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U.S. DEPARTMENT OF TRANSPORTATION

**NATIONAL HIGHWAY TRAFFIC SAFETY
ADMINISTRATION**

LABORATORY TEST PROCEDURE

FOR

FMVSS No. 218

Motorcycle Helmets



ENFORCEMENT
Office of Vehicle Safety Compliance
Room 6111, NVS-220
400 Seventh Street, SW
Washington, DC 20590

**OVSC LABORATORY TEST PROCEDURE NO. 218
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REVISION CONTROL LOG

OVSC LABORATORY TEST PROCEDURE TP-218 Motorcycle Helmets

TEST PROCEDURE		FMVSS No. 218		DESCRIPTION
REV. No.	DATE	AMENDMENT	EFFECTIVE DATE	
00	3/74	38FR22391	3/1/74	Original release signed by O.D.
01	9/7/83			Added sections 2.1-2.3, revised sections 3, 10 - 12, 16, Figure 1A
02	10/18/84			No significant changes
03	11/23/92			Revised entire document
04	6/27/2003	N/A	N/A	Updated (codes, metric, fix typos), add retention test pull rate and minor changes
05	2/28/2006	N/A	N/A	General update affecting entire document.
06	11/30/2006	N/A	N/A	Corrected typographical errors on pages 33 (retention test rate) & 49 (penetration striker radius).
07				
08				
09				
10				

1. PURPOSE AND APPLICATION

The Office of Vehicle Safety Compliance (OVSC) provides contracted laboratories with laboratory test procedures (TPs) which serve as guidelines for obtaining compliance test data. The data are used to determine if the vehicle or item of motor vehicle equipment being tested is potentially non-compliant with an applicable 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 interprets 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.

Contractors are 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. There shall be no contradictions between the OVSC laboratory test procedure and the Contractor's in-house test procedure.

The OVSC laboratory test procedures are not intended to limit or restrain a Contractor from developing or utilizing any testing techniques or equipment that will assist in acquiring the required compliance test data.

NOTE:

The OVSC laboratory test procedures, prepared for use by independent laboratories under contract to conduct compliance tests for the OVSC, 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 test procedures may specify test conditions that are less severe than the minimum requirements of the standards themselves. Therefore, even though an item of equipment does not fail when tested in accordance with the OVSC laboratory test procedures, compliance with the standard is not necessarily guaranteed if testing is limited to those performance tests described in the OVSC laboratory test procedures.

2. GENERAL REQUIREMENTS

The purpose of FMVSS No. 218 is to reduce deaths and injuries to motorcyclists and other motor vehicle users resulting from head impacts. FMVSS No. 218 establishes minimum performance requirements for helmets designed for use by motorcyclists and other motor vehicle users. Each helmet shall meet the following requirements when subjected to conditioning procedures specified in S6.4 and tested in accordance with S7.1, S7.2, and S7.3 of FMVSS No. 218. Refer to FMVSS No. 218 for information referenced by section (S). Each of these tests measures the performance of a motorcycle helmet as a total system, i.e., the tests are conducted on a motorcycle helmet as a whole, rather than on helmet components.

- A. IMPACT ATTENUATION — When an impact attenuation test is conducted in accordance with S7.1, all of the following requirements shall be met:
 - (1) Peak accelerations shall not exceed 400 g;
 - (2) Accelerations in excess of 200 g shall not exceed a cumulative duration of 2.0 milliseconds (ms); and
 - (3) Accelerations in excess of 150 g shall not exceed a cumulative duration of 4.0 milliseconds (ms).
- B. PENETRATION — When a penetration test is conducted in accordance with S7.2, the striker shall not contact the surface of the test headform.
- C. RETENTION SYSTEM — When tested in accordance with S7.3:
 - (1) The retention system or its components shall withstand the loads specified without separation; and
 - (2) The adjustable portion of the retention system test device shall not move more than 2.5 cm measured between preliminary and test load positions.

Where the retention systems consists of components which can be independently fastened without securing the complete assembly, each such component shall independently meet the retention system requirements.

- D. CONFIGURATION — Each helmet shall have a protective surface of continuous contour at all points on or above the test line described in S6.2.3. The helmet shall provide peripheral vision clearance of at least 105 degrees to each side of the mid-sagittal plane, when the helmet is adjusted as specified in S6.3. The vertex of these angles, shown in Figure 1 (page 3), shall be at the point on the anterior surface of the reference headform at the intersection of the mid-sagittal and basic planes. The brow opening of the helmet shall be at least 2.5 cm above all

points in the basic plane that are within the angles of peripheral vision as shown in Figure 1, below.

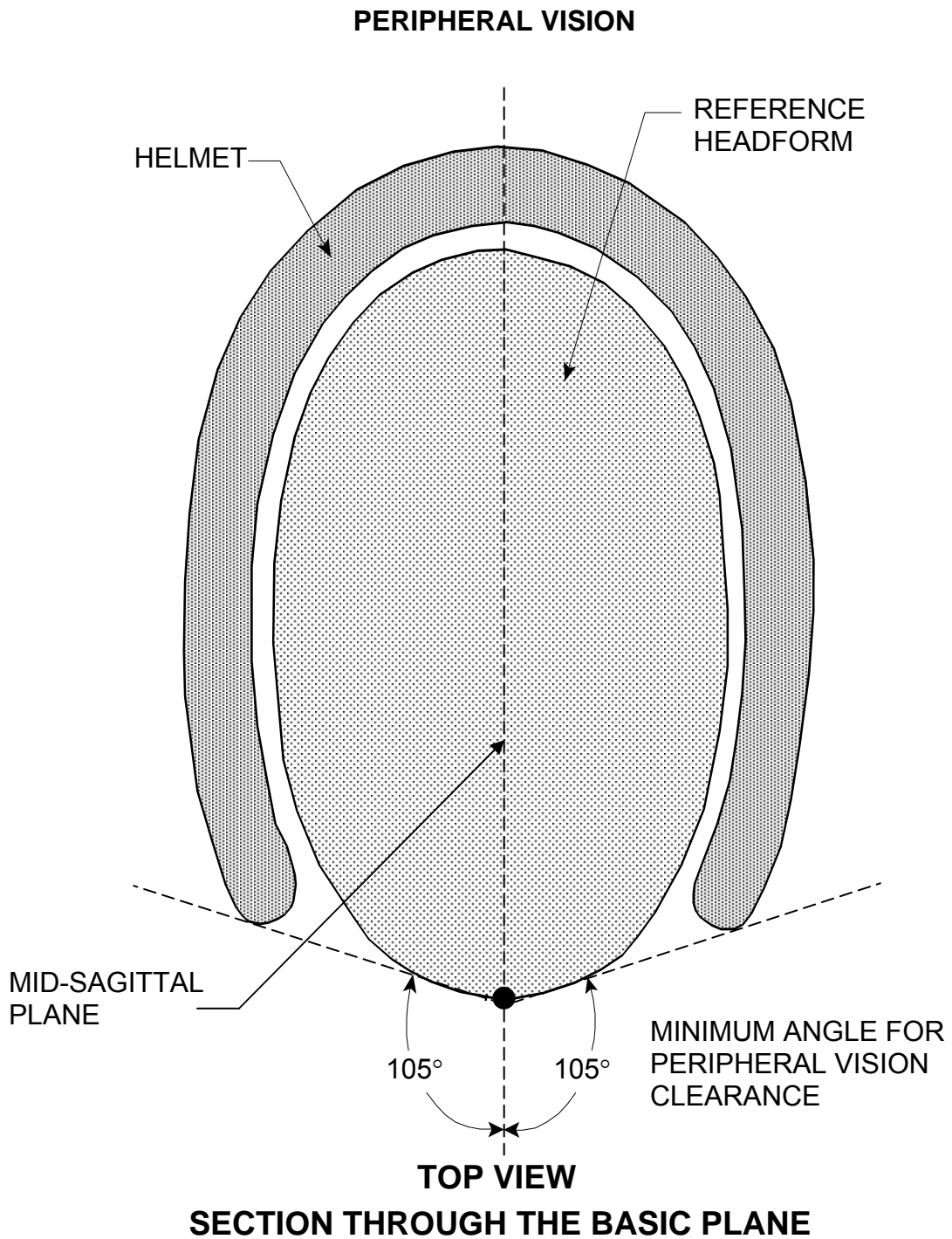
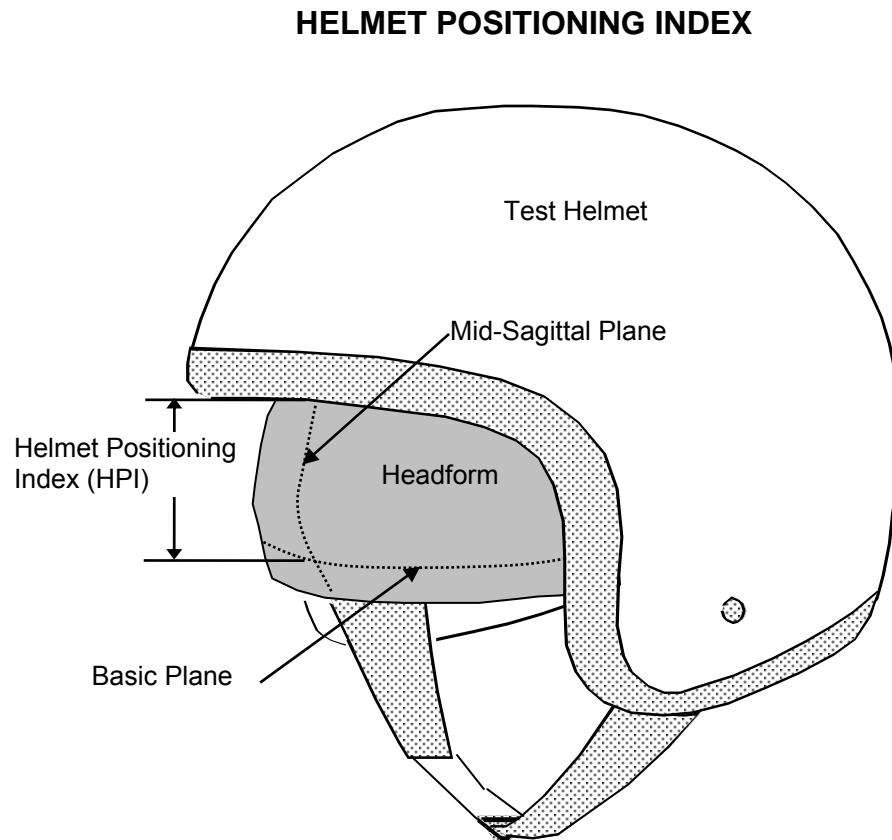


FIGURE 1

- E. PROJECTIONS — A helmet shall not have any rigid projections inside its shell. Rigid projections outside any helmet's shell shall be limited to those required for operation of essential accessories, and shall not protrude more than 5 mm.
- F. LABELING — Each helmet shall be labeled permanently and legibly, in a manner such that the label(s) can be read easily without removing padding or any other permanent part, with the following:
- (1) Manufacturer's name or identification
 - (2) Precise model designation
 - (3) Size
 - (4) Month and year of manufacture. This may be spelled out (for example, June 1988), or expressed in numerals (for example, 6/88).
 - (5) The symbol DOT, constituting the manufacturer's certification that the helmet conforms to the applicable Federal Motor Vehicle Safety Standards. This symbol shall appear on the outer surface, in a color that contrasts with the background, in letters at least 1 cm high, centered laterally with the horizontal centerline of the symbol located a minimum of 2.9 cm and a maximum of 3.5 cm from the bottom edge of the posterior portion of the helmet.
 - (6) Instructions to the purchaser as follows:
 - (A) "Shell and liner constructed of (identify type(s) of materials)"
 - (B) "Helmet can be seriously damaged by some common substances without damage being visible to the user. Apply only the following: (Recommended cleaning agents, paints, adhesives, etc., as appropriate)"
 - (C) "Make no modifications. Fasten helmet securely. If helmet experiences a severe blow, return it to the manufacturer for inspection, or destroy it and replace it."
 - (D) Any additional relevant safety information should be supplied at the time of purchase by means of an attached tag, brochure, or other suitable means.

