he made by impacting a defined test standard.

9.3 Velocity System Calibration —

Impulse dropouts to be determined from the penetration trace.

Electronic calibration from the input of the frequency meter to the chart trace will be done by driving the frequency meter by an oscillator with an electronic frequency counter monitoring the oscillator frequency.

9.3.1 To Check the Center of Percussion of the Pendulum - -

When given L (feet), calculate T in seconds by:

$T = (L \times 4)^2 / g$

Measure the period of the pendulum. If the period is short, increase the mass of the counterweight of L_{cw} until the correct T is obtained. If the period of the pendulum is long, decrease the mass of the counterweight of L_{cw} until the correct T is obtained. These corrections will be minor reflecting the degree of accuracy of component uniformity and weights and lengths measurements.

APPENDIX B....Continued

9.3.2 Verification of Pendulum Weight —

The kinetic energy of a moving mass at a given velocity is defined by the formula KE = ½ M V².

The KE of the physical pendulum is defined by:

$$KE = (M V^2) / 2 = (W_T / g)(L \times L_{cgs})(\omega^2 / 2)$$

$$M_{cw}L_{cw}^2 = I_T - (I_T - T_{cw}) \qquad \text{(A)}$$

$$L_{cw}M_{cw} = (I_T / L) - (L_{cgs} - L_{cw})(M_T - M_{cw}) \qquad \text{(B)}$$

Equations (A) and (B) may be solved simultaneously to determine the mass M_{cw} and position L_{cw} of the counter weight.

APPENDIX C
SAE RECOMMENDED PRACTICE
PASSENGER CAR SIDE DOOR LATCH SYSTEMS
SAE J839 JUL82

1. SCOPE

This SAE Recommended Practice establishes minimum performance requirements and test procedures for evaluating and testing passenger side door latch systems. It is limited to tests that can be conducted on uniform test fixtures and equipment in commercially available laboratory test facilities.

The test procedures and minimum performance requirements outlined in this recommended practice are based on currently available engineering data. It is intended that all portions of the recommended practice will be periodically reviewed and revised, as additional knowledge regarding vehicle latch performance under impact conditions is developed.

2. TERMINOLOGY

2.1 LATCH

A mechanical device employed to position the door in a closed position relative to the vehicle body with provisions for controlled release (or operation).

BASIC LATCH COMPONENTS (NOMENCLATURE) ARE:

PLATE

The main body or frame for supporting working components, appendages and transmitting or distributing loads to the door structure.

ROTOR (OR BOLT)

The rotating or sliding member of the latch which engages and restrains the latch to the striker.

RATCHET

A member of the latch connected to the rotor to provide an abutment or abutments which, when properly indexed, become engaged with a related pawl to inhibit motion of the rotor in one direction.

PAWL

A member of the latch that can be caused to engage the abutments of the ratchet to inhibit relative motion between the two parts except in one direction.

APPENDIX C....Continued

2.2 STRIKER

A mechanical device with which the latch engages on the opposing member of the body.

2.3 FULLY LATCHED POSITION

The attitude that exists between the latch and striker when the door if securely positioned in the fully closed position.

2.4 SECONDARY LATCHED POSITION

The attitude that exists between the latch and striker when the latch holds the door in a position less than fully closed.

NOTE: The secondary latched position may be included in the side door latch, as an added mechanical feature to reduce the possibility of the door opening freely, in the event the door is not closed to the fully latched position. It should be recognized that doors are intended to be in the fully latched position whenever the vehicle is in motion.

3. BASIC REQUIREMENTS

3.1 LONGITUDINAL LOAD

An automotive door latch and striker assembly, when tested as described under test procedures, must be able to withstand an ultimate longitudinal load of 11,000 N when in the fully latched position (see paragraph 4.1) and 4450 N when in the secondary latched position (see paragraph 4.2).

3.2 TRANSVERSE LOAD

An automotive door latch and striker assembly, when tested as described under test procedures, must be able to withstand an ultimate transverse load of 8900 N when in the fully latched position (see paragraph 4.3) and 4450 N when in the secondary latched position (see paragraph 4.4).

APPENDIX C....Continued

3.3 INERTIA LOAD

An automotive door latch, when contained in the door latch system (including the door latch, striker assembly, outside handle, key cylinder and any connecting mechanisms) and, in the fully latched position, when evaluated by calculation, must remain in the fully latched position when subjected to an inertia load of 30 g in any direction. (See paragraph 5.)

NOTE: Due to the interdependency of the components, it is important that the door latch be analyzed within the confines of the total system and these results considered the basis of acceptance.

4. STATIC TESTS

4.1 LONGITUDINAL LOAD — FULLY LATCHED POSITION

4.1.1 PURPOSE

To determine the ability of the vehicle latch and striker to withstand a test load perpendicular to the face of the latch.

4.1.2 EQUIPMENT

(a) Tensile testing machine

(b) Static test fixture (see Figure 1)

4.1.3 OPERATION

(a) Attach the test fixture to the mounting provisions of the latch and striker. Align the direction of engagement parallel to the linkage of the fixture. Mount fixture with latch and striker in fully latched position in the test machine so as to apply a load perpendicular to the face of the latch.

(b) Locate weights to apply a 890 N load tending to separate the latch and striker in the direction of the door opening.

(c) Apply the test load at a rate not to exceed 5 mm/min until failure. Record maximum load.

4.2 LONGITUDINAL LOAD — SECONDARY LATCHED POSITION

APPENDIX C....Continued

4.2.1 PURPOSE

To determine the ability of the vehicle latch and striker in the secondary position to withstand a test load perpendicular to the face of the latch.

