

**STANDARD LINEAR IMPACTOR TEST METHOD AND  
EQUIPMENT USED IN EVALUATING THE  
PERFORMANCE CHARACTERISTICS OF  
PROTECTIVE HEADGEAR AND  
FACE GUARDS**

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Prepared By



**NATIONAL OPERATING COMMITTEE  
ON STANDARDS FOR ATHLETIC EQUIPMENT**

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## 1. Scope

- 1.1 This standard test method describes laboratory equipment and basic requirements pertinent to linear impactor testing of protective headgear with face guards. The concept of the linear impactor is to deliver an impact to a helmeted, instrumented, headform on a Hybrid III neck and free to move post impact. This test method has been designed to more closely emulate on field impacts believed to be responsible for MTBI. It is believed that compliance with this test method will reduce the likelihood of MTBI. Deviations, additions or both, to this test method will be specified, as required, in individual standard performance specifications.
- 1.2 ***All testing and requirements of this standard specification must be in accordance with NOCSAE DOC.001 where appropriate.***
- 1.3 This standard test method is limited to use with products associated with specific NOCSAE standards.
- 1.4 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices plus determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

- 2.1. STANDARD DROP TEST METHOD AND EQUIPMENT USED IN EVALUATING THE PERFORMANCE CHARACTERISTICS OF PROTECTIVE HEADGEAR, NOCSAE DOC.001

## 3. Specific Terminology

- 3.1. See Section 3, NOCSAE DOC.001.
- 3.2. Descriptions of terms specific to this standard
  - 3.2.1. Critical sizes are defined as follows:
    - 3.2.1.1. The helmet's "Stetson" size that corresponds to the correct headform's "Stetson" size.
    - 3.2.1.2. The thinnest padding configuration for a particular helmet shell on the smallest headform designated for the selling size range for that particular shell.
    - 3.2.1.3. High Temperature: Expose product to conditioned temperature of  $100^{\circ}\text{F} \pm 3^{\circ}\text{F}$  ( $39^{\circ} \pm 1^{\circ}\text{C}$ ) for at least four hours and a maximum of twenty-four (24) hours.
    - 3.2.1.4. MTBI-Mild Traumatic Brain Injury. For purposes of this standard MTBI is the near threshold brain injury level that typically produces post concussion signs and symptoms without anatomical change.

- 3.2.1.5. Linear Impactor. A device that is capable of delivering an impact to the target by moving along a straight line towards the target. The impactor head (moving section that after acceleration is allowed to free travel to the target in a guided fashion) shall have a mass of 13.3 kg  $\pm$ 3%, and have a convex face conforming to the radius in fig x. The face shall be padded with a polyurethane foam having a density of 13 lbs. pcf and xxxxx mechanical properties. The impactor shall be capable of delivering impacts at velocities from 6m/s to 12m/s.

#### 4. Significance and Use

- 4.1. The purpose of this test method is to provide reliable and repeatable measurements for the evaluation of various types of protective headgear. This test method is based on pass/fail criteria only for SI and within specified tolerances for other measures.
- 4.2. A passing headgear is able to withstand the impact at an acceptable SI and meets all other requirements of the Performance Specifications when tested in accordance with this test method.
- 4.3. This test method must be used in conjunction with the specific individual standard performance specifications relative to a specific activity.

#### 5. Summary of Test Method

- 5.1. Headgear: A headgear is positioned on a headform that is mounted onto a hybrid III neck assembly which is rigidly mounted to a linear bearing table to achieve a somewhat realistic post impact situation. The linear impactor head is propelled at the headgear such that the impact energy (Joules) is within 3% of the specified level. At impact, the instantaneous resultant acceleration is measured by a triaxial accelerometer and the Severity Index calculated.

#### 6. Certification

- 1.1 NOCSAE publishes standards but does not conduct surveillance to assure compliance to standards. It is the sole responsibility of firms that manufacture or recertify protective products to certify that all requirements of these standards are met, including on going statistically relevant QC protocols. Firms utilizing the NOCSAE logo to originally (prior to the first time such product/model is offered for sale) certify products, must submit documentation in the form of a test report from an independent A2LA accredited ISO 17025 certified laboratory, with the appropriate scope. (Other independent forms of certification to ISO 17025 may be acceptable in place of A2LA accreditation <sup>1</sup>) In addition, at least annually, each firm that originally certified a product as compliant shall provide proof of on-going compliance in the form of a laboratory report from an A2LA accredited ISO 17025 certified laboratory with the appropriate scope. (Other independent forms of certification to ISO 17025 may be acceptable in place of A2LA accreditation <sup>1</sup>) The number of samples submitted shall be equal to the number required in the appropriate standard, section titled sample size. These reports are limited to the

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<sup>1</sup> The decision to accept other than A2LA proof of compliance with ISO 17025 shall be made by the executive director or his/ her appointee.

product performance and markings, warnings and other literature.