G. HELMET POSITIONING INDEX — Each manufacturer of helmets shall establish a helmet positioning index (HPI) for each helmet he or she manufactures. This index shall be furnished immediately to any person who requests the information, with respect to a helmet identified by manufacturer, model designation, and size. Refer to Figure 2, below, for a description of the HPI.



Helmet Positioning Index- The distance from the lowest point of the brow opening at the lateral midpoint of the helmet to the basic plane of a reference headform when the helmet is firmly and properly positioned on the reference headform.

FIGURE 2

3. SECURITY

The Contractor shall provide appropriate security measures to protect the OVSC test equipment from unauthorized personnel during the entire compliance test program. The Contractor is financially responsible for any acts of theft and/or vandalism which occur during the storage of test equipment. Any security problems which arise 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 shall be sent to the IPM (with copy to the COTR) within 48 hours. The Contractor shall protect and segregate the data that is collected during each OVSC compliance test from data generated during all previous and subsequent tests. No information concerning the compliance test program shall be released to anyone except the COTR, unless specifically authorized by the COTR or the COTR's Division Chief or Department Head.

NO INDIVIDUALS, OTHER THAN CONTRACTOR PERSONNEL DIRECTLY INVOLVED IN THE COMPLIANCE TEST PROGRAM, SHALL BE ALLOWED TO WITNESS ANY MOTORCYCLE HELMET COMPLIANCE TEST UNLESS SPECIFICALLY AUTHORIZED BY THE COTR.

4. GOOD HOUSEKEEPING

Contractors shall maintain the entire equipment 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. All testing shall be coordinated to allow monitoring by the COTR.

6. TEST DATA DISPOSITION

The Contractor shall make all preliminary compliance test data such as electronic data files, hand-written data files, and photographs or physical evidence of test failures, available to the COTR on location within four hours after the test. Final test data, including digital printouts and computer generated plots (if applicable), 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 retained by the Contractor for a minimum of three years.

7. GOVERNMENT FURNISHED TEST ITEMS (GFTI)

PROPERTY RECEIPT

Government Furnished Test Items (GFTI) means samples of motorcycle helmets owned or acquired by the Government and subsequently provided to a Contractor for use in the performance of a contract.

The Contractor has the responsibility of accepting motorcycle helmets delivered from motorcycle helmet manufacturers or distributors. In both instances, the Contractor acts on the behalf of OVSC when signing an acceptance of GFTI.

The Contractor shall inspect and provide evidence of receipt of the GFTI within five (5) calendar days of receiving the GFTI. All helmets shall be individually inspected. Any damaged helmet is unacceptable for testing and the COTR shall be notified immediately so that a replacement item can be obtained. Following inspection, the Contractor shall record the date of receipt, make, model, quantity, and condition of all helmets. The GFTI shall be stored appropriately. The Contractor may use the monthly status report format described in Section 14.1 of and shown in Section 16 of this test procedure as evidence of receipt or may list the date of receipt, make, model, quantity, and condition of all helmets in a separate document.

The COTR may request informal interim status updates from the Contractor to facilitate OVSC's internal reporting requirements.

PROPERTY STORAGE

After inspection, helmets shall be stored in a clean, dry, secure storage area to prevent damage to them in any manner that may affect test results. Refer to Section 3. Security for additional storage requirements.

DISPOSITION OF GFTI

No test items shall be destroyed or disposed of until authorized by the COTR.

Test items that have “passed” compliance requirements and any identical unused test items are typically maintained until the program year is complete. Test items that have “failed” compliance requirements and any identical unused test items are typically maintained for two years or until the investigation is closed, whichever is greater.

8. CALIBRATION OF TEST INSTRUMENTS

Before the Contractor initiates the safety compliance test program, a test instrumentation calibration system shall be implemented and maintained in accordance with industry established calibration practices such as ANSI/NCSL Z540-1-1994, Calibration Laboratories and Measuring and Test Equipment – General Requirements or ISO 17025:2000. The calibration system shall be set up and maintained as follows:

- A. Standards for calibrating the measuring and test equipment shall be stored and used under appropriate environmental conditions to ensure 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 TO EXCEED TWELVE (12) MONTHS.** Records showing the calibration traceability to the National Institute of Standards and Technology (NIST) shall be maintained for all measuring and test equipment.
- C. All measuring and test equipment and measuring standards shall be labeled with the following information:
 - (1) Date and place of calibration;
 - (2) Date of next scheduled calibration;
 - (3) Name of the technician or commercial facility who performed the calibration;

- D. A written calibration procedure which includes as a minimum the following information for all measurement and test equipment shall be provided by the Contractor:
- (1) Equipment identification including the type of equipment, manufacturer, model number, etc.
 - (2) Measurement range
 - (3) Full scale accuracy
 - (4) Calibration interval
 - (5) Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident)
 - (6) Measurement uncertainty
- E. Records of calibration for all test instrumentation shall be kept by the Contractor in a manner that ensures established calibration schedules are maintained. All such records shall be readily available for inspection when requested by the COTR.
- F. The calibration system shall be accepted by the COTR before the test program commences.

9. PHOTOGRAPHIC DOCUMENTATION

Each final report shall include clear, legible, and labeled color images approximately 10 cm tall by 15 cm wide, with minimum resolution of 150 dpi. The color images must be sufficiently clear to be reproducible in black and white using standard office equipment.

A representative helmet shall be photographed sufficiently to provide a complete visual description of the helmet. The following photographs are suggested:

- A. 3/4 frontal view;
- B. Interior view, with retention system hardware and labels clearly shown;
- C. Rear or other view that clearly shows the required permanent marking;
- D. A view of the helmet showing both penetration sites;
- E. A one page, legible collage of all labels not legibly shown in the other views;

- F. Representative views of failures as described below:
- (1) Any visually apparent damage, associated with a failure or the inability of a helmet to complete the test program with the damage circled and the helmets labeled; and.
 - (2) Any witness marks that clearly show evidence of a penetration test failure, especially where damage associated with a failure may be difficult or impossible to see;
- G. A photograph or digital image of the test setup for each phase of testing.

Additional photographs of test set-ups for failed helmets shall be taken and retained on file as requested by the COTR. These photographs do not need to be included in the final report.

10. DEFINITIONS

BASIC PLANE

A plane through the centers to the right and left external ear openings and the lower edge of the eye sockets of a reference headform or test headform (see Figure 3, page 12).

COMPLETE COVERAGE HELMET

A motorcycle helmet that covers the ears, base of the skull, lower face and chin.

DISCRETE HELMET SIZE

The size of the helmet that corresponds to standard industry convention for measuring hat size. The American designation, for example 6³/₄, indicates 6 ³/₄ inches is the diameter of an equivalent circle; the European equivalent, for example 54, indicates 54 cm is the circumference of an equivalent circle.

FULL COVERAGE HELMET

A motorcycle helmet that covers the ears and base of the skull, but not the lower face or chin.

HELMET POSITIONING INDEX (HPI)

The distance in centimeters, as specified by the manufacturer, from the lowest point of the brow opening at the lateral midpoint of the helmet to the basic plane of a reference headform, when the helmet is firmly and properly positioned on the reference headform.

MIDSAGITTAL PLANE

A longitudinal plane through the apex of a reference headform or test headform that is perpendicular to the basic plane as shown in Figure 1 (page 3).

PARTIAL COVERAGE HELMET

A motorcycle helmet that covers the top of the skull but not the ears, base of the skull, lower face, or chin.

REFERENCE HEADFORM

A measuring device contoured to the dimensions of one of the three headforms described in Table 1, with surface markings indicating the locations of the basic, mid-sagittal, and reference planes, and the centers of the external ear openings.

REFERENCE PLANE

A plane above and parallel to the basic plane on a reference headform or test headform (Figure 2, page 5) at the distance indicated in Table 1.

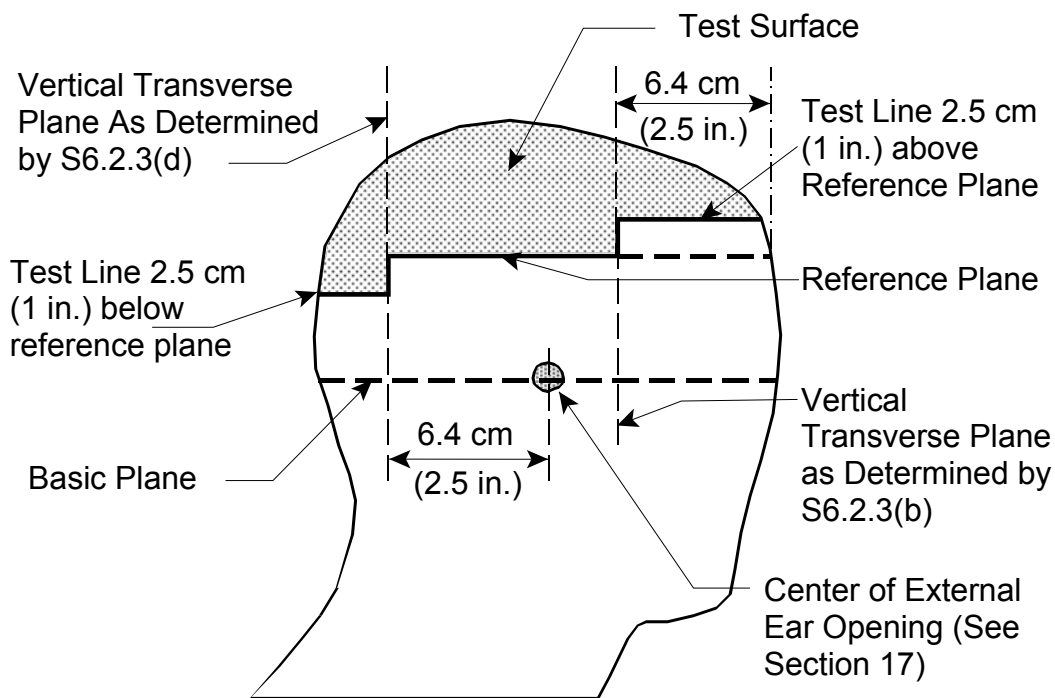
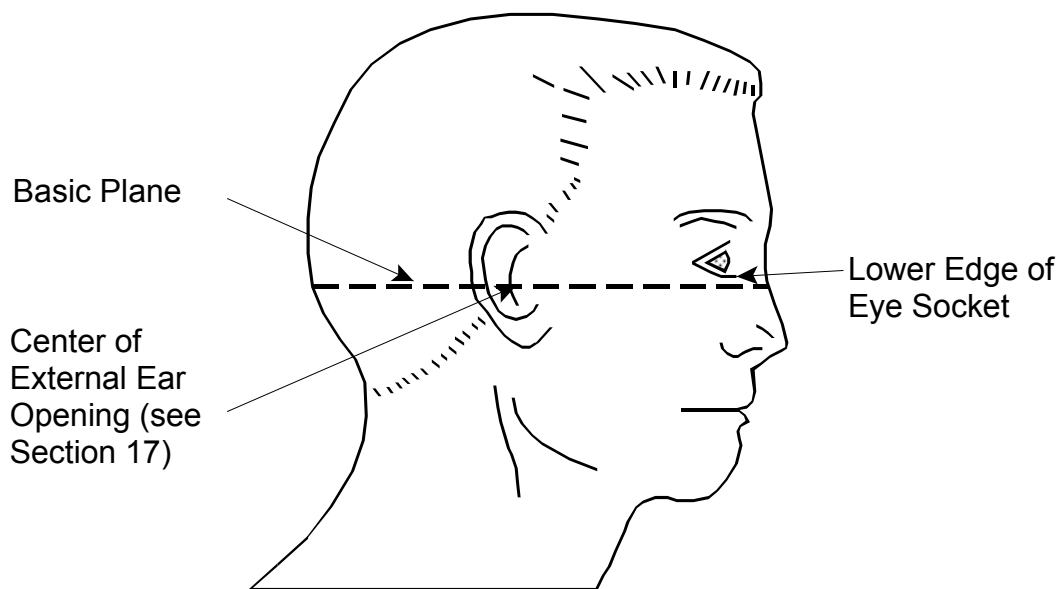
RETENTION SYSTEM

The complete assembly by which the helmet is retained in position on the head during use.

