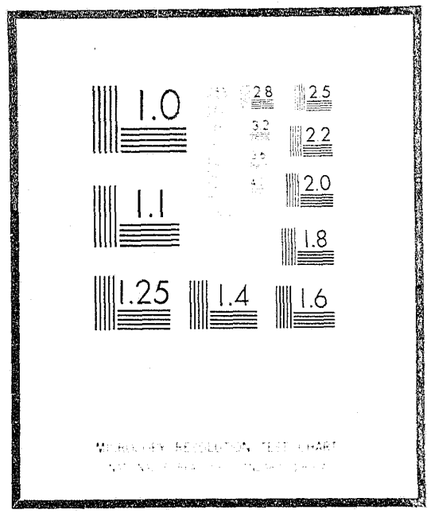
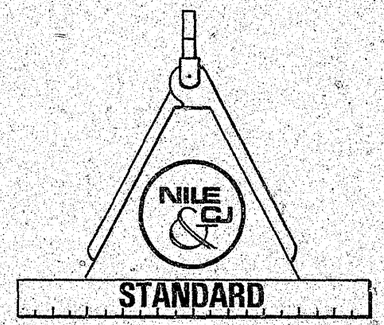


NILECJ-STD-0104.00
OCTOBER 1974

LAW ENFORCEMENT STANDARDS PROGRAM

RIOT HELMETS



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LAW ENFORCEMENT STANDARDS PROGRAM

NILECJ STANDARD FOR RIOT HELMETS

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

OCTOBER 1974

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NILECJ STANDARD FOR RIOT HELMETS

CONTENTS

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-0104.00, Riot Helmets, is a law enforcement equipment standard developed by LESL and approved and issued by NILECJ. Additional standards as well as other documents will be 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 riot 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 to be 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.

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

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

NILECJ STANDARD FOR RIOT HELMETS

1. PURPOSE

The purpose of this standard is to establish performance requirements and methods of test for helmets to be worn by law enforcement officers during civil disturbances, riots or other situations that pose a threat of injury from blows to the head.

2. SCOPE AND CLASSIFICATION

Riot helmets covered by this standard are of one class. It should be noted that they are not generally designed to offer protection against gunfire. Requirements for face shields are not included in this standard.

3. DEFINITIONS

3.1 Basic Plane

The plane through the centers of the external ear openings and the lower edges of the eye sockets (see figure 1).

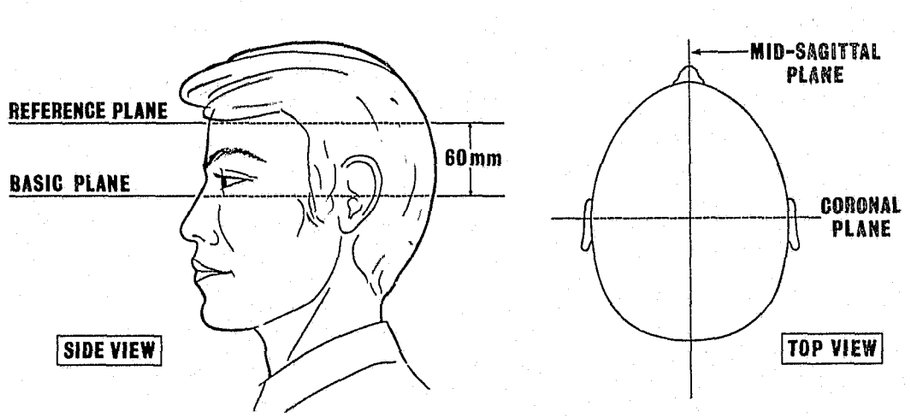

FIGURE 1. *Head Planes.*

3.2 Coronal Plane

The plane, perpendicular to the basic and mid-sagittal planes, which passes through the centers of the external ear openings (see figure 1).

3.3 Edging

The edge, rim, or rim trim around a helmet.

3.4 Headform

A test device which conforms to the configuration of the human head above the basic plane.

3.5 Mid-Sagittal Plane

The plane, perpendicular to the basic and coronal planes, which symmetrically bisects the head (see figure 1).

3.6 Reference Plane

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

3.7 Retention System

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

4. REQUIREMENTS

4.1 Sampling for Test

Four riot helments, size 7¼ and selected at random, shall constitute a test sample.