DOOR LATCH STATIC LOAD TEST FIXTURE (LONGITUDINAL LOAD)

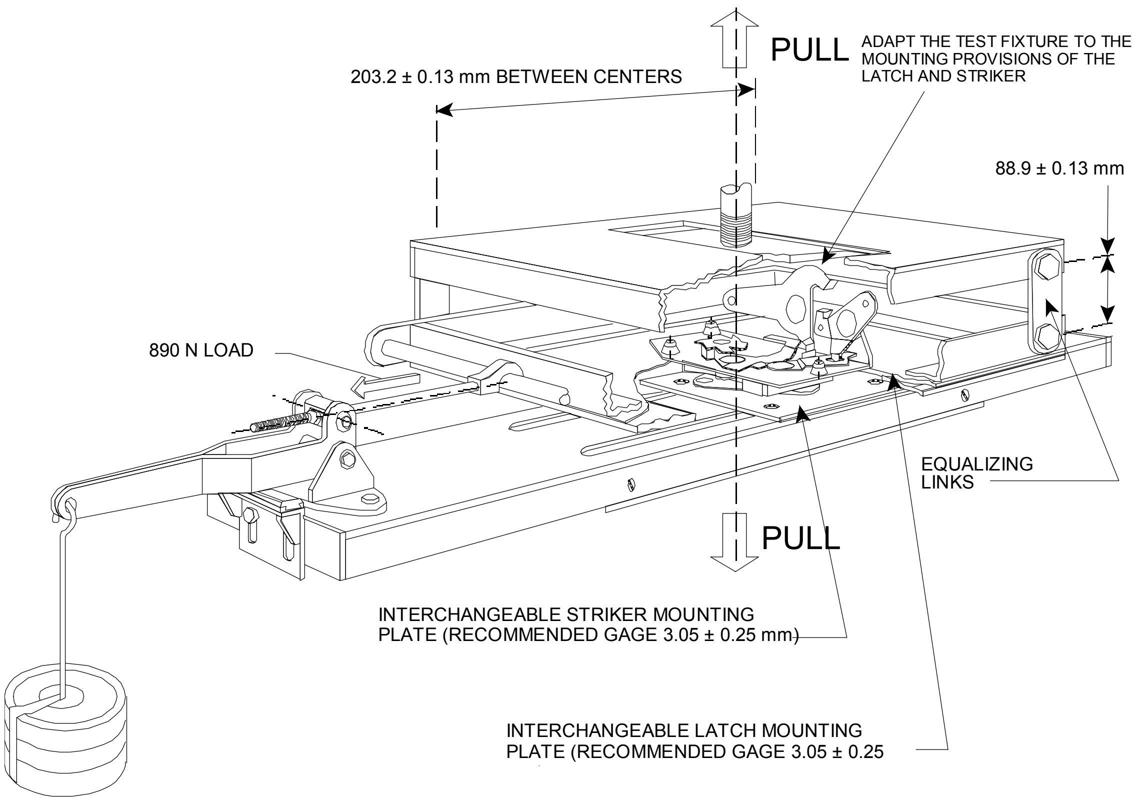


FIGURE 1

4.2.2 EQUIPMENT

(a) Tensile testing machine

(b) Static test fixture (see Figure 1)

4.2.3 OPERATION

(a) Attach the test fixture to the mounting provisions of the latch and striker. Align the direction of engagement parallel to the linkage of the fixture. Mount fixture with latch and striker in secondary latched position in the test machine so as to apply a load perpendicular to the face of the latch.

(b) Locate weights to apply to 890 N load tending to separate the latch and striker in the direction of the door opening.

APPENDIX C....Continued

(c) Apply the test load at a rate not to exceed 5 mm/min until failure. Record maximum load.

(d) The test plate to which the door latch is mounted will have a striker cutout configuration similar to the environment in which the door latch will be mounted on normal vehicle doors.

4.3 TRANSVERSE LOAD — FULLY LATCHED POSITION

4.3.1 PURPOSE

To determine the ability of the vehicle latch and striker to withstand the test load in the direction of door opening.

4.3.2 EQUIPMENT

(a) Tensile testing machine

(b) Static test fixture (see Figure 2)

4.3.3 OPERATION

(a) Adapt the test fixture to the mounting provisions of the latch and striker. Mount fixture with the latch in the fully latched position in the test machine so as to apply a load in the direction of door opening.

(b) Apply the test load at a rate not to exceed 5 mm/min until failure. Record the maximum load.

4.4 TRANSVERSE LOAD — SECONDARY LATCHED POSITION

4.4.1 PURPOSE

To determine the ability of the vehicle latch and striker in the secondary position to withstand the test load in the direction of door opening.

4.4.2 EQUIPMENT

(a) Tensile testing machine

(b) Static test fixture (see Figure 2)

