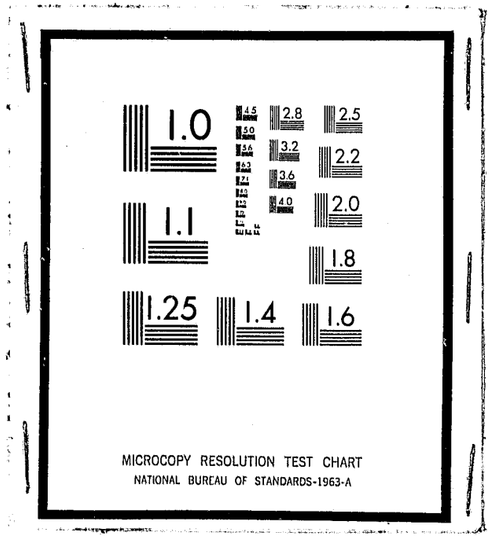
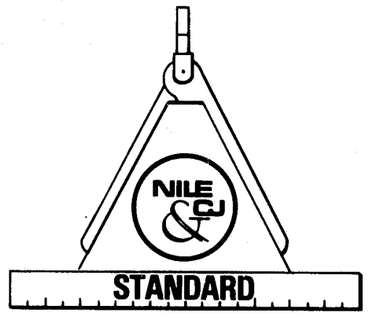


NILECJ-STD-0196.00
SEPTEMBER 1975

LAW ENFORCEMENT STANDARDS PROGRAM

BALLISTIC HELMETS



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LAW ENFORCEMENT STANDARDS PROGRAM

NILECJ STANDARD FOR BALLISTIC HELMETS

A Voluntary National Standard Promulgated by the National Institute of Law Enforcement and Criminal Justice.

SEPTEMBER 1975

U.S. DEPARTMENT OF JUSTICE
Law Enforcement Assistance Administration
National Institute of Law Enforcement and Criminal Justice

LAW ENFORCEMENT ASSISTANCE
ADMINISTRATION

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NATIONAL INSTITUTE OF LAW ENFORCEMENT
AND CRIMINAL JUSTICE

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ACKNOWLEDGMENTS

This standard was formulated by the Law Enforcement Standards Laboratory of the National Bureau of Standards under the direction of Ronald C. Dobbyn, Manager, Protective Equipment Program, and Jacob J. Diamond, Chief of LESL. The technical research was performed by Nicholas J. Calvano, project leader, and other personnel of the NBS Product Engineering Division.

NILECJ STANDARD for BALLISTIC HELMETS

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FOREWORD

Following a Congressional mandate[1] to develop new and improved techniques, systems, and equipment to strengthen law enforcement and criminal justice, the National Institute of Law Enforcement and Criminal Justice (NILECJ) has established the Law Enforcement Standards Laboratory (LESL) at the National Bureau of Standards. LESL's function is to conduct research that will assist law enforcement and criminal justice agencies in the selection and procurement of quality equipment.

In response to priorities established by NILECJ, LESL is (1) subjecting existing equipment to laboratory testing and evaluation and (2) conducting research leading to the development of several series of documents, including national voluntary equipment standards, user guidelines, state-of-the-art surveys and other reports.

This document, NILECJ-STD-0106.00, Ballistic Helmets, is a law enforcement equipment standard developed by LESL and approved and issued by NILECJ. Additional standards as well as other documents are being issued under the LESL program in the areas of protective equipment, communications equipment, security systems, weapons, emergency equipment, investigative aids, vehicles and clothing.

This equipment standard is a technical document consisting of performance and other requirements together with a description of test methods. Equipment which can meet these requirements is of superior quality and is suited to the needs of law enforcement agencies. Purchasing agents can use the test methods described in this standard to determine firsthand whether a particular equipment item meets the requirements of the standard, or they may have the tests conducted on their behalf by a qualified testing laboratory. Law enforcement personnel may also reference this standard in purchase documents and require that any equipment offered for purchase meet its requirements and that this compliance be either guaranteed by the vendor or attested to by an independent testing laboratory.