4.2 User Information

The information supplied to the user with each helmet shall include the following:

a) Recommended cleaning agents, paints, adhesives, etc., which can be applied to the helmet without damaging the shell and impairing its function.

b) A warning that a helmet subjected to a severe blow may no longer protect the wearer.

4.3 Test Sequence

The helmets shall be examined to determine compliance with the requirements of paragraphs 4.8, 4.9 and 4.10, and shall then be tested for compliance with the requirements of paragraphs 4.4, 4.5, 4.6 and 4.7, in that sequence.

4.4 Peripheral Vision

The helmets shall provide peripheral visual clearance of at least 120 degrees to each side of the mid-sagittal plane when measured as described in paragraph 5.1.

4.5 Impact Attenuation

Each helmet shall be subjected to the impact attenuation test described in paragraph 5.2. No measured peak acceleration shall exceed 400 times the acceleration due to gravity (400 g_n), no acceleration in excess of 200 g_n shall exceed three milliseconds in duration, and no acceleration in excess of 150 g_n shall exceed five milliseconds in duration.

4.6 Penetration Resistance

Each helmet shall be tested for penetration resistance in accordance with paragraph 5.3 without any demonstrable electrical contact being made between the penetration test striker and the headform.

4.7 Retention System

Each helmet shall be tested for retention system static strength in accordance with paragraph 5.4 without any break occurring and without any resulting slip or stretch of more than 25 mm (1.0 in).

4.8 Projections

The helmets shall have no incompressible projections that protrude more than 2.5 mm (0.10 in) inside the shell, or more than 5 mm (0.20 in) outside the shell.

4.9 Openings

The helmets shall have no slits, holes or other openings above the reference plane.

4.10 Labeling

Each helmet shall be permanently and legibly labeled in a manner such that the label

can be easily read without removing padding or any other permanent part, and shall include the following information:

a) name or designation of manufacturer.
b) model designation.
c) size.
d) month and year of manufacture.
3) lot number.

5. TEST METHODS

5.1 Peripheral Vision Test

5.1.1 Test Headform

The test headform shall be size 7¼ (see figure 4) and shall have two slots which define a 120-degree angle lying in the basic plane, with the apex at the point of intersection of the mid-sagittal and basic planes and the front surface of the headform, as shown in figure 2.