TEST HEADFORM

A test device contoured to the dimensions of one of the three headforms described in Table 1, with surface markings indicating the locations of the basic, mid-sagittal, and reference planes.

BASIC PLANE and TEST LINE



NOTE: Solid lines would correspond to the test line on a test helmet.

FIGURE 3

11. PRETEST REQUIREMENTS

11.1 CONTRACTOR TEST PROCEDURE

Prior to conducting any compliance test, Contractors are required to submit a detailed in-house test procedure to the COTR that includes a step-by-step description of the methodology to be used when conducting compliance tests. Written approval must be obtained from the COTR before initiating the compliance test program so that all parties are in agreement.

The Contractor shall also submit a checklist for conducting compliance tests. This checklist shall reflect the steps described in the in-house test procedure and be used to conduct each helmet test.

11.2 TEST DATA LOSS

A compliance test is not to be conducted unless all of the various test conditions specified in the applicable OVSC laboratory test procedure have been met. Failure by a Contractor to obtain the required test data and to maintain acceptable limits on test parameters in the manner outlined in the applicable OVSC laboratory test procedure may require a retest at the expense of the Contractor. The retest costs shall include the cost of the replacement test sample(s) and all costs associated with conducting the retest. The retest sample(s) shall be identical to the original GFTI.

The original test specimen used for the invalid test shall remain the property of OVSC, and the retest specimen shall remain the property of the Contractor. If there is a test failure, the Contractor shall retain the retest specimen for a period not exceeding 180 days. If there is no test failure, the Contractor may dispose of the retest specimen upon notification from the COTR that the final report has been accepted.

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 two (2) weeks after receipt of notification by the Contracting Officer that a retest is required. If a retest is conducted, no final report is required for the original test.

11.3 DATA RECORDING

Environmental Data

Environmental data (test area and conditioning environments) shall be continuously monitored and permanently recorded on strip charts, circular charts, in electronic files or other suitable print-out media throughout the conditioning and testing period. If the recording technique is digital, the environmental condition shall be recorded no less frequently than once per two minute interval.

Environmental data shall be recorded within the accuracy parameters specified:

- A. Temperature shall be recorded in degrees Celsius within ± 2 °C of actual values.
- B. Relative humidity shall be recorded within $\pm 5\%$ RH of actual values.

Environmental data shall be included in the final report or retained on file and made available to the COTR upon request.

Test Data

The performing agency shall, with appropriate instrumentation, permanently record the following data within the accuracy parameters specified:

- A. Headform velocity at impact shall be recorded in m/s within ± 0.2 m/s of actual values; accelerations from impact attenuation tests (FMVSS No. 218, S7.1) shall be recorded in g within ± 5.0 g of actual values, and corresponding dwell times in milliseconds (ms) shall be recorded within ± 0.04 ms of actual values.
- B. Evidence of any contact between the striker and the test headform resulting from penetration tests (FMVSS No. 218, S7.2).
- C. Retention system test loads (FMVSS No. 218, S7.3) shall be recorded in kg to within ± 1.0 kg of actual values.
- D. Net displacement of the adjustable portion of retention system test device (FMVSS No. 218, S7.3.4) shall be recorded in cm to an accuracy of ± 0.0254 cm.

11.4 DEVIATIONS

The Contractor shall notify the COTR if any deviations from this test procedure are necessary prior to performing the deviation. Any additional problems or questions regarding the technical portion of this contract should also be referred to the COTR within 48 hours via telephone and within one week via e-mail or official letter.

12. COMPLIANCE TEST EXECUTION

12.1 TEST HELMETS

Five (5) structurally identical helmets of the same size and similar dates of manufacture shall be provided for a test, four of which shall be subjected to the prescribed series of tests after proper environmental conditioning and the fifth shall be retained for use as a spare in the event that additional testing needs to be conducted. Any other use of the spare helmet for test purposes shall be discussed with the COTR first.

12.2 GENERAL TEST CONDITIONS

Unless otherwise specified, all tests and measurements shall be conducted under the following environmental conditions:

Room Ambient	21°C ± 6°C
Relative Humidity	40% to 60%

The laboratory shall be capable of setting, controlling, and reading the environmental condition parameters so that when the accuracies of the instrumentation and the systems are considered in evaluating the recorded data the results are within the upper and lower limits of the specifications. During all phases of testing, environmental conditions shall be continuously monitored and permanently recorded in accordance with Section 11.3.

Prior to testing, helmets shall be prepared to the conditions described in Section 12.5, *Preparation of Test Samples*.

12.3 PERSONNEL TRAINING

Technicians responsible for conducting compliance tests shall be thoroughly familiar with the requirements and test conditions for each test phase to be performed. Each technician shall be specifically instructed in the proper operation of all equipment used during testing.

Personnel supervising the compliance test program shall be thoroughly familiar with the requirements, test conditions, and test equipment.

12.4 TEST SEQUENCE

Helmet preparation and tests shall be performed in the following sequence:

- A. Visual and dimensional inspection (FMVSS No. 218- S5.4, S5.5, and S5.6)
- B. Conditioning – FMVSS No. 218, S6.4
- C. Impact attenuation — FMVSS No. 218, S7.1
- D. Penetration resistance — FMVSS No. 218, S7.2
- E. Retention System strength — FMVSS No. 218, S7.3

12.5 PREPARATION OF TEST SAMPLES

12.5.1 HEADFORM SELECTION

The headform selected for compliance testing shall be based on the discrete helmet size designated on the helmet or provided by the COTR. If no discrete size designation is available, obtain guidance from the COTR before proceeding. Table 1 lists the discrete helmet sizes and the corresponding headform sizes.

HELMET SIZE DESIGNATION	HEADFORM SIZE
Less than or equal to 6-3/4 (European Size 54)	SMALL
Greater than 6-3/4, but less than or equal to 7-1/2 (European Size 60)	MEDIUM
Greater than 7-1/2 (European 60)	LARGE

Table 1. Headform Selection

If the helmet size designation falls into more than one of three size ranges, it shall be tested on each appropriate headform. If this is the case, the test lab shall consult the COTR before beginning testing.

12.5.2 WEIGHING

The weight of each helmet shall be measured prior to beginning testing. The helmet shall be prepared to the test configuration for the purpose of weighing. For example, if the helmet has tags or accessories that will not be in place during testing, they shall be removed prior to weighing.

12.5.3 PROJECTIONS

External projections shall be measured perpendicularly to the plane tangent to the helmet shell surface at the location of the projection.

12.5.4 LABELING

Label permanency means that the label cannot be removed intact, i.e., removal can only be accomplished by destruction or removal of the label in pieces.

The manufacturer shall identify the type(s) of materials that the shell and liner are constructed of on a label on the helmet. The description of the materials must be clear to the purchaser.

12.5.5. MARKING

Before beginning the compliance test, contact the COTR to obtain the helmet positioning index (HPI) for the helmet being tested. Refer to Section 10 for a definition of HPI and Figure 2 (page 5) for a diagram showing HPI.

Each helmet shall be marked prior to testing. It is suggested that a marking fixture be constructed and used to mark the helmet. This fixture may serve the two-fold purpose of —

- (a) Applying the $4.5 \pm .05$ kg mass to the apex of the helmet for seating (this may be accomplished with dead weight), and
- (b) Providing positioning indicators (on a base plate or otherwise external to the reference headform) to ensure consistent and accurate marking.

In accordance with FMVSS No. 218, S6.2:

- (1) Use a headform that is firmly seated with the basic and reference planes horizontal. Place the helmet to be tested on the appropriate headform (per section 12.5.1 of this test procedure).
- (2) Place a 4.5 kg mass on the helmet's apex. Center the helmet laterally and seat it firmly on the reference headform according to its HPI.
- (3) Maintaining the load and position described in step 2, draw a test line on the outer surface of the helmet along the portions of the planes that intersect with the helmet surface as described below:
 - a. A plane 2.5 cm above and parallel to the reference plane in the anterior portion of the reference headform;
 - b. A vertical transverse plane 6.4 cm behind the point on the anterior surface of the reference headform at the intersection of the mid-sagittal and reference planes;
 - c. The reference plane of the reference headform;
 - d. A vertical transverse plane 6.4 cm behind the center of the external ear opening in a side view; and
 - e. A plane 2.5 cm below and parallel to the reference plane in the posterior portion of the reference headform.

Refer to Figure 3, page 12 for a diagram of the test line.

The impact sites, once chosen, shall be marked on the helmet shell to ensure that the two successive blows are delivered to the same location (should the helmet shift due to impact and require repositioning).

In addition to the above described marking, each helmet shall be labeled with a laboratory assigned serial number and the environmental condition to which it will be subjected, prior to and during testing.

CAUTION: Certain substances which could be used to mark helmets may cause chemical degradation of the shell material. It is therefore suggested that only water based markers or wax pencils be used for this purpose.

In addition to marking the helmet, it is recommended that the headform(s) be marked in a non-permanent fashion to provide the test operator a quick reference indicator for realigning the helmets using the HPI prior to each test.

12.5.6 PERIPHERAL VISION

Peripheral vision shall be measured while the helmet is properly positioned and seated, with a $4.5 \pm .05$ kg static load, on the reference head-form. A device with an accuracy of $\pm 1^\circ$ shall be used for this measurement.

Each helmet shall provide a minimum peripheral vision of 105° to each side of mid-sagittal plane.

12.5.7 CONDITIONING

Prior to testing, one (1) each of the sample helmets shall be maintained at the following environmental conditions for at least 12 hours —

Ambient	$21^{\circ}\text{C} \pm 6^{\circ}\text{C}$
High Temperature	$50^{\circ}\text{C} + 0^{\circ}\text{C}, - 4^{\circ}\text{C}$
Low Temperature	$-10^{\circ}\text{C} + 8^{\circ}\text{C}, - 0^{\circ}\text{C}$
Water Immersion	$25^{\circ}\text{C} \pm 6^{\circ}\text{C}$

Testing shall commence at two minutes after the helmet has been removed from its conditioning environment and the helmet shall be returned to its conditioning environment after testing. A record of test dates and times out of the conditioning environment shall be made for each helmet test. Although this data shall be collected and made available to the COTR upon request, it is not required to be included in the final report. Before beginning a subsequent test on that helmet, the helmet shall be maintained at the appropriate environmental condition as described below in Table 2.

If the time out of the conditioning environment is x	Then the helmet must be returned to the conditioning environment for y
$x \leq 4$ minutes	$y \geq 3$ minutes; or
$4 \text{ minutes} < x \leq 5$ minutes	$y \geq 6$ minutes; or
$5 \text{ minutes} < x \leq 6$ minutes	$y \geq 9$ minutes; or
$6 \text{ minutes} < x \leq 7$ minutes	$y \geq 12$ minutes; or
$n \text{ minutes} < x \leq n+1$ minutes (where n is an integer)	$y \geq 3(n-2)$ minutes or 12 hours (whichever is less)

Table 2. Required Time for Reconditioning

The laboratory shall be capable of setting, controlling, and recording the temperatures maintained by the environmental conditioning equipment so that when the accuracies of the instrumentation and the systems are considered in evaluating the recorded data, the results are within the upper and lower limits of the specifications.

12.6 IMPACT ATTENUATION TEST

The following information is provided to clarify FMVSS No. 218, S7.1.

12.6.1 TEST EQUIPMENT AND TOLERANCES

A. Test Headforms

The test headforms used for the impact attenuation test shall conform to the dimensions described in Figures 4, 5, 6, and 7 (pages 24-27) and Section 17.

