



## Standard Specification for Protective Headgear Used in Martial Arts<sup>1</sup>

This standard is issued under the fixed designation F 2397; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification covers performance requirements for head protection used for training and competition in martial arts such as karate, wushu, and taekwondo, where normal contact between participants may be repeated, but is limited to a level that is not intended to produce injury. These activities typically take place in indoor or outdoor environments where the temperature is moderate. This specification recognizes the desirability of a lightweight and streamlined construction, and ventilation; however it is a performance specification, and is not intended to restrict design.

1.2 All testing and requirements of this specification shall be in accordance with Test Methods F 1446, except where noted in this specification.

1.3 Partial utilization of this standard is prohibited. Any statement of compliance with this specification shall be a certification that the product meets all of the requirements of the specification in its entirety. A product that fails to meet any one of the requirements of this specification is considered to have failed the specification, and shall not be distributed or sold with any indication that it meets parts of the specification.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 *ASTM Standards:*<sup>2</sup>

F 1446 Test Methods for Equipment and Procedures Used in Evaluating the Performance Characteristics of Protective Headgear

### 3. Terminology

3.1 See Test Methods F 1446.

### 4. Significance and Use

The purpose of this specification is to provide reliable and repeatable test methods for the evaluation of protective headgear for martial arts training and competition. Injuries resulting from accidentally hard hand-to-head impacts, foot-to-head impacts, and head-to-ground impacts may be decreased in severity and, in some cases, prevented. No headgear can protect against all impacts, foreseeable or not. Forces resulting from strikes to the head due to kicks, punches, and falls are not well understood. The mechanism of possible injury is not addressed in this specification.

### 5. Certification

5.1 See Test Methods F 1446.

### 6. Apparatus

6.1 *Test Headforms*—Headforms to be used for the stability and falling impact tests in this specification are as defined in Test Methods F 1446. The appropriate size headform shall be selected for the headgear to be tested. For the striking impact tests in this specification, it is acceptable to use the appropriate size Hybrid III head- and neck-forms.

6.2 *Stability Test Instruments and Equipment*—Stability test instruments and equipment shall be in accordance with the requirements of the roll-off test described in Test Methods F 1446.

6.3 *Falling Impact Test Instruments and Equipment*—Impact test instruments and equipment for falling impact shall be in accordance with the requirements of Test Methods F 1446, using the flat anvil described in Test Methods F 1446.

6.4 *Striking Impact Instruments and Equipment*—All tests for striking impact shall be performed with a Hybrid III headform and neck. A tri-axial accelerometer capable of measuring impact of at least 1000-G and frequencies greater than 3 kHz, mounted at the center of mass of the headform, shall be used to measure the resultant acceleration of the headform. The headform and neck are to be rigidly connected at the neck to a 25-kg steel mass, and suspended head-down on a flexible joint. The striker shall be an aluminum tube with a length of  $500 \pm 5$  mm from its pivot point to the strike point, extend an additional  $50 \pm 5$  mm beyond the strike point, and have an external diameter of  $80 \pm 5$  mm. The mass of the tube shall be  $4.5 \pm 0.2$  kg, uniformly distributed along its length.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

The striker shall be loaded with a spring or a falling mass, such that when the striker is rotated back and released, it rotates forward toward the headform and strikes it at the designated points. No force is to be applied to the striker by the spring or falling mass once the striker rotates forward beyond the initial impact point, however, the striker must be free to rotate forward after impact. Rotating the striker further backwards before releasing it can increase the striking speed. The terminal speed impact shall be measured within 100 mm of the point of free rotation. A schematic diagram of a typical striking impact tester is shown in Fig. 1.

### 7. Samples for Testing

7.1 Conditions and attachments in accordance with Test Methods F 1446.

7.2 *Number of Samples*—A test normally requires seven samples of each size. All testing may be done on two size groups only if the material, material thickness, and construction of all the sizes are the same, that is, differing in coverage area only. If only two size groups are tested, the sizes must represent the largest and smallest sizes that will fit the appropriate headform. If the material, material thickness, or construction is different between each size, then all sizes must be tested.