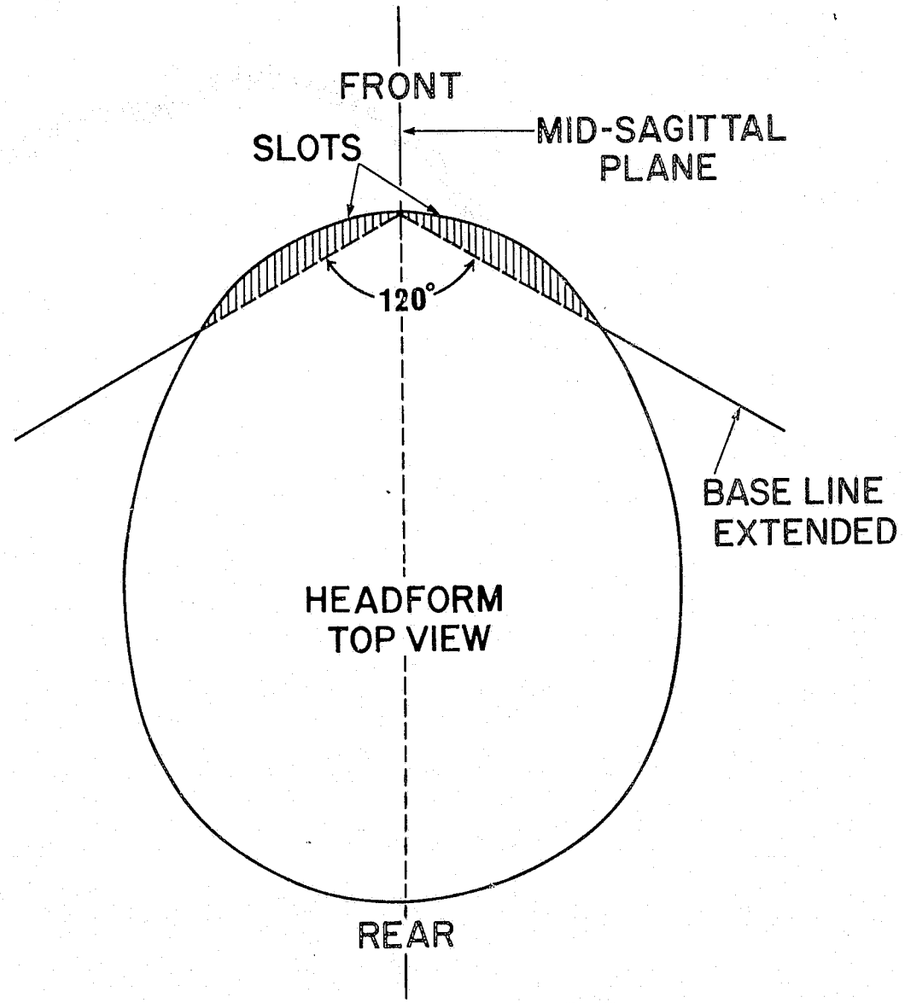

FIGURE 2. *Peripheral Vision Test Headform.*

5.1.2 Test Procedure

Place the helmet squarely on the headform so that the mid-sagittal plane of the helmet coincides with the mid-sagittal plane of the headform. Using a straightedge placed along the base of the slot, determine whether the edging of the helmet protrudes forward of the extended line defined by the base of each slot.

5.2 Impact Attenuation Test

Four specimen helmets, each subjected to a different environmental conditioning, as described in paragraph 5.2.2, are subjected to this test. A schematic diagram of the impact attenuation test set-up is shown in figure 3.

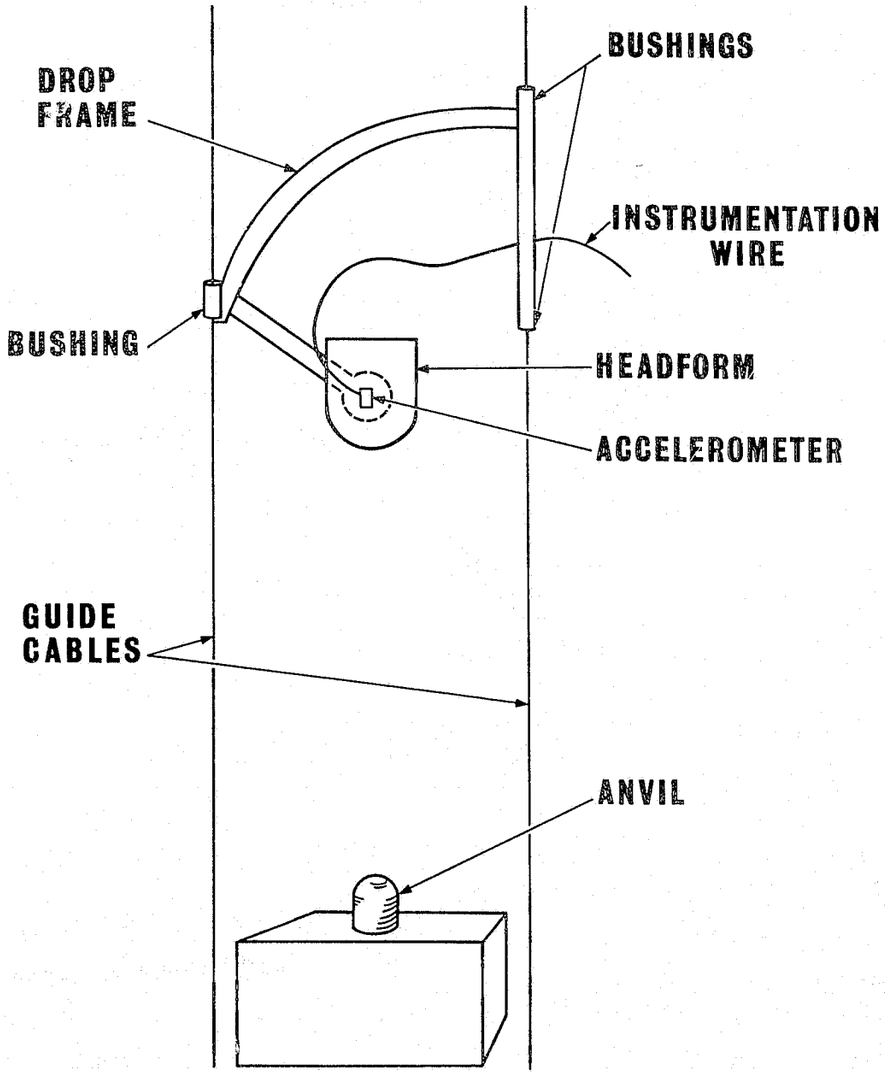

FIGURE 3. *Impact Attenuation Test Setup.*

5.2.1 Test Equipment

5.2.1.1 Test Headform

The test headform shall be size 7¼ and shall exhibit no resonance frequencies below 3000 Hz; it may be made of any suitable material, such as magnesium alloy K-1A. Dimensions are given in figure 4.