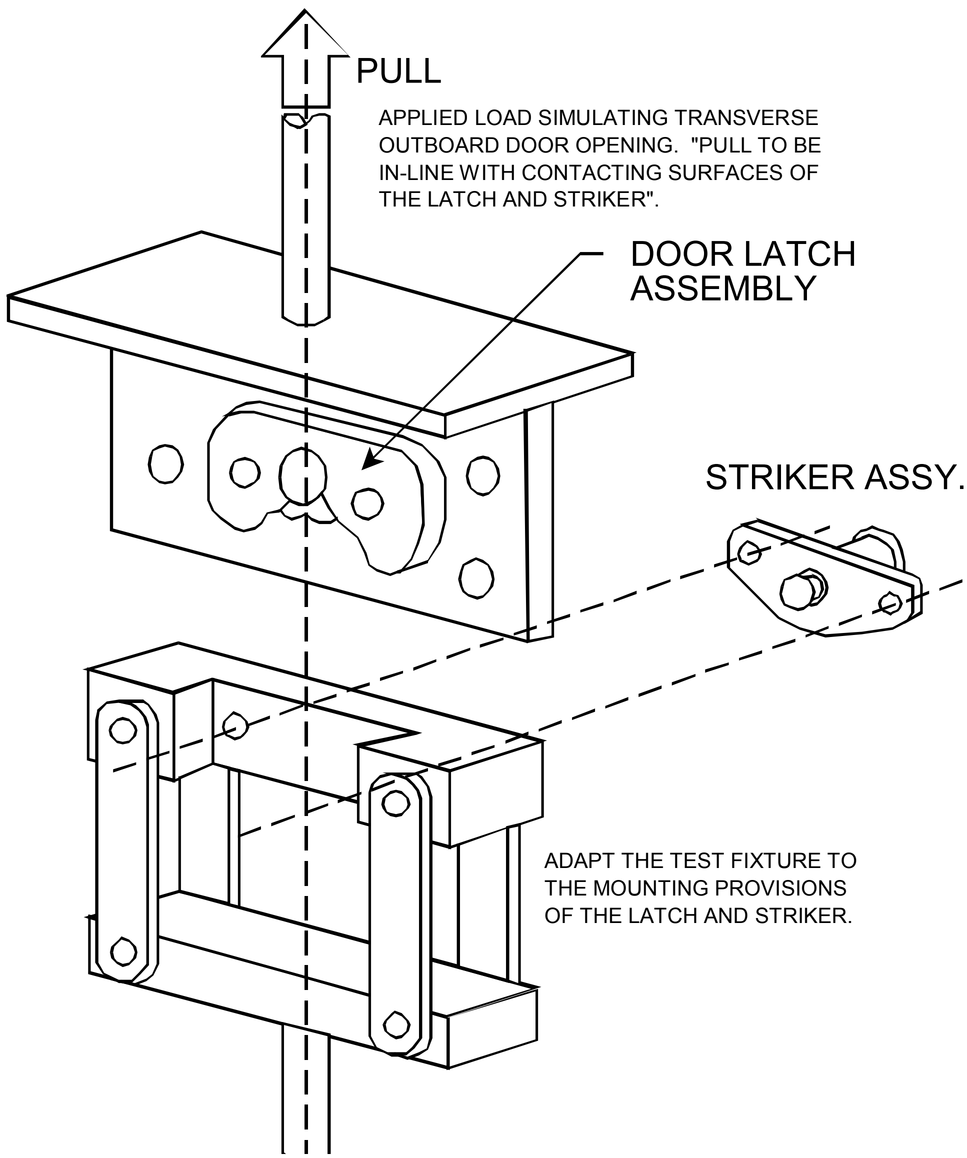
APPENDIX C....Continued

4.4.3 OPERATION

(a) Adapt the test fixture to the mounting provisions of the latch and striker. Mount fixture with the latch and striker in secondary latched position in the test machine so as to apply a load in the direction of door opening.

(b) Apply the test load at a rate not to exceed 5 mm/min until failure. Record the maximum load.

DOOR LATCH - STATIC LOAD FIXTURE (TRANSVERSE LOAD)



APPENDIX C....Continued

5. INERTIAL ANALYSIS

5.1 PURPOSE

To determine the ability of the vehicle latch system to resist inertia loading by means of a mathematical analysis of the component parts in their true car relationship.

NOTE: Due to the complexity of physical testing for inertial characteristics it is judged to be more practical and more accurate to base evaluations on mathematical analysis. The procedure described in this section provides a means for analytically determining the ability of a door latch system to withstand inertia loading. Spring forces are the average of the minimum spring output in the installed position and the minimum spring output in the release position. Friction effects and work to be done are not considered in the calculations. Gravitational pull on components may also be omitted if it tends to restrict unlatching. These omissions from the calculations are permissible because they provide additional factors of safety.

5.2 CALCULATION CONSIDERATION

Each component or subassembly can be calculated for its minimum inertia load resistance in a particular direction. Their combined resistance, to the unlatching operation, must assure that the door latch system (when properly assembled in the vehicle door) will remain latched when subjected to an inertia load of 30 g in any direction. Figure 3 is in example of the components and combinations of components to be considered.