The necessarily technical nature of this NILECJ standard, and its special focus as a procurement aid, make it of limited use to those who seek general guidance concerning ballistic helmets. The NILECJ Guideline Series is designed to fill that need. We plan to issue guidelines to this as well as other law enforcement equipment as soon as possible, within the constraints of available funding and the overall NILECJ program.

The guideline documents being issued are highly readable and tutorial in nature in contrast to the standards, which are highly technical, and intended for laboratory use by technical personnel. The guidelines will provide, in non-technical language, information for purchasing agents and other interested persons concerning the capabilities of equipment currently available. They may then select equipment appropriate to the performance required by their agency. Recommendations for the development of particular guidelines should be sent to us.

NILECJ standards are subjected to continuing review. Technical comments and recommended revisions are invited from all interested parties. Suggestions should be addressed to the Program Manager for Standards, National Institute of Law Enforcement and Criminal Justice. Law Enforcement Assistance Administration, U.S. Department of Justice, Washington, D.C. 20531.

Lester D. Shubin, Manager
Standards Program
National Institute of Law
Enforcement and Criminal Justice

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[1] Section 402(b) of the Omnibus Crime Control and Safe Streets Act of 1968, as amended.

NILECJ STANDARD FOR BALLISTIC HELMETS

1. PURPOSE AND SCOPE

The purpose of this standard is to establish performance requirements and methods of test for helmets intended to protect the wearer against gunfire. Requirements for face shields are not included in this standard.

2. CLASSIFICATION

Ballistic helmets covered by this standard are classified into two types, by level of performance. Table 1 summarizes the protection they afford.

Table 1. Protection Afforded by Ballistic Helmets

Threat	Protection Afforded: Type .22 LRP—.38 Spec. Helmet	Protection Afforded: Type .357 Magnum Helmet
.22 LRHV (P)*	Yes	Yes
.38 Special lead RN*	Yes	Yes
.25 ACP	Yes	Yes
.32 ACP	Yes	Yes
12 gauge #4 lead shot	Yes	Yes
.357 Magnum*	No	Yes
.45 ACP	No	Yes
.38 Special, HV	No	Yes
9 mm Luger FMJ	No	Yes
.22 LRHV (R)	No	Yes
12 gauge 00 lead BK	No	Yes

*As specified in paragraph 5.1.

Abbreviations: ACP—automatic Colt pistol
BK—buckshot
FMJ—full metal jacketed
HV—High Velocity
LRHV—Long Rifle High Velocity
(P)—pistol
(R)—rifle
RN—round nose

2.1 Type .22 LRP—.38 Special

This helmet protects against the standard threats as defined in paragraphs 5.1.1 and 5.1.2. It also provides protection against lesser threats such as caliber .25 and .32 handgun rounds, and 12 gauge No. 4 lead shot.

2.2 Type .357 Magnum

This helmet protects against the standard threat as defined in paragraph 5.1.3. It also provides protection against lesser threats such as the .22 LR (rifle), 9 mm Luger and 12 gauge 00 lead buckshot, as well as the threats mentioned in paragraph 2.1.

3. DEFINITIONS

3.1 Angle of Incidence

The angle between the line of flight of a bullet and the perpendicular to the plane tangent to the point of impact. See figure 1.

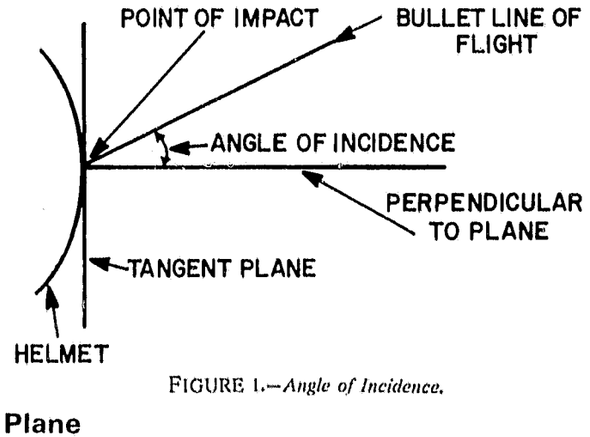


FIGURE 1.—*Angle of Incidence.*

3.2 Basic Plane

The plane through the centers of the external ear openings and the lower edges of the eye sockets. See figure 2.