These headforms shall be constructed of magnesium alloy (K-1A), and exhibit no resonant frequencies below 2,000 Hz. The center of gravity of the test headform and the supporting assembly is specified in FMVSS No. 218, S7.1.8

B. Drop Test System

A monorail drop test system is used for impact attenuation.

The apparatus used to guide the drop assembly shall be constructed and maintained to ensure a free fall within $\pm 1^\circ$ of vertical. The guide-drop assembly interface shall be designed with suitable tolerances and materials in order to minimize any frictional effects and comply with the requirements of S7.1.7-S7.1.8. The acceleration transducer shall be mounted at the center of gravity of the test headform with the sensitive axis aligned to within 5° of vertical when the test headform assembly is in the impact position.

The laboratory must be capable of setting the drop heights so that when the accuracy of the measuring device is considered in evaluating the recorded data the results are within the specified limits.

Drop Assembly Weights

The combined weight of the instrumented test headform and supporting assembly for impact tests shall be as follows:

SMALL	3.5 kg, + 0.00 kg, - 0.063 kg
MEDIUM	5.0 kg, + 0.00 kg, - 0.090 kg
LARGE	6.1 kg, + 0.00 kg, - 0.108 kg

C. Anvils

The flat anvil is constructed of steel with a 12.7 cm minimum diameter impact face, and the hemispherical anvil is constructed of steel with a 4.8 cm radius impact face.

12.6.2. TEST LOCATION

The laboratory shall perform impact attenuation tests at the same locations on each of the four helmets during the impact attenuation test. The impact sites may be at any point in the area above the test line and separated by a distance not less than one-sixth of the maximum circumference of the helmet in the test area. It is recommended that the laboratory implement a method to show the impact sites. For example, marking the anvil with an "X" using a water-based marker or wax pencil that will transfer to the helmet, is a suitable method.

The laboratory shall perform impact attenuation tests within ± 45 degrees of the locations identified on Data Sheet 4, or as directed by the COTR.

12.6.3 SYSTEM CHECK

Immediately prior to, and at the conclusion of the 32-impact series for each set of helmets, the entire system shall be tested for possible faults by making a series of check drops onto a standardized impact media (a 2.54 cm open blue Modular Elastomer Programmer (MEP) Calibration Pad has proven suitable for this purpose).

The drop height and media for these checks shall be chosen to demonstrate the system's capability to produce and record an acceleration vs. time history of (nominally) 400 g with a minimum 1 ms duration above 200 g.

Check drops shall be made using the same headform and drop assembly that will be used to conduct the impact attenuation test. The headform shall be bare and the point of impact and accelerometer axis shall be

vertically aligned. During the posttest, the headform shall be aligned in a manner that is consistent with the pretest check drop.

A systems check shall consist of 6 drops. The first 3 drops are considered "warm-up" drops. Permanent recording of data is not required for these impacts. The second 3 drops shall be recorded and the results of these drops shall become part of the test data presented in the final report.

A system shall be considered defective if —

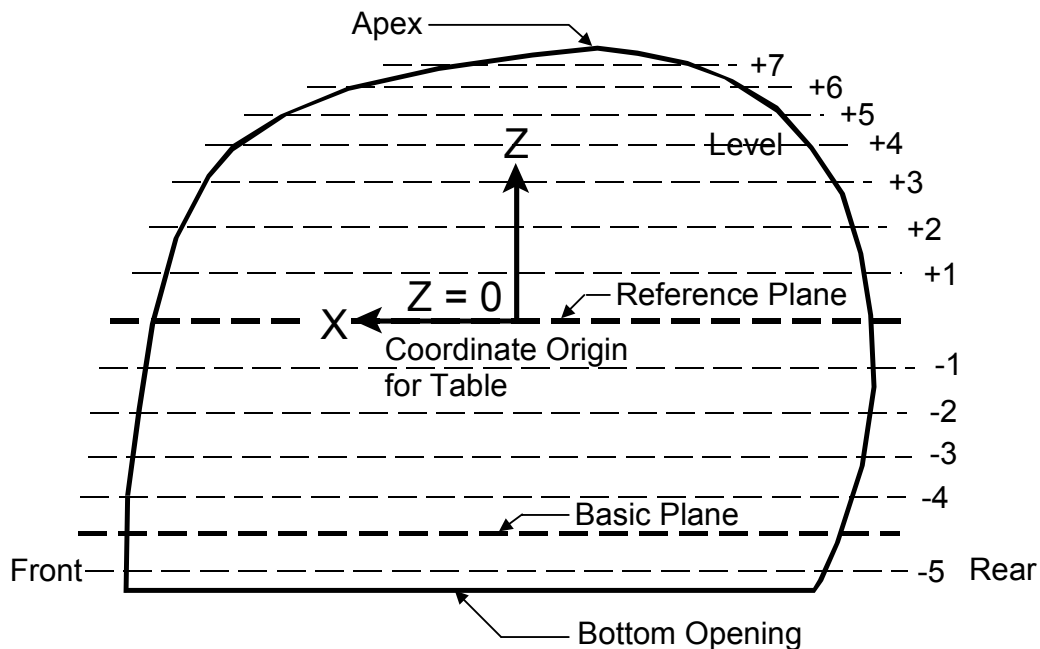
- (1) none of the three recorded accelerations are greater than 375 g, or
- (2) the average of pretest and posttest checks (recorded drops only) differs by more than 40 g.

If, at the completion of the impact portion of a test program, either condition is found to exist, contact the COTR before proceeding with the test.

In addition, immediately prior to the first drop check and after the final posttest check, a highly accurate ($\pm 0.1\%$ voltage) calibration signal shall be injected into the system. The output produced by this signal shall be recorded and maintained on file

HEADFORM SECTIONS

Mid-Sagittal Plane (Symmetrical Plane)



Headform Coordinate Systems (Right Hand Rule)