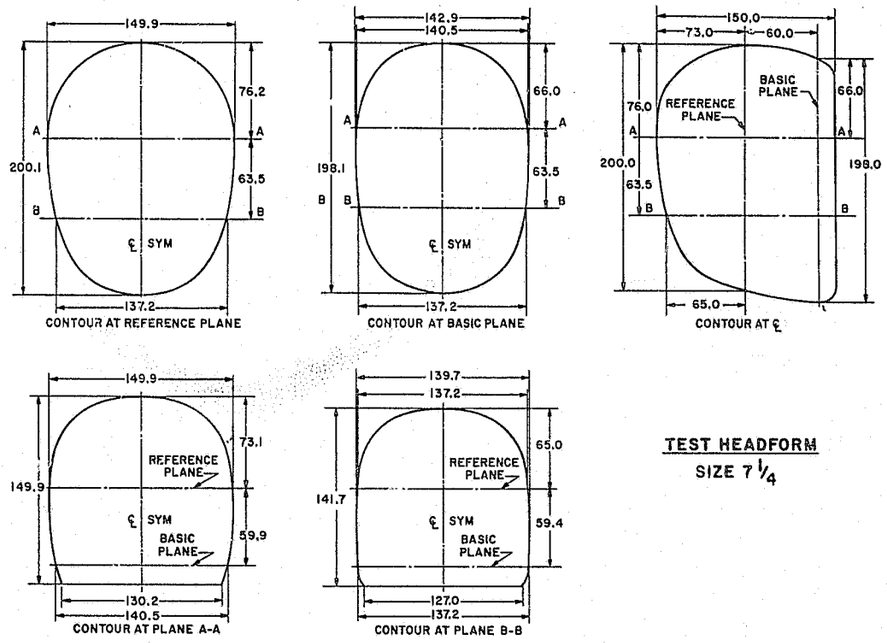

Figure 4. *Test Headform. Dimensions are in Millimeters.*

5.2.1.2 Drop Assembly

The drop assembly consists of the test headform, the accelerometer, and the supporting crossarm assembly and shall have a total mass of 5 kg (11 lb) minimum and 6 kg (13.2 lb) maximum. The center of mass of the assembly shall lie within a cone of 10 degrees included angle about the vertical, with apex at the point of impact.

5.2.1.3 Test Anvil

The test anvil shall be steel and have a hemispherical striking surface with a 48 mm (1.9 in) radius of curvature. The anvil shall be firmly mounted on a steel plate 250 × 250 × 25 mm (10 × 10 × 1 in) minimum, backed with a solid mass of at least 140 kg (309 lb).

5.2.1.4 Acceleration Measurement System

An accelerometer is used to measure the acceleration imparted to the helmeted headform upon striking the anvil and 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. The time duration of acceleration shall be measured to within ±0.1 millisecond.

5.2.1.5 Reference Anvil

The reference anvil is substituted for the test anvil to check the acceleration measurement system. When the bare headform is dropped from an appropriate height [0.5 to 1.2 meters (1.6 to 3.9 feet)], it shall produce a peak acceleration of 400 g_n and accelerations above 200 g_n of at least one millisecond duration. The reference anvil may be of any material which will reproducibly yield these results with the required precision (5.2.1.4).

A reference anvil found to be suitable is a 1-inch Open Blue Modular Elastomer Programmer, available from MTS Systems Corp., P. O. Box 24012, Minneapolis, Minn. 55424.

5.2.1.6 Conditioning Chambers

The low temperature box shall be a controlled, mechanically cooled instrument capable of providing an ambient temperature of -10 ± 2°C (14 ± 3°F) and of holding this temperature for at least 24 hours.

The high temperature box shall be a circulating air oven capable of providing an ambient temperature of 50 ± 2°C (122 ± 3°F) and of holding this temperature for at least 24 hours.

5.2.2 Conditioning for Testing

5.2.2.1 Room Temperature

Condition one helmet at a temperature 20–28°C (67–82°F) for at least 4 hours.