3.3 Coronal Plane

The plane, perpendicular to the basic and mid-sagittal planes, which passes through the centers of the external ear openings. See figure 2.

3.4 Fair Hit

A hit that impacts the helmet at an angle of incidence no greater than 5 degrees, and is at least 50 mm (2.0 in) from a prior hit or the edge of the helmet.

3.5 Mid-Sagittal Plane

The plane, perpendicular to the basic and coronal planes, which symmetrically bisects the head. See figure 2.

3.6 Penetration

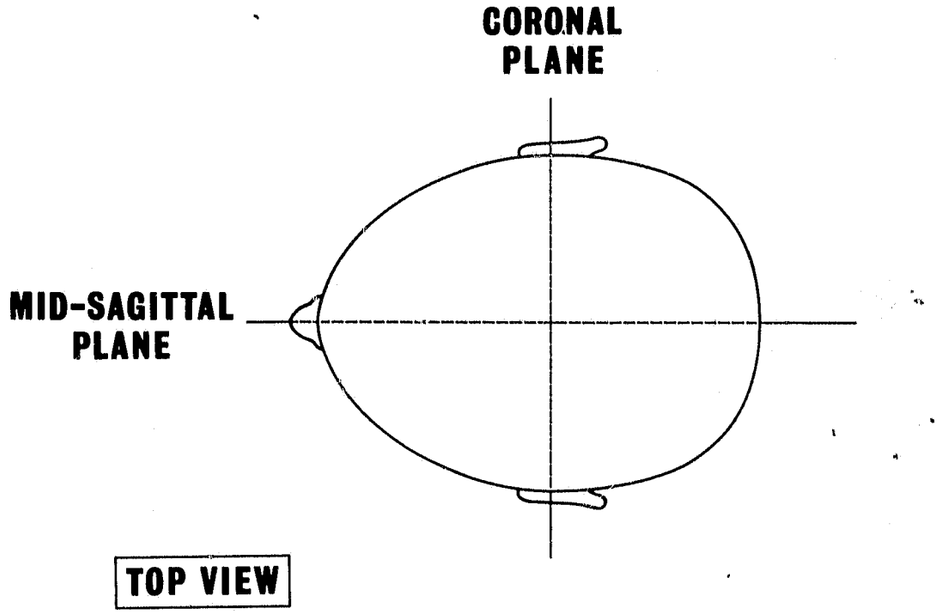
Perforation of a witness plate by any part of the test specimen or test bullet, as determined by the passage of light when the witness plate is held up to a 60-watt light bulb.

3.7 Reference Plane

The plane 60 ± 1 mm (2.36 ± 0.04 in) above and parallel to the basic plane. See figure 2.

3.8 Witness Plate

A thin sheet of aluminum whose perforation serves as a means of determining penetration.