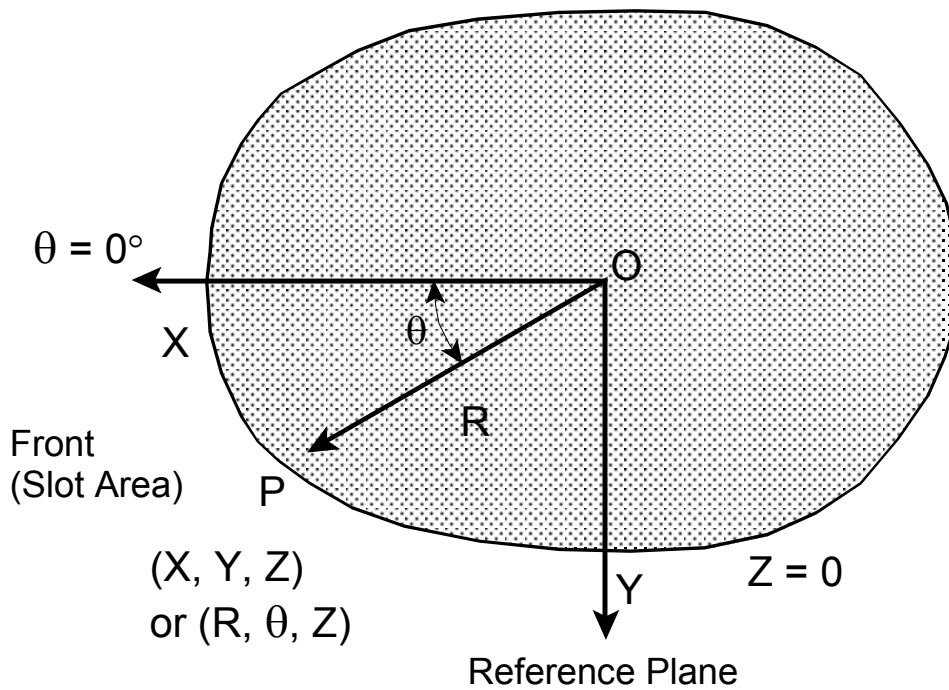


FIGURE 4

SMALL HEADFORM

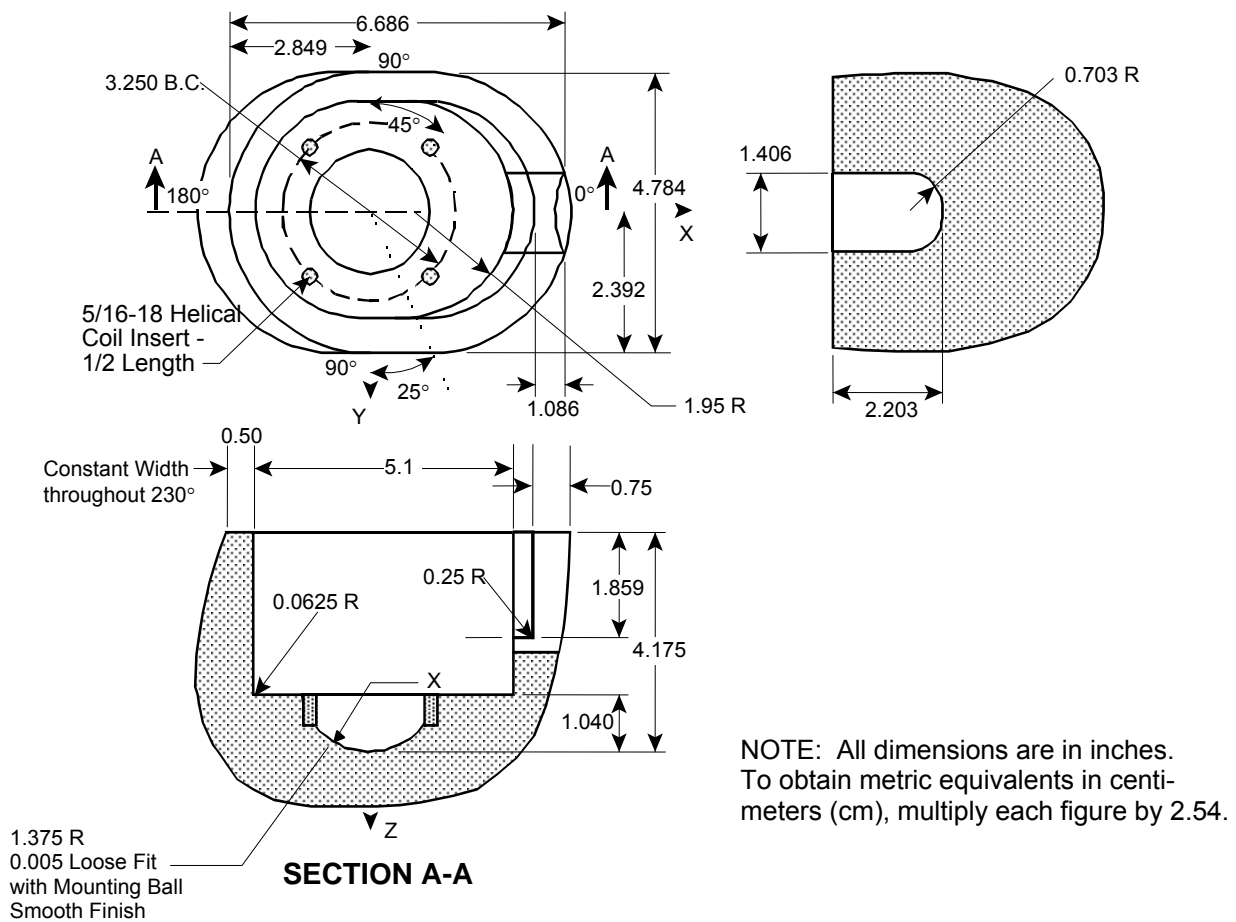


FIGURE 5

MEDIUM HEADFORM

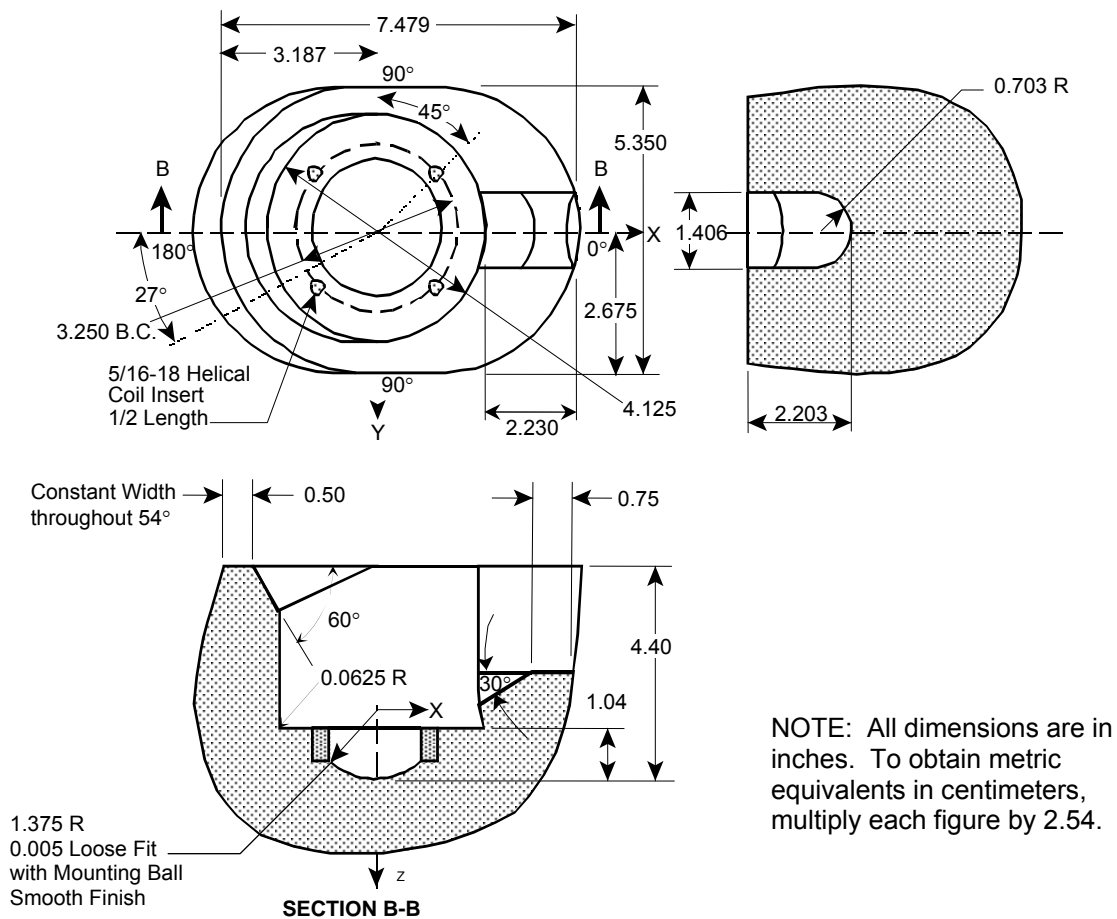
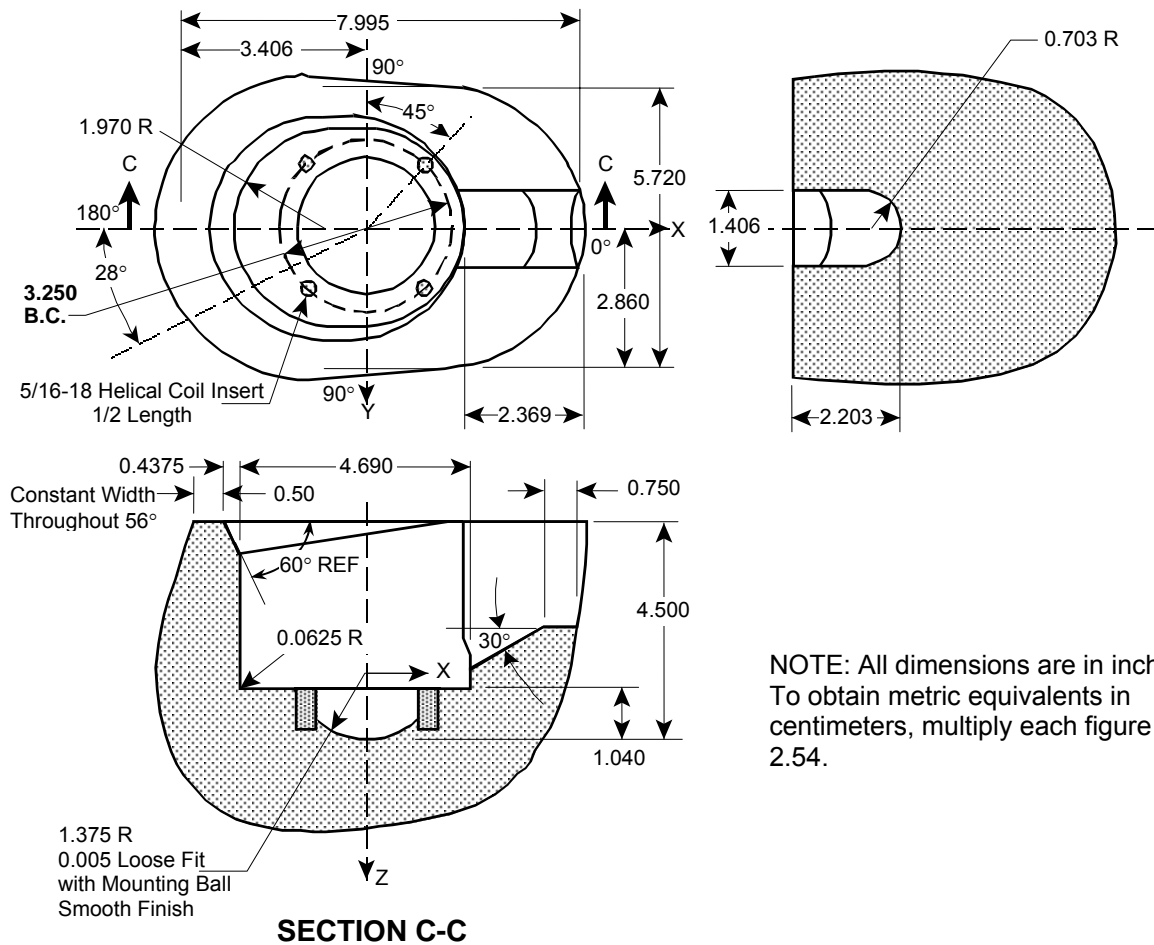


FIGURE 6

LARGE HEADFORM



NOTE: All dimensions are in inches. To obtain metric equivalents in centimeters, multiply each figure by 2.54.

FIGURE 7

12.6.4. TEST PROCEDURE

- (1) Once systems checks are completed, replace the MEP with either of the two steel anvils. Align the test headform for the desired impact location.
- (2) Prepare the anvil with witness marks that will transfer to the helmet upon impact.
- (3) Place the subject helmet on the test headform and adjust it in accordance with the manufacturer's HPI. Use the chinstrap to fasten the helmet to the drop assembly and prevent slippage during free fall.

CAUTION: Secure the helmet so that it does not shift position before impact or before application of force during testing. Do not tighten chinstrap with more force than is necessary to prevent the helmet from moving before impact or before application of force during testing, as this will result in abnormal deformation and stress prior to impact.

Reposition the helmet as necessary after each impact to realign the helmet with the HPI.

- (4) Raise the drop assembly to the proper height (see Table 3) using a suitable measuring technique (calibrated measuring rods are suggested) to achieve the desired impact speed. The laboratory shall monitor the actual drop heights to ensure the mechanical drop system is functioning properly. The actual drop height shall be within 5% of the theoretical drop height.

Anvil	Impact Speed	Nominal Drop Height
Hemispherical	5.2 m/s, + 0 m/s, - 0.4 m/s	138.4 cm
Flat	6.0 m/s, + 0 m/s, - 0.4 m/s	182.9 cm

Table 3. Impact attenuation impact speeds

- (5) Simultaneously release the drop assembly and trigger the instrumentation system to permanently record the acceleration-time trace. The acceleration-time trace for all 32 test drops shall be included in the final report. Each plot shall include information identifying the helmet, drop number, time, date, helmet test condition (such as ambient, low temperature, high temperature, or water immersed), impact location, anvil type, impact velocity, peak acceleration (g), and dwell times (ms) at 150 g and 200 g.
- (6) Repeat the above steps (changing headform position and anvils as necessary) until all 32 impacts are completed. Each helmet is impacted at four sites with two successive identical impacts at each site. Two of these sites are impacted upon a flat steel anvil and two upon a hemispherical steel anvil.
- (7) Perform posttest systems checks in accordance with Paragraph 12.6.3, *System Check*.
- (8) Record the results of the impact attenuation test on Data Sheet 4 and include the data sheet in the final report. For each impact, the drop number, helmet test condition, impact location, anvil type, peak g, dwell times at 150 g and 200 g, and impact velocity shall be recorded.

12.6.5 FAILURE CRITERIA

Accelerations in excess of 400 g or cumulative dwell times in excess of 2.0 ms above 200 g or 4.0 ms above 150 g shall be recorded as failures.

12.7 PENETRATION TEST

The following information is provided to clarify FMVSS No. 218, S7.2.

12.7.1 TEST EQUIPMENT AND TOLERANCES

(A) Headform

The test headforms used for the penetration test shall conform to the dimensions described in Figures 4, 5, 6, and 7 (pages 24-27) and Section 17.

Test contactable surface of the headforms used for the penetration test shall be constructed of a metal or metallic alloy having a Brinell hardness number no greater than 55. If, during the course of testing, the headform

is damaged (indented) by the penetration striker, it shall be repaired prior to the next test.

(B) Guided free-fall apparatus

The apparatus used to guide the free-fall of the penetration striker shall be constructed and maintained to ensure a free fall within $\pm 1^\circ$ of vertical. If the apparatus completely encloses the striker (such as a tube), it shall provide a clearance between the striker and guide of not greater than 5.1 mm total.

(C) Striker

The weight of the penetration striker shall be 3 kg, + 0.00 kg, - 0.029 kg. The striker tip shall have an included angle of 60° , + 1.0° , - 0.0° and a cone height of 3.8 cm, + 0.25 cm, - 0.0 cm. The striking point shall have a radius of 0.5 mm radius, + 0.08 mm, - 0.0 mm and a minimum hardness of 60 Rockwell (Scale C).

12.7.2 TEST LOCATION

The laboratory shall perform penetration tests at the same locations on each of the four helmets. These locations shall be above the test line such that penetration sites are at least 7.6 cm apart, and at least 7.6 cm from the center of any impact applied during impact attenuation testing and not on a fastener or other rigid projection.

Typically, the location of the first penetration test shall be in the crown area of the helmet, greater than 7.6 cm from the center of any impact applied during the impact attenuation test or as directed by the COTR.

Typically, the location of the second penetration test shall be on the side area of the helmet, greater than 7.6 cm from the center of any impact applied during the impact attenuation test and from the first penetration test location, or as directed by the COTR.

The laboratory shall photograph the penetration test sites and include the image in the final report.

12.7.3 TEST PROCEDURE

- (1) Align the headform for the desired penetration location and apply witness tape to the potential contact area.
- (2) Place the subject helmet on the test headform and adjust it in accordance with the manufacturer's HPI. Use the chinstrap as necessary to fasten the helmet to the drop assembly and prevent slippage prior to the striker contacting the helmet.
- (3) Raise the penetration striker assembly to the proper height using a suitable measuring technique (calibrated measuring rods are suggested). The penetration striker shall be dropped in a guided free fall from a height of 3 m, + 0.0 m, - 0.03 m, measured from the tip of the striker to the outer surface of the subject helmet when properly positioned on the test headform. The laboratory must be capable of setting the drop height to ensure velocity is within the specified range.
- (4) Release the striker assembly.
- (5) Remove the helmet from the headform and examine the headform for evidence of contact between it and the striker. Record the results on Data Sheet 5 and include this sheet in the final report. If contact is made, photograph the penetration site on the headform and carefully remove the witness tape from the headform. Retain and store the evidence securely with the data sheets for that helmet. Removal and storage of the witness tape shall be done in such a manner as to not destroy, distort or otherwise obliterate the resultant indentation. A digital image of the witness tape showing evidence of a failure shall be included in the final report.
- (6) If the headform is damaged, refinish it before conducting the next test.