APPENDIX C....Continued

INERTIA LOADING

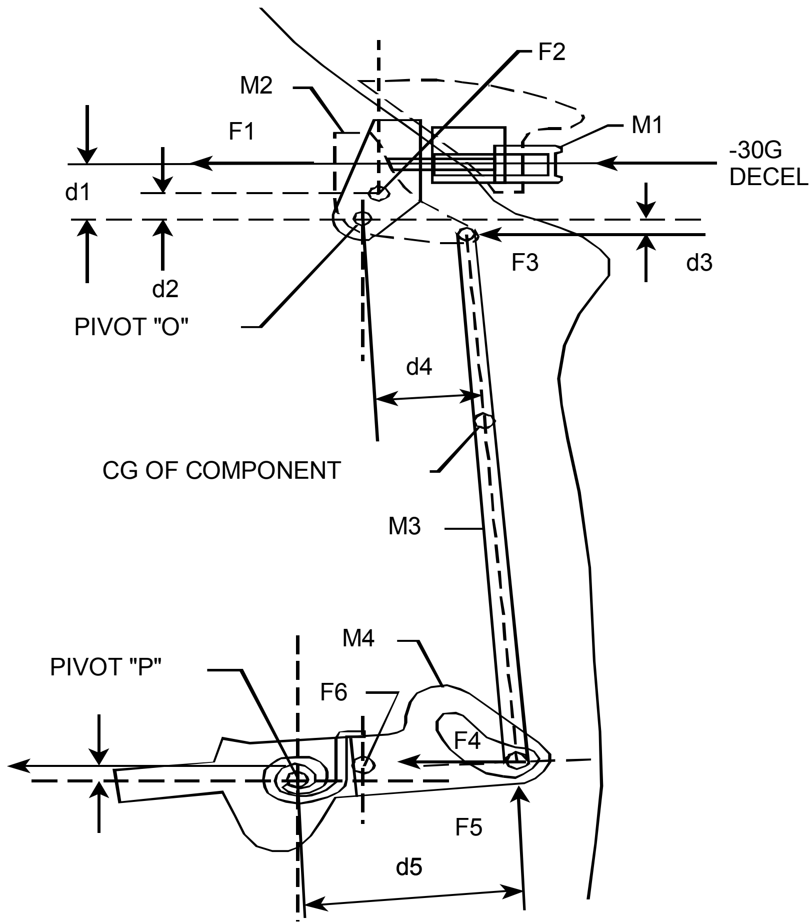


FIGURE 3

INERTIA LOADING -- SAMPLE CALCULATION

Given: Door Latch System Subjected to 30 g Deceleration
Average Push-Button Spring Output Force = 4.5 N
Pawl Spring Output Torque = 0.45 Nm

$a = 30\ g\ (m/s^2)$

$F = ma = 30\ mg = 294.2\ m$

$M_1 = 0.0163$ kg	$d_1 = 31.50$ mm
$M_2 = 0.0227$ kg	$d_2 = 10.67$ mm
$M_3 = 0.0122$ kg	$d_3 = 4.83$ mm
$M_4 = 0.0422$ kg	$d_4 = 31.50$ mm
	$d_5 = 37.60$ mm
	$d_6 = 1.91$ mm

APPENDIX C....Continued

$F_1 = M_1$ạ (avg. spring output) = (0.0163 x 294.2)̦ 4.5 = 0.30 N
$F_2 = M_2a$ = 0.0227 x 294.2 = 6.68 N

$F_3 = (M_3a)/2$ = (0.0122/2) x 294.2 = 1.80 N

$M_o = F_1$ x $d_1 + F_2d_2$̦ F_3d_3 = 0.30 x 31.5 + 6.68 x 10.67̦ 1.80 x 4.83 = 72.0 Ṇmm

$F_5 = M_o/d_4$ = 72.0/31.5 = 2.30 N

$F_6 = M_4a$ = 0.0422 x 294.2 = 12.42 N

M_p = (pawl spring output)̦ (F_5 x d_5 + F_6 x d_6)/1000 = 0.45̣ (2.30 x 37.60 + 12.42 x 1.91)/1000 = 0.34 Ṇm

EQUATIONS		METRIC UNITS	
SYMBOL	DEFINITION	SYMBOL	DEFINITION
m	Mass	kg	Kilogram
a	Acceleration	m/s^2	Meter per second squared
g	Gravitational Acceleration	m/s^2	9.806 650 Meter per second squared
d	Distance to Pivot	mm	Millimeter
F	Force	N	Newton
M	Moment About a Point	Ṇm	Newton Meter (preferred)
		Ṇmm	(NewtoṇMillimeter)

APPENDIX D
SAE RECOMMENDED PRACTICE
BODYFORMS FOR USE IN MOTOR VEHICLE PASSENGER COMPARTMENT IMPACT DEVELOPMENT
SAE J984 JUN80

1. INTRODUCTION

This recommended practice specifies various bodyforms for use in motor vehicle passenger compartment impact development and test work. Although various degrees of bodyform articulation are possible, an attempt has been made to limit the number of forms and their complexity to help eliminate additional variables and provide uniformity. Individual test procedures will specify which particular body form should be used for that test. Additional forms, are devised and changes to existing ones are made, this recommended practice will be modified as necessary.

2. 6½ INCH METAL BODYFORM

This headform is beneficial for testing purposes since, due to its rigidity, it imparts all the impact energy into the test specimen. It consists simply of a 6½ inch OD metal hemispherical shell. Wall thickness, transducer placement, mounting methods, and the type of metal used may vary provided:

(a) the effective weight of the form is as prescribed in the procedure specifying its use and

(b) the headform retains its shape and properties during and after impact. See Figure 1 for details of a typical metal bodyform.

3. 6½ INCH TISSUE SIMULATING BODYFORM

This form is a qualitative aid in development work to study pressure concentration to the head and knee. It consists of a 6 inch diameter pine hemisphere covered with a suitable simulated scalp and skin of approximately 0.25 inch thickness. The effective weight of the form is as prescribed in the procedure specifying its use. See Figure 2 for details.

4. SKIN AND UNDERLAYER CHARACTERISTICS

As a guide to what constitutes a suitable skin and underlayer, the characteristics listed in Table 1 are offered. No one substance, or combination of substances, presently fits all the parameters of human tissue so the values are merely representative for a synthetic skin and underlayer.