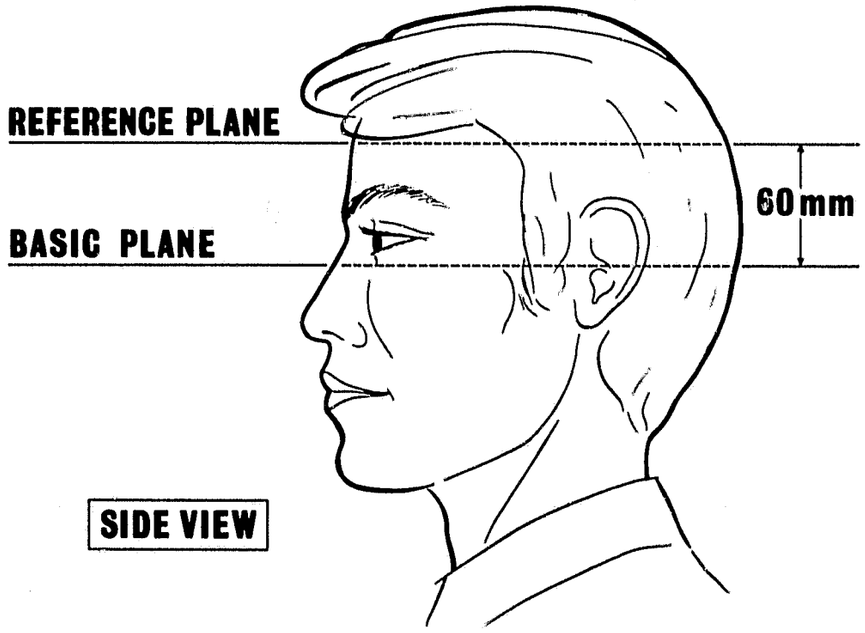


FIGURE 2.—*Head Planes.*

4. REQUIREMENTS

4.1 Sampling for Test

Three helmets, size 7 1/4 and selected at random, shall constitute a test sample.

4.2 Test Sequence

The helmets shall be examined to determine compliance with the requirements of paragraphs 4.3, 4.4, 4.5 and 4.6 and shall then be tested for compliance with the requirements of paragraphs 4.7 and 4.8, in that sequence.

4.3 Projections

The helmets shall have no rigid projections that protrude from the inside shell surface.

4.4 Openings

The helmets shall have no slits, holes, or other openings.

4.5 Workmanship

The helmets shall be free from dents, blisters, cracks, crazing, chipped or sharp corners and other evidences of inferior workmanship.

4.6 Labeling

Each helmet shall be permanently and legibly labeled so that the label can be easily read without removing padding or any other permanent part, and shall include the following information:

a) name, designation or logo of the manufacturer
b) type of helmet, according to Section 2 of this standard
c) size
d) month and year of manufacture
e) lot number

4.7 Ballistic Penetration

Two helmets shall be tested for resistance to ballistic penetration in accordance with paragraph 5.2. Penetration by any fair hit shall constitute failure.

4.8 Ballistic Impact Attenuation

One helmet shall be tested for ballistic impact attenuation in accordance with paragraph 5.3. No measured peak acceleration shall exceed 400 g_n (400 times the acceleration due to gravity).

5. TEST METHODS

5.1 Test Equipment

5.1.1 Caliber .22 Test Weapon and Ammunition

The test weapon may be a caliber .22 handgun or test barrel. The use of a handgun with a 15 to 16.5 cm (6 to 6.5 in) barrel is suggested. Test bullets shall be caliber .22 Long Rifle High Velocity lead, with nominal weights of 2.6 grams (40 grains) and with measured velocities of 328 ± 32 meters (1077 ± 105 feet) per second.

5.1.2 Caliber .38 Special Test Weapon and Ammunition

The test weapon may be a caliber .38 Special handgun or test barrel. The use of a handgun with a 15 to 16.5 cm (6 to 6.5 in) barrel is suggested. Test bullets shall be caliber .38

Special round-nose lead, with nominal weights of 10.2 grams (158 grains) and with measured velocities of 244 ± 16 meters (800 ± 52 feet) per second.

5.1.3 Caliber .357 Magnum Test Weapon and Ammunition

The test weapon may be a caliber .357 Magnum handgun or test barrel. The use of a handgun with a 15 to 16.5 cm (6 to 6.5 in) barrel is suggested. Test bullets shall be caliber .357 Magnum lead, with nominal weights of 10.2 grams (158 grains) and with measured velocities of 423 ± 30 meters (1837 ± 98 feet) per second.

5.1.4 Chronograph

The chronograph shall have a precision of one microsecond and an accuracy of two microseconds. Its triggering devices shall be of either the photoelectric or conductive screen types.