12.7.4 FAILURE CRITERIA

Contact between the striker and the surface of the test headform at any point above the test line shall be recorded as a failure.

Contact between the headform and striker shall be demonstrated using some evidence that can be stored after the test is complete. For instance, evidence of the penetration failure may be provided through use of witness tape or similar material applied to the headform before the test in order to reveal any contact of the striker onto the headform that is indicative of the penetration failure.

12.8 RETENTION SYSTEM TEST

The following information is provided to clarify FMVSS No. 218, S7.3.

12.8.1 TEST EQUIPMENT AND TOLERANCES

(A) Headform

The test headforms used for the retention system test shall conform to the dimensions described in Figures 4, 5, 6, and 7 (pages 24-27) and Section 17.

(B) Retention System Test Device

The retention system test device consists of both an adjustable loading mechanism by which a static tensile load is applied to the helmet retention assembly and a means for holding the test headform and helmet stationary. The retention system test device shall allow the retention assembly to be fastened around two freely moving rollers, both of which have a 1.3 cm diameter and a 7.6 cm center-to-center separation, and which are mounted on the adjustable portion of the tensile loading device. Refer to Figure 8 (page 34).

The laboratory shall be capable of applying the retention system loads so that when the accuracies of the instrumentation and the systems are considered in evaluating the recorded data the results are within the upper and lower limits of the specified conditions.

12.8.2 TEST PROCEDURE

- (1) Inspect the retention system to determine if the helmet can be fastened without securing the complete assembly. If this is possible, contact the COTR to determine how to test the retention system before beginning the test.
- (2) Place the subject helmet on the test headform such that the basic plane is normal to the force of gravity and adjust it in accordance with the manufacturer's HPI.
- (3) Securely fasten the retention system around the two freely moving rollers in a manner that avoids contact between the rollers and helmet's buckle.

- (4) Apply a preliminary load of 22.7 kg, + 4.5 kg, - 0 kg in the direction normal to the basic plane to the retention system and hold for a minimum of 30 seconds.
- (5) Record the vertical distance between the apex of the helmet and a fixed point on the moveable test device.
- (6) Increase the load to 136 kg, + 0.0 kg, - 4.5 kg at the rate of 1.0 - 3.0 cm/min measured between the roller assembly and the headform. Maintain this load for 120 seconds, + 0 seconds, - 10 seconds.
- (7) After 120 seconds (+0 seconds, -10 seconds) at full test load, measure and record the vertical distance between the apex of the helmet and a fixed point on the moveable test device (same point as used for previous measurement).
- (8) Summarize the results of the retention tests on Data Sheet 6 and include the data sheet in the final report. Include the retention system test plots for each of the four retention system tests in the final report. Each plot shall include information identifying the helmet, date, helmet test condition (such as ambient, low temperature, high temperature, or water immersed), maximum load, and extension at the maximum load.

12.8.3 FAILURE CRITERIA

When tested as previously described —

- A. The retention system, its components and attachments (including the helmet shell) shall attain the specified loads without separation; and
- B. The adjustable portion of the retention system test device shall not move more than 2.5 cm, measured between preliminary and full test load positions.

RETENTION SYSTEM TEST DEVICE

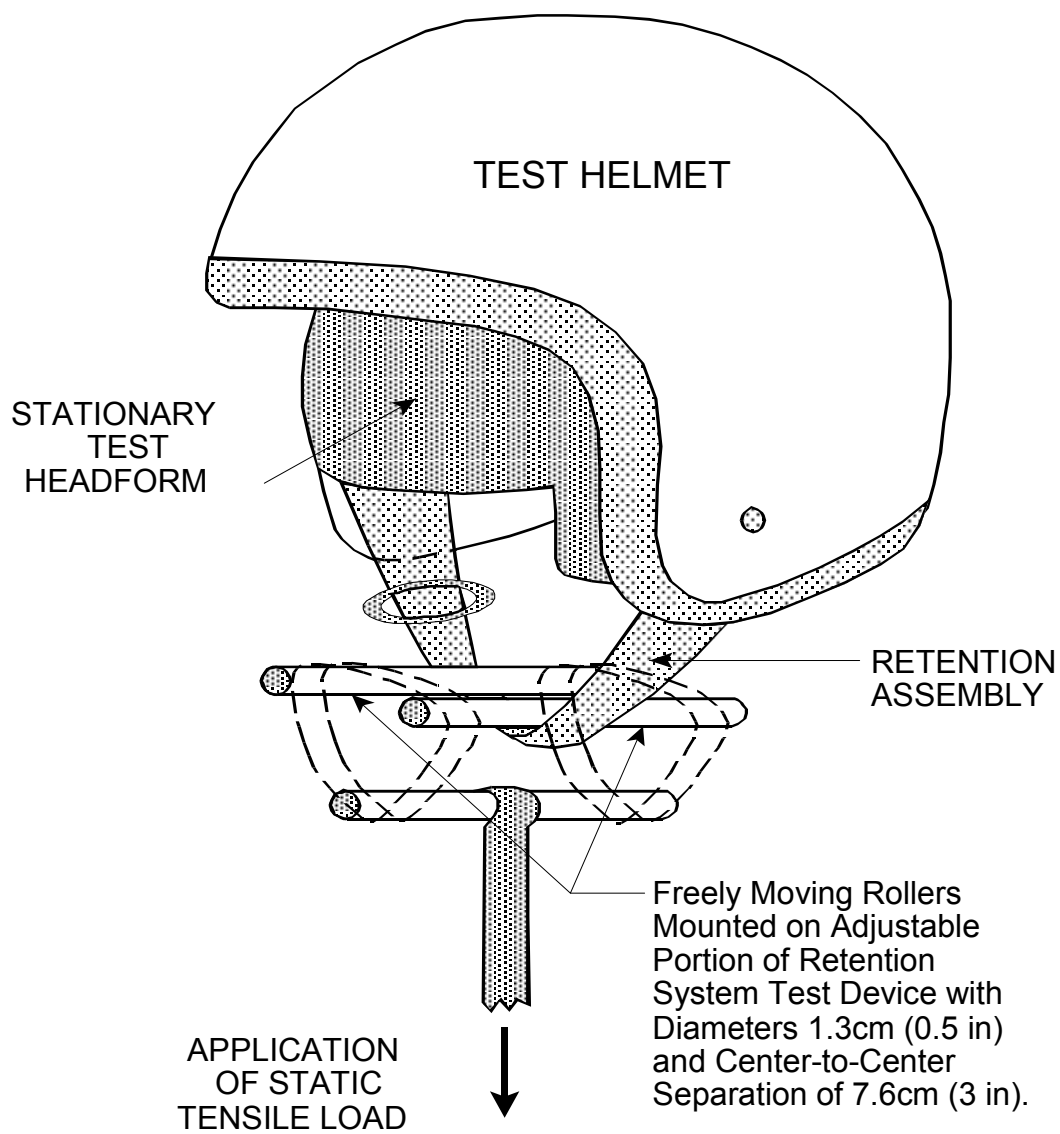


FIGURE 8

13. POSTTEST REQUIREMENTS

The Contractor shall verify all data sheets have been filled out completely and accurately and all necessary photographs have been taken.

14. REPORTS

14.1 MONTHLY STATUS REPORTS

The Contractor shall submit a monthly report to the COTR on the 10th day of each month beginning when the first test item is received until the last test is completed for the fiscal year.

Monthly status reports shall include the following:

- A. Test assets received and number of tests and reports scheduled for the reporting period and completed during the reporting period;
- B. Schedule for tests and reports for the next reporting period;
- C. Brief description of test failures which occurred during the reporting period;
- D. Problems or delays that the Contractor experienced during the reporting period which are related to the supplies and services required under this contract;
- E. Specific action that the Contractor proposes to correct problems or delays identified

The COTR may request informal interim status updates from the Contractor to facilitate OVSC's internal reporting requirements.

A sample Monthly Status Report is shown Section 16, *Forms*. This report shall list the report number; the brand, model, size, and type of helmet; the date the helmet is received at the lab; the date testing is started; and if the helmet passes or fails testing. For helmets that fail testing, a brief failure description, e.g., peak-g, dwell time, penetration, retention, labeling, DOT-symbol, etc. will be provided.

The Contractor shall also submit a monthly report to the COTR listing the equipment that is being stored. This Equipment Storage Report shall be submitted until all items of equipment are disposed of. A sample Equipment Storage Report is shown Section 16, *Forms*.

14.2 TEST FAILURE NOTIFICATION

Any indication of a test failure shall be communicated by telephone to the COTR within 1 working day and in writing by e-mail or fax within 2 working days. A Notice of Test Failure (see Section 16. *Forms*) with a copy of the particular compliance test data sheet(s), preliminary data plot(s), and photographs as applicable shall be included. In the event of a test failure, a posttest calibration check of some 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.

The final determination of "passed" or "failed" shall be made by the COTR upon acceptance of the final report. Therefore, no test items shall be destroyed or disposed of until authorized by the COTR. Test items which have "failed" compliance requirements and any unused test items identical to the test items which have "failed" compliance requirements, shall be stored by the contractor for at least 2 years after the test failure at no additional cost, unless directed by the COTR to do otherwise.

14.3 FINAL REPORTS

14.3.1 COPIES

One paper and one electronic copy of the final report shall be submitted to and received by the COTR for acceptance within three weeks of test completion or received before the end of the fiscal year, whichever comes first. The final report format to be used by all Contractors is described in Sections 14.3.2-14.3.5 of this report.

Payment of Contractor's invoices for completed compliance tests may be withheld until the final report is accepted by the COTR. Contractors are requested to NOT submit invoices before the COTR is provided copies of the final report.

Contractors are required to submit a draft version of the final report within two weeks after the compliance test is conducted.

Contractors shall **PROOF READ** all final reports before submitting them 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.

The electronic copy of the final report shall be provided to the COTR in MS Word or .pdf format that is compatible and size appropriate for storage in the OVSC's database. The final report shall be provided with all required signatures. The recommended compression settings can be obtained from the COTR.

14.3.2 REQUIREMENTS

The final report and associated documentation (including photographs, see Section 9) are relied upon as the chronicle of the compliance test. The final 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 shall describe in detail any compliance test events that deviate from the test procedures approved by the COTR as well as any events that are not directly associated with the standard but are of technical interest shall also be included in the final report. Such events shall be included in Appendix A of the final report.

Instructions for the preparation of the first three pages of the final 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 218-ABC-XX-001, where —
218 is the FMVSS tested
ABC are the initials for the laboratory
XX is the last two digits of the Fiscal Year of the test program
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 No. 218

Motorcycle Helmets

Safety Equipment Company

(state the brand and model of the tested helmet)

- (3) Contractor's Name and Address such as

COMPLIANCE TESTING LABORATORIES, INC.