### 8. Calibration and Standardization

8.1 See Test Methods F 1446.

### 9. Conditioning Environments

9.1 See Test Methods F 1446. Only the ambient, high temperature, and water immersion environments shall be used.

### 10. Test Schedule

10.1 One sample from each size group to be tested will be inspected according to the schedule listed in Test Methods F 1446.

10.2 Two headgear will be assigned to the ambient conditioning environment. Two headgear will be assigned to each of the other two conditioning environments.

10.3 Testing will be performed in the following order:

10.3.1 Retention test

10.3.2 Low-energy falling impact test.

10.3.3 High-energy falling impact test.

10.3.4 Low-energy striking impact test.

10.3.5 High-energy striking impact test.

10.4 Testing must be complete 30 min after initial removal from the conditioning environment. Once testing has begun on a sample, all tests on that sample must be completed within 3 min. For each minute, or fraction thereof, this time limit is exceeded, the sample must be returned to the conditioning environment for an additional 5 min.

### 11. Test Methods

11.1 *Reference Marking*:

11.1.1 Place the headgear on the appropriate headform in accordance with Test Methods F 1446. Pre-load with a ballast of 5 kg.

11.1.2 Draw lines A-B-C-D-E on the headgear as shown in Fig. 2. This represents the test line for impact in the frontal, temporal, and occipital directions. Lines A-B-C and D-E are parallel to the reference and basic planes. Line B-D is co-planar with the coronal plane. The center of impact may be selected to be anywhere on or between the test lines.<sup>3,4</sup>

11.2 *Configuration*:

11.2.1 In general, the headgear shall be constructed to reduce the acceleration of the wearer's head and to remain on the wearer's head during and after impact. The headgear shall also include the following features.

11.2.2 *Openings*—The headgear shall be designed so that the ears have a connection to the environment to enable the wearer to hear, as well as to prevent air pressure damage caused by blows to the ear. There shall also be an alternate air path for relieving pressure to the ears in case a blow to the ear seals all of the connections. This alternate air path shall be constructed such that a rigid 6-mm diameter rod can pass unobstructed from each ear to the environment.

11.2.3 *External Surface*—The headgear must be cushioned externally to prevent injury to the striking implement, presumably a foot, hand, or another part of the body. The external surfaces of the headgear, including any exposed hard buckles or fasteners, shall be cushioned with the equivalent of at least 6 mm of a material with a maximum durometer hardness of 40 on the Shore A scale.

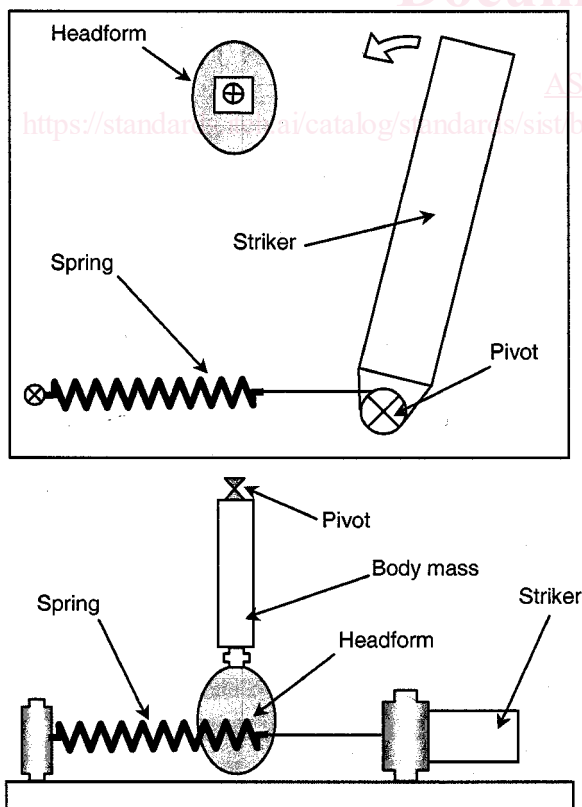


FIG. 1 Striking Impact Test.

<sup>3</sup> The Hybrid III 50<sup>th</sup> percentile male head corresponds to ASTM headform size J.