5.1.5 Penetration Test Headforms

Each penetration test headform shall be size 7 1/4 and shall have the dimensions shown in figure 3. The sagittal penetration type shall be so modified that it can rigidly hold a witness plate in the coronal plane, as shown in figure 4. Conversely, the coronal penetration type shall be able to hold a witness plate in the sagittal plane, as shown in figure 4.

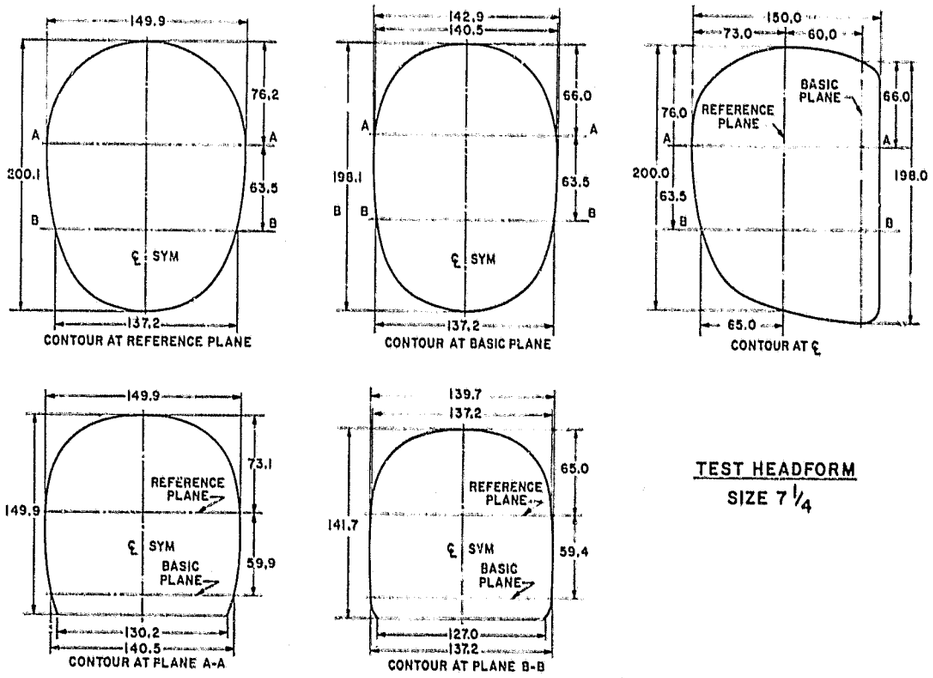


FIGURE 3.—*Test Headform. Dimensions are in millimeters.*

5.1.6 Impact Test Headform

The impact test headform shall be size 7 1/4, shall have the dimensions given in figure 3, and shall exhibit no resonance frequencies below 3000 Hz; it may be made of any suitable material, such as magnesium alloy K-1A. A test headform found to be suitable can be obtained from Cragar Industries, Inc., P. O. Box 5626, 19007 S. Reyes Avenue, Compton, California 90224.