APPENDIX D....Continued

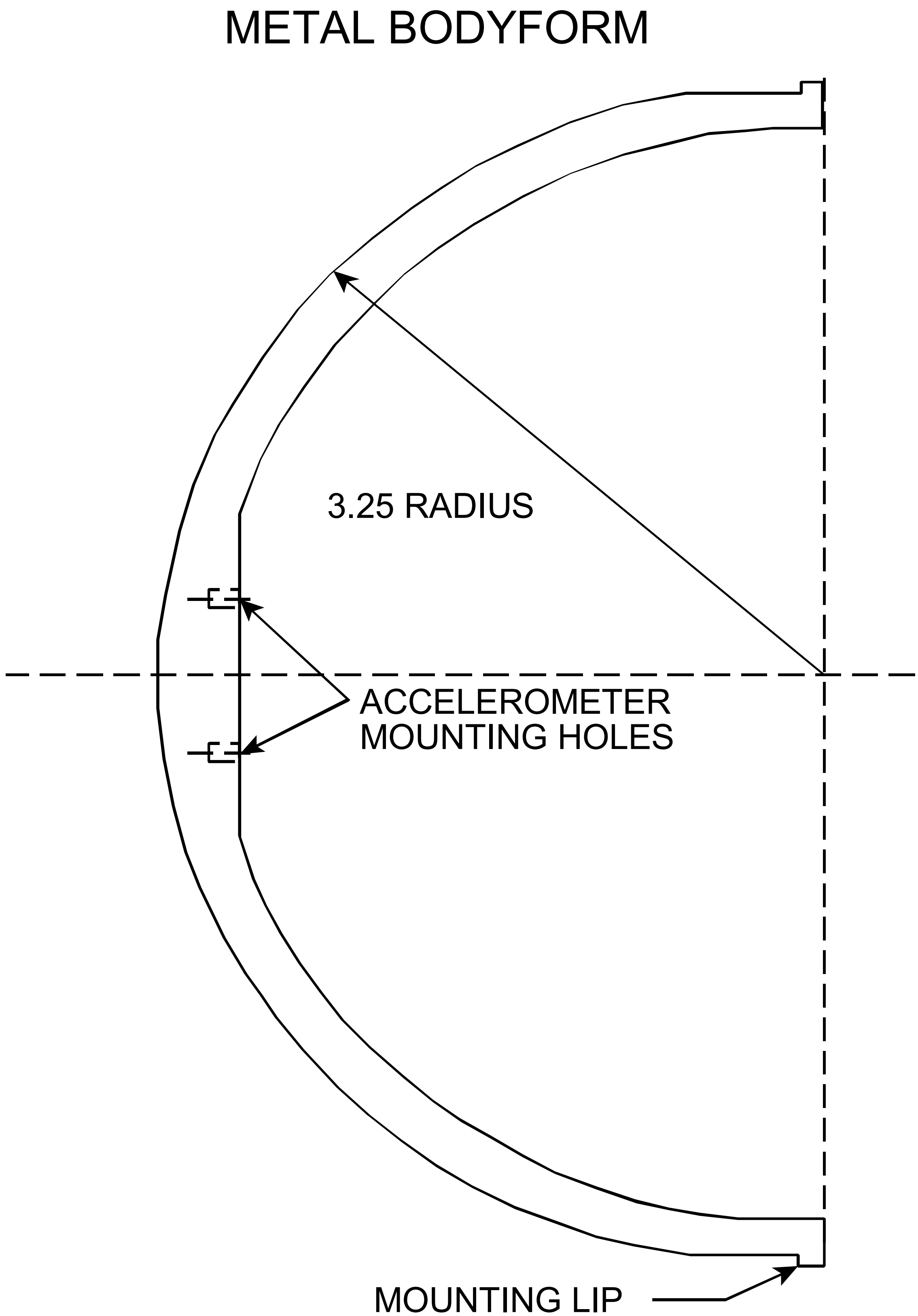


FIGURE 1

APPENDIX D....Continued

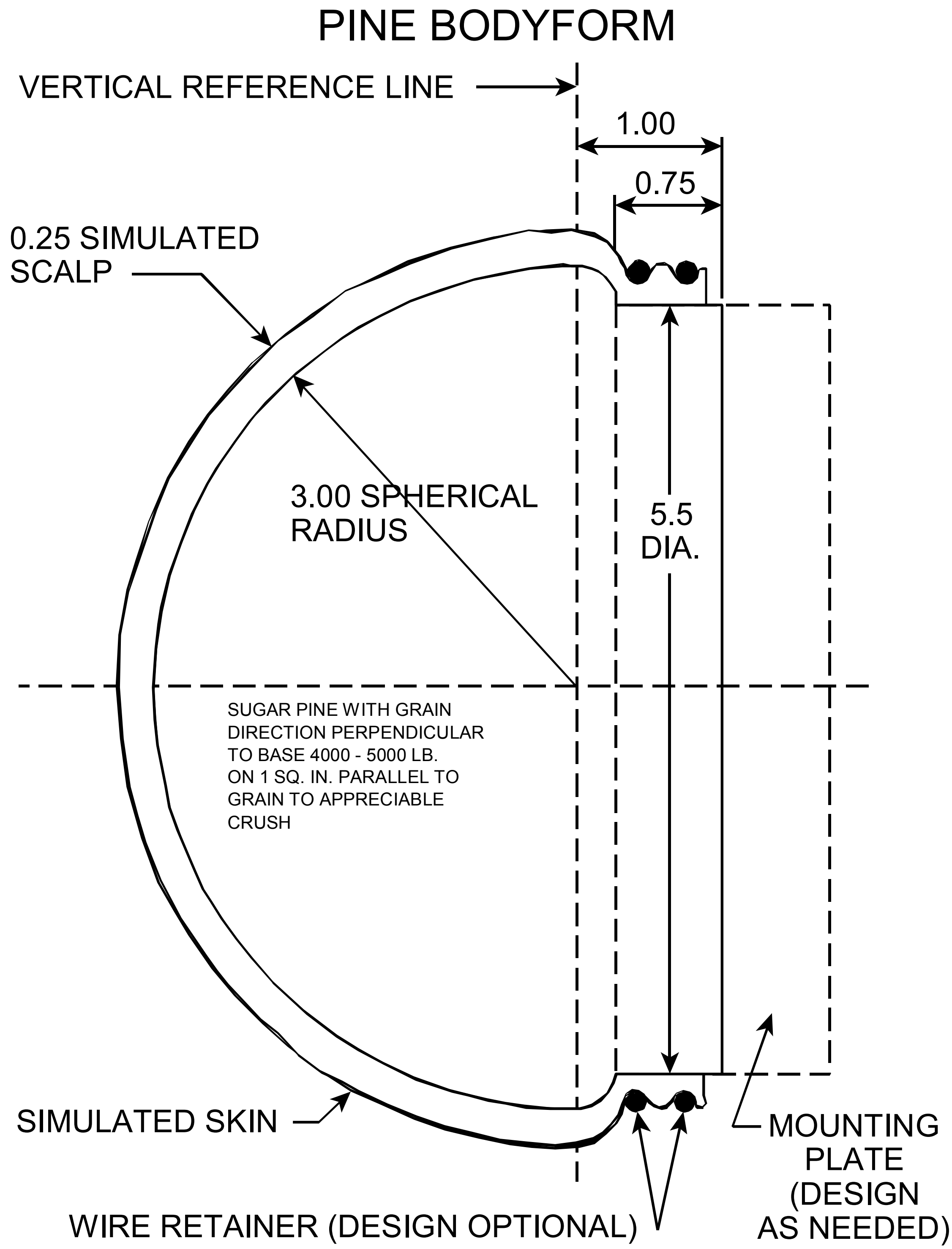


FIGURE 2

APPENDIX D....Continued

	THICKNESS inches	TENSILE STRENGTH psi	ELONGATION percent	PENETREMETER*
Synthetic Skin	0.030 ± 0.003	1000 ± 5%	100 ± 5	16—18
Synthetic Underlayer	0.250 ± 0.025	250 ± 10%	50 ± 10	Not Applicable

NOTE: Animal skin such as Napa goat skin or wet chamois may be used. When this type of skin is used, the skin thickness requirements do not apply.

* See C.W. Gadd, "Strength of Skin and its Measurement," ASME 65-WA/HUB-8

5. OTHER BODYFORMS

Other specialized bodyforms may be developed for specific tests and these will be included in the related procedures. Examples of this are the body block reported in the SAE J944 and crash test dummies to be described in a report under development.

APPENDIX E
SAE RECOMMENDED PRACTICE
INSTRUMENTATION FOR IMPACT TESTS
SAE J211 JUN80

1. SCOPE

The purpose of this SAE Recommended Practice is to provide guidelines for instrumentation used in automotive safety impact tests. The aim is to achieve uniformity in instrumentation practice and in reporting test results, without imposing undue restrictions on the performance characteristics of the individual elements in an instrumentation or data analysis system. Use of this recommended practice will provide a basis for meaningful comparisons of test results from different sources.

2. DEFINITIONS

2.1 DATA CHANNEL

All of the instrumentation from and including a single transducer (or multiple transducers whose output are combined in some specified way) up to and including any analysis procedures that may alter the data.

2.2 SCALE FACTOR

The intended ratio of real-to-analog values (for example, g/in. (cm) of trace deflection, lb (g)/V of tape recorder signal).

2.3 STATIC ACCURACY

For d-c channels, the deviation from the channel scale factor at zero frequency. For a-c channels, the deviation from the channel scale factor at a designated frequency between f_L and f_H of Figure 1.

2.4 DYNAMIC ACCURACY