5.2.2.2 Low Temperature

Condition a second helmet by exposing it in a controlled environmental temperature apparatus to a temperature of -10 ± 2°C (14 ± 3°F) for not less than 4 hours nor more than 24 hours.

5.2.2.3 High Temperature

Condition a third helmet by exposing it in a circulating air oven to a temperature of 50 ± 2°C (122 ± 3°F) for not less than 4 hours nor more than 24 hours.

5.2.2.4 Water

Condition a fourth helmet by immersing it in water at a temperature of 25 ± 5°C (77 ± 9°F) for not less than 4 hours nor more than 24 hours.

Begin testing immediately after a helmet is removed from the conditioning environment. The maximum time the helmet may be out of the conditioning environment shall not exceed 5 minutes. After 5 minutes of testing return the helmet to the conditioning environment for at least 15 minutes if testing is to be resumed immediately; otherwise, condition again for at least 4 hours.

5.2.3 Test Procedure

Mount the accelerometer at the center of mass of the drop assembly with the sensitive axis aligned to within 5 degrees of the true vertical when the headform is in the impact position.

Prior to testing, allow all electronic equipment to warm up for 30 minutes or until stability is achieved, whichever time is greater. Throughout calibration and testing, the ambient temperature should be 20–28°C (68–82°F) and the relative humidity 30 to 70 percent.

Check all instrumentation before and after each continuous sequence of tests by impacting the bare instrumented headform on the reference anvil. Record a minimum of three such impacts before and after a test sequence and make them part of the test record. Should the acceleration-time history not meet the required tolerance (5.2.1.4) prior to testing, adjust the equipment as necessary. Should the post-test average differ from the pre-test average by more than 40 g_n, discard the entire test series.

Position the helmet squarely on the headform and secure it to the headform-crossarm assembly by its chin strap or other means which will not interfere with the test, so as to maintain this position during guided fall.

Adjust the vertical drop height, defined as the minimum distance between the anvil and the outer surface of the bare test headform, to provide a calculated impact energy of 108 joules (80 ft lb) + 1 percent − 0. The mass of the test helmet is not included in calculating the impact energy.

Impact each helmet once at each of four sites: front, side, back and top.

Impact the front of each helmet in the area bounded by the reference plane, the plane parallel to and 50 mm (2.0 in) above the reference plane, and the planes parallel to and 50 mm (2.0 in) to either side of the mid-sagittal plane.

Impact the side of each helmet in the area bounded by the reference plane, the plane parallel to and 50 mm (2.0 in) above the reference plane, and the planes parallel to and 50 mm (2.0 in) to either side of the coronal plane.

Impact the back of each helmet in the area bounded by the reference plane, the plane parallel to and 50 mm (2.0 in) above the reference plane, and the planes parallel to and 50 mm (2.0 in) to either side of the mid-sagittal plane.

Impact the top of each helmet at a point within 50 mm (2.0 in) of the intersection of the mid-sagittal plane, the coronal plane, and the outer surface of the helmet.

Record the acceleration-time history of each impact and continue this procedure until each of the four conditioned helmets has been tested.

5.3 Penetration Resistance Test

The same four test helmets used in the impact attenuation test are subjected to this test. A diagram of the penetration resistance test set-up is shown in figure 5.

5.3.1 Test Equipment

5.3.1.1 Test Headform

The test headform shall be size 7¼ and, above the reference plane, shall have an electrically conductive surface which is electrically connected to the contact indicator (5.3.1.3).

5.3.1.2 Penetration Striker

The penetration striker shall have a mass of 3.0 kg + 45 g − 0.0 g (6.6 lb + 0.1 lb − 0.0 lb). The point of the striker shall be a cone with an included angle of 60 ± 0.5 degrees, a height of 38 mm (1.5 in), and a tip radius of 0.5 ± 0.1 mm (0.020 ± 0.004 in). The hardness of the striking tip shall be Rockwell scale–C 60. The penetration striker shall be electrically connected to the contact indicator (5.3.1.3).

5.3.1.3 Contact Indicator

The contact indicator shall indicate when electrical contact of 1 millisecond duration or longer has been made between the penetration striker and the conductive surface of the test headform.

5.3.2 Conditioning for Testing

Condition each helmet in the same environment to which it was subjected in the impact attenuation test, as described in paragraph 5.2.2.