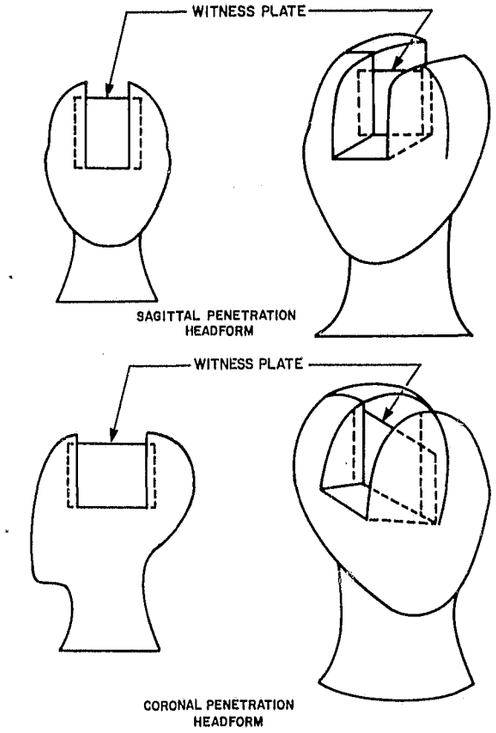


FIGURE 4.—*Ballistic Penetration Test Headforms.*

The impact headform shall be rigidly mounted on a base (see figure 5) which is free to move in the direction of motion of the test bullet. The total mass of the instrumented headform and base assembly shall be 5.0 ± 0.5 kg (11 ± 1.1 lb) and the static force, parallel to the direction of motion, required to initiate motion of the assembly shall not exceed 9 newtons (2 pounds force).

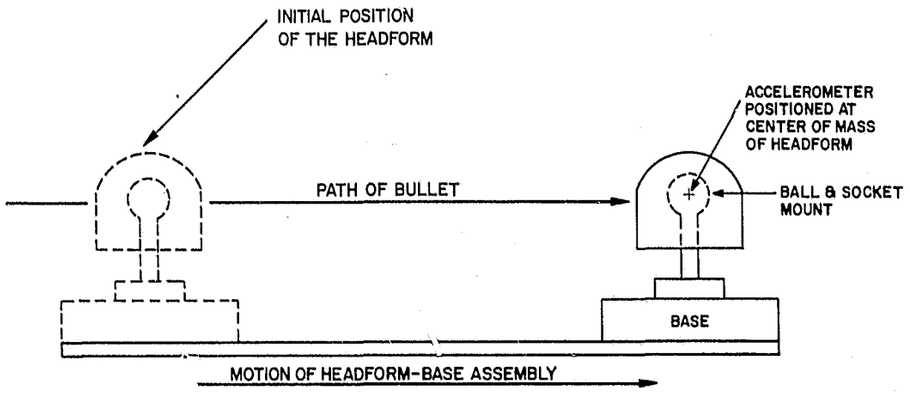


FIGURE 5.—*Ballistic Impact Test Headform—Base Assembly.*

5.1.7 Witness Plate

The witness plates shall be 0.5 mm (0.020 in) thick, and shall be made of type 2024-T3 or 2024-T4 aluminum alloy.

5.1.8 Acceleration Measurement System

The accelerometer should be able to withstand shocks up to 2000 g_n. The acceleration data channel, including all instrumentation which may alter the frequency content of the test data and all recording and analysis procedures, shall comply with SAE Recommended Practice J211b requirements for channel class 1000.

5.2 Ballistic Penetration Test

Set up the test equipment as shown in figure 6. Firmly clamp the appropriate test weapon, with the barrel horizontal, in such a manner that the alignment of the weapon is not altered when it is discharged. Use the caliber .22 test weapon and ammunition to test type .22 LRP-.38 Special helmets, and use the caliber .357 Magnum test weapon and ammunition to test type .357 Magnum helmets.