4335 West Dearborn Street

Detroit, Michigan 48090

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

Office of Vehicle Safety Compliance

400 Seventh Street, SW

Room 6111 (NVS-220)

Washington, DC 20590

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: _____
(signature)
(printed name)

Approved By: _____
(signature)
(printed name)

Approval Date: _____

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: _____

Acceptance Date: _____

- 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

218-ABC-XX-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 No. 218 Compliance Testing of (Helmet brand and model)

Block 5 — REPORT DATE

(month, date and year) e.g. October 28, 2002

Block 6 — PERFORMING ORGANIZATION CODE

ABC (NHTSA's 3-digit alpha-code for test lab)

Block 7 — AUTHOR(S)

John Smith, Project Manager / Bill Doe, Project Engineer

Block 8 — PERFORMING ORGANIZATION REPORT NUMBER

(in testing lab's format if different from DOT report number)

Block 9 — PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories
405 Main Street
Detroit, MI 48070

Block 10 — WORK UNIT NUMBER

Leave blank

Block 11 — CONTRACT OR GRANT NUMBER

DTNH22-03-D-12345

Block 12 — SPONSORING AGENCY NAME AND ADDRESS

US Department of Transportation
National Highway Traffic Safety Administration
Office of Vehicle Safety Compliance (NVS-220)
400 Seventh Street, SW, Room 6111
Washington, DC 20590

Block 13 — TYPE OF REPORT AND PERIOD COVERED

Final Test Report
Month Day, Year – Month Day, Year

Block 14 — SPONSORING AGENCY CODE

NVS-220

Block 15 — SUPPLEMENTARY NOTES

Leave blank

Block 16 — ABSTRACT

Compliance tests were conducted on the (insert brand and model of helmet tested) Motorcycle Helmet in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-218-XX. 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. If there is a failure, replace “None” with the paragraph of FMVSS No. 218 where the failure occurred and a brief statement of the failure.

Block 17 — KEY WORDS

Compliance Testing
Safety Engineering
FMVSS No. 218

Block 18 — DISTRIBUTION STATEMENT

Copies of this report are available from —

National Highway Traffic Safety Administration
Technical Information Services (NPO-405)
400 Seventh Street, SW, Room 2336
Washington DC 20590

e-mail: tis@nhtsa.dot.gov
FAX: 202-493-2833

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

14.3.4 TABLE OF CONTENTS

Final Report Table of Contents shall include the following:

- A. Section 1 — Purpose of Compliance Test
- B. Section 2 — Compliance Test Data Summary
- C. Section 3 — Test Data
- D. Section 4 — Test Failure Details (if applicable)
- E. Appendix A — Interpretations or Deviations From FMVSS No. 218
- F. Appendix B — Test Equipment List and Calibration Information
- G. Appendix C — Photographs

15. DATA SHEETS

DATA SHEET 1
HELMET DATA

HELMET BRAND NAME: _____

HELMET MODEL DESIGNATION: _____

HELMET MANUFACTURER: _____

HELMET SIZE: _____

HELMET COVERAGE: Partial - _____; Full - _____; Complete Facial _____

HELMET POSITIONING INDEX: _____

SHELL MATERIAL: _____

LINER MATERIAL: _____

BUCKLE DESCRIPTION: _____

HELMET	A Ambient	B Low Temp	C High Temp	D Water Immersed	E Spare
SHELL COLOR/PATTERN					
WEIGHT (grams)					
MONTH & YEAR OF MANUFACTURE					

COMMENTS:

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

**DATA SHEET 2
SUMMARY OF TEST RESULTS**

REPORT NO.: _____

DATE: _____

P - Pass or F - Fail

HELMET	A	B	C	D	COMMENTS
TEST	AMBIENT	LOW TEMP	HIGH TEMP	WATER IMMERSED	
IMPACT					
PENETRATION					
RETENTION					

INDICATE P - PASS OR F - FAIL

TEST	PASS	FAIL
PERIPHERAL VISION		
PROJECTIONS		
LABELING		

COMMENTS:

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

**DATA SHEET 3
SELECTION OF APPROPRIATE HEADFORM**

REPORT NO.: _____

DATE: _____

Paragraph S6.1 - If the helmet size designation falls into more than one of three size ranges, it shall be tested on each appropriate headform. Consult with the COTR before beginning the test.

HELMET SIZE DESIGNATION	HEADFORM SIZE
Less than or equal to 6-3/4 (European Size 54)	SMALL
Greater than 6-3/4, but less than or equal to 7-1/2 (European Size 60)	MEDIUM
Greater than 7-1/2 (European 60)	LARGE

COMMENTS:

CONDITIONING FOR TESTING — Paragraph S6.4 — The protective headgear shall be conditioned for not less than 12 hours, in the specified environmental condition shown below, prior to test.

Ambient Conditions	21°C ± 6°; 40% to 60% Relative Humidity
Low Temperature	-10°C + 8°C, -0°C
High Temperature	50°C + 0°C, -4°C
Water Immersion	25°C ± 6°C

The maximum time during which the protective headgear may be out of the conditioning environment shall not exceed 4 minutes. It must then be returned to the conditioning environment for a minimum of 3 minutes for each minute or portion of a minute in excess of 4 minutes out of the conditioning environment or 12 hours, whichever is less, before proceeding with testing on that helmet.

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

DATA SHEET 4
IMPACT ATTENUATION- SYSTEMS CHECK

REPORT NO.: _____

DATE: _____

Paragraph S5.1 and S7.1

Anvil	Impact Velocity
Hemispherical	5.2 m/s, + 0 m/s, - 0.4m/s
Flat	6.0 m/s, + 0 m/s, - 0.4 m/s

Ambient Temperature (°C)	Relative Humidity (%)
Headform Size	Drop Assembly Weight (kg)

SYSTEMS CHECK	TRIAL DROP	DROP HEIGHT (cm)	VEL. (m/s)	PEAK g	DWELL TIME (ms)		TEST RECORD	GROUP NO.
					150 g	200 g		
PRETEST	1						A	
	2						B	
	3						C	
PRETEST AVERAGE		XXXX	XXXX		XXX	XXX	XXXXX	XXXXX
POSTTEST	1						D	
	2						E	
	3						F	
POSTTEST AVERAGE		XXXX	XXXX		XXX	XXX	XXXXX	XXXXX
DIFFERENCE BETWEEN PRETEST AND POSTTEST AVERAGES					DIFFERENCE NOT TO EXCEED 40 g			

(Continued on next page)

DATA SHEET 4 IMPACT ATTENUATION

Helmet	Condition	Helmet Type	Impact Location (+/- 45 degrees)							
		Half /Full	Forehead		Left Side		Right Side		Rear	
		Complete	Left Front		Right Rear		Right Front		Left Rear	
		Impact No.	1	2	1	2	1	2	1	2
A	Ambient	Anvil	HEMI		HEMI		FLAT		FLAT	
		Test Record No.	1	2	9	10	17	18	25	26
		PEAK g								
		ms @ 150 g								
		ms @ 200 g								
		VEL. (m/s)								
B	Low Temp.	Anvil	HEMI		HEMI		FLAT		FLAT	
		Test Record No.	3	4	11	12	19	20	27	28
		PEAK g								
		ms @ 150 g								
		ms @ 200 g								
		VEL. (m/s)								
C	High Temp.	Anvil	HEMI		HEMI		FLAT		FLAT	
		Test Record No.	5	6	13	14	21	22	29	30
		PEAK g								
		ms @ 150 g								
		ms @ 200 g								
		VEL. (m/s)								
D	Water Immersed	Anvil	HEMI		HEMI		FLAT		FLAT	
		Test Record No.	7	8	15	16	23	24	31	32
		PEAK g								
		ms @ 150 g								
		ms @ 200 g								
		VEL. (m/s)								

COMMENTS:

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

DATA SHEET 5 PENETRATION

REPORT NO.: _____ DATE: _____

Paragraph S5.2 and S7.2

WEIGHT OF STRIKER: 3 kg

POINT OF STRIKER: Radius = 0.5 mm, included angle of 60°, + 1.0°, - 0.0°, hardness minimum of 60 Rockwell "C" Scale and a cone height of not less than 3.81 cm.

HEIGHT OF FALL: 300 cm, + 0.0 cm, - 3.05 cm, measured from the tip of the striker point to the outer surface of the mounted protective headgear.

FAILURE CRITERION: When tested, the protective headgear shall be failed if the striker has made an indentation in the headform.

TEST	HELMET	PASS	FAIL	CONDITIONS
1	A			AMBIENT
2	A			AMBIENT
3	B			LOW TEMPERATURE
4	B			LOW TEMPERATURE
5	C			HIGH TEMPERATURE
6	C			HIGH TEMPERATURE
7	D			WATER IMMERSED
8	D			WATER IMMERSED

COMMENTS:

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

**DATA SHEET 6
RETENTION SYSTEM**

REPORT NO.: _____

DATE: _____

Paragraph S5.3 and S7.3

AMBIENT TEMPERATURE: _____ °C ; AMBIENT HUMIDITY: _____ %

REQUIREMENTS:

READING	REQUIREMENT
Initial	22.7 kg, + 4.54 kg, - 0 kg
Final	136 kg, + 0 kg, - 4.5 kg

ELONGATION NOT TO EXCEED 2.54 cm AFTER LOAD INCREASE

HELMET	CONDITIONS	INITIAL READING cm	FINAL READING cm	ELONGATION cm
A	AMBIENT			
B	LOW TEMPERATURE			
C	HIGH TEMPERATURE			
D	WATER IMMersed			

PERIPHERAL VISION - Paragraph S5.4 - Helmet shall provide a minimum peripheral vision of 105° to each side of the mid-sagittal plane. The brow opening shall be at least 2.54 cm above all points in the basic plane that are within the angles of peripheral vision.

	REQUIREMENTS	RESULTS
DEGREE EACH SIDE M.S. PLANE	> 105°	
BROW OPENING	> 2.54 cm	

COMMENTS:

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

**DATA SHEET 7
PROJECTIONS**

REPORT NO.: _____

DATE: _____

Paragraph S5.5

PROJECTION	REQUIREMENT
Internal rigid	None
External rigid	Operational, shall not protrude more than 5 mm

TEST RESULTS:

PROJECTION	PRESENT? (Y/N)	HEIGHT (mm)
Internal		
External		

COMMENTS:

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

**DATA SHEET 8
LABELING**

REPORT NO.: _____

DATE: _____

S5.6 *Labeling* - Each helmet shall be permanently and legibly labeled, in a manner such that the label(s) can be easily read without removing padding or any other permanent part, with the following:

Required Information	Pass	Fail
Manufacturer's name or identification		
Precise model designation		
Size		
Month and year of manufacture		
The symbol DOT... on the outer surface, in a color that contrasts with the background, in letters at least 1 cm high, centered laterally with the horizontal centerline of the symbol located a minimum of 2.9 cm and a maximum of 3.5 cm from the bottom edge of the posterior portion of the helmet		
Instructions to the purchaser as follows:	-----	-----
“Shell and liner constructed of (identify type(s) of materials).”		
“Helmet can be seriously damaged by some common substances without damage being visible to the user.”		
“Apply only the following: (Recommended cleaning agents, paints, adhesives, etc., as appropriate.”		
“Make no modifications.”		
“Fasten helmet securely.”		
“If helmet experiences a severe blow, return it to the manufacturer for inspection, or destroy it and replace it.”		

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

16. FORMS**FMVSS No. 218 MONTHLY STATUS REPORT**

Contract No.: _____

Date: _____

LAB No.	Manufacturer Brand & Model Size	Headform Size HPI	Status Received- M/DD/YY Tested- MM/DD/YY	Results
01				
02				
03				
04				
05				
06				
07				
etc.				

Number of tests scheduled for the next reporting period: _____

Number of reports scheduled for the next reporting period: _____

Description of any problems and/or delays in testing:

Description of specific actions taken to correct the problems and/or delays:

LABORATORY NOTICE OF TEST FAILURE TO OVSC

Contract Number	DTNH22-	
Fiscal Year		
Date(s) of Failure		
Report Number		
Brand & Model		
Manufacturer		
Helmet Coverage		
Size		
Date(s) of Manufacture		
Failure Reported By		
Test Failure Description		
<i>Section(s) & Requirement(s)</i>	<i>Failure(s)</i>	
Comments		
Notification to NHTSA		
COTR:		
Date:		
Signature:		

17. MEDIUM HEADFORM- EXTERIOR DIMENSIONS

BOTTOM OPENING, Z=-3.02 & LEVEL -5, Z= -2.900

θ	Bottom Opening Z = -3.02			Level -5 Z= -2.900		
	R	X	Y	R	X	Y
0	4.292	4.292	0	4.293	4.293	0
10	4.266	4.201	0.741	4.270	4.205	0.742
20	4.159	3.908	1.423	4.172	3.920	1.427
30	3.967	3.436	1.984	3.961	3.430	1.981
40	3.660	2.804	2.353	3.670	2.811	2.359
50	3.332	2.142	2.553	3.352	2.155	2.568
60	3.039	1.520	2.632	3.067	1.534	2.656
70	2.839	0.971	2.668	2.869	0.981	2.696
80	2.720	0.472	2.679	2.772	0.481	2.730
90	2.675	0	2.675	2.709	0	2.709
100	2.703	-0.469	2.662	2.724	-0.473	2.683
110	2.764	-0.945	2.597	2.794	-0.956	2.626
120	2.888	-1.444	2.501	2.917	-1.459	2.526
130	2.985	-1.919	2.287	3.040	-1.954	2.329
140	3.100	-2.375	1.993	3.175	-2.432	2.041
150	3.175	-2.750	1.588	3.232	-2.799	1.616
160	3.186	-2.994	1.090	3.246	-3.050	1.110
170	3.177	-3.129	0.552	3.237	-3.188	0.562
180	3.187	-3.187	0	3.246	-3.246	0

Units: R, X, Y, and Z- inches. To convert to centimeters, multiply each figure by 2.54.
 θ - degrees.