## **7. Construction**

- 7.1. General: Headgear shall be constructed to reduce the acceleration of the wearer's head, and to remain on the wearer's head, during impact. Optional devices fitted to the headgear shall be designed so that they are unlikely to cause injury during use.
- 7.2. Headgear must survive all test protocols substantially intact and ready for use.
- 7.3. Projections in Headgear: Any internal rigid projections that may contact the wearer's head during impact shall be covered so as to reduce the likelihood of injury.

## **8. Materials**

- 8.1. Materials used in the headgear shall be durable and resistant to exposure to sun, rain, cold, dust, vibration, perspiration and products likely to be applied to the skin or hair. Materials known to cause skin irritation or disease shall not be used. Lining materials, if used, may be detachable for washing. If hydrocarbons, cleaning fluids, paints, transfers/decals or other additions will affect the headgear adversely, a warning shall be provided.

## **9. Samples for Testing**

- 9.1. Headgear shall be tested complete, in the condition as offered for sale or use unless specified otherwise in an individual Performance Specification.
- 9.2. Headgear used for testing must be selected in a random manner.

## **10. Conditioning**

See Section 12, NOCSAE DOC.001.

## **11. Test Instruments and Equipment**

- 11.1. Recommended Linear Impactor including Linear Bearing Table Assembly (See Figure 1)
- 11.2. Electronic speed monitor capable of measuring the in-bound velocity of the linear impactor head within 3 inches of contact to the headgear.
- 11.3. The entire moving assembly of the linear bearing table and the supporting headform apparatus that may be in motion during or after an impact shall not exceed  $??\text{kg} \pm 0.5 \text{ kg}$ . This aggregate weight does not include the headform or the Hybrid III neck assembly.

11.4. See Section 15, NOCSAE DOC.001.

## 12. Impact Attenuation Tests

12.1. Standard Impact Locations for medium headform (see Figure 2)

**NOTE:** Impacts should hit as close to the center of the impactor head as is possible and directed through the CG of the headform.

12.2. Front Face guard (FFG) - Located on the median plane 2 3/8 "below the anterior intersection of the median and basic plane.

12.3. Lower Front Boss (LFB) - A point in the 45-degree plane from the median plane measured clockwise and located 1/2" below the basic plane.

12.4. Lower Side (LS) - Located on the Coronal plane on the right side of the headform 1 3/16" above the basic plane.

12.5. Lower Rear Boss (LRB) - Point located 135 degrees clockwise from the anterior intersection of the median and references planes and 1 3/16" above the basic plane.

12.6. Lower Rear (LR) - Point located 1 3/16" above the posterior intersection of the median and basic planes.

12.7. Random - Any point located in the impact area but no closer than one inch from the edge of the headgear. Random locations must allow rotator assembly to be locked in position selected.

*This standard is subject to revision at any time by the responsible technical authority and must be reviewed every five years and if not revised either reapproved or withdrawn. Your comments are invited either for revision, modification or creation of additional standards and should be addressed to NOCSAE's Executive Director. Check the web at [www.nocsae.org](http://www.nocsae.org) to obtain the latest version of a standard.*