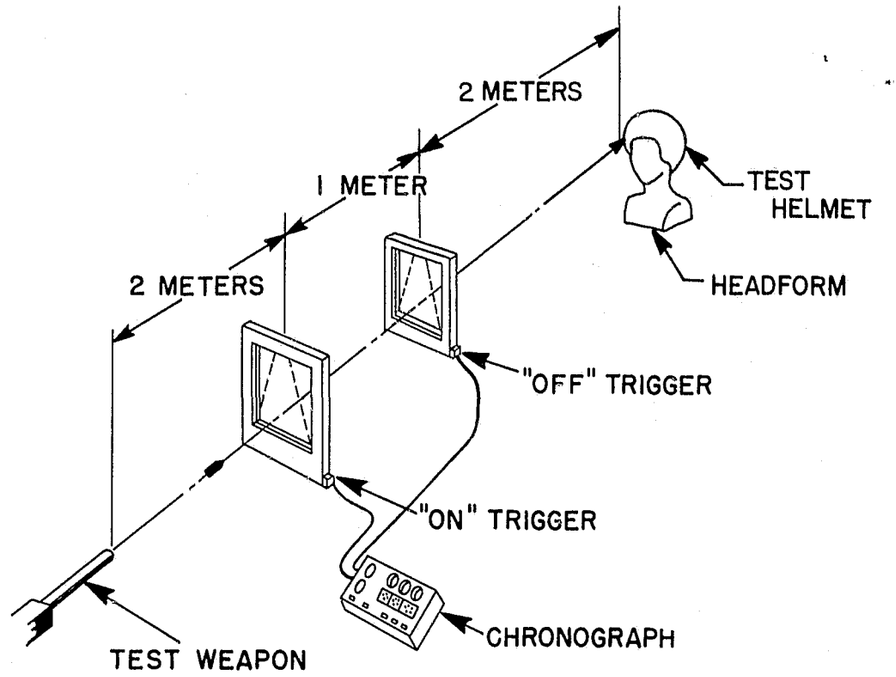


FIGURE 6.—*Test Setup.*

Position a sheet of cardboard five meters (16 feet) from the muzzle of the test weapon and fire a pre-test round through the cardboard to determine the line of flight and the point of impact of the bullet.

Place the triggering devices two and three meters (6.6 and 9.8 feet), respectively, from the muzzle of the test weapon and arrange them so that they define planes perpendicular to the line of flight of the bullet. Measure the distance between them with an accuracy of one millimeter (0.04 in).

Insert a witness plate in the sagittal penetration test headform, place the helmet under test on the headform and secure it by its chin strap or by other means which will not interfere with the test. Place the helmeted headform in back of the sheet of cardboard, with the desired point of impact touching the bullet hole made by the test round, and then remove the cardboard.

Fire one round at the front of the helmet, hitting it at a point no more than 90 mm (3.5 in) above the basic plane and no more than 50 mm (2.0 in) from the mid-sagittal plane.

Record the time of flight of the bullet between the two triggering screens, as determined by the chronograph, and calculate the bullet velocity. Then fire a round at the back of the helmet, impacting it within the area diametrically opposite the front impact area. Examine the helmet and witness plate to determine whether penetration occurred when a bullet traveling at an acceptable speed made a fair hit within the required area.

If no penetration occurred, place the helmet on the coronal penetration test headform and shoot it once on each side, at a point no more than 50 mm (2.0 in) above the basic plane and no more than 75 mm (3.0 in) from the coronal plane.

If no penetration occurs, test a second helmet, which has been preconditioned by immersion for two to four hours in water at 25 ± 5°C (77 ± 9°F).

5.3 Ballistic Impact Attenuation Test

Set up the test equipment as shown in figure 6 and locate the line of fire and point of impact of the bullet as described in paragraph 5.2. Use the caliber .38 Special test weapon and ammunition to test type .22 LRP-.38 Special helmets, and use the caliber .357 Magnum test weapon and ammunition to test type .357 Magnum helmets.

Mount the accelerometer at the center of mass of the impact test headform in such a manner that it can be easily repositioned for all impacts; a universal ball-and-socket mount has been found to be suitable. Position the helmet squarely on the headform and secure it by its chin strap or other means which will not interfere with the test. Position the instrumented test headform-base assembly in the line of fire so that the sensitive axis of the accelerometer and the line of fire are colinear within 5 degrees.

Allow all electronic equipment to warm up for thirty minutes or until stability is achieved, whichever time is greater, prior to testing, and perform the tests at an ambient temperature of 20-28°C (68-82°F) and a relative humidity of 30 to 70 percent.

Shoot four test rounds at the helmet, one at each of the four sites as described in paragraph 5.2, and measure the velocity of each fair hit and the headform acceleration which it produces.

APPENDIX A—REFERENCES

1. SAE Recommended Practice J211b, Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, N.Y.
2. NILECJ-STD-0104.00, "Riot Helmets," Stock Number 2700-00286, Price 65 cents, U.S. Government Printing Office, Washington, D.C. 20402, (October 1974).
3. NILECJ-STD-0105.00, "Crash Helmets," (in press).

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