The change in scale factor as a function of input frequency.

2.5 FULL SCALE

The maximum usable linear range of an instrument.

2.6 DATA CHANNEL FULL SCALE

That value of a data channel determined by the instrument in the channel with the lowest full-scale level. This is expressed in terms of the measured variable (input). For example, F.S. = 50 g, 1000 lb, 500 g, 100 cm/s, etc.

APPENDIX E....Continued

3. DATA CHANNEL REQUIREMENTS

These requirements fall into two categories:

- Static accuracy
- Dynamic accuracy

3.1 STATIC ACCURACY

3.1.1 REQUIREMENTS

The static accuracy of a data channel is dependent upon the complex interaction of many factors, such as linearity, zero drift, hysteresis, etc. As a basis for evaluating the static accuracy of a data channel, each testing agency shall maintain a record of the instrumentation used, listing the equipment by function, manufacturer, model and serial number, date of last calibration, and calibration interval.

3.1.2 SUGGESTED GUIDELINES

The following guidelines are suggested when evaluating the static accuracy of a data channel:

(a) Laboratory calibration checks should be made at ¼, ½, and full scale for each data channel. A calibration signal equal to at least 80 percent full scale should be provided at the time of test.

(b) Bipolar channels should be checked in each direction.

(c) Data channels should be scaled to make allowance for higher than expected test values.

(d) Consideration should be given to the effects of test site conditions (for example, temperature).

(e) Calibration should be made on a periodic basis utilizing measuring and test equipment traceable to known standards.

APPENDIX E....Continued

3.2 DYNAMIC ACCURACY

3.2.1 REQUIREMENTS

This property of a data channel is specified by a curve which plots the channel output/input ratio versus frequency of the applied calibration signal. Figure 1 contains recommended limits for the various classes of data channels that are referenced in paragraph 4. If the data channel frequency response falls entirely within the shaded area in Figure 1, it meets the requirements of this recommended practice.