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# Linear Impactor Drawing

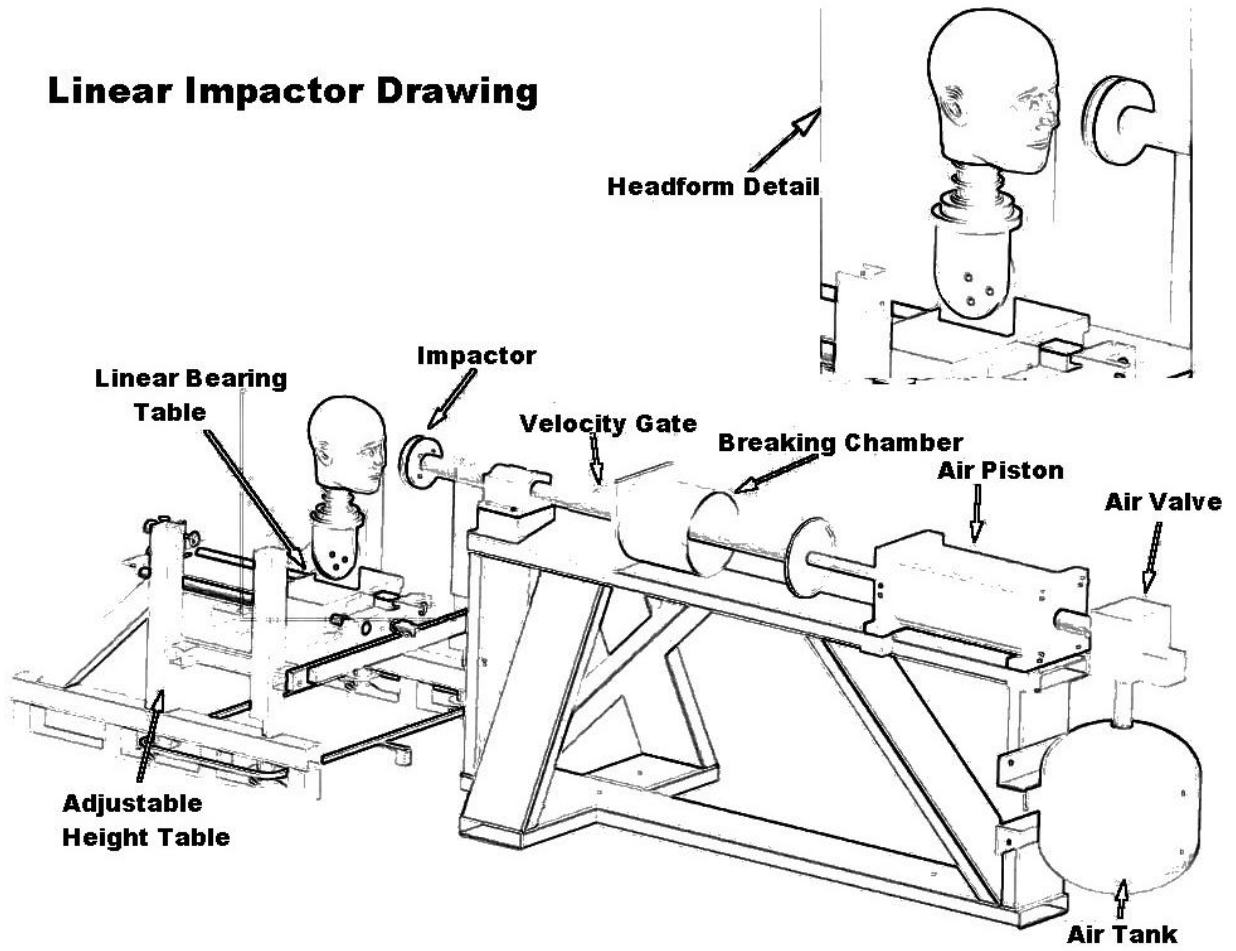
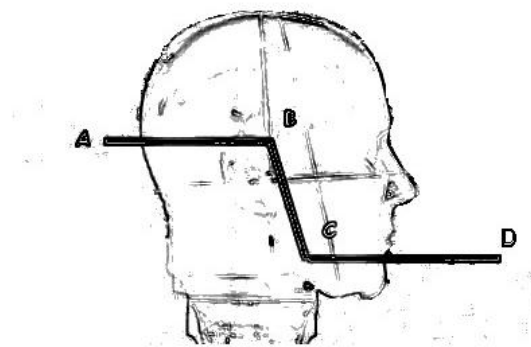


Figure 1



Impact Area – for a headgear that is to be tested on the medium headform\*, the impact area must include all locations on the headform which lie on or above a line (AB)  $1 \frac{3}{16}$  inches above and parallel to the BASIC PLANE posterior to the CORONAL PLANE and on or above a line (CD)  $2 \frac{3}{8}$  inches below and parallel to the BASIC PLANE forward of a point  $1 \frac{3}{16}$  inches anterior to the CORONAL PLANE, and forward and above line (BC) which connects these two lines. See Fig x

\* For the large head forms line AB is  $1 \frac{7}{16}$ " above and line CD is  $2 \frac{5}{8}$ " below the basic plane. For the small headform line AB is  $\frac{15}{16}$ " above and line CD is  $2 \frac{1}{8}$ " below the basic plane.

Figure 2