5.3.3 Test Procedure

Place the conditioned, complete helmet on the rigidly mounted test headform and secure it by its chin strap or by other means which will not interfere with the test. Adjust the helmet in the same manner as a person would adjust it to his head. Drop the penetration striker in guided fall onto the outer surface of the helmet anywhere above the reference plane and at least 75 mm (3.0 in) from the center of a previous impact site or penetration site. Drop the striker from a height of 3.00 + 0.01 − 0 meters (118.1 + 0.4 − 0 inches), as measured from the striker point to the point of the impact on the outer surface of the helmet. Apply a minimum of two penetration blows to each of the four helmets.

5.4 Retention System Test

The same four test helmets used in the impact attentuation test are subjected to this test. A diagram of the retention system test set-up is shown in figure 6.

5.4.1 Test Headform

The test headform shall be size 7¼ and capable of supporting the helmet when a load of 1780 newtons (400 pounds force) is applied to the retention system.

5.4.2 Conditioning for Testing

Again condition each helmet in the same environment to which it was subjected in the impact attenuation test, as described in paragraph 5.2.2.

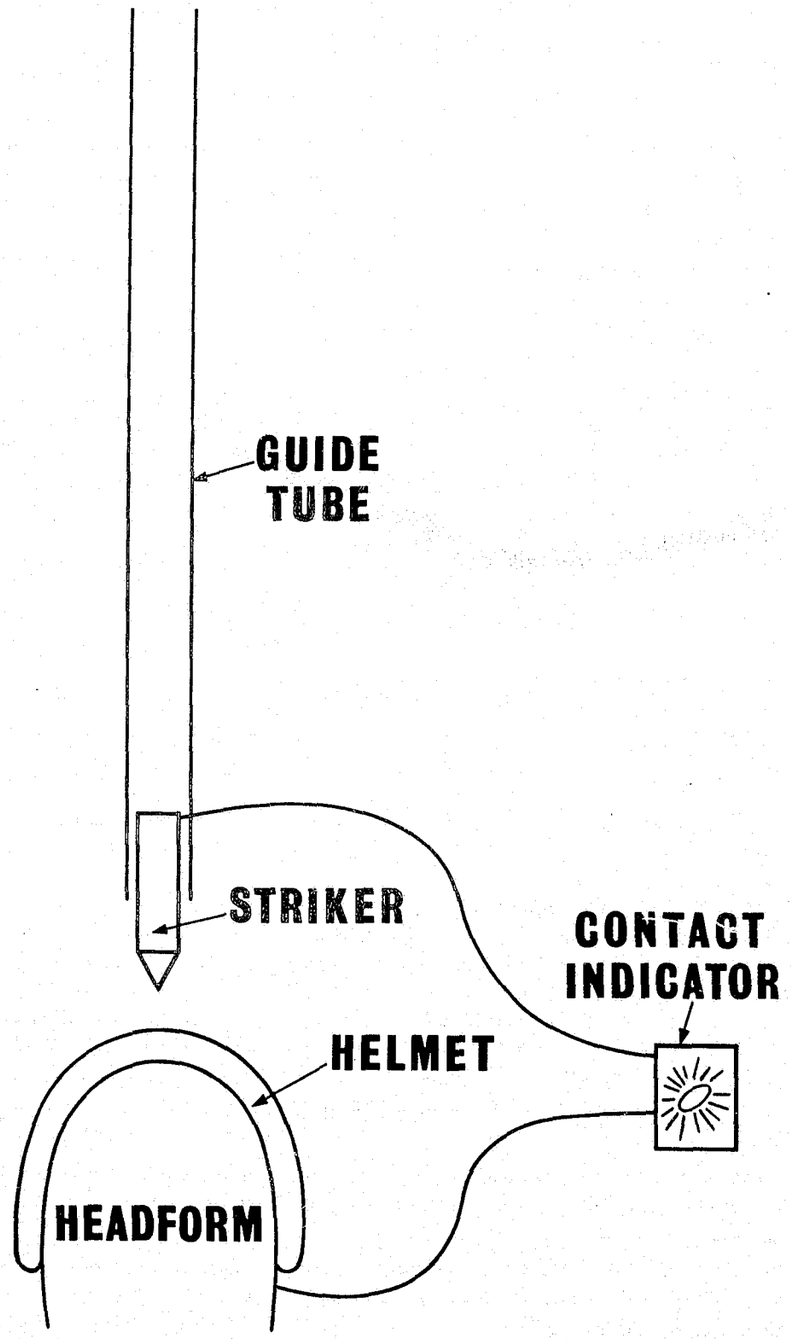

FIGURE 5. *Penetration Resistance Test Setup.*

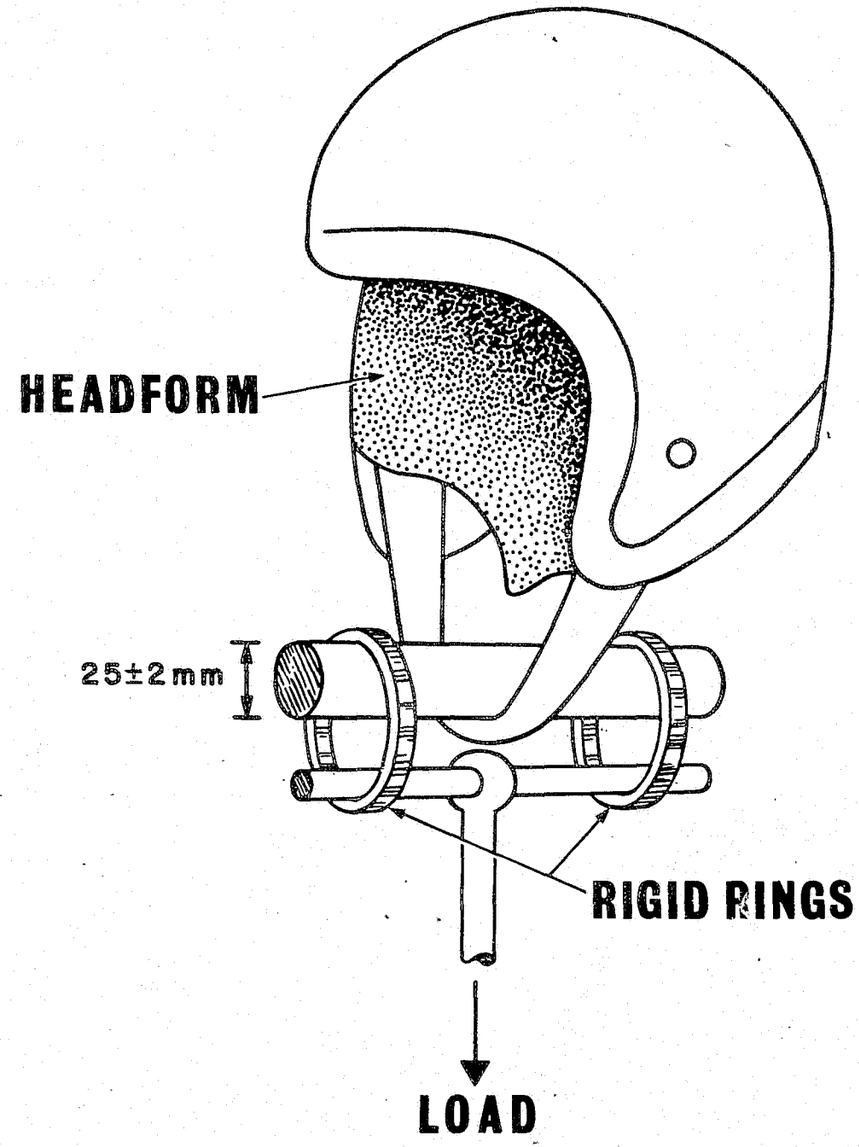

FIGURE 6. *Retention System Test Setup.*

5.4.3 Test Procedure

Place the conditioned, complete helmet on the rigidly mounted test headform and fasten the chin strap to the loading device, as shown in Figure 6. Adjust the helmet on the headform so that the points of attachment of the chin strap to the helmet will be subjected to the same test as the chin strap. Support the helmet so that it will not move during the application of the test loads.

Apply the test loads perpendicular to the basic plane of the headform and symmetrically with respect to the helmet retention system.

Statically load the retention system with 225 newtons (50 pounds force) for at least 30 seconds and then measure the maximum distance between the chin strap and the apex of the helmet. Do not remove the load.

Apply an additional 1230 newtons (276 pounds force) to the retention system for at least 3 minutes and again measure the maximum distance between the chin strap and the apex of the helmet.

Record any break in the retention system. Record any slip or stretch as the difference between the two distance measurements. Continue this test until each of the four conditioned helmets has been tested.

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2. Standard for Protective Headgear (1970), Snell Memorial Foundation, San Francisco, California.
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