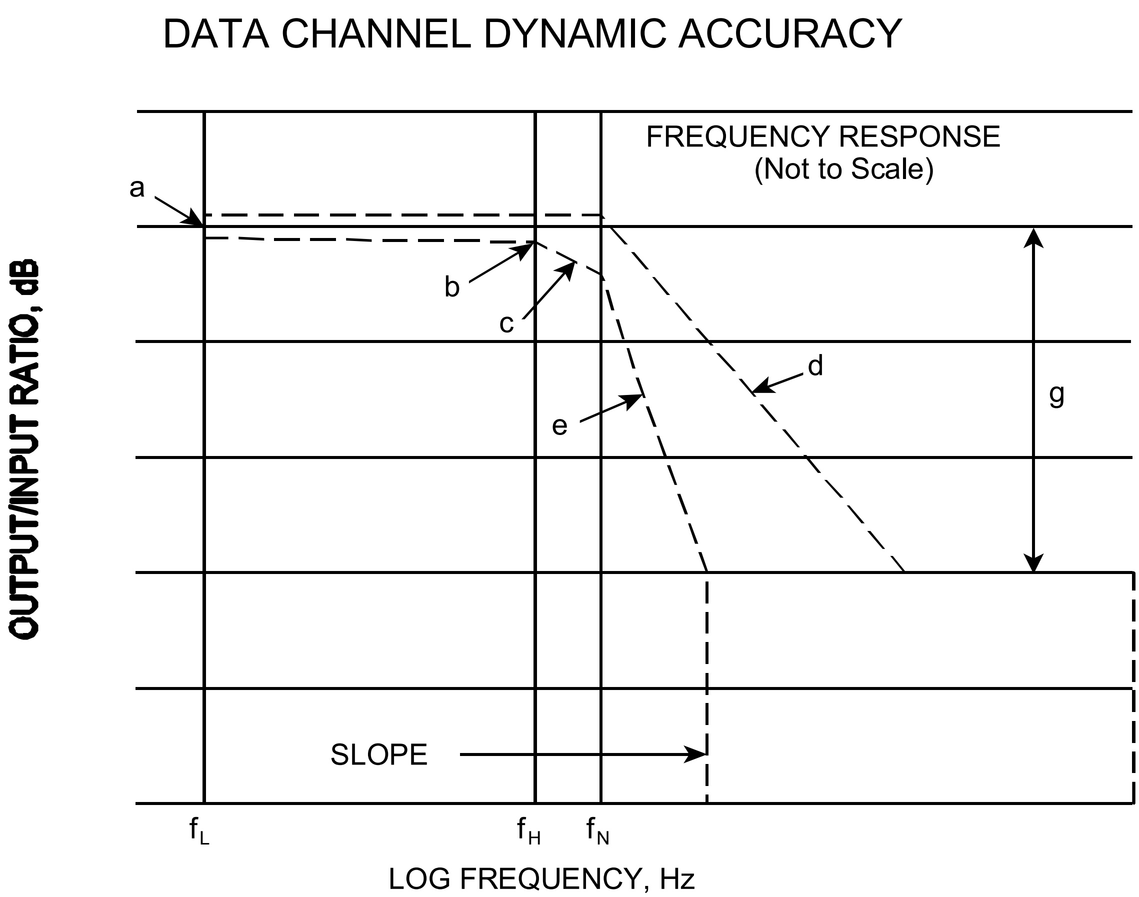


FIGURE 1

FREQUENCY RESPONSE VALUES

CHANNEL CLASS	f_L Hz	a dB	f_H Hz	b dB	f_N Hz	c dB	d dB/ octave	e dB/ octave	g dB
1000	< 0.1	± 0.5	1000	+0.5,-1	1650	+0.5,-4	- 9	- 24	- 30
600	< 0.1	± 0.5	600	+0.5,-1	1000	+0.5,-4	- 9	- 24	- 30
180	< 0.1	± 0.5	180	+0.5,-1	300	+0.5,-4	- 9	- 24	- 30
60	< 0.1	± 0.5	60	+0.5,-1	100	+0.5,-4	- 9	- 24	- 30

APPENDIX E....Continued

3.2.2 SUGGESTED GUIDELINES

The following guidelines are suggested when evaluating the dynamic accuracy of a data channel:

(a) The input signal for testing frequency response should be equivalent to at least 80 percent of full scale for the data channel. For certain transducers, it may not be practical to obtain 80 percent of full scale for the full frequency range.

(b) Consideration should be given to the effect of cable length and temperature on frequency response.

3.3 SUBSYSTEM EVALUATION

If desired, transducers and subsystems may be evaluated individually and the results factored into the total data channel accuracy, taking into account interaction effects.

4. DATA CHANNEL SELECTION

The selection of a frequency response class is dependent upon many considerations, some of which may be unique to a particular test. The ultimate usage of the data and good engineering judgment will determine what portions of the frequency spectrum are significant or useful. The various classes of frequency response in Figure 1 are intended to permit appropriate choices for different engineering requirements.

It is important to note that valid comparisons using different frequency response classes may be difficult to make. It is useful to establish specific frequency response classes when comparing test results from different sources. The frequency response classes in Table 1 are recommended for that purpose. These recommendations reflect current practices and equipment. However, it is recognized that other considerations (for example, biomechanics) may impose special instrumentation requirements.

The channel class recommendations for a particular application should not be considered to imply that all the frequencies passed by that channel are significant for the application. In several cases, such as the occupant head accelerations, the headform accelerations, and the femur force, the recommendation may be higher than necessary but current biomechanical knowledge will not permit a closer specification.