BASIC PLANE, Z= -2.360 & LEVEL -4, Z=-2.000

θ	Basic Plane Z = -2.360			Level-4 Z= -2.000		
	R	X	Y	R	X	Y
0	4.272	4.272	0	4.247	4.247	0
10	4.248	4.184	0.738	4.223	4.159	0.733
20	4.147	3.897	1.418	4.120	3.872	1.409
30	3.961	3.430	1.981	3.940	3.412	1.970
40	3.687	2.824	2.370	3.683	2.821	2.367
50	3.384	2.175	2.592	3.392	2.180	2.598
60	3.111	1.556	2.694	3.132	1.566	2.712
70	2.927	1.001	2.751	2.960	1.012	2.782
80	2.815	0.489	2.772	2.860	0.497	2.817
90	2.779	0	2.779	2.838	0	2.838
100	2.802	-0.487	2.759	2.861	-0.497	2.818
110	2.887	-0.987	2.713	2.958	-1.012	2.780
120	3.019	-1.510	2.615	3.098	-1.549	2.683
130	3.180	-2.044	2.436	3.260	-2.096	2.497
140	3.306	-2.533	2.125	3.405	-2.608	2.189
150	3.398	-2.943	1.699	3.516	-3.045	1.758
160	3.458	-3.250	1.183	3.585	-3.369	1.226
170	3.475	-3.422	0.603	3.612	-3.557	0.627
180	3.472	-3.472	0	3.609	-3.609	0

Units: R, X, Y, and Z- inches. To convert to centimeters, multiply each figure by 2.54.
 θ - degrees.

LEVEL -3, Z=-1.500 & LEVEL-2, Z=-1.000

θ	Level -3 Z= -1.500			Level -2 Z= -1.000		
	R	X	Y	R	X	Y
0	4.208	4.208	0	4.148	4.148	0
10	4.179	4.116	0.726	4.112	4.050	0.714
20	4.075	3.829	1.394	4.013	3.771	1.373
30	3.902	3.379	1.951	3.844	3.329	1.922
40	3.654	2.799	2.349	3.609	2.765	2.320
50	3.377	2.171	2.587	3.352	2.155	2.568
60	3.094	1.547	2.680	3.137	1.569	2.717
70	2.982	1.020	2.802	2.989	1.022	2.809
80	2.891	0.502	2.847	2.902	0.504	2.858
90	2.876	0	2.876	2.884	0	2.884
100	2.918	-0.507	2.874	2.943	-0.511	2.898
110	3.021	-1.033	2.839	3.052	-1.044	2.868
120	3.170	-1.585	2.745	3.225	-1.613	2.793
130	3.337	-2.145	2.556	3.397	-2.184	2.602
140	3.483	-2.668	2.239	3.536	-2.709	2.273
150	3.604	-3.121	1.802	3.657	-3.167	1.829
160	3.682	-3.460	1.259	3.751	-3.525	1.283
170	3.725	-3.668	0.647	3.807	-3.749	0.661
180	3.741	-3.741	0	3.822	-3.822	0

Units: R, X, Y, and Z- inches. To convert to centimeters, multiply each figure by 2.54.
 θ - degrees.

LEVEL -1, Z=-0.500 & REFERENCE PLANE, Z=0.000

θ	Level -1 Z = -0.500			Reference Plane Z = 0.0		
	R	X	Y	R	X	Y
0	4.067	4.067	0	3.971	3.971	0
10	4.033	3.972	0.700	3.935	3.875	0.683
20	3.944	3.706	1.349	3.853	3.621	1.318
30	3.777	3.271	1.889	3.701	3.205	1.851
40	3.552	2.721	2.283	3.491	2.674	2.244
50	3.323	2.136	2.546	3.279	2.108	2.512
60	3.126	1.563	2.707	3.101	1.551	2.686
70	2.987	1.022	2.807	2.979	1.019	2.799
80	2.912	0.506	2.868	2.910	0.505	2.866
90	2.893	0	2.893	2.890	0	2.890
100	2.895	-0.503	2.851	2.945	-0.511	2.900
110	3.064	-1.048	2.879	3.062	-1.047	2.877
120	3.231	-1.616	2.798	3.228	-1.614	2.796
130	3.411	-2.193	2.613	3.413	-2.194	2.615
140	3.560	-2.727	2.288	3.563	-2.729	2.290
150	3.682	-3.189	1.841	3.681	-3.188	1.841
160	3.783	-3.555	1.294	3.773	-3.546	1.290
170	3.885	-3.826	0.675	3.832	-3.774	0.665
180	3.857	-3.857	0	3.844	-3.844	0

Units: R, X, Y, and Z- inches. To convert to centimeters, multiply each figure by 2.54.
 θ - degrees.

LEVEL +1, Z=0.500 & LEVEL+2, Z=1.000

θ	Level +1 Z = 0.500			Level +2 Z= 1.000		
	R	X	Y	R	X	Y
0	3.830	3.830	0	3.665	3.665	0
10	3.801	3.743	0.660	3.613	3.558	0.627
20	3.725	3.500	1.274	3.554	3.340	1.216
30	3.587	3.106	1.794	3.436	2.976	1.718
40	3.399	2.604	2.185	3.271	2.506	2.103
50	3.205	2.060	2.455	3.102	1.994	2.376
60	3.044	1.522	2.636	2.959	1.480	2.563
70	2.927	1.001	2.751	2.854	0.976	2.682
80	2.861	0.497	2.818	2.792	0.485	2.750
90	2.855	0	2.855	2.783	0	2.783
100	2.897	-0.503	2.853	2.832	-0.492	2.789
110	3.007	-1.029	2.826	2.938	-1.005	2.761
120	3.176	-1.588	2.751	3.102	-1.551	2.686
130	3.372	-2.168	2.583	3.294	-2.117	2.523
140	3.520	-2.697	2.263	3.450	-2.643	2.218
150	3.643	-3.155	1.822	3.564	-3.087	1.782
160	3.728	-3.503	1.275	3.637	-3.418	1.244
170	3.777	-3.720	0.656	3.675	-3.619	0.638
180	3.782	-3.782	0	3.670	-3.670	0

Units: R, X, Y, and Z- inches. To convert to centimeters, multiply each figure by 2.54.
 θ - degrees.

LEVEL +3, Z=1.450 & LEVEL+4, Z=1.860

θ	Level +3 Z = 1.450			Level +4 Z= 1.860		
	R	X	Y	R	X	Y
0	3.419	3.419	0	3.061	3.061	0
10	3.382	3.331	0.587	3.035	2.989	0.527
20	3.299	3.100	1.128	2.966	2.787	1.014
30	3.197	2.769	1.599	2.872	2.487	1.436
40	3.052	2.338	1.962	2.754	2.110	1.770
50	2.911	1.871	2.230	2.642	1.698	2.024
60	2.786	1.393	2.413	2.522	1.261	2.184
70	2.700	0.924	2.537	2.477	0.847	2.328
80	2.647	0.460	2.607	2.442	0.424	2.405
90	2.636	0	2.636	2.442	0	2.442
100	2.691	-0.467	2.650	2.492	-0.433	2.454
110	2.796	-0.956	2.627	2.599	-0.889	2.442
120	2.961	-1.481	2.564	2.758	-1.379	2.389
130	3.147	-2.023	2.411	2.936	-1.887	2.249
140	3.301	-2.529	2.122	3.081	-2.360	1.980
150	3.408	-2.951	1.704	3.176	-2.751	1.588
160	3.479	-3.269	1.190	3.230	-3.035	1.105
170	3.514	-3.461	0.610	3.270	-3.220	0.568
180	3.502	-3.502	0	3.271	-3.271	0

Units: R, X, Y, and Z- inches. To convert to centimeters, multiply each figure by 2.54.
 θ - degrees.

LEVEL +5, Z=2.250 & LEVEL+6, Z=2.560

θ	Level +5 Z=2.250			Level +6 Z= 2.560		
	R	X	Y	R	X	Y
0	2.526	2.526	0	1.798	1.798	0
10	2.521	2.483	0.483	1.798	1.771	0.312
20	2.464	2.315	0.843	1.757	1.651	0.601
30	2.387	2.067	1.194	1.719	1.489	0.860
40	2.305	1.766	1.482	1.678	1.285	1.079
50	2.232	1.435	1.710	1.652	1.062	1.266
60	2.174	1.087	1.883	1.641	0.821	1.421
70	2.144	0.733	2.015	1.645	0.563	1.546
80	2.132	0.370	2.100	1.673	0.291	1.648
90	2.147	0	2.147	1.712	0	1.712
100	2.213	-0.384	2.179	1.809	-0.314	1.782
110	2.316	-0.792	2.176	1.925	-0.658	1.809
120	2.463	-1.232	2.133	2.066	-1.033	1.789
130	2.624	-1.687	2.010	2.213	-1.423	1.695
140	2.763	-2.117	1.776	2.358	-1.806	1.516
150	2.863	-2.479	1.432	2.469	-2.138	1.235
160	2.919	-2.743	0.988	2.536	-2.383	0.867
170	2.954	-2.909	0.513	2.561	-2.522	0.445
180	2.958	-2.958	0	2.556	-2.556	0

Units: R, X, Y, and Z- inches. To convert to centimeters, multiply each figure by 2.54.
 θ - degrees.

LEVEL +7, Z=2.750 & NOTES

θ	Level +7 Z=2.750			NOTES:
	R	X	Y	
0	1.081	1.081	0	<p>1. Apex is located at (-0.75, 0, 3.02) for (X, Y, Z) or (0.75, 180, 3.02) for (R, Θ, Z).</p> <p>2. Center of ear opening is located at (0.40, 2.78, - 2.36) for (X,Y,Z) or (2.80, 81.8, - 2.36) for (R, Θ,Z).</p> <p>3. Scale all dimensions by 0.8941 for small headform.</p> <p>4. Scale all dimensions by 1.069 for large headform.</p> <p>5. Headform is symmetrical about the mid-sagittal plane.</p> <p>6. Units: R, X, Y, Z – inches Θ – degrees</p> <p>7. To obtain metric equivalents in centimeters multiply each figure by 2.54.</p>
10	1.088	1.072	0.189	
20	1.055	0.991	0.361	
30	1.039	0.900	0.520	
40	1.039	0.796	0.668	
50	1.052	0.676	0.806	
60	1.068	0.534	0.925	
70	1.106	0.378	1.039	
80	1.171	0.203	1.153	
90	1.242	0	1.242	
100	1.422	-0.247	1.400	
110	1.489	-0.509	1.399	
120	1.683	-0.842	1.458	
130	1.801	-1.158	1.380	
140	1.954	-1.497	1.256	
150	2.083	-1.804	1.042	
160	2.138	-2.009	0.731	
170	2.175	-2.142	0.378	
180	2.175	-2.175	0	

Units: R, X, Y, and Z- inches. To convert to centimeters, multiply each figure by 2.54.
 θ - degrees.