APPENDIX E....Continued

TABLE 1

TYPICAL TEST MEASUREMENTS — FREQUENCY RESPONSE	CHANNEL CLASS[a]
VEHICLE STRUCTURAL ACCELERATIONS FOR USE IN:	
Total Vehicle Comparison[b]	60
Collision Simulation (for example, impact sled) Input	60
Component Analysis	600
Integration for Velocity or Displacement	180
Barrier Face Force	60
Belt Restraint System Loads	60
OCCUPANT:	
Head Acceleration	1000
Chest Acceleration	180
Chest Deflection	180
Femur Force	600
Sled Accelerations	60
Steering Column Loads	600
Headform Accelerations	1000

[a] Filtering can cause appreciable time lag (for example, approximately 2.5 ms with Class 60 channel). These effects should be considered when comparing film and electronic data, or when performing integrations.

[b] When overall acceleration of the frame or body in a given direction is desired and a higher frequency response class is used, readability of the data may be improved by electrically averaging outputs of two or more transducers at different locations prior to recording of the output.

5. DIGITAL DATA PROCESSING

This section establishes guidelines for digital data processing equipment used by crash testing agencies.

APPENDIX E....Continued

5.1 PRESAMPLE FILTERING

Crash test data generally has high-frequency components above the Channel Class f_H. This can occur more often with undamped accelerometers. Presample filtering should be used to keep these components from causing aliasing errors in the sampling process. The user is cautioned to examine the unfiltered data for signal overloads, since the filtering process can mask certain overload conditions. Since Class 1000 data is generally the highest frequency data required in crash testing, many laboratories set the presample filter to Class 1000 and use digital filtering for lower classes.

5.2 SAMPLE RATE

The minimum acceptable sampling rate is a function of many variables, particularly sophistication of the reconstruction method used in the processing of software. For those installations utilizing only simple reconstruction software, the sample rate should be at least five times the -3db frequency of the presample filters. In installations with Class 1000 presample filters, this corresponds to a minimum sampling rate of approximately 8000 samples/second/channel. If analog recorders are used for time expansion, appropriately lower sampling rates are permissible.

5.3 RESOLUTION

Digital word lengths of at least 8 bits (including sign) should be used to be assured of reasonable accuracy in processing. In those systems in which the dynamic range of the data is less than 50 percent of the A/D converter full-scale, a higher resolution may be required.

5.4 DATA PROCESSING

Processing software is typically used to scale and filter data, determine zero levels, perform mathematical operations and prepare data plot formats.

5.4.1 DIGITAL FILTERING

Filtering may be either phase-shifting or phase-less. Phase-shifting filters will cause time offsets and phaseless filters will cause time uncertainty either of which will cause problems in comparing data to film, and comparing data to data if the class filters are different. Filtering should precede all non-linear operations, such as calculation of resultant vectors and Severity Index.

5.4.2 SCALING AND ZEROING

Software should be used to determine zero levels and calibration factors rather than relying on set gains and expecting no zero drift. Zero offset errors in orthogonal components cause comparable errors in resultant computation that are often difficult to detect.

5.4.3 INJURY INDEX CALCULATIONS

Calculations of Severity Index should use all sampled data points. Head Injury Criterion should use all data points for the integration. However, the maximizing time intervals need be no more precise than 1 ms.

6. OTHER MEASUREMENT RECOMMENDATIONS

6.1 IMPACT VELOCITY

This can be calculated by measuring the time required to traverse a known distance prior to impact. Determination of impact velocity should be accurate to ± 1 percent.

6.2 TEST SPECIMEN CRUSH

6.2.1 Residual crush is a single-valued data point, with respect to a designated reference point. Determination of residual crush should be accurate to ± 5 percent.

6.2.2 Maximum dynamic crush is a measurement of the maximum deformation of the test specimen during the impact. This is also measured with respect to a designated reference point. Contingent on the size of the specimen and the magnitude of the expected dynamic crush, the following are possible measurement methods:

(a) High-speed motion picture photography

(b) Double integration of acceleration data

(c) Use of a specific displacement transducer

Accuracy should be ± 5 percent.

6.3 STEERING COLUMN DISPLACEMENT

This can be measured by various techniques relative to a designated reference point on the vehicle. The coordinate system in which displacement is measured should be indicated. Determination of steering column displacement should be accurate to ± 0.5 inches (± 1.27 cm).

APPENDIX E....Continued

6.4 TIMING MARKS

Timing marks are essential in data analysis and correlation of high-speed film to other data channels. Timing frequency stability should be ± 1 percent. Timing synchronization should be ± 1 ms.

6.5 TIME OF CONTACT

Time of initial contact can be accomplished by recording a switch actuated by the impact or by observing the instant the test acceleration exceeds ½ g. It should also be recorded in film data through strobe lights or timing mark channels. Time of contact should be known within ± 1 ms.

6.6 TRANSDUCER MOUNTING

Mechanical resonances associated with transducer mounting should not distort readout data.

In cases where properties of non-mechanical test subjects preclude rigid transducer mounting, an analytical or experimental evaluation of mounting effects on the data should be provided.

7. REPORTING REQUIREMENTS

In reporting results of tests, the following information should be provided with data tabulations, time history traces, etc.:

7.1 The data channel class if in accordance with Figure 1.

7.2 If the user's data channel does not conform to any of the classes given, the channel can be designated as Class "X". Information should accompany Class "X" data relating it to the tabulated quantities on Figure 1.

7.3 The list of equipment established in paragraph 3.1.1.

7.4 Description of designated reference points used in paragraphs 6.2.1, 6.2.2, and 6.3.

7.5 Transducers mounting analysis as required by paragraph 6.6.